TMAC Resources Inc.

HOPE BAY PROJECT
2019 Nunavut Water Board Annual Report






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Prepared by
TMAC Resources Inc.
Toronto, ON

Prepared for
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Executive Summary – English

The Hope Bay Project is an approximately 20 km × 80 km property along the south shore of Melville Sound in Nunavut, Canada. The Belt is TMAC Resources Inc.'s (TMAC) prime holding and is its sole focus for exploration, development and mining. This report to the Nunavut Water Board (NWB) has been prepared to summarize the Project activities and monitoring conducted under TMAC Type A Water Licences 2AM-DOH1335, 2AM-BOS1835, Type B Water Licences 2BB-MAE1727, 2BB-BOS1727, and the exploration Type B Water Licence 2BE-HOP1222 for 2019.

In 2019 commercial operations continued at Doris with continued efforts to stabilize mill throughput and optimize gold recovery.

Civil construction activities included the completion of construction of the Roberts Bay Discharge System (RBDS) and installation of the associated underground mine dewatering and Tailings Impoundment Area (TIA) discharge pipelines and pumping infrastructure. The RBDS facilitates dewatering of the Doris mine and removal of excess water from the TIA to Roberts Bay. The ocean discharge pipeline with sunken diffuser and recirculation pipeline were successfully installed into Roberts Bay during the open water season. As part of this system, a Water Treatment Plant was constructed to remove Total Suspended Solids from underground mine water at Doris prior to discharge through the RBDS. No discharge occurred to Roberts Bay in 2019.

Earthworks began at the Madrid North site to support the commencement of mining of the Naartok East Crown Pillar and Madrid North underground decline. This included construction of the first kilometre of the Madrid North all-weather-road, the Madrid North Contact Water Pond, and construction of the Madrid North Waste Rock storage pad. Laydown space and access roads were constructed to support shop facilities, lunchroom/offices and wash car facilities. An overburden stockpile was established to store overburden removed during of mining of the Naartok East Crown Pillar.

Underground waste development continued at Doris in 2019 with further advancement of below the dyke (BTD) decline and necessary support infrastructure. TMAC continued ore development with long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris, and continued ore sill development in the DCO. TMAC also continued waste development of the DCO for future mining horizons. Long hole blasting continued throughout 2019, with all ore production trucked to surface and processed through the mill or added to the stockpile. Construction of the DCO Vent Raise was completed to support underground ventilation requirements. Development of the Doris Central (DCN) decline continued in 2019.

Ore development also occurred from surface in 2019 with the commencement of surface blasting and hauling of ore and waste from the Naartok East Crown Pillar Recovery (NECPR). Development of the Madrid North underground decline began in Q4 of 2019. Backfill and reclamation of the Doris Crown Pillar Trench was completed in 2019.

One dorm was added to allow an additional 48 bed spaces at Doris Camp and an additional 5 million litre fuel tank was constructed at the Roberts Bay Fuel Storage and Containment facility.

In the fall, TMAC concluded another successful sealift operation including the purchase and delivery of diesel fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Waste disposal, fuel usage and chemical storage stayed consistent with previous years. Fourteen spills were reported to the Nunavut Spill Line, Water Licence Inspector and KIA Major Projects office. The remaining spills that occurred during 2019 were minor in nature, occurring on camp pads and infrastructure, with quick response and clean up resulting in negligible impact to the receiving environment. Empty cargo aircraft were utilized in 2019 for waste backhaul from the Doris Camp to KBL Environmental in Yellowknife to arrange for final remediation/disposal.

Water use in 2019 was conducted in accordance with the Type A Water Licence 2AM-DOH1335 for Doris-Madrid, the Type A Water Licence 2AM-BOS1835 and the Type B Water Licences 2BB-BOS1727 for Boston, the Type B Water Licences 2BB-MAE1727 for Advanced Exploration at Madrid, and the Type B Water Licence 2BE-HOP1222 for regional exploration. The referenced water licences include provisions for sampling programs that involve recording data related to the volume of water extracted for any purpose, testing of effluents (e.g., treated sewage effluents) discharged to the environment, and monitoring water quality within specific Project areas (e.g., surface discharge downstream of construction areas, storm water from an engineered containment structure, sewage and oily water effluent, etc.). Water usage in 2019 was conducted within approved limits. In fact, TMAC was successful in recycling greater than 95% of its process water from the tailings impoundment area, greatly reducing the allowable water draw from Doris Lake. All effluent discharges to the environment in 2019 were compliant with the allowable discharge limits outlined in the water licences.

Community consultation in 2019 focused on engaging positively and effectively with communities and the Inuit Environmental Advisory Committee regarding TMAC operations, employment and contracting opportunities and consultation on TMAC's environmental monitoring and fisheries offsetting.

In 2019 the focus of TMAC's permitting and modification efforts were on component specific approvals as required for portions of Project, including waste rock handling, roads, the marine discharge pipeline, water crossings, and water and waste containing engineered structures.

As demonstrated above, TMAC strives to continually achieve compliance with the various regulatory requirements and maintain community relationships. Environmental monitoring in accordance with the existing Water Licences, Framework Agreement, Project Certificate, authorizations, management plans and environmental effects monitoring plans will continue during 2020.

ᓇᐃᓪᓕᒋᐊᕐᓯᒪᔪᑦ ᐅᖃᐅᓯᑦ - Inuktitut (North Baffin)

The Hope Bay,ᒥ ᐱᓕᕆᐊᖑᔪᖅ ᑕᑭᓂᖃᕐᑐᖅ ᓴᓂᐊᓂ 20 km × 80 km ᓇᒻᒥᓂᕆᔭᐅᔪᖅ ᓯᒡᔭᖓᓃᑦᑐᖅ ᖃᓂᒋᔭᖓᓂ Melville Sound,ᒥ ᓄᓇᕗᒻᒥ, ᑲᓇᑕᒥ. ᑖᒃᑯᐊ Belt,ᑯᑦ ᓇᒻᒥᓂᕆᖏᑦ TMAC Resources Inc.,ᑯᑦ (TMAC) ᓇᒥᓂᖃᓱᑎᒃ ᐊᒻᒪ ᑲᒪᔨᒻᒪᕆᐅᔪᑦ ᕿᓂᕐᓂᕐᒥᒃ ᑰᓇᐅᔭᓕᐅᕈᑎᒃᓴᓂᒃ, ᐱᔭᓪᓕᐊᑎᑦᓯᓂᕐᒥᒃ ᐊᒻᒪ ᐅᔭᕋᓐᓂᐊᕐᓂᕐᒥᒃ. ᐅᑯᐊ ᑐᓴᕋᒃᓴᓕᐊᖑᓯᒪᔪᑦ ᓄᓇᕗᒻᒥ ᐃᒪᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔨᓄᑦ ᐋᖅᑭᒃᓱᕐᑕᐅᓯᒪᔪᑦ ᓇᐃᓪᓕᒋᐊᕐᓯᒪᑎᓪᓗᒋᑦ ᐱᓕᕆᐊᖑᔪᑦ ᒥᒃᓵᓄᑦ ᐊᒻᒪ ᖃᐅᔨᓴᕐᓂᕙᓂᕐᒥᒃ ᒪᓕᑦᓱᒋ ᐅᑯᐊ ᑲᒪᒋᔭᑦ ᐊᑖᒍᑦ ᐅᑯᐊ TMAC Type ᐃᒪᓕᕆᔾᔪᑎ ᓚᐃᓴᓐᓯ 2AM-DOH1335, 2AM-BOS1835, Type B ᐃᒪᓕᕆᔾᔪᑎ ᒪᐃᓴᓐᓯᑦ 2BB-MAE1727, 2BB-BOS1727, ᐊᒻᒪ ᕿᓂᕿᓐᓇᐅᑏᑦ Type B ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯ 2BE-HOP1222 for 2019.

2019,ᒥ ᑰᓇᐅᔭᓕᐅᕋᓱᐊᕐᑐᑦ ᑲᔪᓯᖏᓐᓇᓚᐅᕐᑐᑦ Doris,ᒥ ᐊᒻᒪ ᐋᖅᑭᐅᒪᑎᑦᓯᖏᓐᓇᕋᓱᐊᕐᓱᑎᒃ ᓯᖃᓪᓕᕆᕙᒻᒥᒃ ᐊᒻᒪ ᓂᕆᐅᓐᓂᖃᕐᓱᑎᒃ ᓇᓂᓯᓂᐊᕐᑐᒋᒋᐊᖅ ᒌᓄᒥᒃ.

ᓴᓇᓂᖃᓚᐅᕐᑐᑦ ᐱᐊᓂᒃᓯᓪᓗᑎᓪᓗ Roberts Bay,ᒥ ᒪᕐᓗᑯᖃᕈᑎᓂᒃ ᐊᒻᒪ ᐋᖅᑭᒃᓯᓪᓗᑎᒃ ᐅᔭᕋᓐᓂᐊᕐᕙᐅᑉ ᐃᑭᐊᓂ ᓄᓇᒥ ᐃᒪᓕᕆᐅᑎᓂᒃ ᐊᒻᒪ ᒪᕐᓗᑯᖃᕙᒻᒥᒃ ᓱᓪᓗᑯᑖᒃᑯᑦ ᒪᕐᓗᑯᓂᒃ ᐊᒻᒪ ᑯᕙᔾᔪᑎᓂᒃ ᐋᖅᑭᒃᓯᐃᓪᓗᑎᒃ. ᐱᓕᕆᕙᐅᒻᒥ RBDS,ᖑᔪᑦ ᐃᒪᓕᕆᔾᔪᑎᐅᒻᒪᑕ Doris ᐅᔭᕋᓐᓂᐊᕐᕙᐊᓂ ᐊᒻᒪ ᐆᔭᐃᒍᑕᐅᓪᓗᑎᒃ ᐃᒪᕐᒥᒃ ᐅᔭᕋᓐᓂᐊᕐᕙᐅᔪᒥᑦ Roberts Bay,ᒧᑦ. ᑕᓇᐅᕐᒥ ᐅᕐᓱᐊᓗᒻᒧᑦ ᓱᓪᓗᑕᖃᐅᕐᑐᖅ ᑯᕙᓯᕙᓐᓂᒃ ᐃᑭᐊᓂ ᐃᒪᐅᑉ ᐊᒻᒪ ᓱᓪᓗᑖᒃ ᐃᓕᔭᐅᑦᓯᐊᓚᐅᕐᑐᖅ Roberts Bay,ᒥ ᐊᐅᔭᐅᓂᐊᓂ ᐃᒪᐅᓂᐊᓂ. ᐃᓚᒋᔭᐅᑎᓪᓗᒍ ᐋᖅᑭᒃᓱᕐᑕᐅᓯᒪᓂᖏᓐᓄᑦ, ᐃᒪᕐᒧᑦ ᓴᓗᒻᒪᖕᓴᐃᒍᑎᒃ ᐋᖅᑭᒃᑕᐅᓚᐅᕐᑐᖅ ᐆᔭᐃᒍᑕᐅᓂᐊᕐᑎᓪᓗᒍ ᑕᒪᐃᓐᓂᒃ ᓱᕈᕐᓂᒃ ᐅᔭᕋᓐᓂᐊᕐᕙᐅᑉ ᐃᖅᑲᖓᓂ ᓄᓇᒥᖓᕐᑐᑦ ᐅᔭᕋᓐᓂᐊᕐᕙᒻᒥᑦ ᑕᕝᕙᓂ Doris,ᒥ ᐱᔭᕐᑕᐅᓚᐅᕐᑎᓐᓇᒋᑦ ᓱᓕ ᐱᓕᕆᕙᒻᒥᑦ. ᑭᓈᔪᖃᕐᓯᒪᖏᑦᑐᖅ ᓱᕈᕐᓂᒃ Roberts Bay,ᒥ 2019,ᒍᑎᓪᓗᒍ.

ᑕᐃᔭᐅᔪᑦ Earthworks ᐱᓇᓱᐊᕆᐊᓕᓚᐅᕐᓯᒪᔪᑦ Madrid North,ᒥ ᐃᑲᔪᕐᓯᓪᓗᑎᒃ ᐱᒋᐊᓕᕐᑎᓪᓗᒍ ᐅᔭᕋᓐᓂᐊᕐᓂᖅ ᓈᕐᓱᒃᒥ, Naartok East Crown Pillar ᐊᒻᒪ Madrid North,ᒥ ᐃᑭᐊᓂ ᓄᖅᑲᕐᑎᑕᐅᓚᐅᕐᑐᖅ ᐃᖅᑲᖓᓂ ᐱᓕᕆᓂᖅ. ᓴᓇᓂᖃᓚᐅᕐᑐᑦ ᓯᕗᓪᓕᕐᒥ ᑭᓚᒥᑐᕐᓂ Madrid North,ᒥ ᐊᖅᑯᑎᒥᒃ ᖃᖓᓕᒫᒧᑦ, ᐊᒻᒪ Madrid North ᐃᒪᓕᕆᓪᓗᑎᒃ ᑕᓯᕐᒥ, ᐊᒻᒪ ᓴᓇᓪᓗᑎᒃ Madrid North,ᒥ ᒪᕐᓗᑯᖃᐅᑎᒥᒃ ᓯᕐᓗᐊᒥᒃ ᐅᔭᕋᓂ. ᐃᓂᒃᓴᓕᐅᓚᐅᕐᑐᑦ ᒪᓂᖅᑲᒥ ᐊᒻᒪ ᐊᖅᑯᑎᖏᑦ ᐋᖅᑭᒃᓱᓇᐊᕐᑕᐅᓪᓗᑎᒃ ᐃᑲᔪᕐᓯᒍᑕᐅᓂᐊᕐᑎᓪᓗᒋᑦ ᐱᓕᕆᕙᒃᓴᓄᑦ ᓂᐅᕙᕐᕙᓄᑦ, ᓂᕆᕙᒻᒧᑦ/ᐊᓪᓚᕙᓐᓄᑦ ᐊᒻᒪ ᐅᐊᓴᕐᕙᒧᑦ ᓄᓇᒃᑰᕈᑎᓄᑦ. ᓄᐊᓗᐊᓕᕐᑐᓄᑦ ᒪᕐᓗᑯᓄᑦ ᐃᓂᒃᓴᓕᐅᓚᐅᕐᑐᑦ ᐅᔭᕋᓐᓂᐊᕐᕙᒻᒥᑦ ᓴᖅᑭᑕᐅᔭᓪᓕᐊᔪᓂᒃ ᑕᕝᕙᓂ Naartok East Crown Pillar,ᒥ ᐅᔭᕋᓐᓂᐊᕐᕙᒻᒥ.

ᐃᒪᐅᑉ ᐃᖅᑲᖓᓂ ᐱᓕᕆᓂᖓ ᑲᔪᓯᖏᓐᓇᓚᐅᕐᑐᖅ Doris,ᒥ 2019,ᖑᑎᓪᓗᒍ ᐊᒻᒪ ᐱᓕᕆᒋᐊᓪᓚᑦᓯᑎᒃ ᓄᓇᐃᑦ ᓇᕿᓐᓂᖏᓐᓂ ᐊᒻᒪ ᓴᓇᓪᓗᑎᒃ ᐱᓕᕆᔾᔪᑎᓄᑦ ᐃᑲᔫᒃᑲᓐᓂᕈᑎᒃᓴᓂᒃ. TMAC,ᑯᑦ ᓱᓕ ᓴᕙᕋᔭᒃᓴᓂᐊᕐᑐᑦ ᓂᐅᕐᑐᕐᓂᒃᑯᑦ ᑕᑭᔪᒥᒃ ᐊᒻᒪ ᖀᕐᑎᓇᓂᒃᑯᑦ Doris,ᒥ ᐅᑯᓂᖓ Connector (DCO) ᐊᒻᒪ BTD,ᓂᒃ Doris,ᒥ, ᐊᒻᒪ ᓴᕙᕋᔭᒃᓴᓂᐊᕐᓱᑎᒃ ᓱᓕ ᑕᕝᕙᓂ DCO,ᒥ. TMAC,ᑯᑦ ᓱᓕ ᐋᖅᑭᒃᓱᐃᕙᓪᓕᐊᔪᖅ ᒪᕐᓗᑯᓕᕆᔾᔪᑎᓂᒃ ᑕᕝᕙᓂ DCO,ᒥ ᐊᑐᕐᑕᐅᒐᔭᕐᑐᓂᒃ ᓯᕗᓂᒃᓴᒥ ᐅᔭᕋᓐᓂᐊᓂᐅᔭᕐᑐᓄᑦ. ᓱᓕ ᓄᓇᒥ ᖀᕐᑎᓇᑲᑕᓚᐅᕐᑐᑦ 2019,ᒥ, ᐊᒻᒪ ᓴᖅᑭᑎᓇᓪᓗᑎᒃ ᓴᕙᕋᔭᒃᓴᓂᒃ ᐊᔾᔭᕐᑐᕐᑕᐅᑎᓪᓗᒋᑦ ᐊᕙᑎᒧᑦ ᐅᓯᑲᑕᐅᑎᒃᑯᑦ ᓄᓇᒃᑰᕈᑎᒃᑯᑦ ᐊᒻᒪ ᐃᓕᐅᖅᑲᕐᑕᐅᓪᓗᑎᒃ ᓯᖃᓪᓕᕐᕙᒻᒧᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐃᓕᐅᖅᑲᕐᑕᐅᓪᓗᑎᒃ ᑲᑎᕐᓱᕐᓯᒪᔪᓄᑦ. ᓴᓇᔭᐅᓂᖓ ᐅᖅᑰᓴᐅᑏᑦ ᐱᐊᓂᒃᑕᐅᓚᐅᕐᑐᖅ ᐊᑐᕋᔭᕐᑎᓪᓗᒋᑦ ᓄᓇᐅᑉ ᐃᑭᐊᓄᑦ ᐃᒪᕐᒥᓗ ᐊᓂᕐᓂᖃᕈᑎᓄᑦ. ᓴᓇᔭᐅᒐᔭᕐᓂᐊ ᓄᖅᑲᕐᑎᑕᐅᓚᐅᕐᑐᖅ Doris Central,ᒥ ᑲᔪᓯᖏᓐᓇᕋᓂ 2019,ᒥ.

ᓴᕙᕋᔭᒃᓴᓂᐊᕐᓂᖅ ᑲᔪᓯᓚᐅᕐᓯᒪᔪᖅ ᐱᒋᐊᕐᓱᑎᒃ 2019,ᒥ ᐱᒋᐊᖅᑳᕈᑎᖃᕐᓱᑎᒃ ᖀᕐᑎᓇᓂᕐᒥᒃ ᐊᒻᒪ ᐊᔾᔭᕐᑐᐃᓂᕐᒥᒃ ᓴᕙᕋᔭᒃᓴᓂᒃ ᐊᒻᒪ ᓱᕈᕐᓂᒃ ᒪᕐᓗᑯᓂᒃ ᑕᕝᕙᖓᑦ ᓈᕐᑑᕐᒥᑦ, Naartok East Crown Pillar Recovery (NECPR),ᒥᑦ. ᐱᕙᓪᓕᐊᕙᐅᓚᐅᖏᑦᑐᖅ Madrid North,ᒥ ᓄᖅᑲᕐᑎᑕᐅᓚᐅᕐᒪᑦ ᐱᒋᐊᕐᓱᑎᒃ Q4 2019,ᒍᑎᓪᓗᒍ. ᒪᕐᓗᑯᐃᑦ ᐊᒻᒪ ᓇᒻᒥᓂᖃᕆᐊᓪᓚᓐᓂᖓ Doris Crown Pillar Trench ᐱᐊᓂᒃᑕᐅᓚᐅᕐᑐᖅ 2019,ᒥ.

ᐃᓪᓗᐊᕈᓯᓕᐅᓚᐅᕐᖓᑦ ᐊᑕᐅᓯᕐᒥᒃ ᐃᓚᒋᐅᑎᓂᐊᕐᑐᒥᒃ 48,ᓄᑦ ᐃᓪᓕᕐᓄᑦ ᑕᕙᓂ Doris,ᒥ ᐅᔭᕋᓐᓂᐊᕐᕕᐅᒥ ᐊᒻᒪ ᐋᖅᑭᒃᓯᒋᐊᓪᓚᑦᓱᑎᒃ 5 ᒥᓕᐊᓂᒃ ᓕᑐᕐ ᐅᕐᓱᐊᓗᖃᐅᑎᒥ ᓴᓇᔭᐅᓪᓗᓂᓗ Roberts Bay,ᒥ ᐅᕐᓱᐊᓗᒻᒧᑦ ᓯᕐᓗᐊᖑᓂᐊᕐᑎᓪᓗᒍ ᐊᒻᒪ ᓯᐊᕐᓗᐊᖑᓂᐊᕐᓗᓂ.

ᐅᑭᐊᒃᓵᒥ, ᑖᒃᑯᐊ TMAC,ᑯᑦ ᑲᔪᓯᑎᑦᓯᓯᐊᓚᐅᕐᑐᑦ ᐅᓯᒍᔅᔭᐅᓂᕐᒥᒃ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ, ᐊᒻᒪ ᓂᐅᕕᕐᓂᒃᑯᑦ ᐊᔅᔭᕐᓯᓂᒃᑯᑦ ᐅᕐᓱᐊᓗᒻᒥᒃ ᐊᒻᒪ ᖃᕐ ᑕᕀᓂᒃ ᐊᒻᒪ ᐊᑐᐃᓐᓇᕈᕐᑎᑦᓯᓪᓗᑎᒃ ᐃᑲᔪᕈᑎᒃᓴᓂᒃ ᐅᔭᕋᓐᓂᐊᕐᕕᐅᒥ ᐊᒻᒪ ᓯᖃᓪᓕᕆᕆᕕᐅᒥ. ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᐊᔅᔭᕐᑐᐃᓚᐅᕐᖓᑦ ᐅᕐᑯᒪᐃᑦᑑᑎᐊᓗᓐᓂᒃ ᓄᓇᒃᑰᕈᑎᓂᒃ ᐊᒻᒪ ᓱᓇᕐᕈᑎᒃᑲᓂᕐᓂᒃ ᐅᔭᕋᓐᓂᐊᓂᕐᓂᒧᑦ ᐊᒻᒪ ᓴᓇᓂᕐᒧᑦ ᐊᐅᓚᒍᑕᐅᔪᓂᒃ.

ᒪᕐᓗᑯᓕᕆᓂᖅ, ᐅᕐᓱᐊᓗᒻᒥᒃ ᓴᓂᕐᕙᐃᓯᒪᓂᖅ ᐊᒻᒪ ᐅᕐᓱᐊᓗᒻᒥᒃ ᐊᑐᕐᓂᖅ ᐊᒻᒪ ᐊᑦᑕᓇᕐᑐᓄᑦ ᓯᕐᓗᐊᓕᕆᓂᖅ ᑕᐃᒪᐃᑦᓴᐃᓇᕐᑐᑦ ᐊᕐᕌᒍᕋᑖᕐᓯᒪᔪᑎᑐᑦ. 14 ᖃᐅᔨᔭᐅᓯᒪᓚᐅᕐᑐᑦ ᐅᕐᓱᐊᓗᒻᒥᒃ ᑯᕕᕋᒃᓂᑯᐃᑦ ᓄᓇᕗᒻᒥ ᐅᖁᓚᐅᒃᑯᑦ, ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᑎᒧᑦ ᐊᒻᒪ ᕿᑭᕐᑖᓗᒻᒥ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒋᖕᒋᑕ ᐱᓕᕆᐊᖑᔪᓂᒃ ᐊᖏᕔᑎᓂᒃ ᐱᓕᕆᔨᐊᓄᑦ. ᐅᕐᓱᐊᓗᒻᒥᒃ ᑯᕕᓂᑯᐃᑦ 2019,ᒥ ᐊᖏᓛᓐᓂᖏᒻᒪᑕ, ᐊᒻᒪ ᐊᑐᕐᑕᐅᓪᓗᑎᒃ ᐱᓕᕆᕕᐅᒥ ᐊᒻᒪ ᓴᓇᕕᐅᔪᓂ, ᐊᒻᒪ ᑲᒪᒋᔭᐅᑦᓴᐅᑎᒋᓚᐅᕐᑐᑦ ᐊᒻᒪ ᓴᓗᒻᒪᖕᓴᕐᑕᐅᓪᓗᑎᒃ ᑲᒪᑦᓯᐊᖏᓐᓂᕕᓂᕐᒧᑦ ᐊᕙᑎᒥᒃ. ᐅᓯᔭᒃᓴᖅᖏᑐᐊᕐᒪᑕ ᖃᖓᑕᓲᑦ ᐊᑐᕐᑕᐅᖃᑦᑕᓚᐅᕐᑐᑦ 2019,ᒥ ᒪᕐᓗᑯᓂᒃ ᐅᓯᓂᕐᒧᑦ ᑕᕝᕙᖓᑦ Doris Camp,ᒥᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᕕᒻᒧᑦ ᔫᐊᓗᓇᐃᒧᑦ ᑭᖑᓪᓕᕐᐹᒥ ᖃᐅᔨᓴᕐᑕᐅᓂᐊᕐᑎᓪᓗᒋᑦ ᐋᖅᑭᒃᓯᒋᐊᓪᓚᑦᑕᐅᓗᑎᒃ/ᐃᒋᑕᐅᓗᑎᓪᓗ.

ᐃᒪᕐᒥᒃ ᐊᑐᓚᐅᕐᓂᖅ 2019,ᒥ ᑲᔪᓯᑕᐅᓚᐅᕐᑐᖅ ᒪᓕᑦᓱᑎᒃ Type A,ᒥ ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯᒥᒃ, Licence 2AM-DOH1335 ᐊᑐᕐᑐᓂ ᐅᕙᖓ Doris-Madrid, ᐊᒻᒪ Type A ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯ. Licence 2AM-BOS1835 ᐊᒻᒪ Type B ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓰᑦ 2BB-BOS1727 ᐊᑐᕐᑐᑦ ᐅᕙᖓ Boston, ᐊᒻᒪ Type B ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓰᑦ 2BB-MAE1727 ᕿᓂᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᒃᓴᓂᒃ ᐅᕙᓂ Madrid, ᐊᒻᒪ Type B ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯ 2BE-HOP1222 ᐊᕕᑦᑐᕐᓯᒪᓂᒃᑯᑦ ᕿᓂᕐᓂᕐᒧᑦ ᑫᓇᐅᔭᓕᐅᕈᑎᒃᓴᓂᒃ. ᐅᖃᐅᓯᐅᓯᒪᔪᑦ ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓰᑦ ᐱᖃᓯᐅᑎᔪᑦ ᒪᓕᒐᕐᓂᒃ ᖃᐅᔨᓴᕆᐊᖃᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᓂᒃ ᐱᖃᓯᐅᑎᓗᒋᑦ ᓂᐱᓕᐅᕆᓂᖅ ᐱᔾᔪᑎᖃᕐᑐᓂᒃ ᖃᓄᐃᓪᓗᐊᕐᑐᒥᒃ ᐃᒪᕐᒥᒃ ᐊᑐᕐᓂᕐᒥᒃ, ᖃᐅᔨᓴᕈᑎᖃᕐᓂᕐᒧᑦ (ᓵᕐᓗ, ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᓱᕈᕐᓂᒃ) ᐃᒋᑦᓯᓂᖅ ᐊᕙᑎᒧᑦ, ᐊᒻᒪ ᖃᐅᔨᓴᕆᐊᖃᕐᓂᖅ ᐃᒪᕐᒥᒃ ᐱᓕᕆᓂᒃᑯᑦ (ᓵᕐᓗ ᐊᕙᑎᒥᑦᑐᓂᒃ, ᐊᒻᒪ ᖃᐅᔨᓴᕐᓂᖅ ᐃᒪᖓᓂᒃ ᐱᓕᕆᕕᐅᔪᓂ (ᓵᕐᓗ, ᐊᕙᑎᒥᑦ ᑰᓐᓂᑦ ᓴᓇᕕᐅᔪᓂᑦ, ᐊᓄᕆᒧᑦ ᐃᒪᐅᑉ ᐊᑲᐅᖏᓕᐅᑎᖏᓐᓂᒃ ᓱᕈᕐᑕᐅᓗᑎᒃ ᓱᕈᕐᓄᑦ, ᖁᕐᕕᓐᓄᑦ ᐊᒻᒪ ᐅᕐᓯᒥᑎᑦᓯᒪᔪᓄᑦ, ᓵᕐᓗ). ᐃᒪᕐᒥᒃ ᐊᑐᕐᓂᖅ 2019,ᒥ ᐋᖅᑭᒃᑕᐅᓯᒪᓚᐅᕐᑐᑦ ᐊᖏᕐᑕᐅᓯᒪᔪᑎᒍᑦ ᖃᓄᖅ ᐊᖏᑎᒋᔪᒥᒃ ᐊᑐᕈᓐᓇᕐᓂᕐᒧᑦ. ᐊᓪᓛᑦ, ᑖᒃᑯᐊ TMAC ᑲᔪᓯᑦᓯᐊᕐᓂᖃᓚᐅᕐᑐᑦ ᑲᒪᒋᐊᖅ ᐊᑐᒃᑲᓐᓂᕈᓐᓇᕐᑐᓂᒃ ᒪᕐᓗᑯᓂᒃ ᐅᓄᕐᓂᖅᓴᐅᒃᐸᑕ 95% ᐃᒪᕐᒥᒃ ᐊᑐᕐᑐᒥᒃ ᒪᕐᓗᑯᓄᑦ ᐱᓕᕆᕕᐅᒥ, ᐊᑐᖏᓐᓂᖅᓴᐅᓕᕐᓯᑎᒃ ᐃᒪᕐᒥᒃ ᑕᕙᖓᑦ Doris Lake,ᒥᑦ. ᒪᕐᓗᑯᐃᑦ ᐊᓂᐊᔪᑦ ᐊᕙᑎᒧᑦ 2019,ᒥ ᒪᓕᒍᑕᐅᓯᒪᔪᑦ ᐊᖏᓂᖏᓐᓂᒃ ᒪᕐᓗᑯᐃᑦ ᐅᖃᐅᓯᐅᓯᒪᓪᓗᑎᓪᓗ ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯᓂ.

ᓄᓇᓖᑦ ᑲᑎᒪᑎᑕᐅᓯᒪᔪᑦ 2019, ᐱᔾᔪᑎᖃᕐᓱᑎᒃ ᐊᑲᐅᓈᕐᑐᓂᒃ ᐊᒻᒪ ᐊᒃᑐᕐᑕᐅᓂᕆᔭᕐᑕᖕᒋᑕ ᓄᓇᓖᑦ ᒥᒃᓵᓄᑦ ᐊᒻᒪ ᐃᓄᐃᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔾᔪᖕᒋᑕ ᐃᓱᒪᓗᒋᔭᖏᓐᓂᒃ ᐅᖃᐅᓯᖅᓱᑎᒃ ᐱᔾᔪᑎᓕᓐᓂᒃ TMAC,ᑯᑦ ᐊᐅᓚᔪᓯᖏᓐᓂᒃ, ᐃᖅᑲᓇᐃᔭᕐᑎᖅᑲᕐᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐅᖃᖅᑎᖅᑲᐊᖅᑲᓂᕐᒥᒃ TMAC,ᑯᑦ ᐊᕙᑎᓕᕆᓂᒃᑯᑦ ᖃᐅᔨᓴᐊᖅᑲᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐃᖃᓗᓐᓂᒃ ᖃᐅᔨᓴᖃᐅᑎᓂᒃᑯᑦ ᐊᑐᕐᑕᐅᓂᖏᓐᓂᒃ.

2019,ᒥ ᐃᒃᐱᒋᔭᖃᓗᐊᓚᐅᕐᑐᑦ TMAC,ᑯᑦ ᐱᔪᓐᓇᐅᑎᖏᓐᓂᒃ ᐊᒻᒪ ᐋᖅᑭᒃᓯᐃᒋᐊᓪᓕᒋᐊᖃᕐᓂᕐᒥᒃ ᐊᖏᕐᑕᐅᒋᐊᖃᕐᑎᓪᓗᒋᑦ ᑐᕋᖓᔪᑦ ᐱᓕᕆᐊᖑᔪᒧᑦ, ᐱᖃᓯᐅᑎᓪᓗᒋᑦ ᐅᔭᕋᓕᕆᓂᒃᑯᑦ ᓯᖃᓪᓕᕐᓂᑯᓂᒃ ᑲᒪᓂᖅ, ᐋᖅᑯᑎᓕᕆᓂᖅ, ᐃᒪᕐᒥ ᓱᓪᓗᑯᑖᒥᑦ ᓱᕈᓕᕆᓂᖅ, ᐃᒪᓕᕆᓂᖅ ᑐᕋᕐᑐᓂᒃ ᐊᔾᔨᒌᖏᑦᑐᓄᑦ, ᐊᒻᒪ ᐃᒪᓕᕆᓂᖅ ᐊᒻᒪ ᓱᕈᓕᕆᓂᖅ ᐱᔾᔪᑕᐅᓗᓂ ᐱᓕᕆᐅᓯᖏᓐᓂᒃ.

ᐅᖃᐅᓯᐅᓯᒪᒻᒪᑕ ᖁᓛᓂ, TMAC,ᑯᑦ ᐱᓂᐊᕐᓂᖅᑐᑦ ᑲᔪᓯᑦᓯᓯᐊᕐᓂᕐᒥᒃ ᐊᔾᔨᒌᖏᑦᑐᓂᒃ ᒪᓕᒃᐅᒋᐊᓕᓐᓂᒃ ᐊᒻᒪ ᐋᖅᑭᐅᒪᑎᑦᓯᓯᐊᕐᓂᒃᑯᑦ ᓄᓇᓖᓐᓂᒃ ᐱᓕᕆᖃᑎᖃᑦᓯᐊᕐᑐᒃᓴᐅᓂᕐᒧᑦ. ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᕐᓂᖅ ᒪᓕᒍᑕᐅᓪᓗᓂ ᐅᓪᓗᒥ ᐊᑐᕐᑕᐅᔪᓄᑦ ᐃᒪᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᓐᓯᓂᒃ, ᐊᖏᖃᑎᒋᒍᑕᐅᓯᒪᔪᓂᒃ, ᐱᓕᕆᐊᒧᓪᓗ ᓇᓗᓇᐃᒃᑯᑎᖃᕈᑕᐅᓗᓂ, ᒥᐊᓂᕐᓯᓂᒃᑯᑦ ᐸᕐᓇᒃᑕᐅᓯᒪᓗᓂ ᐊᒻᒪ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐸᕐᓴᒃᓯᒪᓗᑎᒃ ᐊᕐᕋᒍᖓᓂ 2020.

Atanguyup Titikgakgaikhimayunik Havakhautit – Inuinnaqtun

Talvani Kapihiliktuk Havakhautit nunat nallautakgutauvaktuk 20 km x 80 km nungumangaah nunat hingnikgiyanik Mellville Kangikhuakyauni Nunavutmi, Kanatami. Tamna Uyagukhiukvik TMAC Havakvik Havakvit (TMAC) ilingaitunik nangmingnikgiyainiklu pivaktunik havakviuluakpaktunik ammigiplugit uyagukhiukviuvaktunik kinikhiayauvaktunik, aullaktikgutikhanik imalu uyagukhiukvitlu. Una uniklutinik tahapkununga Nunavut Katimayit Imalikiyit Katimayit (NWB) pivaktunik havagiplugit upalungaiyakhugit piyauyukhanik havakhiktauyukhanik titikgakgaikhimayunik Havakhautikhanik hulilukakgutauyukhanik imalu havagiyauyukhanik ataniktuktauhimayunik havagiyauyunik talvunakukhimayunik TMAC Kanukgitunik A Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ubluanganit Atuknianut Imaktigut 2AMDOH1335, 2-BSI835, Kanukgitunik B Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut Imaktigut 2BB-MAE1727, 2BB-BOS1727, havagiyauvaktunik uyagukhiukviuvaktunik kinikhiayauvaktunik Kanukgitunik B Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ubluanganit Atuknianut Imaktigut 2BE-HOP1222 uvani 2019.

Uvani 2019 nangminilingnik havakvit havakviuvaktunik havakhimakpaktunik talvani Doris pilingnik pinnahuaknikmun pihimakhutik havakviuyukhamik uyaguktakvikhamik talvanilu naahugidjutiplugit goldingnik ilingaiknikmun.

Nayugainik havakviuyukhanik hulilukakgutauvaktunik ilauhimayuniklu iniktikgutikhanik havakviuyukhanik talvani Roberts Kangikhuani Kuvikgakvikhak Atugakhak (RBDS) talvanilu ilikgiyauyukhaniklu atadjutivaktunik nunaap atangnungaktukhanik uyaguktakvinik imaiyainikmun imaktuktunik ingilgavikhainik talvanilu Atukhimayunik Imakluk Kuvikgakvik Nayuganik (TIA) kuvikgakvik tuukhualiukhimayunik imakluknik talvanilu imaktuktunik milukakvit hungnayauhimayunik. Talvani RBDS havakviuvaktunik imaiyainikmun imaktuktunik ingilgavikhainik talvani Doris uyagukhiukvikmi talvanilu imaiyainikmunlu imaklukakniinik talvani TIA talvunga Roberts Kangikhuani. Talvanilu taryumi kuvikgakvikhamik tuukhualiukhimayunik pilingnik havakhikhimayunik atani taryumi kuvikgakvikhanik pilingnik ingilgaavikhanik tuukhualiukhimayunit pihimayut iniktauvaktunik talvunga Roberts Kangikhuani havagiyauvakhimayuk auyami hila malikhugu. Pihimayunik ilauhimayunik atugakhainiklu, aah Imaktuktunik Halumakhitinik Havakvikhamik hungnayauhimayunik piyukhanik nutiktauyanginik Tamakpianganik Havagiyauvaktunik Uyaguktakvinit talvanga havakhikhimayunit nunaap atanit imaktukpaktunitlu talvani Doris hivuagutlu kuvikgakvikhanik talvanilu RBDS. Pihimangitut havangitpaktunik takungnaitut talvani Roberts Kangikhuakyukmi uvani 2019.

Hilani havakviuvaktuk havalikhimayunik talvani Madridmi Tunungani nayuganik piyukhanik ikayutauyukhanik havakviuyukhanik uyagukhiukviuvaktunik talvani Naartuk Kivatani Uyaguktakvit Havakvit talvanilu Madrid Tunungani nunaap atangingnik ilingakpaktunik. Talvanilu ilauhimayunik havakviuyukhak havagilgaklugu nungumagiyanik talvani Madridmi Tunungani hila-maliklugu-apkuutikhak, talvanilu Madridmi Tunungani Kuvikgakvik Imakluknik Nayugakhak, talvanilu havakvikhak talvani Madrid Tunungani Ikakungukpaktunik Uyaguktakgaikhimayunik tuutkumavik nayugakgiyanik. Tamayakakvik nayugaat talvanilu atuktautaktuk apkuutat havakhikhimayunik piyukhanik ikayutauyukhanik hungnavinik havakviuvaktunik, nirgivik/havakvit talvanilu wuakhivit akhaalutinik havakvik. Aah ihuumalutiggingnaitumiklu pihimayut tutkuktuivaktunik havagiyauyakgaikhimayunik pidjutauyanginik tutkumayaakgaikhimayunik pidjutinaitumik ihuumalutigginaitumik nutikgiakakgumik uyaguktakvinit talvani Naartok Kivatani Uyaguktakvit Havakvit.

Atani nunaap kugluakviuvaktunik havakhikhimayunik havagiyauvaktunik huli talvanilu Doris uvani 2019 pilingnik hivunikgiktunik ilingaitkiyauyunik atani ulguktakvinit (BTD) ilingakpaktunik nakukgutauvaktuniklu ikayutauyukhanik havagiyauvaktunik. TMAC havagivakgait huli uyaguktakhutik pilingnik takiyunik ikuutakhutik imalu kaaguktakhutik talvani Doris Atadjutigikpaktunik (DCO) talvanilu BTD talvani Dorismi, talvanitauk havakviuvaktumik huli uyaguktakviuvaktuk uvani DCO. TMAC pivakhimayut havagiplugit uyaguktakhimakhutik talvani DCO pidjutiyukhanik hivunikgiktukhanik uyaguktaknikmun ilingaituniklu. Takiyunik ikuutakhutik kaaguktakhutik havagiyauhimakpaktunik 2019, pilingnik uyaguktakhimayunit havagiyauhimayunik uyaktauvaktunik akhaalutikut atanit nunaap pivakgait nunaap kangungnungautivakgait piyauyukhanik havagiyauyukhanik uyaguktakviuyukhanik naliak ilauyukhanik talvunga kalikgiktiktauvaktunik uyaguktakgaikhimayunit tutkuktauvaktunik. Hungnayauvaktunik talvani DCO Kingaliukhimayuk Kulvaktiktauhimayuk hungnayauvaktuk piyangani ikayutauyukhanik nunaap atani havakvit kingakhainik havakhikariakaktuniklu. Havagiyauvaktunik talvani Dorismi Kitikgiyanik (DCN) ilingakpaliavaktunik uvani 2019.

Uyaguktakvit havagiyauvaktunik takungnakhimayunik nunaap kangani uvani 2019 pilingnik havagiyauvaktunik nunaap kangani kugaaktaktunik imalu uyaktakhugit uyaguktakhimayunik imalu kalikgiktiktauvaktunik uyaguktakhimayunik talvani Naartok Kivatani Uyaguktakvit Ilingaikgutauvaktunik (NECPR). Havagiyauvaktunik talvani Madrid Tunungani nunaap atani havakvit ilingakpaliktunik pidjutihimayunik uvani Q4 talvuna 2019. Ulguktakgianginik ilidjuhikgingukfaakniaklugu talvanilu ilidjuhikgingukfaakniaklugulu talvani Doris Uyaguktakviani Kalikgiktiktauvaktunik Havakviat pihimayaat iniktauvakhimayuk uvani 2019.

Atauhikmiklu havakvikhamik ilauhimayuk havakvikhamik hingniktakvikhamik 48 nik igluyakakvikhamik inikhainik talvani Doris Ingnituklianik talvanilu ilauhimayunik havakhikpakhimayunik 5 millianmik imakuktuutilanganik ukhuukluit kataakyukhanik imakakvikhamik hungnayauvaktuk talvani Roberts Kangukhuani Ukhuukluit Tuutkumavikhak talvanilu Tamaayakakvik havakvik.

Uvani ukiakhami, TMAC havagivakhimayainik alauyunik ungniguutivakhimayunik taryumi havakvinik ilauhimayunik niuyauvakhimayunik akkuiktuanguyunik talvunalu akyaktauvaktunik ukhuukluknik pihimayuniklu havagivakgainiklu kaaguktautinik atugakhaniklu ikayutauvaktunik uyaguktakvit imalu havakvit uyaguktakvit kikhuktuivit hulilukakvit. Talvanilu taryumi uygaktauvaktunik tamayukhanik ilauhimayunik havagiplugit akhaalutikyuanik ulguktautikhanik imalu atugakhaniklu ikayutauyukhanik uyagukhiuknikmun talvanilu hungnayauvaktunik havakviuvaktuniklu.

Ikakungukpaktunik ikakuktauvaktunik, ukhuukluknik atukhimayunik imalu tukungnalingniklu tutkumavik pihimayuk kangnukgilihimangituniklu pivakhimayunit aipangungniknitanitlu. Ammigaituniklu kuvihivaktunit havakhiktauvaktunik unikluktauhimayunik tahapkununga Nunavut Kuvihigumik Imakluknik Tuhaktitauyukhut, Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut Imaktgut Ihiviukhiyiit tahapkuatlu KIA Hivitunikhainiklu Havakhautit havakvit. Talvanilu aulahimayunitlu kuvigaktauvaktunit takungnakhimayunik talvuna 2019 pihimayut kayakutaungitunik ilingaktikgutaulimaituniklu hilamiutanut, takungnakhimayunik ingnituklinik nayugainik imalu hungnayauhimayunik, pilingnik kilamiukgutauvaktunik kiudjutauhainikpaktuniklu imalu halumakhiktauhainakpaktunik naunaitunik pihimayunik ilingaktikgutinaitumik talvani nunaap kanganungakpaktuniklu. Atukhutik uhitunik tingmitinik uvani 2019 atugakhanik uyaktakgianginik talvanga Doris Ingnitukliat talvungalu KBL Nunagiyanut Yalunaimut piyukhanik havakhiktauyukhanik inikgutauvaktunik halumaktikginikmun/ikakungukpaktuniklu.

Imaktigut atuktauvaknik uvani 2019 pihimayait havagiyauvaktunik malikhugit pilingnik Kanukgitunik A Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut 2AM-BOS1835 taimaituniklu Kanukgitunik Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut 2BB-BOS1727 talvani Bostonmi, tamnalu B Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut 2BB-MAE1727 havakhiktukhanik Ilingaitunik Uyagukhiukvit Kinikhianikmun talvanilu Madridmi, talvunalu Kanukgitunik B Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut 2BE-HOP1222 havagiyauyukhanik nunatutukanik uyagukhiukvit kinikhianikmunlu. Tahapkununa havakhiktauyukhanik imaktigut naunaitkutak atuktauvaktunik atugakhanut nungudjutilingnik ulbuanganit atuknianut ilauhimayunik hivunikgiyakhainiklu ihiviukhinikmun havakhautikhaniklu pihimayunik havakhautikhanik ilauvaktunik uniklutinik naunaitkutanik atadjutauvaktunik talvani nallautakgutauvaktunik imak kugluaktitauvaktuk nalikmut kanukgilidjutivaktunik, ihiviukhinikmunlu kugluaktitauvaktunik (uvunalu., halumakhiktauvaktunik imakluknik atukhimayuniklu) kugluaktitauvaktunik talvunga nunaani, imalu munakgiyauyukhanik imaktigut kanukgitakhaniklu talvani nalikmiklu Havakhautinik nayugainiklu (uvunalu., nunaap kangani kugluaktitauvaktunik ungmuut havakvinilu nayugainik, hilaap taimailipkakpagainik imakaknit talvani havakviuvaktunik nayugainik havakvit, imakluknik atukhimayunik imalu ukhuuklukaktuniklu imakmi atuktauvaktunik, kanuklu.). Imak atuktauvaktuk uvani 2019 pihimayunik havagiyauvaktunik angiutauvaktunik nungumalingnik kangiktaulimaitunik. Imalu kanukgitunik, TMAC pihimayut ungniguutivaktuniklu atukhimakhugu atuktauvaktunit ima 95% mik atuktauvaktunit imak talvunga kuvikgakvit imakluknik nayuganik, ilingaktikgutinaitumiklu atuktauvaktunik imak talvanga Doris Tahik. Tamakpianginik atuktauvaktunik kugluaktitauvaktunik talvunga nunaap kanganut uvani 2019 pihimayunik adjikikhimavaktunik havakhikhimayunit havagiyautaktunik kugluaktitautaktunik nungumalingnik kangiktaulimaitunik naunaitkutalingnik havakhikpaktunik imaktigut naunaitkutak atuktauvaktunik atugakhanut nungudjutilingnik ulbuanganit atuknianut.

Nunalingni malikgaliukgutauvaktunik uvani 2019 ammigiyauyukhanik atadjutigiknikmunlu havakatigiktiaknikmun talvanitunik nunalingni tahapkunanilu Inuit Nunalikiyit Tutkikhaiyit Katimayit kauhimayauvaktunik TMAC havakvit, havakhakhiukpaktuniklu imalu havaktitauvaktunik havakhautikhanik uvunalu ataniktutauvaktunik talvani TMAC nunalikiyit munakgiyauyukhanik imalu ikalukhiuktit havagivakgainiklu.

Uvani 2019 tahapkunani ammigiyauyukhanik TMAC atugakhanik naunaitkutakhamik atukufuukpaktunik atugakhanik atuknianut imalu tutkikhainikmun pinnahuaknikmun pihimayunik akkitautivaktunik nalikmut angiutauvaktuniklu havakhikariakaktuniklu ilanginik Havakautikhanik, ilauhimayuniklu ikakungukpaktunik uyaguktakhimayuni, apkuutinik, talvanilu taryumi kugluaktitauvaktunik tuukhualiukhimayuniklu, imakaknit ikaktakvit, imalu imakaknit talvanilu ikakungukpaktunik pilingnik havakviuvaktunik havakvit.

Pihimayunik havagiyauvaktunik kulani uma, TMAC hivunikgingnikmunlu havagihimakhugit ungnigutivaktunik malikhugit pilingnik nalikmut kauhimayauvaktunik havakhikariakaktunik pihimakhutik havagihimakhugit nunalingnilu havakatigiktiaknikmunlu. Nunaap ilidjuhianik munakgiyauvaktuk malikhugit havakhikhimayunik atuktauvaktunik Imaktigut Naunaitkutak Atuktauvaktunik Atugakhanut Nungudjutilingnik Ulbuanganit Atuknianut, Havakhautikhanik Angiutauvaktunik, Havakhautit Naunaitkutak angiutauvaktunik, munakgiyauyukhanik pangnattauyunik imalu nunaap atuknianut havaginiakhugit munakgiyauyukhanik pangnattauyunik pilugit havagiyauhimaktukhanik talvuna 2020.

HOPE BAY BELT PROJECT
2019 Nunavut Water Board Annual Report

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Acronyms and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AEMP	Aquatic Effects Monitoring Program
DNSEMC	Doris North Project Specific Committee
KitSEMC	Kitikmeot Socio-Economic Monitoring Committee
m	Metre
NEF	Nunavut Economic Forum
NWB	Nunavut Water Board
RBDS	Roberts Bay Discharge System
SDS	Safety Data Sheets
t	Tonnes
TDGA	*Transportation of Dangerous Goods Act*
TIA	Tailings Impoundment Area
TMAC	TMAC Resources Inc.
WRIA	Waste rock influenced area
WWTF	Wastewater treatment facility

1. Introduction

This report to the Nunavut Water Board (NWB) has been prepared to summarize the Project activities and monitoring conducted under TMAC Resources Inc. (TMAC) Type A Water Licence(s) 2AM-DOH1335, 2AM-BOS1835, Type B Water Licence(s) 2BB-MAE1727, 2BB-BOS1727 and the exploration Type B Water Licence 2BE-HOP1222. Concordance tables referencing where in this report the requirements of the reporting outlined in each of the referenced water licences has been met are presented in Appendix A.

The referenced water licences include provisions for sampling programs that involve recording data related to the volume of water extracted for any purpose, testing of effluents (e.g., treated sewage effluents) discharged to the environment, and monitoring water quality within specific Project areas (e.g., surface discharge downstream of construction areas, storm water from an engineered containment structure, sewage and oily water effluent, etc.). These data are summarized and referenced on the completed NWB Annual Report Forms, included as Appendix B and all monitoring data is provided in Appendix D of this report.

2. Regulatory Framework and Legal Matters

The key regulatory and legal documents that relates to this report are the Project Type A and B Water Licence(s), however this report is presented in context of other applicable regulatory authorizations and schedules. TMAC holds, or will soon hold, the permits and authorizations required to carry out the future work scope. A listing of the key regulatory instruments that allowed for work to be completed in 2019 is provided in Table 2-1.

Table 2-1. Key TMAC Permits/Licences and Approvals

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
NIRB Project Certificate	009	Authorization for Madrid-Boston to proceed, provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project. The Project includes the construction of all required surface Infrastructure and operation of three new mines at Hope Bay: Madrid North, Madrid South and Boston.	Life of Doris Project	None
NIRB Project Certificate	003	Authorization for Doris to proceed provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project.	Life of Doris Project	None
NWB Type A Water Licence Amendment No.2	2AM-DOH1335	Water Licence for Doris and Madrid project that authorizes the construction, operation and reclamation of the Doris, Madrid and the all- weather road of the Hope Bay Project. Licence scope includes Amendment No.1.	22 years	March 2035
NWB Type A Water Licence Amendment No.1	2AM-DOH1323	Water Licence for Doris with a 10-year term that authorizes the construction, operation and reclamation of the Doris Project. Licence was renewed (with certain amendments) in November 2016. – Superseded by Amendment No. 2 2AM-DOH1835.	10 years	August 2023
NWB Type A Water Licence Amendment	2AM-BOS1835	Water Licence for the Phase 2 Boston Site that authorizes the construction, operation and reclamation of the Boston Project.	17 years	March 2035
Type B Water Licence for the HBVB including a camp at Windy Lake	2BE-HOP1222	Water Licence that allows for the use of water and disposal of waste associated with regional exploration program including drilling and camp operations.	10 years	June 2022

(continued)

Table 2-1. Key TMAC Permits/Licences and Approvals (continued)

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
Type B Water Licence for bulk sample exploration at Boston	2BB-BOS1727	Water licence that allows for the use of water and the disposal of waste for the Boston Advanced Exploration Project. Licence was renewed in July 2017, was formerly 2BB-BOS1217.	10 years	July 2027
Type B Water Licence for Madrid Advanced Exploration Amendment No.2	2BB-MAE1727	Water licence that allows for the use of water and the disposal of waste for an undertaking classified as Mining and Milling as per Schedule II of the Regulations for the Madrid Advanced Exploration Project (Amended in 2018).	10 years	May 2027
Framework Agreement		Framework Agreement provides comprehensive land tenure governing the issuance of surface exploration licences, advanced exploration leases, commercial leases, and compensation associated with tenure. Framework Agreement includes a belt-wide Land Use Licence, an Inuit Impact and Benefits Agreement (IIBA) and a Water and Wildlife Agreement. Framework Agreement was signed in March 2015 for belt-wide land tenure.	20 years	March 2035
Water and Wildlife Agreement		Included as a Schedule to the Framework Agreement, this Agreement details compensation to be provided to the KIA and Inuit beneficiaries for negative effects that may occur to wildlife harvesting and water as a result of mining related activities across the Belt.	20 years	March 2035
Amended and Restated Inuit Owned Lands Commercial Lease	KTCL 313D001	Commercial Lease for use of designated lands associated with the Hope Bay Volcanic Belt (HBVB) area. Currently, lands have been designated that encompass Doris. Expansion to include other areas of the HBVB is administrative in nature. Original Commercial Lease was amended and restated in March 2015 as a means to obtain surety of belt-wide land tenure.	20 years	March 2035
Inuit Impact and Benefits Agreement		Included as a Schedule to the Framework Agreement, this Agreement details the benefits to be provided to the KIA and Inuit beneficiaries from the Hope Bay Project, including compensation, employment and contracting opportunities. The IIBA originally signed in association with Doris was revised in March 2015 and expanded in scope to encompass belt-wide activities.	20 years	March 2035

(continued)

Table 2-1. Key TMAC Permits/Licences and Approvals (completed)

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
KIA Advanced Exploration Agreements	KTAEL15C001 KTAEL15C002	Two agreements as per the terms of the Framework Agreement enabling quarry operations at designated locations in the Hope Bay Belt and advanced exploration at Boston.	5 year renewable annually thereafter for up to 20 years	March 2020
KIA Land Use Licences		Enables exploration activities across the Hope Bay Belt as per the terms of the Framework Agreement.	1 year automatic renewable for 20 years	March 2016
DFO authorization	NU-02-0117.2	Construction of the jetty in Roberts Bay.		December 2009
DFO authorization	NU-1000-0028	Changes to the Doris jetty.		July 2012
DFO authorizations	NU-02-01117.3	Construction of the Doris Tailings Impoundment Area (TIA) north dam.	Life of Mine	None
Navigable Waters Permit	8200-02-6565	Installation of the jetty in Roberts Bay.	N/A	N/A
Navigable Waters Permit	2018-600028	Approval for Jetty in Roberts Bay	N/A	N/A
Navigable Waters Permit	2018-600006	Approval for Marine Outfall Berm	N/A	N/A
Jetty Lease	77A3-1-2	Foreshore lease from the Crown for construction and operation of the Roberts Bay Jetty.	30 years	June 2047
Marine Outfall Berm	77A/3-3-2	Lease from Crown for construction and operation of Roberts Bay Marine Outfall Berm.	30 years	July 2048
Amendment to Schedule 2 of the Metal Mining Effluent Regulations (MMER)	Registration SOR/2008-216	Designation of Tail Lake as a tailings impoundment.	Life of Mine	None

3. Summary of Project Activities for 2019

3.1 CONSTRUCTION AND OPERATIONS

In 2019 commercial operations continued at Doris with continued efforts to stabilize mill throughput and optimize gold recovery. In 2019 the mill processed 592,932 tonnes (t) of ore and poured 137,140 ounces of gold, and successfully treated 48,709 t of cyanide solutions. The installation of the gravity concentrators was completed in 2019 which improved gold recovery. Projects such as the installation of scavenger columns and improved resin circuits began in the mill to further improve gold recovery.

Civil construction activities included the completion of construction of the Roberts Bay Discharge System (RBDS) and installation of the associated underground mine dewatering and Tailings Impoundment Area (TIA) discharge pipelines and pumping infrastructure. The RBDS allows dewatering of the Doris mine and removal of excess water from the TIA to Roberts Bay. The ocean discharge pipeline with sunken diffuser and recirculation pipeline were successfully installed into Roberts Bay during the open water season. As part of this system, a Water Treatment Plant was constructed to remove Total Suspended Solids from underground mine water prior to discharge through the RBDS. No discharge occurred to Roberts Bay in 2019.

Earthworks began at the Madrid North site to support the commencement of mining of the Naartok East Crown Pillar and Madrid North underground decline. This included construction of the first kilometre of the Madrid North all-weather-road, the Madrid North Contact Water Pond, and construction of the Madrid North Waste Rock storage pad. Laydown space and access roads were constructed to support shop facilities, lunchroom/offices and wash car facilities. An overburden stockpile was established to store overburden removed during mining of the Naartok East Crown Pillar. A laydown was constructed adjacent to the Madrid North underground portal location, which included a lined area for ore/waste rock re-handling, shop facilities, power generator and sea can storage area.

Underground waste development continued at Doris in 2019 with further advancement of below the dyke (BTD) decline and necessary support infrastructure. TMAC continued ore development with long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris, and continued ore sill development in the DCO. TMAC also continued waste development of the DCO for future mining horizons. Long hole blasting continued throughout 2019, with all ore production trucked to surface and processed through the mill or added to the stockpile. Construction of the DCO Vent Raise was completed to support underground ventilation requirements. Development of the Doris Central (DCN) decline continued in 2019.

Ore development also occurred from surface in 2019 with the commencement of surface blasting and hauling of ore and waste from the Naartok East Crown Pillar Trench (NECPT). Development of the Madrid North underground decline began in Q4 of 2019.

Backfill and reclamation of the Doris Crown Pillar Trench was completed in 2019.

One dorm was added to allow an additional 48 bed spaces at Doris Camp. To accommodate increased fuel storage required for future project activities, an additional 5 million litre fuel tank was constructed at the Roberts Bay Fuel Storage and Containment facility.

In the fall of 2019, TMAC concluded another successful sealift operation including the purchase and delivery of 23,000,000 L of diesel fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Site layouts and aerial photos for the Belt are provided in Appendix C of this report and provide details of the existing camps, infrastructure and equipment at site.

3.2 EXPLORATION

The 2019 Exploration and Geoscience program at Hope Bay consisted of both underground and surface diamond drilling, regional prospecting, gold in till sampling and a lake-bottom sediment sampling program on Doris and Patch Lake. The 2019 exploration program at Doris included drilling high-grade targets in the BTD extension for mineral resource expansion and drilling in the DCO and DCN to support mine development. Priorities for the 2019 regional exploration program focussed on prospective targets near established or planned infrastructure where successful exploration would influence future economic development on the belt.

Exploration activities operated throughout the year on the Hope Bay belt. An ice drilling program was conducted at the Madrid deposit on Patch Lake from January to April and included an ice portage program at the Madrid pit from January to February 2019. In May 2019, exploration began a regional drill program in areas proximal to the Doris deposit. Once complete at Doris, regional exploration transitioned to mid-belt targets, in preparation for drilling to operate out of Boston camp. In June, all exploration personnel moved to Boston camp once the site was operational. Operations at Boston included camp support personnel, contractors and TMAC employees. Exploration activities were heli-supported from June until November and included diamond drilling, regional prospecting and till sampling programs. Boston camp was decommissioned for season from December, 2019 to January, 2020.

A total of 75,849 metres in 469 diamond drill holes, 135 regional prospecting samples, 1,267 glacial gold in till samples and 97 lake sediment samples were obtained in 2019.

3.2.1 Drilling

Underground diamond drilling at Doris operated continuously throughout 2019. The diamond drilling program focused on expansion drilling in the high-grade zones within the Doris BTD and infill drilling within the DCO, DNO and DCN to support detailed mine planning. A total of 375 underground diamond drill holes, totalling 43,860 metres was completed in 2019.

TMAC contracted Geotech Drilling Services Ltd. to complete the diamond drilling on the Hope Bay Belt for both underground and surface operations in 2019. On surface, no drill setup or associated items were placed within 31 metres of any waterbody during the open water season and no spills were reported into water bodies. Water quality monitoring was performed on runoff from drill sites and water used for drilling to ensure the respective Water License Criteria were met. Drill cuttings and mud were contained within a recirculation system and were transported and stored in approved containment areas including the TIA at Doris.

Surface diamond drilling activities for the 2019 Exploration and Geoscience program occurred between January and November within the Hope Bay Belt. Diamond drilling focused on regional targets proximal to the Doris, Madrid and Boston deposits. Regional targets drilled outside of these deposits were planned along proposed infrastructure routes to promote potential economic development of near infrastructure. A winter drilling program was conducted between January and April 2019, with drill rigs positioned on Patch Lake as well as on land within the Madrid pit area. Ice portages were built when necessary and rigs were pulled with a D6 dozer and telescopic handler. During the summer/fall season between May and

November, drill rigs were situated in heli-portable shacks and positioned with the support of helicopters. All drill sites on surface were reclaimed following the decommissioning of drills. A total of 94 surface diamond drill holes, totalling 31,989 metres was completed in 2019.

3.2.2 Regional Prospecting Program

A regional prospecting program was completed on the Hope Bay belt in 2019. Prospecting and reconnaissance involved structural and geochemical mapping in conjunction with grab sampling in various areas. The purpose of this program was to follow-up on historical showings and mineral occurrences within the Belt and better understand the geology and geochemical signature of current and potential drill targets.

In relation to ground disturbance, prospecting is a very low impact exploration method. Grab samples are collected with the use of a standard geologist hammer on outcrops or boulders of interest. Sample sizes ranged between 0.5 and 3 kilograms and were submitted for analysis. A method of non-destructive testing was implemented for use in the field programs during the 2019 field season. Use of a portable x-ray fluorescent machine (pXRF) for on-site and live geochemical analysis eliminates the need for geologists to take samples from sites.

A total of 135 regional prospecting samples were collected during the 2019 regional prospecting program as grabs and channels.

3.2.3 Till Sampling Program

The 2019 till sampling program was completed during snow-free months from June to September while tundra and outcrops were exposed. These programs focused on exploration outside of the main deposit areas, in effort to test the potential for additional mineralization. The sampling program was designed to test for down-ice flow anomalies within the glacial material transported during the last glaciation. This type of systematic sampling enabled for testing of covered valleys for potential mineralization. This program did not involve the use of heavy equipment and therefore had a minimal impact on the tundra or outcrops.

The samples were collected from a geomorphologic feature that is referred to as a frost boil. This feature represents a zone of frost related movement that transports the basal till material back to the surface of the tundra. The sampling protocols involved the collection of approximately 10kg of till material from the frost boil. A hole was dug to remove the till, which was then sieved to remove over sized grains from the sample. Once the material was collected, the remaining silt/sand/gravel was returned to the hole and contoured to minimize impact. Typically, a hole dug for till sampling is approximately 30 to 50 centimetres in diameter and 50 centimetres deep.

A total of 1,267 samples were collected during the 2019 TMAC till sampling program.

3.2.4 Lake Sediment Sampling Program

A lake sediment sampling program was conducted for two weeks in February, 2019 on Doris and Patch Lake. A two-person crew was contracted through Aurora Geosciences to complete the survey out of the Doris camp when ice thicknesses were ideal. The crew travelled every day to the field using snowmobiles with minimal disturbance to the tundra and environment.

An electric ice auger was used to bore holes through the ice. Samples were retrieved from the lake bottom using a torpedo-style sediment sampler. The sampling instrument was released at the surface of the lake and allowed to drip to the bottom and plunge through the sediment. If frozen, a butterfly vale would engage and keep the material in the barrel of the sampler. A minimum of 50 grams of lake bottom material was recovered at each station and submitted for assay and analysis.

A total of 97 samples were collected from the 2019 TMAC lake sediment sampling program; 79 samples from Doris Lake and 18 from Patch Lake. On twelve occasions in shallow areas, the lake bottom was frozen and no material was recovered.

3.2.5 Channel Sampling Program

A regional channel sampling program was completed on the Hope Bay belt in 2019. The purpose of this program was to follow-up on highly prospective drill targets to better understand the geology, structure and mineralization of veins sets. Channels were taken at the Too and Domani target areas.

Channel samples involve cutting a 1 to 2 inch by approximately 3 to 7 metre long transect into exposed and clean outcrop. Outcrop is washed with debris removed. Channels were geologically and structurally mapped and sampled for analysis. Areas of exposed outcrop were preferred for channel sampling and the tundra disturbance not required. As material is removed for sampling, a small aluminum tag and flagging tape marker are left to denote sample sites.

A total of 40 channels were sampled in 2019; 12 and Domani and 28 at Too. A length of 140.5 metres of rock was sampled for a total of 90 samples.

4. Summary of Project Plans for 2020

4.1 CONSTUCTION AND OPERATIONAL WORK PLANS FOR FUTURE YEAR (2020)

The following activities are planned for the Doris site and associated permitted infrastructure for 2020:

4.1.1 Doris

- Construction of waste oil storage berm to temporarily store waste oil for backhaul;
- Construction of Millwright/Electrical shop on current Doris footprint;
- Expansion of glycol heat loop system to maintenance shops, warehouse and arctic corridor to reduce fuel consumption;
- Construction of surface wash bay facility;
- Construction of DCN Vent Raise;
- Expansion of the Doris accommodation complex;
- Construction of additional dry facilities at Doris Camp;
- Engineering of a waste management area (including landfill) in Quarry 2;
- Installation of additional contact water sumps in proximity to the Doris camp pad as per TMAC water management system; and
- Repair of tailings catch basin located west of Doris Creek.

4.1.2 Madrid

- Development of Madrid Infrastructure, access/winter roads and pads approved under the Type 2AM-DOH1335;
- Installation of fuel tank and construction of secondary containment berm to support Madrid activities;
- Madrid North underground development;
- Installation of Madrid underground fresh air raise;
- Installation of water management sumps at Madrid North Waste Rock Pad; and
- Naartok East Crown Pillar Recovery.

4.1.3 Boston

- It is anticipated that the Boston Camp will be opened for exploration work in the summer of 2020 and kept open during the winter of 2020/2021; and
- No development is planned for Boston other than maintenance of infrastructure to support exploration and camp use.

4.2 EXPLORATION WORK PLANS FOR FUTURE YEAR (2020)

Exploration activities for 2020 will include surface and underground diamond drilling, a gold in glacial till sampling program along with regional mapping and prospecting programs. A limited regional program will be completed, however, the focus for 2020 will be on areas which have potential to impact near to mid-term production at both Doris and Madrid.

Surface diamond drilling planned for 2020 will consist of approximately 10,000 metres of regional surface exploration drilling and 12,000 metres of definition drilling on the Madrid North Naartok West zone. Regional drilling will focus on the Doris Valley area, north of the Doris deposit, and will follow-up on positive results from 2019. Surface drilling on the Naartok West zone will focus on stope definition in advance of production scheduled in 2021. Approximately 50,000 metres of underground drilling at Doris has been planned with the following three objectives: (1) continued definition drilling in the Connector, Central and BTD extension zones, (2) infill and expansion drilling to upgrade confidence and expand the BTD Extension, and (3) initial expansion drilling in the Connector BTD area. Initial drilling at Boston in 2019 returned positive results, however, the decision was made not to proceed with a 2020 Boston surface program.

5. Water Use and Waste Disposal

During 2019, water management at Hope Bay Project Site was in line with the authorized Type A Water Licence for Doris and Madrid 2AM-DOH1335, the Type B Regional Exploration Licence 2BE-HOP1222, and the Type B Water Licence for Boston 2BB-BOS1727. No activities occurred under the Type A Water Licence 2AM-BOS1835 for Boston or the Type B Water Licence 2BB-MAE1727 for Madrid, therefore no water was used or waste produced from activities associated with these licences.

An overview of the sampling programs for each of the sites (Doris, Windy, Madrid and Boston) including site photographs showing the locations of monitoring sites as well as annual water sampling programs for the Hope Bay Project are provided in Appendix D of this report.

5.1 DORIS-MADRID

A summary of monitoring conducted for Doris and Madrid under the Type A Water Licence 2AM-DOH1335 is presented in Appendix D.1 of this report as outlined in Schedule I.

Water for domestic use at Doris is obtained from Windy Lake. Water is drawn from the lake at the freshwater intake and trucked to Doris Camp. The Doris Lake pumphouse was not supplying domestic water to Doris Camp in 2019.

Sewage and greywater produced onsite is processed in the sewage treatment plant at Doris in line with Part F Item 5 of the Type A Water Licence 2AM-DOH1335. Sludge produced by the treatment plant is disposed of within the TIA as outlined in the existing Hope Bay Project Domestic Waste Water Treatment Management Plan.

All containment berm water is sampled for water quality against the discharge criteria of the licence. Water that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector; water that does not meet the licence criteria is treated onsite until it is remediated to acceptable levels for discharge to the tundra, is discharged to the TIA, and/or is managed as approved by the Inspector.

Runoff and contact seepage at site is managed in accordance with the approved Quarry Management and Monitoring Plan and Water Management Plan for the Doris Site.

During 2019, TMAC collected data from the following active or seasonally active monitoring stations: TL-1, TL-2, TL-5, TL-6, TL-7a, TL-7b, TL-9, TL-11, TL-12, ST-1, ST-2, ST-4, ST-5, ST-6a, ST-6b, ST-7, ST-7a/MMS-4b, ST-8, ST-9, ST-10, ST-11, ST-12, MMS-1 and MMS-9.

Monitoring at stations ST-3 (Landfill Sump), ST-13 (Doris Contact Water Pond Pad U), MMS-4a (Freshwater intake at Windy Lake North), MMS-6 (Brine Mixing Facility) and MMS-8 (Madrid North Fuel Storage Facility) did not occur, as these facilities were not constructed as of 2019.

The Madrid North Concentrator was not constructed in 2019, therefore no effluent was discharged to the TIA from this facility and no monitoring occurred at station MMS-7. No monitoring at station MMS-10 (Madrid Mine Water Discharge) occurred as no mine water was pumped from Madrid underground workings in 2019.

No activities occurred at Madrid South in 2019. Therefore monitoring at stations MMS-2 (Madrid South Primary Contact Water Pond), MMS-3 (Madrid South Secondary Contact Water Pond) and MMS-5 (Madrid South Fuel Storage Facility) did not occur as these facilities were not constructed as of 2019.

Monitoring of the TIA was undertaken at monitoring station TL-1. Monitoring of the tailings deposited into the TIA continued at monitoring stations TL-5 and TL-6 in 2019. Monitoring of detoxified tailings backfilled underground was completed at monitoring stations TL-7a, TL-7b and TL-11. As described in the Hope Bay Water Management Plan, the sedimentation pond (ST-1) was used as a collection pond for the water that accumulated in the pollution control pond (ST-2) and the three underflow sumps (ST2-S1, ST2-S2 and ST2-S3). The water collected in ST-1 was then transferred to the TIA by pipeline. The sedimentation pond was also used to transfer water from the landfarm (ST-4) and fuel storage facility berms (ST-5, ST-6a and ST-6b) to the TIA. Water from the Doris underground workings (TL-12), Naartok East Crown Pillar Trench (NECPT) and Madrid North Contact Water Pond (MMS-1) was also transferred to the TIA through the sedimentation pond. Dewatering of the TIA did not occur in 2019.

All monitoring was conducted in accordance with the Hope Bay Project Quality Assurance and Quality Control Plan (2019).

TMAC uses external certified laboratories to carry out all analyses reported in the monthly and annual reports. The QA/QC data produced by ALS Canada Ltd. and Bureau Veritas Laboratories Inc. (formerly Maxxam Analytics) are used to determine the accuracy and precision of results in these reports.

Analytical results for all monitoring stations can be found in Appendix D.1.

5.1.1 Water Balance and Water Quality Model

In 2019 commercial operations continued at Doris and monitoring continued at the associated SNP stations. Water quality source terms, climate data, mine water dewatering rates, processing rates and TIA storage curves were reviewed and/or updated in the water and load balance model, with 2017 to 2019 data, to compare against the predicted TIA water quality and water elevation. Results of the Water and Load Balance Assessment, including relevant supporting data, internal modelling results and adaptive management strategies, have been summarized in the Doris Mine Annual Water and Load Balance Assessment found in Appendix E.

5.1.2 Tailings Impoundment Area

The North Dam which ensures containment of reclaim water in the TIA was completed in 2012. The South Dam which ensures containment of tailings solids was completed in 2018. The total tonnage of tailings solids deposited in 2019 was 0.58 Mt. As of December 2019, 49% of the licensed 2.5 Mt TIA tailings capacity has been utilized (1.23 Mt). The water level at the end of December 2019 was 31.9 masl. The full supply level of the TIA is 33.5 masl. This equates to approximately 1.72 Mm3 of additional water storage capacity available in the reclaim pond. Approximately 18,831 tonnes of detoxified tailings were placed underground as backfill.

5.2 WINDY – 2BE-HOP1222

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the NWB details the sampling and analysis requirements for the SNP program. Windy Camp and the Patch Lake Laydown facility were not in use in 2019; therefore, sampling stations associated with camp operations and fuel storage facility are not being used or monitored. Tables in Appendix D.2 of this report summarize the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BE-HOP1222.

Water is obtained from Windy Lake (ST-7a/MMS-4b) for use at Doris Camp under 2AM-DOH1335 and as allowed under 2BE-HOP1222. Water is taken up through a screened intake and sunken heat-traced line by a permanent pump house, which is used as needed to fill a water truck that transports the water to Doris Camp for use.

The camp water treatment and wastewater treatment facility (WWTF) permitted under this licence was not operational in 2019, therefore no sampling was conducted at monitoring stations HOP-1 (freshwater intake), HOP-2 (WWTF discharge), or HOP-3 (point of entry of WWTF discharge to Windy Lake). Water was utilized from Windy Lake for domestic consumption at Doris Camp and the monitoring station ST-7a/MMS-4b (HOP-1) was sampled for the monitoring criteria under the Doris Water Licence 2AM-DOH1335. For the ST-7a/MMS-4b results see the 2AM-DOH1335 Appendix D.1 The Landfarm at Windy Camp (HOP-4) has been dismantled, so no sampling was conducted at this monitoring station.

The bulk fuel storage tanks at Windy Camp were moved to Doris Camp in winter 2009 for use there, and the bulk fuel storage berm (HOP-5) was dismantled in 2012. The bulk fuel storage berm at Patch Lake laydown (HOP-6) was also dismantled in 2012. No sampling was conducted at either of these monitoring stations.

No sampling occurred at monitoring stations HOP-7A HOP-7B, or HOP-7D (located in Quarries A, B, and D, respectively) during 2019 as no discharge of water was required from these areas during the year.

On-ice exploration drilling was conducted in the licence area in 2019 on Patch Lake. Water quality samples were collected to establish water quality prior to, and upon completion of, this on-ice drilling program as outlined in Part F Item 7 and Part J Item 7 of the licence. On-land exploration drilling was also conducted in the licence area in 2019.

Water used for exploration drilling was taken from the closest lake to each drill in accordance with Part C Item 1 of the 2BE-HOP1222 Licence. For drill locations accessible by road or winter ice road, water is hauled by truck from Windy Lake or compliant berm effluent from Doris is recycled through the drills to lessen freshwater lake use. Water is supplied to a water tank at the drill, and recirculation to cool equipment occurs through this tank. For drill locations inaccessible by road, water is drawn directly from the lake with a screened intake hose line or flown by helicopter using a bambi bucket.

A summary of monitoring activities conducted under this licence is provided in Appendix D.2.

No additional details on water use or waste disposal were requested by the Board in 2019 related to the Project. No artesian flow occurrences were encountered in 2019.

5.3 MADRID – 2BB-MAE1727

The Type B Water Licence No. 2BB-MAE1727 issued to TMAC by the NWB details the sampling and analysis requirements for the SNP program. No activities were conducted under this licence in 2019. Activities conducted at Madrid North in 2019 were monitored under the Type A Water Licence 2AM-DOH1335. A summary of monitoring activities conducted under this licence is provided in Appendix D.3.

No additional details on water use or waste disposal were requested by the Board in 2019 related to the Project. No artesian flow occurrences were encountered in 2019.

5.4 BOSTON – 2BB-BOS1727

The Type B Water Licence No.2BB-BOS1727 details the sampling and analysis requirements for the SNP program. The Boston Camp was operational from June to December 2019 to support a regional surface exploration drilling program.

Water was used from Aimaokatalok (Spyder) Lake (BOS-1a) for domestic use at Boston Camp and samples were collected from monitoring station BOS-1a during periods of pumping. No water was used from Stickleback Lake (BOS-1b) and no samples were collected at this monitoring station in 2019.

The Sewage Treatment Facility (BOS-3) was active in 2019 and compliant effluent was discharged to tundra from this facility as outlined in Part D Item 14 and 15 of the licence. Notification of this discharge was provided to the Inspector in May 2019. Monitoring was conducted of this discharge prior to treated effluent entering into Aimaokatalok (Spyder) Lake (BOS-4), however all effluent had been effectively absorbed into the tundra prior to this point and no samples were collected under this monitoring station.

Water management occurred at the Containment Pond (BOS-2), the Bulk Fuel Storage Facility (BOS-5) and the Portal Decline (BOS-9) in 2019. Water quality sampling was completed at these facilities prior to discharge to the environment to confirm effluent quality. Notification of discharges from these facilities was provided to the Inspector in May 2019 and approval was granted prior to any dewatering activities.

Dewatering of the Landfarm Treatment Area (LTA; BOS-6) was not required in 2019. In 2017, TMAC commenced reclamation of the LTA at Boston with excavation of contaminated soils from the LTA into mega-bags for final disposal. The LTA was decommissioned in 2019 and no water quality sampling was conducted for this facility. Contaminated soils were transported to Doris Camp and backfilled in the Doris underground mine as outlined in the Hope Bay Project Hazardous Waste Management Plan.

Water quality sampling of seepage/runoff from the ore stockpiles and camp pad to the tundra (BOS-8) was conducted in 2019.

A summary of water quality monitoring for the Boston Site under this licence 2BB-BOS1727 is provided in Appendix D.4.

No additional details on water use or waste disposal were requested by the Board in 2019 related to the Project. No artesian flow occurrences were encountered in 2019.

5.5 BOSTON – 2AM-BOS1835

The Type A Water Licence No. 2AM-BOS1835 issued to TMAC by the NWB details the sampling and analysis requirements for the SNP program. No activities were conducted under this licence in 2019. Activities conducted at Boston Camp in 2019 were monitored under the Type B Water Licence 2BB-BOS1727. A summary of monitoring activities conducted under this licence is provided in Appendix D.5.

6. Solid Waste Disposal

At present Waste Management for the Hope Bay Project is currently divided into the following management areas which address:

- Non-hazardous Waste Management;
- Landfarm Management; and
- Hazardous Waste Management

6.1 NON-HAZARDOUS WASTE MANAGEMENT

TMAC has an existing Non-hazardous Waste Management Plan (2017) which covers information pertaining to management of non-hazardous waste generated at Doris, Madrid, Boston and the regional exploration leases in the Hope Bay Greenstone Belt. The Hope Bay Project Non-hazardous Waste Management Plan has been developed to ensure that proper documentation, tracking and handling strategies are in place to monitor compliance and take corrective actions as necessary. In general, non-hazardous waste is generated by the camp(s), the kitchen and various on-site facilities and contracting groups. Management of non-hazardous waste includes recycling, treatment, and disposal of waste streams based on their specific characteristics. Incineration is used as a volume reduction treatment on-site for most non-hazardous domestic waste streams.

In 2019, waste produced at site was collected and consolidated at the Doris Waste Management area by the waste management department (includes waste produced during activities at Boston). TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site under the existing Type A Water Licence; however to date a landfill has not been built. Therefore in 2019, all non-hazardous solid waste that could not be incinerated on site was stored on site for later landfilling or back haul to an approved facility off site.

6.1.1 Camp Incinerators

TMAC's Type A Water Licence 2AM-DOH1335, Type B Water Licence 2BE-HOP1222 and Type B Water Licence 2BB-BOS1727 issued by the NWB allows for the incineration of approved waste streams.

Two incinerators for Doris located at the Roberts Bay waste management facility were used from January to August 2019 for waste incineration. Both incinerator units are CY-2050-A-FA models with a capacity of burning 75 kg of waste per hour. In August 2019, a new CY-100-CA incinerator located in Quarry 2 was commissioned for use. This new incinerator has the capacity to burn three 150-185kg batches per day and was used for waste incineration from August until December 2019. The two smaller incinerators located at the Roberts Bay waste management facility were decommissioned once the new incinerator was operational.

There was no incinerator operated at the Windy Camp and no domestic waste produced at Windy Camp in 2019.

Boston Camp was opened from June to December 2019 to support a seasonal surface exploration program. A CY-2020-FA-D model incinerator located at Boston Camp was used for waste incineration and has a capacity of burning 50kg of waste per hour.

Food waste and paper is incinerated as per Incinerator Management Plan (2019) for the Hope Bay Project. This plan outlines TMAC's approach to domestic waste stream segregation and incinerator management as it pertains to all the Hope Bay Project developments. The objective of the plan is to enable the operation of domestic waste incinerators to be undertaken in a safe, efficient and environmentally compliant manner. The Incinerator Management Plan strives to ensure that:

- Only appropriate burnable material enters the incinerator waste stream;
- Animal attractants are promptly incinerated;
- The incinerator is operated in a manner that reduces harmful emissions;
- Residual ash is handled and disposed of properly; and
- Compliance monitoring and reporting associated with incinerator operations are undertaken.

As recommended by the Nunavut Environmental Guideline for the Burning and Incinerations of Solid Waste, written records are kept of date and volume of burnt waste.

As per Schedule B, Item 12 of Type A Water Licence 2AM-DOH1335, TMAC is required to report the results of Incinerator Stack Testing when available compared to the Canada-wide Standards (CWS) for Dioxins and Furans and the CWS for Mercury.

As per Schedule B, Item 11 of Type A Water Licence 2AM-DOH1335, TMAC is required to report the results of Incinerator Stack Testing when available compared to the Canada-wide Standards (CWS) for Dioxins and Furans and the CWS for Mercury. Due to the exceedances observed in the last stack test, TMAC purchased a new incinerator (Westland Model CY-100-CA-D) from the Ketek Group Inc. Installation and commissioning of the incinerator occurred in August 2019. In September 2019, TMAC retained Nunami Stantec Limited Partnership (Nunami Stantec) to conduct dioxins and furans and mercury source emissions testing on the new waste incinerator. The source emission testing was conducted during the period of September 15 to September 18, 2019.

In late 2019, TMAC received results that indicated the average concentration of mercury for the three tests was 0.26 $\mu g/Rm^3$, which is below the CWS/Nunavut stack limit of 20 $\mu g/Rm^3$, corrected to 11% oxygen. The average stack concentrations of dioxins and furans was 1.27 ng TEQ/m^3 which is above the CWS/Nunavut stack limit of 0.08 ng TEQ/Rm^3 (dry, reference conditions of 25°C and 1 atm, corrected to 11% oxygen).

TMAC is investigating the cause of the dioxins and furans testing exceedances. Investigation includes reviewing the incinerator emissions performance with the manufacturer, ensuring manufacturer recommended operational procedures for the incinerator have been implemented and all operators are adequately trained and, and reviewing TMAC's waste segregation practices. Based on the outcome of the investigation TMAC will evaluate if source control or 'end-of-pipe- pollution control technologies is the preferred approach to address exceedances. TMAC will continue to maintain good combustion practices in parallel with improved waste sorting practices to reduce the formation of hazardous compounds during incineration in interim. See Appendix I for additional details.

6.1.2 Open Burning

The disposal method for untreated wood, cardboard and paper products generated on-site is open burning. This method reduces the volume of inert waste disposed of in the landfill. The landfill has yet to be constructed at the Doris Site.

A total of 977 m^3 of clean wood and 934 m^3 of cardboard was open burned in 2019.

All other waste is sorted and stored in sea cans at the Waste Management facility and is either backhauled for disposal or stored until the Landfill is constructed.

6.2 LANDFARM MANAGEMENT

TMAC is permitted to operate a landfarm facility at the Doris and Boston sites to treat hydrocarbon contaminated materials. TMAC's Hydrocarbon Contaminated Material Management and Monitoring Plan (2017) describes the Doris and Boston facility design as it relates to storage and management of hydrocarbon contaminated materials, including soils and water generated at the site and associated facilities. This plan presents the management and monitoring obligations for each facility as modules A and B, respectively.

Hydrocarbon contaminated water and snow is either stored on-site for shipment off-site to an approved facility or treated with the use of an oil separation (absorbent) treatment system (if required) on site and then verified through laboratory analysis to meet discharge criteria prior to discharge the environment. Hydrocarbon contaminated soils (including waste rock and ore) are treated in the Doris Landfarm or placed in the Doris underground mine for permanent storage.

The Doris Landfarm Facility is located on previously disturbed area approximately 0.6 km north of the existing Doris Camp Area, at approximately 432,573 Easting and 7,559,542 Northing (UTM NAD 83, Zone 13). The Facility is located in a restricted area of the site and is situated between the existing all-weather road and Quarry 2.

Hydrocarbon contaminated water, snow and soils (including waste rock and ore) can be treated using on-site facilities at Doris or can be relocated off site to an appropriate remediation/disposal facility.

Only material containing the following hydrocarbons is farmed at the Doris Landfarm facility:

- Diesel fuel;
- Jet fuels (Jet A, Jet A-1); and
- Gasoline.

All other materials are deemed inappropriate for landfarming and will ultimately be placed in the Doris Mine for permanent storage in accordance with the approved Hope Bay Project Hazardous Waste Management Plan or packaged for offsite disposal at a licensed remediation/disposal facility.

The Boston Landfarm facility or Land Treatment Area (LTA), is located at the Boston Camp Site, south west of the tank farm. In 2017, TMAC commenced reclamation of the LTA at Boston with the excavation and stockpiling of contaminated materials into mega-bags for future treatment or shipment offsite to an approved facility. In March 2019, TMAC backhauled 130 m^3 of contaminated soil from the LTA to Doris Camp via a winter track and disposed of this material underground in the Doris Mine as approved in the Hope Bay Project Hazardous Waste Management Plan. The Boston LTA was decommissioned in 2019 and no additional materials will be placed in this facility. Hydrocarbon contaminated materials generated from future activities conducted at Boston will be packaged for backhaul to Doris until a new LTA facility is constructed.

6.3 HAZARDOUS MATERIAL MANAGEMENT

TMAC has a Hazardous Waste Management Plan aimed at ensuring that hazardous waste collection, segregation, handling, storage, transport and disposal procedures are promptly and efficiently carried out, thus minimizing the risk to the site workforce and the environment, as well as reducing the financial cost to the Project. A copy of the updated Hazardous Waste Management Plan is being provided with this Annual Report.

The Hazardous Waste Management Plan requires in general that all hazardous materials will be shipped offsite for disposal at an approved site. The Hazardous Waste Management Plan describes the purpose-designed hazardous waste management facility. Based on the principles of reduction, reuse and recycling, the plan addresses hazardous waste streams in terms of their risks, storage and labelling, transportation, and disposal, including:

- waste glycol (antifreeze);
- waste solvents;
- waste batteries;
- fluorescent tubes;
- penetrable wastes (sharps);
- waste lubricating oils;
- waste aerosols;
- medical wastes and sewage treatment plant sludge;
- applicable incinerator and wood ash;
- contaminated rags, absorbents and soil;
- residue last contained ammonium nitrate packaging; and
- explosives products and explosives residue containers.

6.3.1 Waste Back-haul

Waste materials back-hauled off site are regulated by the *Transportation of Dangerous Goods Act* (TDGA). In 2019, empty cargo aircraft were utilized for waste backhaul from the Doris Camp throughout the year. The table below summarizes the type and volume of hazardous wastes that were transported to KBL Environmental in Yellowknife to arrange for final remediation/disposal in 2019.

Hazardous Waste Type	Volume (m^3)
Used Oil	109
Used Glycol	34
Used Oil/Glycol Mix	11
Used Oil and Water	5
Waste Leachate Mix	5
Water contaminated with hydrocarbons	49
Burn Pan Ash – Contaminated with Arsenic and Chromium	1
Incinerator Ash – Contaminated with Chromium	0.2
Cutting fluid	0.2
Kitchen Grease mixed with water	2
Kitchen Grease	36

6.4 LANDFILL

TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site as per Type A Water Licences 2AM-DOH1335 and 2AM-BOS1835. To date, a landfill has not been constructed. All waste that cannot be incinerated on site is backhauled to an approved facility for disposal or is stored on site for future landfilling. Because a landfill has not been constructed, no landfill management report has been prepared. TMAC will continue to manage solid waste produced in Hope Bay according to three waste management plans:

- Non-Hazardous Waste Management Plan;
- Hazardous Waste Management Plan; and
- Incinerator Management Plan.

These plans describe how various streams of waste are managed.

7. Aquatic Effects Monitoring Program

The Hope Bay Project (the Project) is a gold mining development owned by TMAC Resources Inc. (TMAC) in the West Kitikmeot region of mainland Nunavut. The Project property is approximately 153 km southwest of Cambridge Bay on the southern shore of Melville Sound and contains a greenstone belt (the Belt) that runs 80 km in a north-south direction varying in width between 7 km and 20 km.

The Project consists of three developments: Doris, Madrid, and Boston. Construction of the Doris Mine and associated infrastructure began in 2010, and commercial operations began in 2017. Construction of mining infrastructure at the Madrid North development began in April 2019, followed by a transition to operations in August 2019 with mining of the Naartok East Crown Pillar trench. As of December 2019, construction had not begun at the Madrid South or Boston developments.

This report presents the results of the 2019 Aquatic Effects Monitoring Program (AEMP), the first year of implementation of the approved Belt-wide Hope Bay Project: Aquatic Effects Monitoring Plan (the Plan; TMAC 2018). The primary goals of the AEMP are to evaluate potential Project effects on the surrounding freshwater environment during the construction and operation of the Project, verify predictions from the Madrid-Boston Final Environmental Impact Statement (FEIS; TMAC 2017b), support current and future Fisheries Authorizations, and provide a mechanism to respond to potential Project effects in the freshwater environment through the Response Framework. This framework sets environmental thresholds that, if exceeded, would trigger further investigation and/or mitigation.

The 2019 AEMP includes lakes adjacent to proposed infrastructure that have the greatest potential to receive non-point-source inputs such as runoff or dust (e.g., Doris and Patch lakes) and lakes that could be affected by water loss due to permitted water withdrawal and groundwater seepage into the mines through underground workings (e.g., Doris, Little Roberts, Patch, Glenn, and Windy lakes). Aquatic components evaluated in 2019 included the following: water level and ice thickness, under-ice dissolved oxygen concentration, water temperature, water and sediment quality, phytoplankton biomass, and benthic invertebrates. Statistical and/or graphical analyses were undertaken to determine whether there were any apparent effects of Project activities on these aquatic components in the monitored lakes.

Table 7-1 presents a summary of the overall findings of the evaluation of effects for the 2019 AEMP, as well as the corresponding section in this report in which to find the discussion of the evaluation of effects for each monitoring component. No adverse Project-related effects to under-ice water level, under-ice dissolved oxygen concentrations, water temperature, sediment quality, phytoplankton biomass, or benthic invertebrate community indicators were detected in the exposure lakes (i.e., lakes with the potential to be influenced by the Project). The evaluation of effects concluded that there were potential Project-related effects to under-ice total ammonia and under-ice total molybdenum concentrations in the water column of Doris Lake, as both water quality variables increased relative to baseline levels and increasing trends were not apparent in the reference lake. Concentrations of these variables remained below CCME guidelines for the protection of freshwater aquatic life, indicating that concentrations of total ammonia and total molybdenum remain protective of aquatic life in Doris Lake. Low action level responses under the Response Framework were not triggered for these variables.

There were no Project-related effects identified in Patch Lake; therefore, the spill incident that occurred in June 2019 did not result in any residual adverse changes to water quality, sediment quality, or to the biological communities (sampled two months after the spill in August 2019) in this lake.

Table 7-1. Summary of Evaluation of Effects for 2019 AEMP

Variable	Exposure Lakes Included in Evaluation of Effects	Conclusion of Effect	Low Action Level Triggered?	Report Section
Water Level and Ice Thickness	Windy Lake, Glenn Lake, Patch Lake, Doris Lake, Little Roberts Lake	No Effect	No	3.1
Physical Limnology (Dissolved Oxygen and Temperature)	Windy Lake, Patch Lake, Doris Lake	No Effect	No	3.2
Water Quality	Windy Lake, Patch Lake, Doris Lake	Possible Effect on Under-ice Total Ammonia and Under-ice Total Molybdenum Concentrations in Doris Lake	No	3.3
Sediment Quality	Patch Lake, Doris Lake	No Effect	No	3.4
Phytoplankton Biomass (as Chlorophyll a)	Windy Lake, Patch Lake, Doris Lake	No Effect	No	3.5
Benthic Invertebrates	Patch Lake, Doris Lake	No Effect	No	3.6

8. Geochemical Studies

8.1 DORIS AND MADRID MINES

This section summarizes the operational geochemical monitoring results for Doris Mine, including waste rock from the Doris Mine, flotation tailings slurry and detoxified tailing solids from the Doris Mill, quarry rock used for infrastructure and road construction and seepage monitoring programs of waste rock, construction rock and underground mine backfill (detoxified tailings).

8.1.1 Waste Rock

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan* (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2. The major difference between the two waste rock management programs is that samples are collected from the underground in TMAC (2016) whereas for the TMAC (2019) program, samples are collected from the surface waste rock stockpile on Pad T.

In 2019, waste rock was produced from the underground mine, placed on Pad T and managed as mineralized rock. Mining of the Doris CPRT was completed in 2018 with waste rock placed in a separate stockpile on Pad T.

8.1.1.1 Underground Doris Mine

In 2019, approximately 430,000 t of waste rock were produced from mining in the Doris underground. Approximately 265,000 t was placed directly as backfill in underground stopes with the balance (165,000 t) transferred and placed in a stockpile on Pad T. As per the Waste Rock and Ore Management Plan (2016), all waste rock was designated as mineralized waste rock that will be eventually placed as backfill in the underground mine. In 2019, 90,000 t of waste rock from surface stockpiles was placed as backfill in underground stopes in the Doris underground mine and 178,000 t was placed as backfill (and cover) in the Doris CPRT.

As part of the TMAC (2016) monitoring program conducted from January to April, TMAC collected 19 underground waste rock samples. According to TMAC geologists, in 2019 the majority of waste rock intersected by the Doris underground workings was primarily (95%) mafic metavolcanic flow (1a); and lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, with rare (1%) diabase or felsic dykes. The samples collected were geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). Geological inspections were conducted by TMAC site geologists when monitoring samples were collected. Where possible, both the working face and the muck pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs. Samples were analyzed for total sulphur (S) and total inorganic carbon (TIC) with a subset also analyzed for paste pH, Modified NP and trace elemental content.

For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high, ranging from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

In terms of trace metals, one sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to ten times the average crustal abundance for basalt. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

As part of the TMAC (2019) waste rock monitoring program, SRK collected ten samples in August 2019 (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. Samples were analyzed for ABA and total metals, and a finer fraction for rinse tests and shake flask extraction tests.

For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. The one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP.

Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

8.1.1.2 Doris CPRT

Mining of the Doris CPRT was initiated in November 2018 with completion in December 2018. All waste rock from the CPRT was placed on Pad T, of which 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T and 51,000 t in a separate stockpile on the western extend of Pad. In 2019, 38,000 t of CPRT waste rock was placed as backfill and cover in the CPRT and the remaining 13,000 t was moved to the existing waster rock stockpile on the east side of Pad T.

In 2019, TMAC collected an additional 24 samples from the CPR waste rock stockpile to supplement the six samples collected in 2018 with the objective of demonstrating the suitability of using CPR waste rock as construction rock. The sampling program included all waste rock types intersected during mining of the Doris CPRT. Samples were analyzed for ABA, elemental analysis and SFE tests on a subset of samples.

CPR waste rock samples collected in the stockpile were described as primarily unaltered (1a) grey or green mafic metavolcanics (basalt) with minor sericitic alteration and altered mafic metavolcanics (1as) with moderate sericitic alteration. Trace disseminated to fine-grained pyrite (≤1%) was observed in the majority of samples with trace quartz and carbonate veins.

The results indicate that all 24 of the 2019 samples collected from the CPR waste rock stockpile had values of TIC/AP and NP/AP > 3 and 21 out of 24 samples fulfilled the accompanying sulphur criterion (<0.5%). The results indicate that on balance waste rock from the CPR meets the criteria. Confirmatory samples collected from the as-built cover meet the criteria TIC/AP, NP/AP and sulphur criteria (SRK 2020b).

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure.

8.1.1.3 Underground Madrid North Mine

Mining of the underground Madrid North mine was initiated in December 2019. In 2019, 11,000 t of waste rock was produced from the decline and placed on the Madrid North waste rock pile (WRP) pad. Based on TMAC's geological inspections of the underground, the majority (99%) of waste rock was geologically logged as mafic metavolcanics (1) with minimal sericitic alteration with the balance (1%) logged as quartz-carbonate veining. Sample collection of waste rock for the purposes of geochemical monitoring commenced in January 2020. Results will be reported as part of the 2020 geochemical monitoring activities.

8.1.1.4 Naartok East CPR

Mining of the Naartok East CPR (NE CPR) was initiated in month 2019 with waste rock production starting in month. Using Classification of Waste Rock in Support of Segregating Construction Rock from Naartok East Crown Pillar Recovery, Madrid North, Hope Bay (SRK 2019b), TMAC developed and executed a program of waste rock geochemical monitoring and segregation to identify NE CPR waste rock that was geochemically suitable for construction. SRK (2019b) outlines criteria and field-based methodology using portable XRF (pXRF) to classify waste rock samples as having a low risk of metal leaching and/or acid rock drainage (ML/ARD).

In summary, TMAC executed the geochemical construction monitoring program of waste rock by sampling drill cuttings from each blast round, analyzing the samples by pXRF coupled with geological inspection and classifying samples according the criteria in SRK (2019b). Based on the geochemical classifications of the drill cutting samples, TMAC classified waste rock from each blast round as either suitable for construction (e.g. low risk of ML/ARD) or not suitable for construction (e.g. risk of ML/ARD) followed by segregation and management of waste rock according to the risk classifications.

TMAC's execution of SRK (2019b) included geological logging and pXRF analysis of 1,899 samples of drill cuttings representing 78 blast rounds. Based on the geological inspection of drill cutting samples, waste rock lithologies were predominantly (75%) mafic metavolcanics (1a), 19% mafic metavolcanics with sediments (1aj), 4% quartz-carbonate veins (12q), 2% sedimentary units (5) and <1% late mafic intrusions (10a). Based on the geological inspection and pXRF analysis of drill cuttings, TMAC classified 39% of samples as low risk of ML/ARD and 61% as having risk of ML/ARD. These results were interpolated by TMAC to a field scale, e.g. blast round basis, resulting in 37% of waste rock being classified as geochemically suitable for construction and 63% as not suitable for construction.

In 2019, a total of 170,085 t of waste rock was produced from NE CPR, of which 123,655 t was placed on the Madrid North WRP. Of waste rock placed on the WRP, 16,200 t was determined to be suitable for construction but was not required for construction at the time of hauling and accordingly was placed on the WRP. In 2019, a total of 53,430 t of waste rock was used for construction of the following infrastructure and access roads at Madrid North: NE CPR for in-pit ramps and access roads; Madrid North underground mine portal pad; Madrid North WRP perimeter roads and berms; Madrid North shop laydown pad; and Overburden Dump access roads and cladding (within stockpile area). All waste rock used for construction was determined to have a low risk of ML/ARD except 7,650 t of waste rock that was strategically placed in areas where waste rock seepage will be managed, specifically in pit of NE CPR (7,300 t) and a lined area adjacent to the Madrid North portal (350 t).

As part of the construction verification program in TMAC (2019), TMAC collected four composite samples of waste rock that was used for construction rock and shipped the samples for ABA analysis at an offsite commercial laboratory. Results indicated that the samples were non-PAG with arsenic levels below the screening criteria.

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure. Waste rock placed on the Madrid North WRP will also be subject to annual geochemical monitoring including geological inspection, geochemical sampling, seepage monitoring at the downstream toe of the stockpile and routine collection of the water in the Madrid North contact water pond (CWP).

8.1.2 Tailings

8.1.2.1 Effluent from Process Plant Tailings (TL-5)

Samples of effluent from the Process Plant (TL-5) were collected from January to December 2019. These results are presented in Appendix D of this report. Figures depicting time series of constituent loads from the process plant tailing water discharge (TL-5) to the TIA are presented in Appendix F - 2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project (see Attachment D of Appendix D - 2019 Geochemical Monitoring of Flotation Tailings Slurry and Detoxified Tailings, Doris Mill). The geochemistry of the 2019 process plant tailings discharge (TL-5) is summarized as follows:

- pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u.
- Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019.
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018. Exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

8.1.2.2 Flotation Tailings (TL-6)

Flotation tailings deposition in the Doris TIA commenced on January 20, 2017. A total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA in 2018. Monitoring details are provided in Appendix D.1.

For flotation tailings solids (TL-6) sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019. TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019) and metallurgical tailings samples (SRK 2015).

Trace element content was compared to ten times the average crustal abundance for basalt (Price 1997) as an indicator of enrichment. Trace element content was elevated compared to screening criteria for arsenic, sulphur, gold and one high bismuth sample. All other parameters were below the screening criteria indicating no appreciable enrichment.

8.1.2.3 Detoxified Tailings Solids (TL-7a)

In 2018, a total of 18,831 t (dry weight) of detoxified tailings were placed as backfill in Doris Mine underground stopes. Details are provided in Appendix D.1 of this report.

Sulphur concentrations ranged between 9.6 and 25 % in 2019 and were highest between the months of July and December (21 to 25%). TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015).

All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration in 2018, compared to 15 mg/kg in 2019). All other parameters were below the screening criteria indicating no appreciable enrichment.

8.1.2.4 Detoxified Tailings Filtrate (TL-7b)

For the detoxified tailings filtrate (TL-7b) pH conditions ranged from 8.5 to 8.8 s.u. Concentrations of sulphate (a by-product of milling of sulphide rich ore) ranged from 12,000 mg/L to 28,000 mg/L. Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.

Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process. Milling of the sulphide rich ore results in high concentrations of total metals, including arsenic, antimony, cadmium, cobalt, copper, iron, manganese, molybdenum, nickel, selenium, and silver.

8.1.3 Quarry Rock

8.1.3.1 Quarry Monitoring

Infrastructure at Doris and Madrid North were constructed using rock from Quarry 2 and Quarry D, respectively. Infrastructure constructed at Doris between 2018 and 2019 included the access road to the vent raise; access road to the Doris crown pillar recovery (CPR), cover for the Doris CPR, and access road and jetty at Roberts Bay to the effluent discharge point. Infrastructure constructed at Madrid North included the access road to the Naartok East CPR; Madrid North contact water pond (CWP); access road to the Madrid North CWP; and Naartok East overburden pad berm.

In 2019, TMAC conducted geological inspections in Quarry 2 between May and August and Quarry D in May, July and September For Quarry 2, geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets except for the August inspection. In August, a 3 to 4 m thick band argillite (5a) within mafic metavolcanics was observed in one active face in the western extent of the quarry. All inspections noted the absence of fibrous actinolite. For Quarry D, geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets. All inspections noted the absence of fibrous actinolite. Samples of run-of-quarry rock were collected for geochemical characterization as per the Quarry Management and Monitoring plan (TMAC 2017).

Geochemical monitoring of Quarry 2 ROQ rock indicated all samples of mafic metavolcanics (1a) were non-PAG according to values of NP/AP and TIC/AP. The argillite (5a) sample was classified as having an uncertain potential for ARD owing to higher levels of total sulphur. Elemental analyses indicated enrichment compared to average crustal abundance for sulphur and arsenic in argillite and in the fine fraction of mafic metavolcanics. All other parameters indicated no appreciable enrichment. Results from the SFE tests for mafic metavolcanics (1a) indicated non-acidic pH and metal concentrations below the screening criteria indicating the risk of ML/ARD from Quarry 2 metavolcanics (1a) is low. SFE test results for argillite (5a) indicated non-acidic pH with sulphate concentrations (780 mg/L) suggestive of sulphide oxidation.

Geochemical monitoring of Quarry D ROQ rock indicated that the monitoring samples were non-PAG for all mafic metavolcanics (1a) according to values of NP/AP and TIC/AP. Total sulphur content ranged between 0.09 and 0.26% and Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively. Elemental analyses indicated no appreciable enrichment compared to the screening criteria. SFE test results indicated that all test leachates were non-acidic and that all parameters were below the screening criteria indicating the risk of ML/ARD from Quarry D ROQ rock is low.

8.1.3.2 Construction Monitoring Doris and Madrid

In August 2019, SRK conducted a geological inspection of infrastructure and roads at Doris and Madrid constructed between August 2018 and August 2019 and collected a total of 12 samples. At each sampling site -1 cm and -2 mm sieved splits were collected separately. Field contact rinse tests were conducted on the -2 mm samples. All -1 cm samples were analyzed for total sulphur with a subset analyzed for full ABA and trace element content. A subset were also analyzed for shake flask extractions to assess the soluble component of the samples.

At Doris, SRK conducted a geological inspection of as-built construction that confirmed construction materials for the access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay were characteristic of Quarry 2: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). The geological inspection of the Doris CPR identified CPR waste rock along with ROQ rock from Quarry 2. The geology of construction material used for the access road to the Doris vent raise was characteristic of Quarry 2, except for a 120 m segment that contained a minor amount (~5-10%) of black intermixed fragments of argillite (5a) mixed with mafic metavolcanics (1a). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads, including two samples of waste rock from the CPR cover and one sample from the access road to the vent raise containing argillite (5a).

Total sulphur ranged between 0.18% and 0.45% with the highest sulphur value from the sample containing a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a). For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

SFE test results indicated that all test leachates were alkaline and that the potential for metal leaching from these samples is low. A sample from the CPR cover indicated higher chloride and nitrate levels that suggest waste rock from the underground may be present in the CPR cover material. TMAC notes that the cover design specified that underground waste rock be placed below the active layer and CPR waste rock to be placed as the cover.

At Madrid North, SRK conducted a geological inspection of the access road to the Naartok East CPR, Madrid North CWP, access road to the Madrid North CWP, and Naartok East overburden pad berm. The inspection confirmed that the construction materials were characteristic of Quarry D: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads.

Total sulphur content ranged between 0.07% and 0.22%. Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP. In terms of elemental content, concentrations of all parameters were below the screening criteria, suggesting no appreciable enrichment. SFE test results indicated that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

8.2 BOSTON CAMP

Currently there is no monitoring under the Type A at Boston. This section summarizes monitoring in support of the Boston Camp closure plan under Type B.

8.2.1 Waste Rock and Ore

The Boston ore/waste rock management plan (SRK 2017) includes a commitment to monitor the oxidation of the ore by carrying out a survey of rinse pH and conductivity every ten years. This monitoring was conducted in 2018 and was not a requirement in 2019.

9. Geochemical Seepage Surveys

9.1 DORIS AND MADRID MINES

This section summarizes the seepage surveys conducted at Doris and Madrid Mines as part of the geochemical operational monitoring programs.

9.1.1 Construction (Quarry) Rock and Waste Rock Seepage Survey

The seep survey was carried out between June 19 and June 24, 2019 by TMAC in the Doris North and Madrid areas. The construction seepage monitoring program included visual inspection and opportunistic sampling of seepage downstream of the areas constructed between summer 2018 and summer 2019. Infrastructure surveyed at Doris included the TIA south dam, Marine Outfall Berm (MOFB) access road at Robert's Bay, access road to the Doris Central vent raise, access road to the Doris CPR and Doris CPR cover. Construction rock at Doris was sourced from Quarry 2 except for the Doris CPR cover, which was constructed primarily of Doris CPR waste rock and some quarry rock. Infrastructure surveyed at Madrid North included the access road to Naartok East CPR, overburden pad berm, Madrid North contact water pond (CWP), and access road to the Madrid North CWP. Construction rock at Madrid was sourced from Quarry D. Seepage was observed and samples collected representing construction rock from all aforementioned areas except the Doris CPR cover. As par to the waste rock monitoring program, the toe of the waste rock stockpile and the downstream areas of the waste rock storage area were surveyed. This area is referred to the waste rock influenced area (WRIA). There were no stockpiles of waste rock from Madrid North (Naartok East CPR) at the time of the survey. In addition, three references sites were sampled. Samples were collected from each seepage site observed and submitted to ALS Environmental for geochemical analysis.

A summary of the field measurements is presented in Table 9.1-1. The samples collected within the WRIA had the highest levels of field EC (ranging from 2000 to 3500 μS/cm) compared to other site areas. Field pH ranged from 7.5 to 8.1. Field data were not collected at the three reference stations.

Table 9.1-1. Median Values for Field Conductivity and pH Measurements

Mine Area	Material Source	Site Area	No. of Samples	Conductivity (μS/cm)	pH
Reference	-	Reference (Windy Road)	3	-	-
Doris	Waste Rock	WRIA	6	2300	8.1
	Quarry 2	South Dam	1	300	7.9
		Access Road to Doris CPR	2	270	8.0
		MOFB Access Road	13	190	7.7
Madrid	Quarry D	Access Road to Madrid North CWP	11	79	7.5

The results of the 2019 sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay. Compared with seeps from infrastructure areas, and consistent with previous years, seepage from areas impacted by waste rock had elevated levels of chloride, nitrate and ammonia. Chloride levels are attributed to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock.

In terms of metal leaching from waste rock, concentrations of sulphate, copper and cobalt that have exhibited increasing trends since TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile in 2015. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, cobalt, and copper may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of iron for the 2019 waste rock seepage samples were increasing for samples collected from the berm of the PCP; however, this was attributed to the presence of particulate material less than 0.45 µm that are not truly dissolved species. All waste rock seepage is intercepted, managed and pumped to the TIA.

9.1.2 Underground Backfilled Stopes (TL-11) Seepage Survey

Seepage samples were collected in 2019 from the underground backfilled stopes (TL-11). TMAC completed underground seepage inspections of backfilled stopes in May and December 2019. Fifteen locations were surveyed in May and sixteen locations were surveyed in December. No flowing seeps were identified in the May survey but samples were collected from pools of water located at the base of backfilled stopes to provide additional characterization of water underground near backfilled materials. In December, TMAC collected two seepage samples during the underground survey. Additional details of seepage monitoring can be found in Appendix D.1 of this report.

Seepage sampled from the December survey were interpreted to be contact water of waste rock and tailings backfill. For these samples the pH is slightly alkaline with both seeps reporting a pH of 8.0. Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium). Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set. Cadmium, copper, nickel, selenium and silver were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015). The exception to this was zinc, which reported elevated concentrations in the survey but was not noted as a parameter of potential concern in the HCT program.

9.2 BOSTON CAMP

This section summarizes the geochemical monitoring results at Boston. The seepage and ephemeral streams monitoring programs are conducted annually in the context of the waste rock and ore management and Boston closure plans. The objective of the seepage monitoring is to provide an indication of water quality from the waste rock (camp pad) and ore stockpiles. The seepage samples are collected at the toe of the camp pad. The two objectives of the ephemeral streams program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra.

9.2.1 Seepage Monitoring

There are two opportunistic seepage monitoring programs, seepage monitoring at station BOS8 as indicated by Boston water licence 2BB-BOS1727 and a freshet seepage survey along the north and east sides of the camp pad, and the southern end of the airstrip as specified in the Boston Water and Ore/Waste Rock Management Plan (SRK 2017).

In 2019, a total of three opportunistic seepage samples were collected: two from the northeast side of the camp pad, and one along the road to the airstrip. No seepage was observed along the northern extent of the pad or along the airstrip.

All seepage samples were pH neutral to slightly alkaline (7.8 to 8.0). Sulphate concentrations for the two samples from the NE Pad (19-BOS-01 and BOS-8A) were within the range of historical concentrations and ranged from 400 to 630 mg/L. Chloride and nitrate at 19-BOS-01 (220 and 4 mg/L, respectively) were similarly equivalent to previous measurements.

The seep located at the toe of the road (19-BOS-02) had nitrate, chloride, dissolved arsenic, nickel, and selenium concentrations one to two orders of magnitude lower than the seep samples located at the NE camp pad. Sulphate concentrations at the access road were four to six times lower than the NE Pad and dissolved copper and iron concentrations were roughly equivalent at the two location. In general, metal concentrations in samples collected in 2019 are within the historical range of observed concentrations and no long-term trend was identified.

9.2.2 Ephemeral Streams Monitoring

As outlined in the Water and Ore/Waste Rock Management Plan for the Boston Site, Hope Bay Project, Nunavut (2017), five ephemeral streams (A to E) within the catchments of the Boston camp pad are monitored during spring freshet. The objectives of the program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra. TMAC inspected ephemeral streams A2 to E2 for flow on June 29, 2019. Flow was observed in ephemeral streams A2, D2 and E2 and samples collected for laboratory analysis.

The pH of ephemeral streams A2, D2 and E2 were neutral to slightly alkaline (7.7 to 8.0 s.u.). Sulphate values have oscillated for A2 and D2 whereas E2 has increased slightly since 2009. Chloride concentrations for ephemeral streams exhibit a decreasing trend. Nickel and arsenic values have oscillated for A2 and D2 whereas E2 has remained stable since the start of monitoring. Nitrate, copper, iron and selenium have stable trends. The analysis of the water quality data for ephemeral streams A2, D2 and E2 indicated that concentrations were either decreasing or consistent with historical data except for sulphate at E2 which is increasing. For sulphate concentrations at D2 and E2, values were greater than the maximum predicted value but a loading assessment indicated that concentration is related to dilution from surface waters. Future monitoring will establish any trends. Sulphate and chloride levels are not attenuated by the tundra and the concentrations measured in 2019 validate the Boston 2009 water and load balance. Overall, the water quality of the ephemeral streams is stable and results validate the findings of the water and load balance and that there are therefore no projected impacts to the receiving environment.

10. Fuel Storage

Bulk fuel storage at the Hope Bay Project site is accomplished in compliance with relevant regulations and authorizations. Bulk fuel is stored in steel tanks or manufactured fuel bladders which are housed in a "tank farm" that is lined with an impermeable membrane and surrounded with a berm with sufficient capacity to meet containment criteria (i.e., 110% of the largest tank in the farm). This minimizes the potential of fuel entering the environment from a spill. Chemical storage at the Hope Bay Project site is accomplished in compliance with handling and storage instructions detailed in the respective manufactures Safety Data Sheets (SDS).

TMAC maintains a Hope Bay Project Spill Contingency Plan (most recently revised in 2020), available in Appendix H of this report, which is utilized to safeguard against accidental spills of harmful substances that may negatively affect the environment. Implementation of spill prevention systems are critical to avoid such accidents, followed by a response system that is timely and efficient if spills do occur, and contains and mitigates the negative environmental consequences. The Hope Bay Project Spill Contingency Plan was developed in accordance with the Spill Contingency Planning and Reporting Regulations developed under Section 34 the Government of Nunavut's *Environmental Protection Act* (RSNWT Nu1988), and was developed specifically to address the requirements of the Framework Agreement; NWB Water Licences: 2AM-DOH1335, 2AM-BOS1835, 2BE-HOP1222, 2BB-MAE1727 and 2BB-BOS1727; and NIRB Project Certificates: Number 003 and Number 009; including all amendments. The Hope Bay Project Spill Contingency Plan provides a consistent spill response framework that is available to all site personnel so they can effectively and efficiently respond to a spill of petroleum products and/or hazardous materials regardless of where on the Hope Bay site they are encountered.

The Hope Bay Project Spill Contingency Plan contains detailed inventories and measurable quantities of all on-site hazardous materials and provides layouts indicating locations of all spill response equipment at site. A list of spill containment systems used are summarized below:

- Gravel/HDPE lined containment facilities (e.g., Roberts Bay and Doris Tank Farms);
- HDPE/wood containments (e.g., Jet-A storage at Heli-pad);
- Concrete berms (day-tanks at the Powerhouse);
- Double-walled steel tanks at location of use;
- Steel spill containment (e.g., beneath tanks at incinerator);
- Insta-berms; and
- Plastic spill pallets.

Spill response resources are also described in detail in the existing management plan together with their routine maintenance and inspection. The availability and organization of the human resources deemed required to respond to spill events is described in the Hope Bay Project Spill Contingency Plan, along with the responsibilities of specified personnel and response teams clearly defined. External notification and communication in the event of spill events are addressed and there is also a specified and comprehensive system of internal reporting. The Hope Bay Project Spill Contingency Plan considers the requirements of the Environmental Emergency Regulations (SOR/2019-51). The Plan is subject to annual review and an update to this plan is being provided with this Annual Report in Appendix H.

11. Spill Reports

During 2019, fourteen spills were reported to the Nunavut Spill Line, Water Licence Inspector and KIA Major Projects. No spills were reported to Environment and Climate Change Canada. These fourteen spills met the reporting threshold as outlined in the Nunavut Spill Contingency Planning and Reporting Regulations. In addition to the required Spill Line report, a more detailed follow-up report was filed within thirty days of each reported spill that included a description of the event together with the immediate cause, corrective and preventative action. The fourteen reportable spill events are summarized in Table 11-1 below.

The remaining spills that occurred during 2019 were minor in nature, occurring on land, with quick response and clean up resulting in negligible impact to the receiving environment. TMAC tracks all unauthorized discharges and spills on site, regardless if they are externally reportable or not, and identifies any observable trends. Based on those results, root cause analysis and corrective actions are recorded, tracked and implemented. Inspectors have the opportunity to review the information on demand or when at site conducting inspections.

Table 11-1. Summary of Reportable Spills in 2019

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
9-Feb-19	19-048	10-Feb-18	Glycol 50-60 liters	On February 9, 2019 an operator was loading ore using a 988 loader on the mill ore stockpile to transport to the mill crusher. The operator had scooped up the load and turned to begin backing up when he identified a trail of fluid originating from under the loader. The operator stopped the equipment immediately and called for assistance. Mechanics reported to the scene and found that a coolant hose line had failed allowing the radiator of the loader to drain onto the ground. A total of 50-60L of ethylene glycol 60-40 coolant was released to the snow covered crush pad. Mechanics determined that extreme cold temperatures occurring at the time of the spill, combined with normal wear and tear of the equipment had caused the failure. Spill pads were placed beneath the leak to reduce the amount of spill contacting the ground surface. The loader was then taken to the mechanical shop to replace the hose line. Contaminated materials were removed from the surface of the pad (spill pads, snow and crush) and taken to the waste management facility to be stored for offsite disposal. The loader operator had conducted a pre-operational check of the equipment prior to beginning the task and had not noted any issues or leaks with the coolant hose lines. Preventative maintenance is conducted on this piece of equipment after every 500 operating hours and includes checks of all hose lines. Worn hose lines are replaced if integrity issues are identified. The preventative maintenance had been conducted within the recommended schedule for this equipment at the time of the spill. TMAC internally reviewed the incident and identified the following corrective actions in order to reduce the likelihood of a reoccurrence: • Continue performing pre-operational checks on all equipment prior to use to identify potential issues prior to using the equipment; and • Continue performing preventative maintenance programs on all equipment at the recommended interval (every 500 operating hours).	5-Mar-19
10-Mar-19	19-101	10-Mar-19	Glycol 10-20 liters	At 7:30 am on March 10, 2019, the powerhouse operator identified ethylene glycol coolant on the ground beneath one of the powerhouse generator modules while conducting the daily morning inspection. Glycol was found to be leaking out of the radiator cap on the top of the cooling system. The fluid leaked onto the roof of the generator module and some of the coolant flowed over the side of the building onto the crush pad and concrete foundation below. The follow up investigation identified that failed head gaskets on two of the cylinders had	03-Apr-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				caused oil to pressurize the glycol cooling system. Pressure and volume increased until glycol leaked out of the radiator cap at the top of the system. The generator was immediately shut down to prevent further release. Absorbent pads were used to clean glycol off the generator module to reduce the amount of spill contacting the ground surface. Contaminated materials were removed from the surface of the pad (spill pads, snow and crush) and taken to the waste management facility to be stored for offsite disposal. Clean-up efforts included hand excavation of contaminated snow from the camp pad and spill pads were used to remove fluid from side of the building and the concrete foundation. A small amount of coolant (estimated to be less than 1L) was inaccessible to the clean-up efforts. This material was located under a sheet of stainless steel that was buried under snow and ice. Preventative maintenance is conducted on this generator after every 500 operating hours. The preventative maintenance had been conducted on March 4th, 2019, within the recommended schedule for this equipment at the time of the spill. TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • Continue performing walk around checks twice daily on all generator components to identify potential issues; and • Continue performing preventative maintenance programs on all generators at the recommended interval (every 500 operating hours). Additionally, TMAC will ensure proper housekeeping around the powerhouse pad so that all foreign objects are cleared from the area once the summer thaw permits.	
11-Mar-19	19-103	11-Mar-19	Tailings/Process Water 500-600 liters	On March 11, 2019, while driving along the Tailings Impoundment Area (TIA) access road, the Environmental Technician identified a build-up of discoloured ice along the TIA reclaim pipeline. Mill Maintenance and Site Services personnel were notified and upon inspecting the area, determined that a leak was occurring from a flange in the reclaim pipeline used to transport reclaim water from the TIA to the Process Plant. An estimated 500-600 L of reclaim water was released to surrounding tundra. No material was released to any waterbody. Upon investigation, it was determined that the bolts on a flange connecting two sections of pipe together had become loose. This allowed the two sections of pipe to separate slightly causing the release. The Environmental Supervisor, Mill Maintenance and Site Services personnel were immediately notified. Snow and ice covering the line was removed to	3-Apr-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				expose the pipe and flange. The loose bolts on the flange were tightened stopping the leak. A sample of the reclaim water was collected at the time of the release and was below the discharge criteria outlined in Schedule 4 of the Metal and Diamond Mining Effluent Regulations. As the sample results met this criteria, no additional efforts were made to excavate frozen reclaim water from the surface of the tundra. Excavation would result in damage to tundra and introduce a risk of future permafrost degradation in the area. Contaminated snow and ice that was hand excavated to expose the reclaim pipeline was disposed of in the Tailings Impoundment Area. TMAC internally reviewed the incident and identified the following corrective actions in order to reduce the likelihood of a reoccurrence: • Implement routine preventative maintenance program for reclaim water pipeline, including checks of flange bolts and pipe connections; and • Place delineators at flange locations along reclaim pipeline in summer of 2019 to identify flange locations during winter months and allow effective snow removal at these locations to facilitate inspections.	
26-Mar-19	19-132	26-Mar-19	Glycol 50 liters	At 6:30 am on March 26, 2019, the powerhouse operator responded to an alarm within the powerhouse. It was discovered that generator #5 engine had experienced a catastrophic failure and released oil and glycol on to the deck of the generator module. The ethylene glycol coolant was dripping from the deck of the module and onto the crush pad and concrete foundation below the module. Absorbent pads were used to contain and absorb the dripping and pooling glycol underneath the module. Contaminated materials were removed from the surface of the pad (spill pads, snow and crush) and taken to the waste management facility to be stored for offsite disposal. Preventative maintenance is conducted on this generator after every 500 operating hours. The preventative maintenance had been conducted on March 5th, 2019, and the unit was within the recommended schedule at the time of the spill. TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • Continue performing walk around checks twice daily on all generator components to identify potential issues; • Continue performing preventative maintenance programs on all generators at the recommended interval (every 500 operating hours);	19-Apr-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				• Prior to placement of a replacement generator, the floor of the module will be inspected and any holes caused by the incident will be repaired; and • A solution to seal the seams of each generator module enclosure is being investigated in order to contain any spills inside the module from reaching the crush pad and concrete foundation.	
21-Apr-19	19-165	22-Apr-19	Cement 375 kilograms	On April 21, 2019, an employee was attempting to remove a mega-bag of cement mix out of a sea-can with the telehandler. While removing the mega-bag, it caught a sharp edge on the inside of the sea-can. As a result, approximately 375kg of the mega-bag spilled onto the ground in front of the sea-can. The majority of the contents remained contained within the mega-bag. The cement bag was placed into another sea-can while the hole was being repaired and the area being was cleared. Contaminated snow was removed with shovels and a Bobcat, placed into another mega-bag, and taken to the Tailings Storage Facility for disposal. TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • A spotter must be used for accessing and replacing material in sea-cans; • Spotter and operator will properly assess challenges of area prior to making pick. During this time, they will also discuss the signal language to be used that will allow them to best support the move.	21-May-19
26-Apr-19	19-177	26-Apr-19	Glycol 950 liters	On April 26, 2019, an employee was attempting to remove a plastic tote of ethylene glycol 60-40 coolant from a sea-can with a telehandler. While loading the tote, the forks of the telehandler shifted and punctured the tote. Approximately 950L of coolant was released into the sea-can and onto the camp pad in front of the sea-can doors. In the investigation of this incident, it was found that a spotter was not used. A spotter may have been able to identify a shift in the telehandler forks before a puncture, and assist with any potential issues that may arise when moving material. The operator immediately reported the spill to the supervisor, who contacted the Environmental department. Spill pads were placed to absorb spilled coolant. Contaminated snow was removed by hand and with equipment. This included material that migrated beneath the sea-cans. To do so, the sea-cans were moved and the contaminated material was excavated from the camp pad surface. Contaminated material was placed into drums and taken to the waste management facility to be stored for offsite disposal.	22-May-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • A spotter must be used for accessing and replacing material in sea-cans; • Spotter and operator will agree on a signal language to be used during pick; • Spotter and operator will assess the material and the location for potential challenges associated with the pick. Challenges will be properly mitigated; and • The procedure for the unloading of totes will be thoroughly reviewed and gone over with the team members.	
10-May-19	19-200	11-May-19	Glycol 15 liters	On May 10, 2019, an employee was clearing snow from a laydown area at the Roberts Bay Waste Management facility when a leak of ethylene glycol coolant was identified. The leak was traced to a sea-can container located on the third level of a stack of sea-cans used to store waste materials. The sea-can was brought down for an immediate inspection. An overturned lined mega-bag of clean plastic was identified as the source of the leak. It was found that a 20-liter pail of waste ethylene glycol coolant had been mixed in with the clean plastic waste. The coolant had drained from the pail onto the floor of the sea-can, leached under the doors and ran down the sea-can stack. Approximately 10-15 liters spilled to the camp pad. The sea-can container was brought down from the stack, opened and cleaned. Sea-cans stacked below were also removed. Contaminated snow and crush was removed from the camp pad surface with a skid-steer loader and placed into drums for disposal. TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • Thoroughly inspect materials being brought to Waste Management, and log violations for follow-up. • Ensure that mega-bags are placed into sea-cans upright and secure, to reduce movement during handling of sea-cans.	02-Jun-19
15-Jun-19	19-240	15-Jun-19	Turbid Water Unknown Volume	On June 15, 2019, while stripping a surface layer of overburden for the development of the Naartok East - Crown Pillar Recovery Trench at Madrid North, surface runoff containing sediment within the footprint of the stripping area migrated overland through the active layer of tundra to the shoreline of Patch Lake. This release was noted during a daily construction inspection, at approximately 17:15. The runoff bypassed sediment control installations and entered Patch Lake approximately 100m downstream from the disturbed area. Two separate overland flows, exhibiting visible turbidity, were observed flowing	15-Jul-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				towards and to the shoreline of Patch Lake. The ice had not yet fully melted along the shoreline of the lake, and the sediment was confined to a pool above the ice between the two overland flows. An incident investigation was conducted soon after the incident to determine the root cause. The investigation concluded with the following root causes: • Failure of sediment controls installed between stripping footprint and Patch Lake due to uncertainty of site drainage locations prior to work and under estimation of the volume and rate of water that would be released from the area; and • Failure to select the appropriate sedimentation control measures for the specific terrain and conditions. On June 16, two turbidity curtains were installed in areas where sediment was observed on the shoreline of Patch Lake. The installation of these curtains ensured that sediment was contained close to the shore, minimizing the potential migration into Patch Lake after the lake ice had melted. This additional measure was observed to be effective in containing much of the sediment between the curtain and the shore. On June 17, a newly constructed rock berm was initiated around the perimeter of the stripping area to divert water around the work area and to keep water contained within the footprint prior to resuming stripping activities to reduce the likelihood of a reoccurrence. In addition to the corrective actions, water samples were collected for acute lethality testing and water quality characterization. The incident investigation concluded with the following preventative actions for future overburden stripping in order to reduce the likelihood of a reoccurrence: • Assessment of sedimentation installations prior to commencing overburden stripping activities; • Additional training for personnel on sedimentation control installations; • Conduct thorough assessment of drainage locations (based on historic photos if necessary) to identify flow paths and areas of risk; • Preinstall turbidity curtains where practical; and • Installation of rock berms in high-risk areas prior to stripping of overburden. Representative samples of both flows were collected at the shore where turbidity was observed to be entering Patch Lake. The samples were collected approximately four hours after the event was initially observed, and for two subsequent days after. This was done to quantify the impact of the mitigation measures and potential impacts to Patch Lake. Representative samples were	

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				also collected on the day the release was observed for acute lethality testing. A review of the analytical results showed both streams entering Patch Lake to be non-acutely lethal with a 100% survival rate for both Rainbow trout (96-hour LC50 test) and Daphnia magna (48-hour LC50 test). Water quality results were compared to the MDMER Schedule 4 – Authorized Limits of Deleterious Substances. All parameters were below both the Maximum Authorized Monthly Mean Concentration and the Maximum Authorized Concentration in a Grab Sample with the exception of Total Suspended Solids (TSS). TSS results for NE-C were 93.7, 17.1, and 4.3 mg/L on June 15, 16 and 17 respectively. TSS results for NE-D were 29.3, 8.9, and 3.5 mg/L on June 15, 16 and 17 respectively. Water quality results and photos of the location were appended to the 30-day follow-up report.	
23-Jun-19	19-252	24-Jun-19	Sewage 100 liters	On June 23, 2019, while conducting an inspection of the camp lift station and pipeline facilities at the Boston Camp, an employee identified that the pipe support of the main kitchen grey water line to the camp lift station had failed resulting in the pipe dropping approximately 1ft. While the grey water line was being repaired, two sections of the pipeline separated resulting in approximately 100L of grey water being released to the tundra below. Upon investigation, it was found that a 2” HDPE pipeline had been glued to an ABS pipeline. The additional strain resulting from the pipeline dropping caused the glue to separate at this location. The pipe support was also found to be weathered and no longer adequate to support the weight of the pipe. The pipeline was temporarily shored with new wood materials to realign the pipeline and release strain from the connection. The pipe support materials along the length of this pipeline will be replaced once the area can be accessed by equipment with minimal risk of damage to the tundra. The pipe sections were reconnected and insulated; a Victaulic clamp appropriate for the pipeline materials (HDPE to ABS connection) has been ordered and was installed at this location to reduce the risk of a reoccurrence. Grey water released from the pipeline had soaked into the tundra and could not be recovered. Post-incident water quality sampling was conducted at the shoreline of Aimaokatalok Lake located approximately 80 m downstream of the spill location and compared to a sample collected on June 17, 2019 (BOS-1) prior to the incident. Results of this sampling were provided in the 30-day follow-up report.	23-Jul-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • Use Victaulic fittings for pipe connections that are appropriate for the pipe material; • Conduct assessment of pipe connections along entire length of the grey water pipeline at Boston Camp and replace if necessary; and • Replace current pipe support with robust materials that are less susceptible to weathering and failure.	
28-Jul-19	19-301	28-Jul-19	Sewage 7 cubic metres	On July 28, 2019, a sewage spill was discovered at the north-west corner of the Boston Camp complex. Sewage and grey water from the north section of the camp was released to the camp pad beneath the building and onto the tundra north-west of the building. This section of the camp had been opened on July 20th and was occupied between July 20th and 28th when the spill was discovered. An estimated 7000L of sewage/grey water was released during this time. Upon investigation, it was discovered that a Fernco fitting on the main sewage line had disconnected at some point prior to occupying this section of the camp. It is believed that this fitting had been installed incorrectly and that freeze/thaw conditions over time contributed to the failure. It was also identified that the cribbing under this pipeline is in poor condition and may have contributed to the failure of the fitting. Due to snow drifts around the buildings when Boston Camp was opened in June 2019, this section of the camp was not accessible to conduct an inspection of this infrastructure and a miscommunication between cross-shifts resulted in pre-use inspections of this infrastructure to be overlooked prior to occupying this section of the camp in July 2019. A small pump was used to recover pooled material under the building and on the tundra into plastic totes for treatment in the Sewage Treatment Plant and lime was placed on the crush pad beneath the building to neutralize odours and bacteria. The failed Fernco fitting was replaced to reconnect the pipes and prevent further release of materials. To reduce the risk of failure resulting from freeze/thaw conditions, an expansion joint was ordered and installed on the pipe to replace the Fernco fitting. TMAC internally reviewed the incident and identified the following preventative actions in order to reduce the likelihood of a reoccurrence: • Conduct pre-operational inspections of all sewage and greywater infrastructure during camp commissioning prior to occupying camp, including testing of all infrastructure with fresh water to identify leaks, and document these inspections;	22-Aug-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				• Conduct daily operational inspections of all sewage and greywater infrastructure while camp is occupied and document these inspections; • Use of expansion joint fittings for pipe connections where appropriate to reduce risk of failure due to freeze/thaw conditions; • Conduct full assessment of all connections of sewage and grey water pipelines at Boston Camp and replace as necessary; and • Conduct full assessment of support and cribbing infrastructure for all pipelines at Boston Camp and replace as necessary.	
29-Oct-19	19-445	29-Oct-19	Treated Effluent 1 cubic metre	On October 29, 2019, an operator was completing commissioning work in a water treatment facility at the Doris camp. During this work, the operator inadvertently caused damage to a PVC valve on the treated effluent line. Treated effluent from the damaged valve spilled out of the door and onto the crushed aggregate pad the facility sits on. This is an unauthorized discharge point. An incident investigation was conducted soon after the incident occurred to determine the root cause. The investigation concluded with the following root causes: • Unsupported and un-guarded PVC drain valves located 1” above floor; • Flaw in design of spill containment capacity of building. Although the mine site was not currently discharging the effluent being treated into to the environment, commissioning of the water treatment facility was on-going and samples of the treated effluent were collected at a regular basis to evaluate treatment performance. Based on samples taken at the time of the spill, results were below the Maximum Authorized Monthly Mean Concentration for a deleterious substance as outlined in Schedule 4 of the Metal and Diamond Mining Effluent Regulations (MDMER). Analytical results for the released effluent were provided in the 30-day follow-up report. The operator immediately isolated the line to prevent further spillage. Contaminated snow, ice, and crush was excavated and removed for disposal in the Tailings Impoundment Area. In order to reduce the likelihood of a reoccurrence, the incident investigation concluded with the following preventative actions for future work at this water treatment facility: • Sump and sump pump will be relocated to more adequately capture any released effluent; • Sump pump line will be insulated and/or heat traced to prevent freezing in winter months; and • Supports or protective guards will be placed on all PVC drain values located on or near floor level.	19-Nov-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
30-Oct-19	19-448	30-Oct-19	Untreated Mine Effluent 12 cubic metres	At the time of the spill event, TMAC was in the process of commissioning components of the Robert's Bay Discharge System (RBDS). The RBDS is designed to transport a single compliant effluent stream consisting of effluent from the Tailings Impoundment Area (TIA) and the underground mine workings. Underground workings at the Doris-Madrid Project are dewatered to allow for continued mining activities. In this process, effluent is pumped from an underground sump to a tank in a water treatment pump house (Tank-001). Prior to the incident, a sump pump underground was replaced, resulting in an increase in effluent reporting to Tank-001 than previously observed. This additional effluent, and increased flow, exceeded the capacity of the pump that conveys effluent from Tank-001 to the TIA. Due to this exceedance in pumping capacity, the effluent level in Tank-001 increased above its holding capacity, and effluent began to flow through an overflow pipe on the tank to a sump on the facility floor. Concurrently to the overflow of Tank-001, an electrical fault caused the pump for the sump receiving the overflow to fail, and as a result, untreated mine effluent overflowed the floor sump and eventually over the doorsills and spilled onto the crushed aggregate pad outside of the pump house. An incident investigation was conducted soon after the incident occurred to determine the root cause. The investigation concluded with the following root causes: • Inadequate communication between work groups; • Failure to monitor the pump house building continually during commissioning; • Undersized breaker for sump pump was not identified during dry-commissioning; and • Inadequate warning systems in place prior to wet-commissioning. Upon discovery, the underground effluent pumping was ceased, stopping the active spill. Contaminated snow, ice, and crush was excavated and removed for disposal in the TIA. A larger capacity electrical breaker was also installed to ensure that this particular pump functions as required. In order to reduce the likelihood of a reoccurrence, the incident investigation concluded with the following preventative actions for future work between these work groups, and for future work in the pump house facility: • When conditions change underground, or when pumping activities are altered, notifications will be provided to Mill personnel;	25-Nov-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				• Continual physical monitoring of the pump house facility will occur until cameras and automatic controls are installed in the Mill Control Room; and • A high-level alarm for Tank-001 has been installed to notify the control Mill Control Room in advance of a potential overflow situation.	
5-Nov-19	19-453	5-Nov-19	Untreated Mine Effluent 45 cubic metres	TMAC is in the process of commissioning components of the Roberts Bay Discharge System (RBDS). The RBDS is designed to transport a single compliant effluent stream consisting of effluent from the Tailings Impoundment Area (TIA) and the underground mine workings. Underground workings at the Doris-Madrid Project are dewatered to allow for continued mining activities. In this process, effluent is pumped intermittently from an underground sump to a tank (Tank-001) located in a water treatment pump house. Tank-001 is drained by Pump-001. At the time of the incident (approx. 02:10am), Pump-001 had shut down as no water was being pumped from the underground workings and the level of Tank-001 was low. When pumping from underground recommenced and filled Tank-001, Pump-001 failed to restart. Effluent began to overflow from Tank-001 onto the floor which activated the sump pump. A high level alarm for Tank-001 had been installed to notify the Mill Control Room in advance of a potential overflow situation, however this alarm failed to initiate during this event. The sump pump directed the effluent into an alternate storage tank in the water treatment pump house (Tank-140). As a result of the heightened load, the level in Tank-140 also increased beyond capacity and effluent began to overflow from this tank onto the floor of the facility. Effluent seeped into the Motor Control Centre (MCC) room and triggered an electrical fault, causing power in the facility to be lost. No alarm was activated when the facility lost power, and the status of the building was not discovered until the next control room rounds at 06:00am. Untreated mine effluent overtopped the doorsills of the building and spilled onto the crush aggregate pad outside the pumphouse. Effluent froze to the surface of the camp pad and no effluent was released to the surrounding environment. An incident investigation was conducted soon after the incident occurred to determine the root cause. The investigation concluded with the following root causes: • Inadequate communications between hardware, software and process when the high level alarm failed to communicate to the Mill control room of the potential overflow situation when Pump-001 did not restart; • Inadequate warning systems as no alarm was in place to alert the Mill control room that power was lost in the facility (loss of communications alarm); and • Inadequate barriers in place to prevent water from entering MCC room.	05-Dec-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				The following corrective/preventative actions were identified to reduce the likelihood of a reoccurrence: • Review of control programming and field verification of all alarms. Ensure new alarms are tested prior to recommencing operations; • New alarm will be installed to notify the Mill Control Room if a loss of communications/power has occurred within the facility; • Construct concrete berm at the MCC doorway; • Install an emergency drainage pipe system from the pump house building to the Sedimentation Control Pond to manage overflow in the event the sump pump system is overwhelmed within the facility.	
18-Nov-19	19-465	18-Nov-19	Sewage 100 liters	While performing daily inspections, the Sewage Treatment Plant operator identified that the main lift station in Doris Camp had begun to overflow. An estimated 100L of untreated sewage was released to the gravel floor inside the lift station building. No material was released to the camp pad surrounding the building. At the time of the incident, maintenance was being performed in this section of the camp and a planned power shut down of this area had been conducted. Power to the main lift station had been cut to allow this maintenance to proceed resulting in shutdown of the pump from the main lift station to the Sewage Treatment Plant. Secondary lift stations from other sections of the camp continued to feed into the main camp lift station sump resulting in the overflow. An incident investigation was conducted soon after the incident occurred to determine the root cause. The investigation concluded with the following root causes: • Failure to identify risk of overflow within the system when initiating the power shutdown; and • Inadequate procedures related to shutdown of facilities in this section of the camp which would identify the need to provide backup power to the main lift station pump. Upon discovery, a vacuum truck was used to remove material from within the lift station for transfer to the Sewage Treatment Plant to prevent further overflow until the maintenance was completed and power was restored. Contaminated crush was hand excavated from around the lift station sump and lime was placed on the impacted area to prevent the development of odors or pathogens.	11-Dec-19

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				The following corrective/preventative actions were identified to reduce the likelihood of a reoccurrence: • Improved task planning to be completed by Supervisor prior to initiating planned electrical shutdowns; and • Identify all infrastructure affected during planned maintenance, the potential risks to that infrastructure and develop mitigation measures to minimize those risks prior to starting a task.	

12. Management Plans

The Table 12-1 below provides and overview of all Management Plans for the Hope Bay Project.

Table 12-1. Hope Bay Project Management Plans

Topic	Management Plans	Revision Date
Environmental Management System	Hope Bay Project Environmental Management System	Dec-17
Management Plans		
Emergency Response	Hope Bay Project Emergency Response Plan*	Mar-20
Spill Contingency	Hope Bay Project Spill Contingency Plan*	Mar-20
Hazardous Waste Management Plan	Hope Bay Project Hazardous Waste Management Plan*	Mar-20
Incinerator Management Plan	Hope Bay Project Incinerator Management Plan	Mar-19
De-icing Management	Hope Bay Project Aircraft De-icing Management Plan	Mar-19
QA/QC	Hope Bay Project Quality Assurance Quality Control Plan*	Mar-20
Water Management	Hope Bay Project Doris-Madrid Water Management Plan*	Mar-20
	Hope Bay Project Boston Water Management Plan	Dec-17
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Waste Rock Management Plan	Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan	Mar-19
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Landfarm Management	Hope Bay Project Hydrocarbon Contaminated Material Management Plan	Dec-17
Air Quality	Air Quality Management Plan, Hope Bay Project	Dec-17
Domestic Waste Water Management	Hope Bay Project Domestic Wastewater Treatment Management Plan	Dec-17
	Boston Sewage Treatment Operations and Maintenance Management Plan	Sep-17
WWMP	Doris North Project Wildlife Mitigation and Monitoring Plan	Dec-16
	Wildlife Mitigation and Monitoring Plan	Dec-19
AMEP	Hope Bay Project Aquatic Effects Monitoring Plan	Apr-18
Ground Water Management Plan	Hope Bay Project Ground Water Management Plan	Apr-18
Tailing Management Plan	Hope Bay Project, Phase2 Doris Tailings Impoundment Area – Operations, Maintenance, and Surveillance Manual	Dec-17
	Hope Bay Project Boston Tailings Management Area - Operations, Maintenance, and Surveillance Manual	Dec-17

(continued)

Table 12-1. Hope Bay Project Management Plans (completed)

Topic	Management Plans	Revision Date
Non-Hazardous Waste	Hope Bay Project Non-hazardous Waste Management Plan	Dec-17
Quarry Management	Hope Bay Project Quarry Management and Monitoring Plan	Dec-17
Closure	Hope Bay Project Doris-Madrid Closure and Reclamation Plan	Nov-17
	Hope Bay Project Boston Conceptual Closure and Reclamation Plan	Nov-17
	Hope Bay Project Windy Camp and Patch Lake Facility Updated Closure Plan (SRK)	May-14
	Hope Bay Project: Madrid Advanced Exploration Program: Conceptual Closure and Reclamation Plan (SRK)	Oct-14
Explosives	Hope Bay Project Explosives Management Plan	Nov-17
OPEP	Oil Pollution and Emergency Preparedness Plan	Aug-19
Socio-economic Management Plans		
Health and Safety	Hope Bay Health and Safety Management Plan	Dec-17
Human Resources	Hope Bay Project Human Resources Plan	Sep-16
Community Involvement	Hope Bay Project Community Involvement Plan	Dec-16
Cultural Heritage	Cultural Heritage and Natural Resources Management Plan	Dec-17

** Indicates plan has been updated and is being provided to the NWB in March 2020.*

13. Closure and Reclamation

13.1 PROGRESSIVE RECLAMATION

13.1.1 Operation Areas

In 2019, TMAC conducted progressive reclamation was conducted on the Doris Crown Pillar Recovery Trench. Reclamation of the Doris Crown Pillar Recovery Trench commenced mid-January of 2019, shortly after mining activities were completed. Backfill and final reclamation activities were completed in May 2019.

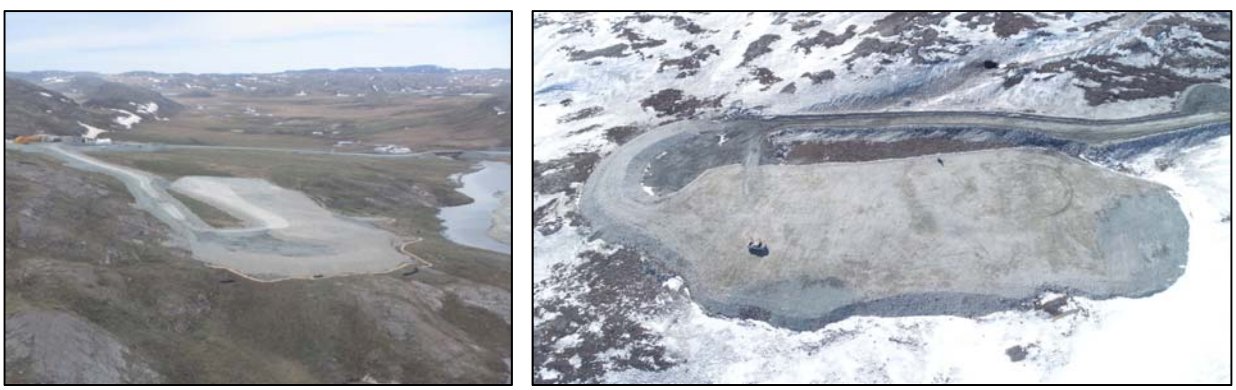
Thermal modelling was conducted by SRK to identify the minimum placement requirements (quantities) to achieve optimal thermal stability of the surrounding overburden, and also identify the maximum allowable elevation of mineralized rock placement within the trench.

Once backfilled, a 1-metre cap of geochemically stable rock was placed. The final cap was designed to promote surface and subsurface flows (contact water) to drain to the underground mine to reduce the extent of surface flows to the environment. The cap was also designed to provide an adequate thermal layer to prevent retrogressive thaw and slumping of the surrounding permafrost.

All sedimentation controls surrounding the Crown Pillar Recovery Trench were removed prior to the onset of winter in 2019.

For aerial photos of the Doris Crown Pillar Recovery Trench post-reclamation activities see Figure 13-1.

Figure 13-1. Doris Crown Pillar Recovery Trench Post-Reclamation Activities



13.1.2 Exploration Areas

Following surface diamond drilling operations, a reclamation process is conducted. Once drill equipment is demobbed from site, all cuttings and drill casings are removed, and the land is leveled with bentonite and capped with peat moss. Following drilling operations on ice, equipment and soiled and/or oily snow and ice are removed from the surface of the lake and deposited in active sumps. Once drilling operations are complete at a drill site, a site closure inspection report is completed by TMAC, reviewed by the site Drilling Supervisor and approved by the TMAC Environment Superintendent. Generalized items inspected in closure review include: water management, drill collar sites and adjacent vegetation inspections and housekeeping. All site closures are photographed with records filed and maintained by TMAC.

No historical drill site reclamation was completed in 2019.

13.2 COST ESTIMATE

The reclamation work for the Hope Bay Project will be done in accordance to approved Closure and Reclamation Plans for the Project. Reclamation progress is monitored through site inspections and annual reporting to the KIA, INAC and NWB, and is documented in updates of the Project Closure and Reclamation Plan and financial security costs estimates. As part of the Type A Water Licence approval process for Boston-Madrid (Phase 2) Project in 2018, financial security costs estimates were updated and approved by the NWB, KIA and CIRNAC which consider all existing infrastructure, proposed Phase 2 infrastructure, and any new information available since the last revision. The resulting financial security estimates and their associated Closure and Reclamation Plans, which are applicable to each site, are outlined in the subsections below.

13.2.1 Doris and Madrid

TMAC maintains Hope Bay Project Doris-Madrid Closure and Reclamation Plan (November 2017) which describes the activities, requirements, and monitoring necessary for the closure and reclamation of the Doris site.

As part of the Type A Water Licence approval process for Boston-Madrid (Phase 2) Project in 2018, TMAC provided to the NWB an updated and final Closure and Reclamation cost estimate, which constituted an agreement between TMAC, KIA and CIRNAC on the financial security parties agreed was required for Doris and Madrid sites. Details of this process can be found on the NWB public registry and resulted in a requirement in Type A Water Licence 2AM-DOH1335 for $62,058,577 to be posted for the Doris-Madrid portion of the Project; $51,659,822 to KIA, $10,398,755 to the Crown. This security is to be posted across nine (9) installments or tranches based on distinct project components.

In addition to the financial security required to be posted for Doris and Madrid under Type A Water Licence 2AM-DOH1335 described above, TMAC also has rights to conduct the Madrid Advanced Exploration Program in accordance with Water Licence No. 2BB-MAE1727 Amendment No.2. In the event TMAC proceeds the Madrid Advanced Exploration Program, and does not commence activities under Type A Water Licence 2AM-DOH1335, TMAC's Conceptual Madrid Closure and Reclamation Plan (2017) will dictate the activities, requirements, and monitoring necessary for the closure and reclamation of the Madrid site(s). In this scenario, TMAC is required to maintain reclamation security in the amount of $7,131,000 for the work at Madrid. As per the amended licence, this amount is split between activities at Madrid North ($4,042,000), Madrid South ($3,072,000) and Madrid North to South All Weather Road (AWR) ($17,000).

13.2.2 Windy

TMAC has an approved Hope Bay Project, Windy Camp and Patch Lake Facility Updated Closure Plan (SRK 2014). This document presents the closure obligations and the plan for closing both facilities, and demonstrates how the closure obligations can be met. A copy of this plan can be found on the NWB public registry.

13.2.3 Boston

For current Boston infrastructure, TMAC has an approved Boston Camp Interim Closure Plan (2014) which was submitted to the NWB May 26, 2014. The plan includes a current closure cost estimate of $5,988,000. This amount includes cost escalation, management of mineralized rock, reclaiming drill sites and other areas of permafrost degradation, remediation of hydrocarbon contaminated soils, indirect costs, and a contingency. A copy of this plan can be found on the NWB public registry.

For planned Boston infrastructure under the Boston-Madrid (Phase 2) Project, TMAC provided to the NWB an updated and final Closure and Reclamation cost estimate as part of the Type A Water Licence approval process. The updated and final Closure and Reclamation cost estimate provided constituted an agreement between TMAC, KIA and CIRNAC on the financial security parties agreed was required for the Bostin site. Details of this process can be found on the NWB public registry and resulted in a requirement in Type A Water Licence 2AM-BOS1835 for $37,458,491 total to be posted; $9,963,564 to KIA and $27,494,927 to the Crown. This security is to be posted across nine (6) installments or tranches based on distinct project components.

14. Community Consultation

TMAC is committed to engaging positively and effectively with local communities in a manner that emphasizes respect, integrity and demonstrates a willingness to learn from experience and embrace necessary change. TMAC recognizes that maintaining engagement and community involvement is necessary throughout the mining cycle, and critical to continuous improvement. TMAC bases its approach to community involvement on the following principles:

1. Identify all Stakeholders in our operations;
2. Effectively engage Stakeholders and establish a dialogue;
3. Provide Stakeholders with means to respond to us as well as generate responses; and
4. Report to Stakeholders and regulators on our Engagements.

TMAC operates within Nunavut, and on Inuit Owned Lands. The KIA, representing the Inuit of the Kitikmeot region, advised TMAC during the IIBA negotiation process that all Kitikmeot communities are considered affected by Hope Bay. As a result, TMAC considers every Kitikmeot Inuk, and their representative organizations including the KIA to be Stakeholders in the Belt. For the purposes of local community engagement, communities involved in the Belt include Kugaaruk, Taloyoak, Gjoa Haven, Cambridge Bay, Umingmaktok, Kingaok, and Kugluktuk, comprising the Kitikmeot region of Nunavut.

In order to effectively engage, establish and maintain a dialogue with TMAC's various local communities, TMAC has implemented a number of steps and activities designed to support two-way communication. These efforts and activities are described in the subsections below.

14.1 CAMBRIDGE BAY OFFICE

TMAC maintains an office in Cambridge Bay, which is the closest, occupied, affected community to the Belt. The office is centrally located in the community, furnished with bilingual signage, and accessible by the public during regular business hours. The primary purpose of this office is to facilitate community engagement. The Cambridge Bay office supports TMAC's engagement of government, regulators, intervenors, interested members of the public, employees, those seeking employment at Hope Bay and other interested parties.

Staff of the Cambridge Bay office are available to communicate directly with local Stakeholders and participate in a number of regional and territorial events that regularly occur in Cambridge Bay, thereby informing communities of TMAC operations, and actively soliciting feedback. The Cambridge Bay office is staffed with a Vice President of Corporate Social Responsibility, a TMAC Liaison and an HR/SR Coordinator. They engage regularly with the public using two-way communications for a variety of activities including:

- Employee and public relations;
- Annual community awareness meetings;
- Regular meetings with individual Inuit job seekers;
- Recruiting and onboarding Inuit personnel;
- Regular communications with Community Liaison Officers in the Kitikmeot;

- Annual meetings between KIA and TMAC Presidents;
- Annual updating of KIA Board by TMAC Executive;
- Attendance at the KIA Annual General Meeting;
- Quarterly participation in the IIBA Implementation Committee;
- Presentation of the IIBA Annual Evaluation Report to the KIA Board;
- At a minimum, semi-annual meetings of the Inuit Environmental Advisory Committee ("IEAC") in order to review environmental management and monitoring plans, discuss project related environmental issues, and obtain advice from knowledgeable Inuit on these matters;
- Meetings between TMAC staff and Kitikmeot Qualified Businesses;
- Regular meetings with relevant KIA Lands, Employment and Training and Executive staff; and
- Annual visits of the KIA Board, IIBA Implementation Committee, IEAC, and individual harvesters at Hope Bay.

14.2 ENGAGEMENT WITH INUIT THROUGH THE IIBA

In accordance with the IIBA, TMAC regularly engages Inuit on a range of matters directly as well as through the KIA. The IIBA includes the following schedules which contain specific provisions of adaptive socio-economic effect mitigation measures aimed at Kitikmeot Inuit:

- Schedule D – Training and Education Opportunities: whereby Inuit are provided support and training for opportunities at the Hope Bay Project;
- Schedule E – Employment: whereby measures and supports are provided to maximize Inuit participation in the Hope Bay Project;
- Schedule F – Business and Contracting Opportunities: whereby Inuit are provided business and contracting opportunities; and
- Schedule I – Inuit Environmental Advisory Committee: whereby Inuit have the opportunity to receive and consider information, provide advice and attempt to resolve community concerns relative to the environment and wildlife for the Hope Bay Project.

14.3 COMMUNITY AWARENESS: KITIKMEOT COMMUNITY MEETINGS

TMAC undertakes regional consultation tours of the Kitikmeot region. The tours consist of visits to each Kitikmeot community by TMAC community relations staff and relevant subject matter experts. TMAC endeavours to schedule the tour for a time of year that promotes participation and provides at least two weeks advanced notice for each Kitikmeot community. During the public meeting, TMAC delivers a presentation that provides the public information on the socio-economic and environmental performance of the Company. TMAC supports public meeting proceedings with simultaneous translation consistent with the dialect of Inuktun used in each community. TMAC logs meeting participants for future reference. In the meetings, community members have an opportunity to make comments, ask questions, and raise any concerns they may have regarding TMAC operations. TMAC documents the proceedings of public meetings in order to track issues and follow up on any concerns.

During the regional consultation tours of the Kitikmeot region, TMAC also endeavours to schedule meetings in each community with specific Stakeholder groups such as Kitikmeot Hamlet Councils and/or senior management, local Nunavut Arctic College and High School classes as specific Stakeholders that may have an interest in employment and training at TMAC.

In 2017, TMAC hosted community meetings in Kugluktuk, Cambridge Bay, Kugaaruk, Taloyoak, and Gjoa Haven from October 18 to November 2, 2017 with the purpose of sharing a Hope Bay Project update and seeking public input on the proposed Madrid-Boston Project.

14.4 COMMUNITY AWARENESS: KITIKMEOT CAREER AWARENESS SESSIONS

TMAC host community and information and career awareness sessions in all Kitikmeot communities regularly in order to maximize Inuit employment opportunities at Hope Bay. The purpose of these sessions is to provide information on:

- expected labour needs of Hope Bay;
- the skills, behaviours and qualifications required for employment and advancement at Hope Bay;
- the training opportunities and educational support programs available to prepare for employment at Hope Bay; and
- career opportunities in related fields such as science, technology, mathematics or professional services.

14.5 SOCIAL MEDIA

TMAC maintains a company Facebook ™ page to both share operational information with communities and increase awareness of mining. TMAC uses its Facebook ™ page to augment information distributed through TMAC's website. TMAC also makes use of Kitikmeot community Facebook ™ pages to advertise job postings, meeting notices, and any other news that may be of interest to Nunavut Stakeholders (http://www.facebook.com/tmacresources/).

Comments, questions or concerns received via social media are addressed promptly in a manner consistent with public meetings.

14.6 ELECTRONIC MAIL

TMAC maintains and periodically updates a listing of electronic mail addresses of Stakeholders, including select community members. This listing includes, but is not restricted to the following:

- Public elected officials;
- Inuit elected officials;
- Relevant federal and territorial regulator employees;
- Relevant Inuit Organization employees;
- Relevant municipal officials; and
- Relevant training and employment agency employees.

When necessary, TMAC distributes electronic mail messages to this listing to inform them of TMAC related events, news and happenings. This engagement activity is conducted to ensure that Stakeholders and communities are well informed and if willing, able to plan participation in any future TMAC engagement.

14.7 NUNAVUT EVENT PARTICIPATION

TMAC ensures it is well informed of key events that occur on an annual basis in Nunavut that represent opportunities for community involvement and dialogue. TMAC makes staff available to attend these events in order to foster communication. These events included the following:

- Kitikmeot Mayor's Meeting;
- Kitikmeot Trade Show; and
- Nunavut Mining Symposium.

14.8 STAKEHOLDER REPRESENTATIVE ORGANIZATIONS

TMAC recognizes that one of the most effective means of engagement and dialogue with Stakeholders and communities is joining with them in an organization of mutual benefit. Towards this aim, TMAC is a member of established organizations involving numerous community members. TMAC's participation in these groups provides members with information on TMAC's activities and, allows them to discuss matters of mutual concern, and undertake initiatives of mutual benefit. These organizations include the following:

- NWT/Nunavut Chamber of Mines;
- Nunavut Mine Training Roundtable; and
- Kitikmeot ASETS Stakeholder Working Group.

14.9 COMMUNITY RELATIONS SUMMARY FOR 2019

TMAC's Corporate Social Responsibility (CSR) group in responsible for leading community relations on behalf of TMAC. TMAC conducts its activities in accordance with the *Community Involvement Plan*, and in compliance with the *Hope Bay Inuit Impact and Benefit Agreement*.

TMAC Corporate Social Responsibility supports the implementation of a number of TMAC Policies and Procedures including:

- Code of Ethical Business Conduct ;
- Respectful Workplace;
- Whistleblower Policy;
- Corrective Action Policy;
- Community Complaints Procedure; and
- Employee and Family Assistance Program.

Also in 2019, work was completed towards a new TMAC Sustainable Development Policy that reinforces social commitments by the company.

During 2019, Julia Micks EVP of Human Resources for TMAC continued to head the community involvement team. Alex Buchan, VP of Corporate Social Responsibility, based in Cambridge Bay is primarily responsible for delivering community involvement activities. The Community Relations team in Cambridge Bay includes Ikey Evalik, Inuit Impact and Benefit Agreement Coordinator, and Sandra Eyegetok, the HR/SR Coordinator.

Communications in 2019 focused on the progression of Doris gold production, and operational expansion into Madrid North. Deliberations of the Inuit Environmental Advisory Committee pursuant to Schedule I of the 2015 Hope Bay IIBA, focused on preparatory research into Phase II Fisheries Offsetting, and expansion of the Hope Bay Wildlife Mitigation and Monitoring Plan to include additional studies required for Phase II development.

TMAC changed office locations in Cambridge Bay in 2019 due to a change in ownership of leased space. TMAC moved from the 2nd floor of the Kitikmeot Center to #6 Kingmik Street. Despite the move, TMAC remains in the downtown area of Cambridge Bay and the new office location remains readily accessible to public walk in traffic.

TMAC continued to participate in territorial, regional and community organizations and groups aligned to support community relations and consultation efforts. These groups include the NWT/Nunavut Chamber of Mines, the Nunavut Mining Symposium Society, the Nunavut Mine Training Roundtable, the KIA regional ASETS Stakeholder group, Kitikmeot Socio-Economic Monitoring Committee and the Cambridge Bay Canadian High Arctic Research Station Committee.

During the course of community engagement activities, TMAC continues to experience a measured degree of support for our mining and exploration operations, and a strong and growing interest in permanent employment and training opportunities related to mine production. Over 700 Kitikmeot residents have applied for work at Hope Bay through our Cambridge Bay office to date. This represents the majority of persons in the Kitikmeot Regional Labour Force that are actively looking for work.

14.9.1 Cambridge Bay Logistics Hub

Cambridge Bay continues to be the logistics hub for TMAC in the Kitikmeot. In 2019, TMAC operated weekly Northern Crew Change Flights from Cambridge Bay into Doris Mine. In alternating weeks, this crew change flight also took in either Kugluktuk (West) and Gjoa Haven, Taloyoak and Kugaaruk (East) workers. TMAC, similar to previous years, utilizes a twin engine 14 seat aircraft for these crew change flights. During 2019, several times due to increases in the size of the Kitikmeot workforce, it was necessary to make multiple flights into Doris mine in order to complete a crew change. If this trend continues, it may be necessary to utilize a larger aircraft in order to perform this logistical operation.

14.9.2 Other Communications in 2019

TMAC continues the use of a project/company Facebook page to provide information on Hope Bay primarily to northern stakeholders. Content of this page includes permitting information, meeting notices, job advertisements, and pictures of site activities linked to Kitikmeot community news pages. Feedback from TMAC information from this social media source is growing and it may be surmised that many younger Kitikmeot residents make better use of this information source than Elders or others more typically reliant on information received during public meetings. The page can be viewed at the following link: https://www.facebook.com/tmacresources.

14.9.3 Corporate Social Responsibility Activities in 2019 by Month

<u>January</u>

- CSR assisting in obtaining letters of support from Kitikmeot leaders and groups for Tuglik Energy Hope Bay alternative energy NRCan funding proposal
- Selection of two Nunavut Mining Symposium Youth Ambassadors initiated.

- IIBA IC meeting held to discuss GN MOU, feedback provided to GN on proposed agreement, vetted by KIA.
- TMAC is a premier sponsor of the Kitikmeot Trade Show: https://kitikmeottradeshow.ca/
- Two site-based contract managers scheduled to attend with SR staff to promote Inuit contracting.
- Coordinated IEAC scheduled for February 26-27 in Cambridge Bay with topics to include Fisheries Offsetting and Aquatic Effects Monitoring.
- Group email activity summary sent to northern stakeholders.

February

- KIA Board Site visit not be completed due to weather – a teleconference meeting was held instead involving Board Member and President.
- Two letters of support obtained or Wind Turbine funding proposal.
- Analysis and preparation conducted for first IIBA Implementation Committee scheduled for March.
- Inuit Employment and Training Targets to be set.
- Discussions held with Government of Nunavut on draft Memorandum of Understanding.
- Group email activity summary sent to northern stakeholders.

March

- CSR staff participated in the 2019 PDAC conference, which included meetings with contractors to discuss Inuit employment and training, and also a Hope Bay IIBA meeting with KIA.
- 2019 Inuit Employment Target set again at 70 Inuit FTEs.
- KIA and TMAC met with Government of Nunavut Economic Development officials to further talks aimed at producing a draft MOU between the parties.
- Presentation delivered to Kitikmeot Contractors workshop in Cambridge Bay, to provide advice and direction on Hope Bay contracting including instructions on how to register as a Kitikmeot Qualified Business.
- CSR attended Canadian High Arctic Research Station Steering Committee meeting in Cambridge Bay to provide briefing on TMAC compliance studies.
- Introductory meeting with new Cambridge Bay based federal Water Inspector to provide orientation to Hope Bay.

April

- CSR participated in the 2019 Nunavut Mining Symposium which included participation in the sponsored Youth Ambassador Program. Other engagements during this event included:
  - Donation to Auction Night;
  - Talk during Reception;
  - KIA Supper (Meeting of Presidents);
  - Several engagements with potential suppliers;
  - Panel discussions on Inuit Employment and Training;

- GN-DOE Wildlife Monitoring meeting;
- Nunavut Mine Training Roundtable; and
- GN-ED&T and KIA meeting on a MOU between the parties.

- o Delivered 2018 Hope Bay Socio-Economic Monitoring Report to Hope Bay Socio-Economic Working Group and Kitikmeot Socio-Economic Monitoring Committee during meetings held in Cambridge Bay.
- o Physical office move completed to new Office location with some facility deficiencies outstanding at month end (Fire Alarm Panel and other electrical).
- o Group email activity summary sent to northern stakeholders.

<u>May</u>

- o CSR conducted an open house event at the Cambridge Bay office May 15th. 25 members of the public attended. Many of the visitors had never attended a TMAC public meetings in the past. Based on this, the open house event is considered a success.
- o A teleconference meeting of the Hope Bay Socio-Economic Monitoring Working Group was held this month in order to complete the review of the 2018 Hope Bay Socio-Economic Monitoring Report. This report was approved by the Parties and subsequently submitted to the Nunavut Impact Review Board.
- o CSR staff delivered two IIBA Orientation presentations to TMAC main office staff. Further follow up presentations are planned for site-based staff.
- o CSR continued to support the Environment Department in its engagement with the Department of Fisheries and Oceans with the intent of developing a Phase II Fisheries Offsetting Plan.
- o Group email activity summary sent to northern stakeholders.

<u>June</u>

- o CSR staff Supported TMAC participation in an Andrew Scheer visit to Iqaluit including a meeting with economic leaders of the territory to discuss northern industrial priorities.
- o 2019 TMAC High School Achievement Award recipients identified and planning initiated for summer site visit.
- o Liaised between Search and Rescue officials and site staff twice this month in order to offer TMAC resources to community search efforts. In both cases missing harvesters were found prior to Hope Bay helicopters entering the search effort.

<u>July</u>

- o CSR undertook preparations for the 2019 TMAC High School Student Achievement Awards this month by ordering Plaques and Cheques, scheduling a mine site visit, and beginning to secure parental permission for same.
- o CSR staff worked with regulators in reference to a grizzly bear deterrent matter at Doris Mine this month, to ensuring information flow.
- o CSR staff delivered a Hope Bay update presentation to the Kitikmeot Inuit Association Board of Directors in Kugluktuk this month. Two questions by Board members were responded to, results shared with TMAC Executive.

- CSR staff assisted ERM contract biologists continue their Freshwater Creek fisheries offsetting research this month including marshalling equipment and securing a field assistant.
- CSR staff facilitated a dialogue between Kitikmeot Corporation (KC) and Site staff over the disposition of core box materials stored at a KC facility in Cambridge Bay.
- Group email activity summary sent to northern stakeholders.

August

- CSR staff, in support of site staff, conducted the 2019 TMAC High School Student Achievement Awards Site visit this month. A total of 11 students participated, including several that were too young to attend in 2018. The visit can be considered successful as students provided overwhelmingly positive feedback and several requested information on TMAC careers.
- CSR staff assisted ERM contract biologists continue their Freshwater Creek fisheries offsetting research in August. This included field work as the Hunters and Trappers Organization contracted field assistant was unavailable for several days.

September

- CSR staff engaged with GN ED&T staff to move the MOU negotiation process forward this month; affected GN departments are now reviewing a final draft of the MOU.
- CSR staff continued preparations for the 2019 Career Awareness tour this month, planned for the first week in October.
- CSR staff assisted Finance and Operations staff in preparing for the renewal of the camp service contract at the end of 2019 in accordance with Schedule F of the Hope Bay IIBA.
- CSR staff provided input into the Hamlet of Taloyoak Community Economic Development planning process, providing advice on how this community could increase Hope Bay employment.
- CST staff assisted ERM contract biologists continue their Freshwater Creek fisheries offsetting research in August. This included field work as the Hunters and Trappers Organization contracted field assistant was unavailable for several days.

October

- CSR staff attended a workshop in Cambridge Bay conducted by Makigiaqta Corporation looking at improvements to the Nunavut Education system in support of Inuit employment and training. The importance of trades related high school coursework and addressing non-attendance was emphasized.
- CSR staff continued preparations for upcoming events such as site based federal voting supports for employees, the 2019 Career Awareness Session Tour and a workshop to be held in Cambridge Bay related to icebreaker regulation.
- CSR staff lead efforts to divest 5 seacans full of drill core box material, sufficient to build 9,500 core boxes, stored in Cambridge Bay remaining from a Newmont local construction pilot project.

November

- CSR Staff attended a Nunavut Planning Commission public hearing in Cambridge Bay this month focused on details of the 2016 Draft Nunavut Land Use Plan. Discussion included a review of instituting large caribou special management areas. A case was made, supported by the local

Hunters and Trappers Organization to instead require mobile caribou protection measures similar to what is in place within the Hope Bay Wildlife Mitigation and Monitoring Plan.

- CSR staff attended the 2019 Yellowknife Geoscience Forum which included the Annual General Meeting of the Nunavut and NWT Chamber of Mines. A side meeting was held with senior officials of the Government of Nunavut to promote investor confidence in the territory. Items discussed included the Mary River environmental review and potential uses of Nunavut carbon tax revenue. A case was made to use these funds to financially support mine alternative energy projects.
- The Sustainability Policy was finalized and distributed to the executive team.

December

- CSR Staff arranged for a matching donation to Kitikmeot community Christmas events and activities based on an invitation to do so from the Kitikmeot Inuit Association.
- CSR staff attended an informal meeting with the KIA to discuss IIBA matters as a quorum for an Implementation Committee meeting was not possible. The KIA was briefed on Hope Bay Inuit employment, training and contracting matters. An updated Kitikmeot Qualified Business Registry list was shared by the KIA.
- CSR provided input into drafting a letter to Environment and Climate Change Canada demanding they revise their press release related to their enforcement action at Hope Bay.

15. Annual Inspection Activities

In 2019 TMAC hosted regulatory inspections for CIRNAC, NIRB, KIA, and WSCC. Details of when those visits occurred and a summary of the reports and follow up from those visits are detailed in Table 15-1.

Table 15-1. Summary of Annual Inspection Activities

Date	Agency	Summary	Follow up	Response
May 7-8-2019	Crown-Indigenous Relations and Northern Affairs Canada	Inspection to verify compliance with the Type A water license, 2AM DOH1335. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities. Inspection of Crown Lease 77A/3-1-2 was also conducted.	The inspector noted multiple snow piles within the Single Tank Farm at Roberts Bay. Inspector wants TMAC Resources to stop pushing snow into the berm at the Bulk Fuel Storage at the Single Tanks Farm.	TMAC would like to clarify that snow is not pushed into any of the secondary containment berms on site. Snow within the secondary containment berms are routinely consolidated into piles to be removed from the secondary containment berms in order to maintain a 110% volumetric storage capacity of the fuel tank in the event of a tank failure.
June 18-20, 2018	Kitikmeot Inuit Association	On June 18-20 the KIA inspected the Doris Commercial Lease area and infrastructure including Roberts Bay, the Jetty, Doris Site and Area, the North Dam and Tailings Impoundment Area infrastructure, and the Doris Windy All-Weather Road. Windy Camp and Boston were also toured.	Roads throughout camp show signs of wear and tear, especially areas with heavy traffic. All roads should be resurfaced to fix potholes. The Roberts Bay tank farm containment area will be adding another 5mL tank that is currently being built. The rock face wall behind is not reinforced; this is a big safety concern. There is a lot of debris all around the crushing and milling plant that is currently being cleaned and put into C-cans. The berm is cracking at the Tank Farm in main camp, which needs to be repaired.	Roads with heavy traffic often require resurfacing after spring thaw. Road maintenance is a regularly occurring task. Spring clean-up of the site was underway during the time of the inspection. All areas identified will continue to be monitored by TMAC.
July 16-18, 2019	Worker's Safety and Compensation Commission	Inspection to verify compliance with Mines Health & Safety Regulations. The inspection focused on exploration activities, underground mining as well as surface infrastructure including the camp facility and warehouse. The inspector issued 2 orders for action.	Order issues.	Compliance report was submitted from TMAC within 30 days.
August 13-15, 2019	Crown-Indigenous Relations and Northern Affairs Canada	Inspection to verify compliance with water licenses 2AM DOH1335, 2BB-BOS1727 and 2BE-HOP1222. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities. Inspection of Crown Leases 77A/3-1-7 and 77A/3-3-2 were also conducted.	No follow up items identified.	
August 13-15, 2019	Kitikmeot Inuit Association	On August 13-15 the KIA inspected the Doris Commercial Lease area and infrastructure including Roberts Bay, the Jetty, Doris Site and Area, the North Dam and Tailings Impoundment Area infrastructure, and the Doris Windy All-Weather Road. Windy Camp and Boston were also toured.	Roads throughout camp show signs of wear and tear, especially areas with heavy traffic. All roads should be resurfaced to fix potholes. The Roberts Bay tank farm containment area will be adding another 5mL tank that is currently being built. The rock face wall behind is not reinforced; this is a big safety concern. The Explosive Magazine has a C-can that does not have a lock on it. Sarah and I were able to access the explosives because the C-can doesn't have a lock. This is a Very big security concern, if we were able to access the explosives without security clearance, others can as well.	The explosives magazine gate was secured immediately upon recognizing the security lock was missing. All areas identified will continue to be monitored by TMAC.
November 12-14, 2019	Crown-Indigenous Relations and Northern Affairs Canada	Inspection to verify compliance with water licenses 2AM DOH1335. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities. Inspection of Crown Leases 77A/3-1-7 and 77A/3-3-2 were also conducted.	During the inspection of this facility the inspector noted silt screen was still on this berm. The Inspector requested this material be removed from the Marine outfall berm to prevent the material from freezing to the surface of the berm. No further concerns were identified during the inspection.	TMAC removed the silt fence from the berm immediately.
December 10-11, 2019	Worker's Safety and Compensation Commission	Inspection to verify compliance with Mines Health & Safety Regulations. The inspection focused on exploration activities, underground mining as well as surface infrastructure including the camp facility and warehouse. The inspector issued 13 orders for action.	Order issues.	Compliance report was submitted from TMAC within 30 days.

References

SRK Consulting (Canada) Inc. 2009. *Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut*. Report 1CH008.022 for Hope Bay Mining Ltd. July 2009.

SRK Consulting (Canada) Inc. 2017. *Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut*. Report 1CT022.009 for TMAC Resources Inc. January 2017.

ERM. 2016. *Doris North Project: 2015 Aquatic Effects Monitoring Program Report*. Prepared for TMAC Resources Inc. by ERM Consultants Canada Ltd.: Yellowknife, NT.

Appendix A
Concordance Table

Type A Water Licence 2AM-DOH1335	
Condition	**Section**
Summary of monitoring reporting performed in accordance with Part I, Item 6. The Summary shall include conversion of daily amounts to monthly and annual amounts.	Section 5, Appendix D
A Geochemical Monitoring and Waste Rock Storage Assessment that includes following: a. For the tailings solids: i. All geochemical data appended; ii. All tonnage data appended and locations of disposal; iii. Discussion of geochemical data (static and kinetic, if applicable) with relevant figures and calculation of NNP and NPR; and iv. Geochemical interpretation of data. b. For waste rock: i. Tonnage of mineralized and un-mineralized Waste Rock placed on Temporary Waste Rock Pad and in other locations as approved by the Boain writing; and ii. Tonnage of Waste rock placed underground. ¤ Geochemical and inspection data . Note: Detox Tailings are characterized by TL-7 (dry detoxified tailings sent underground as backfill (solids)) and proposed TL-8 (filtrate from TL-7 (solution)).	Section 8, Appendix F
Include the report referenced in Part D, Item 18, that presents the data collected from the Quarry Rock Seepage Monitoring and Management Program. The report shall include a discussion of the interpretation of geochemical data and shall be presented to the Board for review.	Section 9, Appendix F
A summary of the results of the monthly TIA Water balance and Water quality model assessments referred to in Part E, Item 24 and any re-calibrations that have been carried out. The report shall include: a. Relevant supporting data; b. a comparison of measured Water balance and Water quality values to predicted values; c. Monitoring and internal modelling results; d. a discussion of any discrepancies in model inputs; and e. Identification of any necessary adaptive management strategies.	Appenidx E
An update on the current capacity of the Tailings Management Area	Section 5.1.2
A record of measurements of the following: a. The flows (m3/day) at monitoring stationTL-2, b. A record of measurements of Doris Lake Water Level	Appendix D.1
Annual review of and submission of any revisions to the Management Plans or Emergency Response or Contingency Plan in the form of either addenda or revised Plan	Section 12

Type A Water Licence 2AM-DOH1335	
Condition	**Section**
A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken	Section 11
The results of the Aquatic Effects Monitoring Program and in accordance with Part I, Item 3	Section 7 Also see 2019 AEMP Report Submisison
A summary of any closure and reclamation work undertaken and an outline of any work anticipated for next year, including changes to implementation and scheduling	Section 13
Incineration stack testing results when stack testing is required	Section 6.1.1 and Appendix I
Annual Landfill Management Report	Section 6.4
A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and an outline of any work anticipated for the next year	Section 3 and Section 4
A summary report describing consultation and participation with local organizations and residents of nearby communities, including a schedule of upcoming events/information sessions	Section 14
GPS locations of monitoring stations as confirmed with the Inspector under Part I, Item 3	Appendix B
A summary of the data requested under Part I Item 5 and 6	Section 5, 9 and 8 Appendix D and G
A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector any other details on water use and waste disposal requested by the board	Section 15
Any other details on Water use or Waste Disposal requested by the Board by November 1st of the year being reported	N/A

Type A Water Licence 2AM-BOS1835	
Condition	**Section**
Summary of monitoring reporting performed in accordance with Part I, Item 11. The Summary shall include conversion of daily amounts to monthly and annual amounts.	Section 5, Appendix D
Information with respect to Geochemical Monitoring and Waste Rock Storage Assessment a. For the tailings solids: b. geochemical data appended; i. All tonnage data appended and locations of disposal; ii. Discussion of geochemical data (static and kinetic, if applicable) with relevant figures and calculation of NNP and NPR; and iii. Geochemical interpretation of data. c. For waste rock: i. Tonnage of mineralized and un-mineralized Waste Rock placed on the Temporary Waste Rock Pad and in other locations as approved by the Board in writing; and ii. Tonnage of Waste rock placed underground.	Section 8, Appendix F
Include the report referenced in Part D, Item 17, that presents the data collected from the Quarry Rock Seepage Monitoring and Management Program. The report shall include a discussion of the interpretation of geochemical data and shall be presented to the Board for review.	Section 9, Appendix F
An update on the current capacity of the Tailings Management Area	Section 5.1.2
Annual review of and submission of any revisions to the Management Plans or Emergency Response or Contingency Plan in the form of either addenda or revised Plan	Section 12
A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken	Section 11
The results of the Aquatic Effects Monitoring Program approved by the Board under Part B, Item 13	Section 7 Also see 2019 AEMP Report Submisison
Annual Adjustments to reclamation security estimates including any additional security that may be required or reductions in security requirements for progressive reclamation actions	Section 13
A summary of any closure and reclamation work undertaken and an outline of any work anticipated for next year, including changes to implementation and scheduling	Section 13
Incineration stack testing results when stack testing is required	Section 6.1 and Appendix I
Annual Landfill Management Report	Section 6.4

Type A Water Licence 2AM-BOS1835	
Condition	**Section**
A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and an outline of any work anticipated for the next year	Section 3 and Section 4
A summary report describing consultation and participation with local organizations and residents of nearby communities, including a schedule of upcoming events/information sessions	Section 14
GPS locations of monitoring stations as confirmed with the Inspector under Part I, Item 3	Appendix B
A summary of the data requested under Part I Item 5 and 6	Section 5, 9 and 8 Appendix D and G
A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector any other details on water use and waste disposal requested by the board	Section 15
Any other details on Water use or Waste Disposal requested by the Board by November 1st of the year being reported	N/A

Type A Water Licence 2BE-HOP1222	
Condition	**Section**
A summary report of water use and waste disposal activities	Section 5.2, Section 6, Appendix D.2
A summary of all information requested and results of the Monitoring Program	Section 5.2, Appendix D.2
A list of unauthorized discharges and a summary of follow-up actions taken	Section 11
A brief description of follow-up actions taken to address concerns detailed in inspection and compliance reports prepared by the Inspector	Section 15
An update to the Spill Contingency Plan, if required, including contact information in the form of an addendum	Section 10, Section 12
A description of all progressive and/or final reclamation work undertaken, including photographic records of site conditions before, during and after completion of operations	Section 13
A summary of modification and/or major maintenance work carried out on the water supply and waste disposal facilities, including all associated structures, and an outline of any work anticipated for the next year	Section 3, Section 4
A summary of any specific studies or reports requested by the board, and a brief description of future studies planned or proposed	Section 4
Any other details on water use or waste disposal requested by the board	Section 5.2

Type A Water Licence 2BB-MAE1727	
Condition	**Section**
The monthly and annual quantities in cubic metres of all freshwater obtained at Monitoring Stations No. MAE-01, No. MAE-02 and MAE-03, including all sources of water identified for domestic and industrial use under Part D, Item 1	Section 5.3, Appendix D.3
The daily, monthly and annual quantities, in cubic metres, of mine water pumped from the underground mine	Section 5.3, Appendix D.3
The monthly and annual quantities in cubic metres of Effluent discharged from the Pollution Control Ponds onto the tundra and/or transported to Doris to be discharged into the TIA, including the analysis result	Section 5.3, Appendix D.3
The monthly and annual quantities in cubic metres of Sewage Effluent transported to the Doris North site	Section 5.3, Appendix D.3
Report all artesian flow occurrences as identified under Part F, Item 9	Section 5.3
An estimate of the volume of waste rock and ore currently stockpiled at site, to date	No waste rock and ore to date.
Tabular summaries of all data generated under the Monitoring Program, Part J	Section 5.3, Appendix D.3
A summary of modifications and/or major maintenance work carried out on the Water Supply Facilities, Buk Fuel Storage Facility, Pollution Control Ponds and any wastewater related facility including all associated structures, and an outline of any work anticipated for the next year	Section 3, Section 4
A list of unauthorized discharges and follow-up action taken	Section 11
Updates or revisions to the Water Management Plan, Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, and Spill Contingency Plan and/ or any other management plan	Section 12
An updated estimate of the current Madrid Advanced Exploration Project restoration and liability, as required under Part C, Item 5, based upon the results of the restoration research, project development monitoring, and any modifications to the site plan	Section 13
A brief description of follow-up action taken to address concerns detailed in inspection and compliance reports prepared by the Inspector	Section 15
A summary of drilling activities and reclamation of drilling sites	Section 3.2, Section 13
A public consultation/participation report describing consultation with local organizations and residents of the nearby communities, conducted during the Report period	Section 14
A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year	Section 13
A summary of any specific studies or reports requested by the Board, and a brief description of any future studies planned or proposed; and any other details on the use of Water or the deposit of Waste requested by the board Board by the 1st of November of year being reported	Section 5.3

Type A Water Licence 2BB-BOS1727	
Condition	**Section**
The monthly and annual quantities in cubic metres of all freshwater obtained from Aimaokatalok (Spyder) Lake, Monitoring Stations No. BOS-1a and from Stickleback Lake, Monitoring Station No. BOS-1b and additional sources of water identified for domestic and other uses under Part C, Item 1	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Mine water pumped from the underground	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Effluent discharged at Monitoring Station Number BOS-2, BOS-2, BOS-4 and BOS-5, BOS-6 and BOS-7	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of non-compliant effluent transported to Doris North's Tailings Impoundment Area	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Sludge removed from the Sewage Treatment Facility	Appendix D. 4
The annual quantities in cubic metres of all soil and types of contaminants from all locations that are placed within the Landfarm facility and/or transported to Doris North Project	Section 6.2
Report all artesian flow occurrences as identified under Part F, Item 3	Section 5.4
Boston Ephemeral Stream Monitoring Report	Section 9.2, Appendix G
Tabular summaries of all data generated under the Monitoring Program	Appendix D.4
A summary of modification and/or major maintenance work carried out on the Water Supply and the Waste Disposal Facilities, including all associated structures, and an outline of any work anticipated for the next year	Section 3, Section 4
A list of unauthorized discharges and follow-up action taken	Section 11
Updates or revisions to the Closure Plan, QA/QC, Water and Ore/Waste Rock Management Plan, Spill Contingency Plan, and Landfarm Plan and/or any other plans	Section 12
A brief description of follow-up action taken to address concerns detailed in inspection and compliance reports prepared by the Inspector	Section 15
A summary of drilling activities and progressive reclamation of drill sites	Section 13.1
An estimate of the current volume of waste rock and ore stockpiled on site	Section 8.2
A public consultation/participation report describing consultation with local organizations and residents of the nearby communities, if any were conducted	Section 14
A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year	Section 13
A summary of any specific studies or reports requested by the Board, and a brief description of any future studies planned or proposed	Section 5.4
Any other details on Water use or Waste disposal requested by the Board by November 1st of the year being reported	Section 5.4

Appendix B
NWB Forms

NWB Annual Report **Year being reported:** 2019

License No:	2AM-DOH1335	**Issued Date:**	August 16, 2013
		Expiry Date:	March 30, 2035

Project Name: Doris-Madrid Project

Licensee: TMAC Resources Inc.

Mailing Address:
181 University Ave
Suite 300, PO Box 33
Toronto, Ontario M5H 3M7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2AM-DOH0713 was assigned from Hope Bay Mining Ltd. to TMAC Resources Inc. on June 18, 2013. This licence was renewed on Aug. 16, 2013 and renamed 2AM-DOH1323. This license was subsequently amended in November, 2016. The licence was amended a second time in December, 2018 and renamed 2AM-DOH1335.

General Background Information on the Project (*optional):

In 2019 commercial operations continued at Doris with continued efforts to stabilize mill throughput and optimize gold recovery. Civil construction activities included the completion of construction of the Roberts Bay Discharge System (RBDS) and installation of the associated underground mine dewatering and Tailings Impoundment Area (TIA) discharge pipelines and pumping infrastructure. The RBDS facilitates dewatering of the Doris mine and removal of excess water from the TIA to Roberts Bay. The ocean discharge pipeline with sunken diffuser and recirculation pipeline were successfully installed into Roberts Bay during the open water season. As part of this system, a Water Treatment Plant was constructed to remove Total Suspended Solids from underground mine water at Doris prior to discharge through the RBDS. No discharge occurred to Roberts Bay in 2019.
Earthworks began at the Madrid North site to support the commencement of mining of the Naartok East Crown Pillar and Madrid North underground decline. This included construction of the first kilometer of the Madrid North all-weather-road, the Madrid North Contact Water Pond, and construction of the Madrid North Waste Rock storage pad. An overburden stockpile was established to store overburden removed during mining of the Naartok East Crown Pillar.
Underground waste development continued in 2019 with further advancement of the below the dyke (BTD) decline and necessary support infrastructure. TMAC continued ore development with long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris, and continued ore sill development in the DCO. TMAC also continued waste development in the DCO for future mining horizons. Long hole blasting continued throughout 2019, with all ore production trucked to surface and processed through the mill or added to the stockpile. Development of the Doris Central (DCN) decline continued in 2019. TMAC continued underground exploration diamond drilling in the BTD, DCO and DCN areas in 2019.
Ore development also occurred from surface in 2019 with the commencement of surface blasting and hauling of ore and waste from the Naartok East Crown Pillar Recovery (NECPR). Development of the Madrid North underground decline began in Q4 of 2019. Backfill and reclamation of the Doris Crown Pillar Trench was completed in 2019.
In the fall, TMAC concluded another successful sealift operation including the purchase and delivery of diesel fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Licence Requirements: the licensee must provide the following information in accordance with

Part B	Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Doris Lake/Windy Lake/lakes proximal to drilling targets/ice road

Water Quantity:

43000 cu.m/yr*	Quantity Allowable Domestic (cu.m)
16820 cu. m/yr	Actual Quantity Used Domestic (cu.m)
2033800 cu.m/yr	Quantity Allowable Domestic, Mining, Milling, Drilling, etc.
23090 cu. m/yr	Total Quantity Used Domestic, Mining, Milling, Drilling, etc

**Part E, Item 1 total volume from "all sources and for all purposes"*

Waste Management and/or Disposal

- ☑ Solid Waste Disposal
- ☑ Sewage
- ☑ Drill Waste
- ☑ Greywater
- ☑ Hazardous
- ☑ Other: Containment Berm and Control Pond Effluent

Additional Details:

Water for domestic use at Doris Camp was obtained from Windy Lake. Water is drawn from the lake at the freshwater intake and trucked to Doris Camp. The Doris Lake pump house is not supplying domestic water to Doris Camp at this time.

Waste produced on site is treated according to Part F of the licence, and in accordance with the relevant Management Plans *(Incinerator Management Plan, Non-Hazardous Waste Management Plan, Hazardous Waste Management Plan, Waste Rock, Ore and Mine Backfill Management Plan, Hydrocarbon Contaminated Material Management Plan, Domestic Waste Water Treatment Management Plan, and Doris-Madrid Water Management Plan*).

Some specifics are as follows:

-Food waste is incinerated as per Part F Item 6.
-Paper products, paperboard packing, and untreated wood waste is open burned as per Part F Item 7.
-TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site as per Part F Item 9. To date, a landfill has not been built. All waste that cannot be incinerated on site is backhauled to an approved facility off site or will be held for deposit in a landfill once constructed.
-Sewage and greywater produced onsite is processed in the sewage treatment plant as per Part F Item 5. Sludge produced by the treatment plant is disposed in the TIA as outlined in the Domestic Waste Water Treatment Management Plan.
-Hazardous materials such as waste oil, glycol, and contaminated soil are shipped offsite for disposal at an approved site as per Part F Item 10.
-All containment berm water is sampled for water quality against the discharge criteria of the licence. Water that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector; water that does not meet the licence criteria is treated onsite until it is remediated to acceptable levels for discharge to the tundra, and/or it is discharged to the TIA.
-Runoff and contact seepage at site is managed in accordance with the Quarry Management and Monitoring Plan and Doris-Madrid Water Management Plan.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)

Date of Spill:

Date of Notification to an Inspector:

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc.)

Please see Section 11. of the attached Annual Report Supplement for a summary of all unauthorized discharges that occurred in 2019 under license 2AM-DOH1335.

Revisions to the Spill Contingency Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 13. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Details attached

Additional Details:

N/A

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Details attached

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc.)

N/A

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

Inspection Report received by the Licensee (Date):

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2AM-DOH1335.

Date Submitted:	March 31 2020	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	647.480.3106 ext. 124
	Fax:	
	email:	Oliver.Curran@tmacresources.com

GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
ST-7 Doris Freshwater Intake	433525	7558727
ST-7a/MMS-4b Windy Freshwater Intake	432626	7550477
Patch Lake (ice road)	434265	7550023

GPS Locations of areas of waste disposal

Location Description	UTM Easting	UTM Northing
TL-5	435539	7556285
TL-6	435539	7556285
TL-7a	435539	7556285
TL-7b	435539	7556285
TL-9	435539	7556285
ST-4	432450	7559600
ST-5	432960	7559270
ST-6A	432954	7563407
ST-6B	432878	7563130
ST-8 STP Discharge	432413	7559596
ST-9 STP Tundra Discharge	430898	7559328

GPS Locations of Active Monitoring Stations not included above*

Monitoring Station	UTM Easting	UTM Northing
TL-1	434712	7558948
TL-2	434059	7559504
TL-11	various locations as required	
TL-12	435539	7556285
ST-1	433093	7558914
ST-2	433217	7558935
ST-10	various locations as required	
ST-11	434573	7559182
ST-12	various locations as required	
MMS-1	433175	7549837
MMS-9	various locations as required	

** Thermal monitoring locations are documented in the Annual Geotechnical Report*

NWB Annual Report **Year being reported:** 2019

License No:	2BE-HOP1222	**Issued Date:**	June 30, 2012
		Expiry Date:	June 30, 2022

Project Name: Hope Bay Regional Exploration Project

Licensee: TMAC Resources Inc.

Mailing Address:
181 University Ave
Suite 300, PO Box 33
Toronto, Ontario M5H 3M7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BE-HOP1222 was issued June 30, 2012 to Hope Bay Mining Ltd. Effective June 18, 2013, the NWB authorized the assignment of Licence 2BE-HOP1222 from Hope Bay Mining Ltd. to TMAC Resources Inc.

General Background Information on the Project (*optional):

Licence 2BE-HOP1222 allows TMAC to carry out activities in support of exploration drilling at the Hope Bay Regional Exploration Project and the Windy Camp, which supports exploration activities.

Licence Requirements: the licensee must provide the following information in accordance with

Part B Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Domestic and dust suppression water sourced from Windy Lake. Water to supply drilling activities taken from source proximal to drilling target.

Water Quantity:	22995 cu.m	Quantity Allowable Domestic (cu.m)
	16820 cu.m	Actual Quantity Used Domestic (cu.m)
	29200 cu.m	Quantity Allowable Drilling (cu.m)
	2457 cu. m.	Total Quantity Used Drilling (cu.m)
	30600 cu.m	Quantity Allowable Dust Suppression (cu.m)
	0 cu.m	Total Quantity Used Dust Suppression (cu.m)

Waste Management and/or Disposal

- [x] Solid Waste Disposal
- [ ] Sewage
- [x] Drill Waste
- [ ] Greywater
- [ ] Hazardous
- [ ] Other:

Additional Details:

The Hope Bay Project was placed into Care and Maintenance in October 2012. Occupancy of the Old Windy Camp ended October 23, 2008 and dismantling and reclamation of the area is on-going.

Water was used from Windy Lake to supply domestic water to Doris Camp in accordance with 2BE-HOP1222 Part C, Item 1. Water used for drilling is taken from the closest lake to each drill using a similar system to the domestic system, or for drill locations accessible by road or winter ice road, water is hauled by truck from Windy Lake, or compliant berm effluent from the Doris Project is recycled through the drills to lessen freshwater lake use. In the case of regional drilling, water is taken from the closest lake to the drill site in accordance with Part C Item 1. Drill cuttings produced under this licence are deposited in a sump constructed for this purpose, an appropriate natural depression located at least 31m from the high water mark of any adjacent water body, or disposed of in the Tailings Imoundmnet Area at the Doris Project. A regional exploration and geotechnical drill program occurred in the license area in 2019.

The Landfarm at Windy Camp and Bulk Fuel Storage Facilities at Windy Camp and Patch Lake have been dismantled and are in the process of reclamation. No effluent is produced at these locations.

Water accumulated in Quarries A, B and D is managed in accordance with the approved *Quarry A, B, D Management and Monitoring Plan* and the relevant sections of Part D of the licence. No discharges of water occurred form these sites in 2019.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)

Date of Spill:

Date of Notification to an Inspector:

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

No unauthorized discharges occurred in 2019 under licence 2BE-HOP1222.

Revisions to the Spill Contingency Plan

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 13. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Additional Details:

Details attached.

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

Additional Details: (date of request, analysis of results, data attached, etc)

No additional sampling requested.

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Additional Details: (Attached or provided below)

No additional sampling requested.

Any responses or follow-up actions on inspection/compliance reports

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BE-HOP1222.

Date Submitted:	March 31 2020	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	647.480.3106 ext. 124
	Fax:	
	email:	oliver.curran@tmacresouces.com

GPS Coordinates for water sources utilized

Source Description	Latitude	Longitude
HOP-1 - Raw water supply intake at Windy Lake	432626	7550477
Raw water supply intake at Doris Lake	433525	7558727
Patch Lake	434265	7550023
Patch Lake	435299	7548050
Milk Bottle Lake	433754	7535755
Kamik Lake	434664	7533990
Too Lake	443782	7492790
Stickleback Lake	441658	7503583
Domani Lake	442671	7502506
Aimaokatalok Lake	440965	7504931

GPS Locations of areas of waste disposal

Source Description	Latitude	Longitude

NWB Annual Report **Year being reported:** 2019

License No: 2BB-MAE1727 **Issued Date:** May 23, 2017
Expiry Date: May 22, 2027

Project Name: Madrid Advanced Exploration Program

Licensee: TMAC Resources Inc.

Mailing Address:
181 University Ave
Suite 300, PO Box 33
Toronto, Ontario M5H 3M7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BB-MAE1727 was assigned to TMAC Resources Inc. on May 23, 2017.

General Background Information on the Project (*optional):

No activities occurred under license 2BB-MAE1727 in 2019.

Licence Requirements: the licensee must provide the following information in accordance with

Part B Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Patch Lake/Windy Lake

Water Quantity:

108000 cu.m/yr*	Quantity Allowable Domestic (cu.m)
0 cu. m/yr	Actual Quantity Used Domestic (cu.m)
not specified	Quantity Allowable Drilling (cu.m)
0 cu. m/yr	Total Quantity Used Drilling (cu.m)

**Part E, Item 1 total volume from "all sources and for all purposes"*

Waste Management and/or Disposal

- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

No water was used or waste disposal under this licence in 2019.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: N/A (as reported to the Spill Hot-line)
Date of Spill: N/A
Date of Notification to an Inspector: N/A
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc.)

No spills occurred in this license area during 2019.

Revisions to the Spill Contingency Plan

Other: (see additional details)

Additional Details:

See Section 12. of attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 13. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Not Applicable (N/A)

Additional Details:

N/A

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Not Applicable (N/A)

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc.)

N/A

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

No inspection and/or compliance report issued by INAC

Additional Details: (Dates of Report, Follow-up by the Licensee)

N/A

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BB-MAE1727.

Date Submitted:	March 31 2020	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	647.480.3106 ext. 124
	Fax:	
	email:	oliver.curran@tmacresouces.com

GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
MAE-01 Windy Freshwater Intake	432626	7550477

GPS Locations of areas of waste disposal

Location Description	UTM Easting	UTM Northing

GPS Locations of Active Monitoring Stations not included above*

Monitoring Station	UTM Easting	UTM Northing
MAE-14	7550317	432644
MAE-15	7550458	433578
MAE-16	7547060	434748

NWB Annual Report **Year being reported:** 2019

License No:	2BB-BOS1727	**Issued Date:**	August 1, 2017
		Expiry Date:	July 31, 2027

Project Name: Boston Advanced Exploration Project

Licensee: TMAC Resources Inc.

Mailing Address:
181 University Ave
Suite 300, PO Box 33
Toronto, Ontario M5H 3M7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BB-BOS1217 was issued Aug 2, 2012 to Hope Bay Mining Ltd. Effective June 18, 2013, the NWB authorized the assignment of Licence 2BB-BOS1217 from Hope Bay Mining Ltd. to TMAC Resources Inc. The license was renewed on August 1, 2017 and renamed 2BB-BOS1727.

General Background Information on the Project (*optional):

The Boston site supports advanced mineral exploration in the south end of the Hope Bay Project. Boston Camp was reopened June 21 2019 to support a regional surface exploration program. The camp was closed December 8 2019 at the conclusion of this exploration program. Routine sampling, inspections and dewatering of water management facilities occurred during the open water season as well as waste backhaul to the Doris site via a winter track in December 2019.

Licence Requirements: the licensee must provide the following information in accordance with

Part B	Item 9

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Aimaokatalok (Spyder) Lake for domestic use and drilling purposes. The total quantity of water allowable by the licence is 36,500 m3/yr or 100 m3/day. There is no differentiation between quantities to be used domestically or for drilling.

Water Quantity:

not specified	Quantity Allowable Domestic (cu.m)
732 cu.m	Actual Quantity Used Domestic (cu.m)
not specified	Quantity Allowable Drilling (cu.m)
0 cu.m	Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal

- [x] Solid Waste Disposal
- [x] Sewage
- [ ] Drill Waste
- [x] Greywater
- [ ] Hazardous
- [x] Other: Fuel Farm Berm, Containment Pond and Mine Portal discharges

Additional Details:

The Boston Camp was opened seasonally to support a regional surface exploration program in 2019. Activities in 2019 included water use, effluent management and licence compliance.

Water for domestic use at Boston Camp was obtained from Aimaokatalok Lake via a 2 inch diameter submerged pipe with a DFO compliant fish screen. This intake pipe is linked to a pump house located approximately 30 metres from shore. In winter, the pump house is moved onto the ice to decrease the length of heat-traced line required to reach the location where the water is open under the ice.

Sewage and greywater produced on site is processed in the sewage treatment plant as per Part D Item 11. Effluent from the Sewage Treatment Plant is sampled for effluent quality against the dischrage criteria of the licence. Effluent that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector. Sludge is transported to Doris camp via winter track for disposal.

Waste produced on site was treated according to Part D of the licence, and in accordance with the relevant Management Plans *(Incineration Management Plan, Non-Hazardous Waste Management Plan, and Hazardous Waste Management Plan*). Some specifics are as follows:

-Food waste, paper waste and untreated wood waste was burned in the incinerator as per Part D Item 3.

-Solid waste that cannot be burned was transferred to the Roberts Bay waste management facility for packaging and is taken offsite for disposal.

-Drill cuttings produced under this licence are disposed of in depressions as per Part F Item 2.

-Waste hazardous materials such as waste oil, glycol, and contaminated soil are shipped to Doris either to be reclaimed or shipped offsite for disposal in an approved facility as per Part D Item 6.

-Fuel berm effluent and Containment Berm effluent is sampled for water quality against the discharge criteria of the licence. Effluent that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector. Effluent that does not meet the licence criteria is treated onsite with an oil-water separator system containing activated carbon and Metsorb media until it is remediated to acceptable levels for discharge.

-The landfarm facility was decommissioned in 2019. Hydrocarbon contaminated material generated by activities under this licence will be transported to Doris for treatment/disposal.

- Effluent from the mine portal/decline is sampled in accordance with the criteria specified for Monitoring Station BOS-9.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)

Date of Spill:

Date of Notification to an Inspector:

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Please see section 11. of the attached Annual Report Supplement for a summary of all unauthorized discharges that occurred in 2019 under license 2BB-BOS1727.

Revisions to the Spill Contingency Plan

Additional Details:

See section 12. of attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Additional Details:

Please see section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see section 13. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Additional Details:

Details attached.

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Additional Details:

Details attached.

Results of any additional sampling and/or analysis that was requested by an Inspector

Additional Details: (date of request, analysis of results, data attached, etc)

No additional sampling or analysis was requested.

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BB-BOS1727.

Date Submitted:	March 31 2020	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	647.480.3106 ext. 124
	Fax:	
	email:	Oliver.curran@tmacresouces.com

GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
BOS-1a - Raw water supply intake at Spyder Lake	440855	7505584

GPS Locations of areas of waste disposal

Location Description (type)	UTM Easting	UTM Northing
BOS-2 - Containment Pond Discharge	441332	7505378
BOS-3 - Sewage Disposal Facility Final Discharge	441191	7505560
BOS-4 - Treated sewage effluent point prior to entry into Aimaokatuk (Spyder) Lake	441211	7505776
BOS-5 - Effluent from the bulk fuel storage facility prior to release	441321	7505322
BOS-6 - Effluent from the landfarm treatment facility prior to release	441274	7505317
BOS-8 - Seepage/runoff from the ore stockpiles and camp pad, monitored on the tundra east of the ore stockpiles	441272	7505473
BOS-9 - Effluent from the portal decline	441219	7505378

NWB Annual Report **Year being reported:** 2019

License No:	2AM-BOS1835	**Issued Date:**	December 7, 2018
		Expiry Date:	March 30, 2035

Project Name: Boston Project

Licensee: TMAC Resources Inc.

Mailing Address:
181 University Ave
Suite 300, PO Box 33
Toronto, Ontario M5H 3M7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2AM-BOS1835 was issued Dec 7, 2018 to TMAC Resources Inc.

General Background Information on the Project (*optional):

No construction, operations or other activities occurred under licence 2AM-BOS1835 in 2019.

Licence Requirements: the licensee must provide the following information in accordance with

Part B	Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Aimoakatalok Lake/lakes proximal to drilling targets/ice road

Water Quantity:

33000 cu.m/yr*	Quantity Allowable Domestic (cu.m)
0 cu. m/yr	Actual Quantity Used Domestic (cu.m)
503000 cu.m/yr	Quantity Allowable Domestic, Mining, Milling, Drilling, etc.
0 cu. m/yr	Total Quantity Used Domestic, Mining, Milling, Drilling, etc.

**Part E, Item 1 total volume from "all sources and for all purposes"*

Waste Management and/or Disposal

- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

No water was used or waste disposal under this licence in 2019. Facilities listed under this licence have not yet been constructed.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)
Date of Spill:
Date of Notification to an Inspector:
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc.)

No spills occurred in this license area during 2019.

Revisions to the Spill Contingency Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 13. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Not Applicable (N/A)

Additional Details:

Facilities under this licence have not yet been constructed. No water used in 2019.

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Not Applicable (N/A)

Additional Details:

Facilities under this licence have not yet been constructed. No waste disposal in 2019.

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc.)

N/A

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

Inspection Report received by the Licensee (Date):

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2AM-BOS1835.

Date Submitted:	March 31 2020	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	647.480.3106 ext. 124
	Fax:	
	email:	Oliver.Curran@tmacresources.com

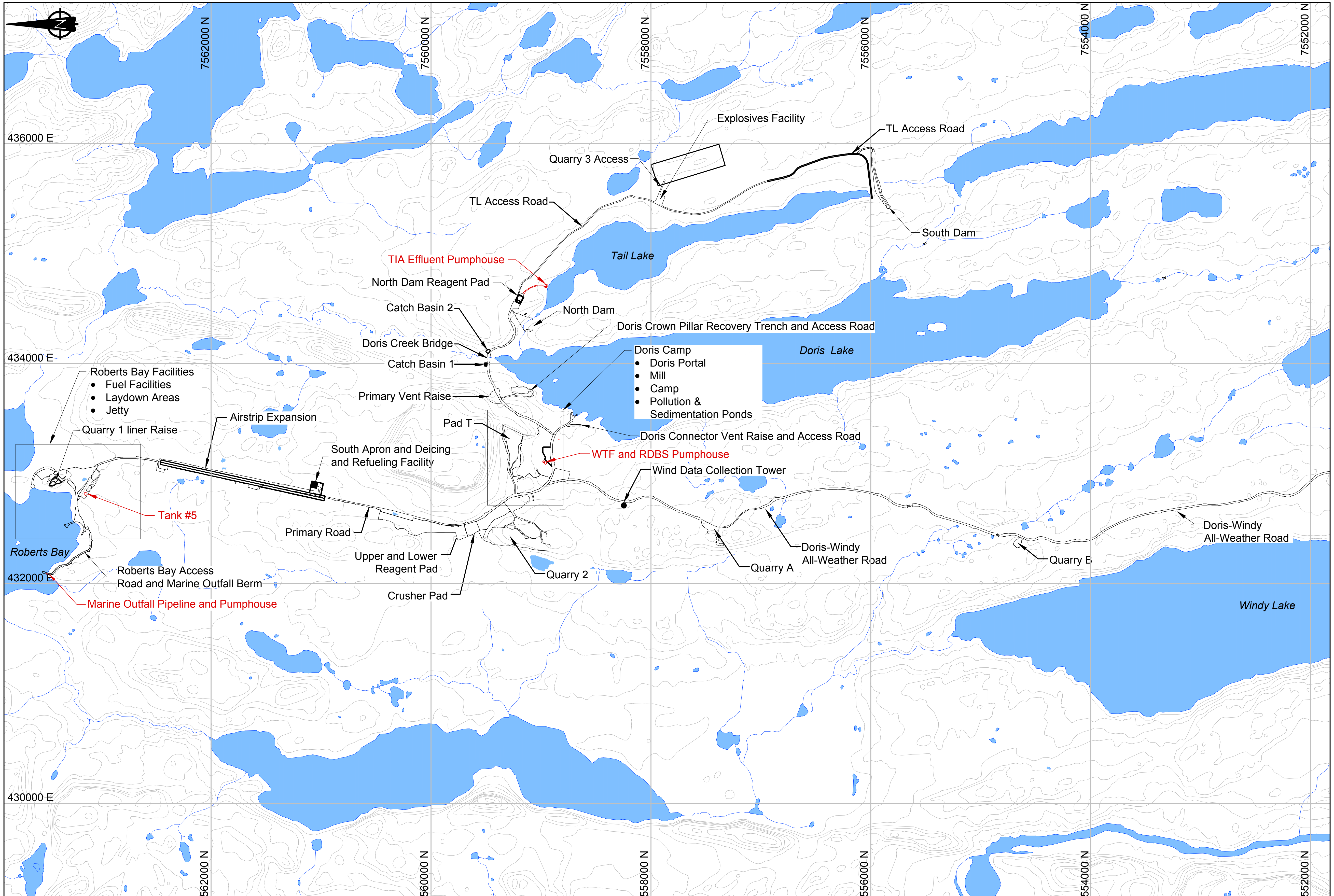
GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing

GPS Locations of areas of waste disposal

Location Description (type)	UTM Easting	UTM Northing

Appendix C
Site Layouts



LEGEND

Asbuilt Crests / Toes

2019 Construction Items

NOTES

1. Coordinate system is UTM Zone 13, NAD83.

srk consulting

SRK JOB NO.: 1CT022.026

FILE NAME: 1CT022.051 - 2019 As-Built Update.dwg

TMAC RESOURCES

HOPE BAY PROJECT

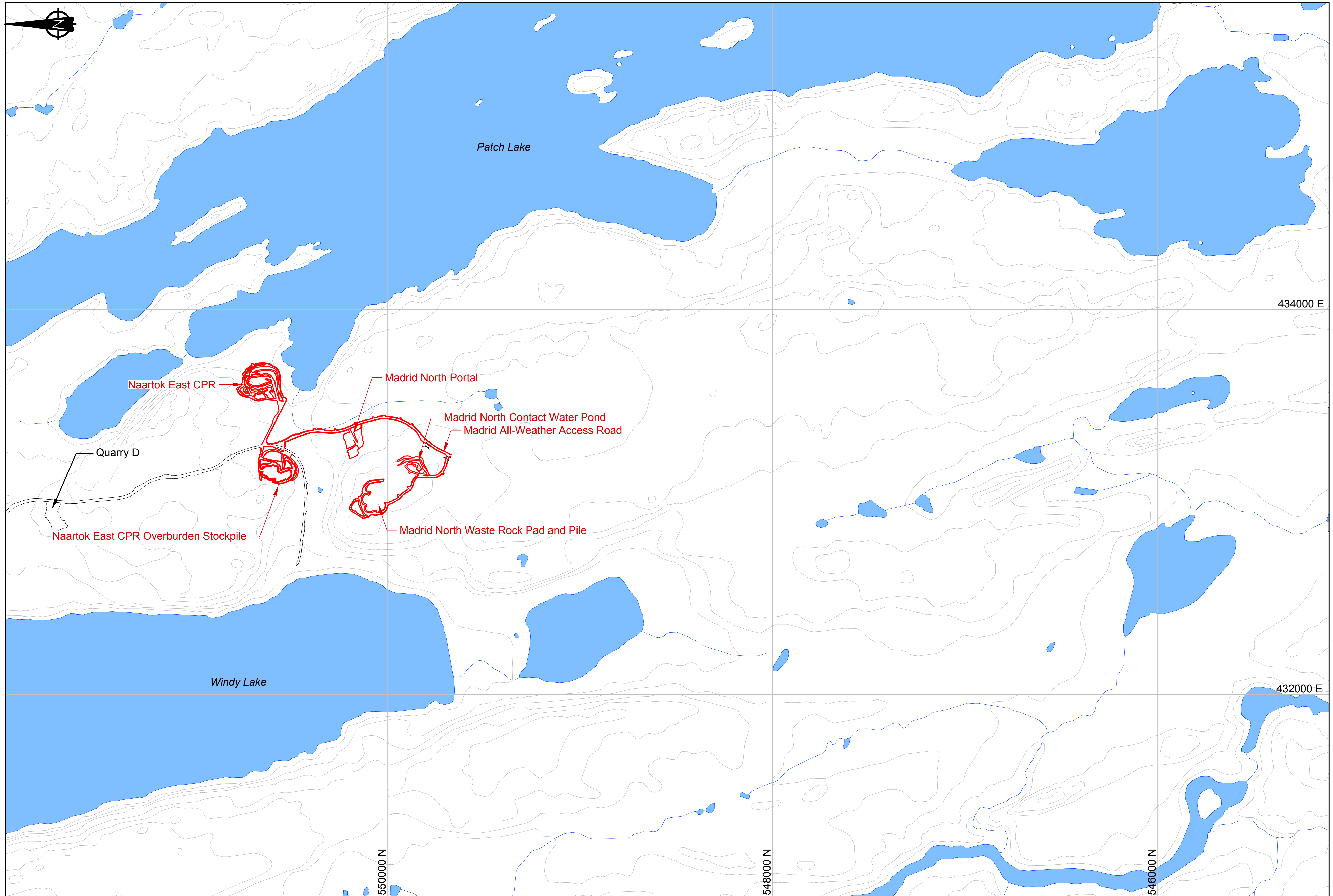
2019 NWB Annual Report

Doris Area 2019
As-Built Summary

DATE: March 2020

APPROVED: --

FIGURE: 1



LEGEND

- Asbuilt Crests / Toes
- 2019 Construction Items

NOTES

1. Coordinate system is UTM Zone 13, NAD83.

0m 200 400 600 800

srk consulting

SRK JOB NO.: 1CT022.026

FILE NAME: 1CT022.051 - 2019 As-Built Update.dwg

TMAC RESOURCES

HOPE BAY PROJECT

2019 NWB Annual Report

Madrid North Area 2019
As-Built Summary

DATE:	APPROVED:	FIGURE:
March 2020	--	2

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TMAC RESOURCES

2019 NWB Annual Report

HOPE BAY PROJECT

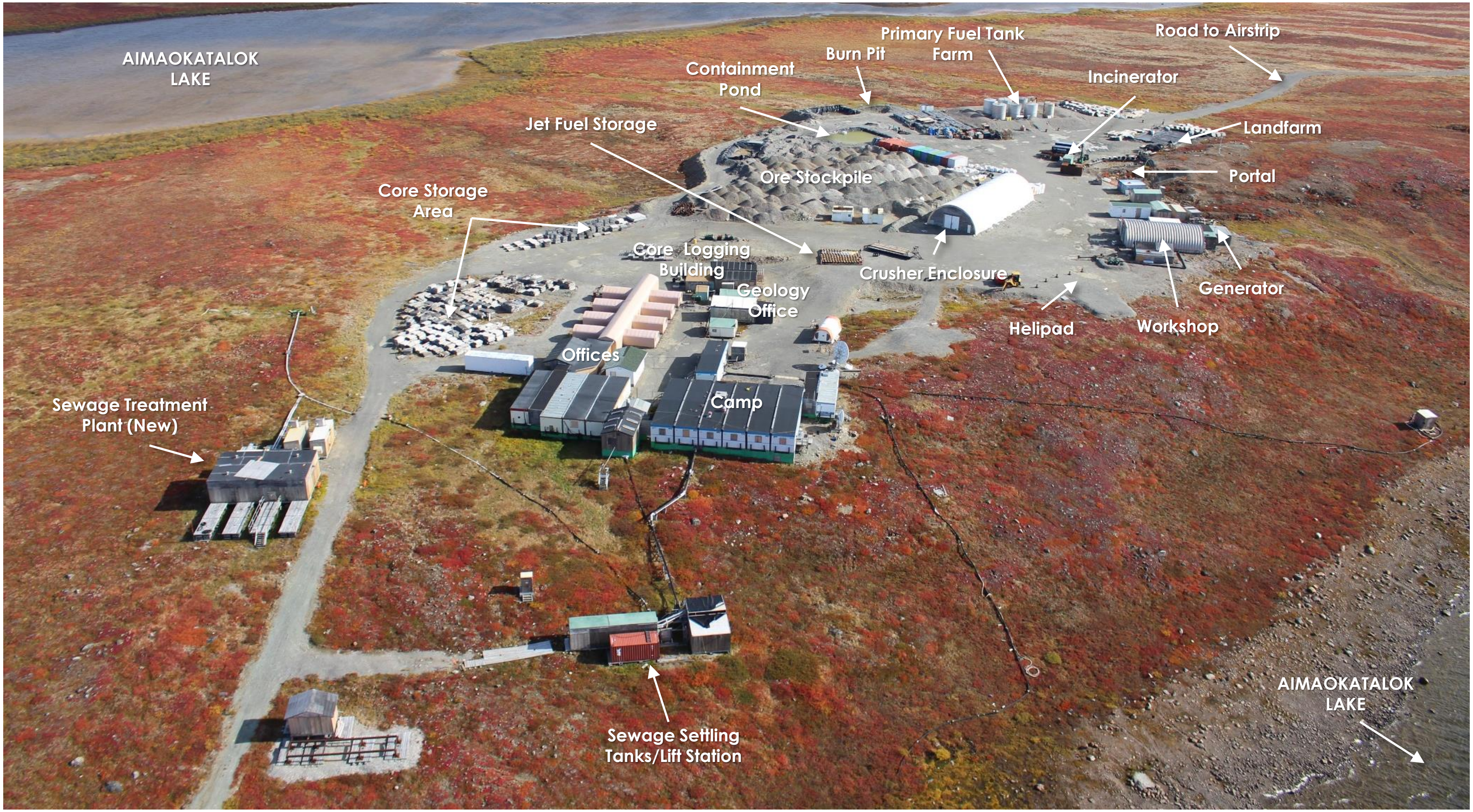
Doris Site (looking North)

TMAC RESOURCES

2019 NWB Annual Report

HOPE BAY PROJECT

Windy Camp (looking East)



TMAC RESOURCES

2019 NWB Annual Report

HOPE BAY PROJECT

Boston Camp (looking South)

Appendix D
Water Licence(s) Monitoring Data

Appendix D.1. 2AM-DOH1335

Appendix D.1. 2AM-DOH1335

The Type A Water Licence No. 2AM-DOH1335 details the sampling and analysis requirements for the Surveillance Network Program (SNP) program. Table D1-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2AM-DOH1335. The location of each sampling point is illustrated in Figures D1-1 through D1-3 below.

Table D1-1. 2AM-DOH1335 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
ST-1	Doris Sedimentation Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-2	Doris Contact Water Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-3	Discharge from Non-hazardous Landfill Contact Water control sump	Construction, Care and Maintenance, Operation, Closure	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-4	Discharge from Landfarm sump	Construction, Operation, Care and Maintenance, Closure	G, HC, total Ammonium, total Lead	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-5	Discharge from Doris Plant Site Fuel Storage and Containment Area Sump	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-6a and ST-6b	Discharge from the Roberts Bay Fuel Storage and Containment Area Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-7	Freshwater pumped from Doris Lake	Construction, Operation, Care and Maintenance, and Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl	Monthly during periods of pumping
			D	Monthly during periods of pumping
			Cl-a	Annually

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
ST-7a	Freshwater pumped from the Windy Lake freshwater intake	Construction, Operation, Care and Maintenance, Closure	G, N1, N2, MT, Cl and, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, T-Ca, and Total Oil and Grease, Free CN, Total CN	Monthly during periods of pumping
			B	
			D	
ST-8	Discharge from Doris Sewage Treatment Plant bio-membrane	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharge to the Tundra, Annually when discharge to the TIA
			Location of discharge	Monthly during periods of discharge
			D	Daily during periods of discharge
ST-9	Runoff from Doris Sewage Treatment Plant discharge - downstream of wastewater treatment plant discharge point and just prior to flow entering Doris Lake	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when ST-8 is discharged to the tundra
ST-10	Doris Site Runoff from Sediment Controls	Construction, Operations, Closure	TSS or Turbidity (following development and approval of a site-specific TSS-Turbidity)	Daily during periods of discharge
ST-11	Reagent and Cyanide Doris Storage Facility Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC , MT, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl Total Ammonia, Total and Free Cyanide, and D	Annually
ST-12	Doris Lake	Operation, Closure	Water Level	Monthly
			Ice Thickness	Annually in April
ST-13	Doris Contact Water Pond associated to Pad U	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
			D	Daily during periods of discharge
TL-1	TIA at the Reclaim Pipeline	Operation, Care and Maintenance, Closure, Post-Closure	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, Fecal Coliforms	Monthly during Operations, Closure and Post-Closure Annually during Care and Maintenance
			Dissolved Oxygen, Redox Potential, BOD	Annually
			Acute Lethality	Annually during Post-Closure
			D	Daily during periods of discharge

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
TL-2	Doris Outflow Creek - upstream (at the flow monitoring station adjacent to the bridge)	Closure, Post-Closure	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Oil and Grease	Annually during Care and Maintenance Annually for 2 years prior to Post-Closure, and during Post-Closure, Increase to three times per year (under ice, freshet, and pre-freeze up), two years prior to breach of the North Dam.
		Operation	D	Daily upon commencement of mining in or beneath the Doris Lake Talik.
TL-3	Doris Outflow Creek (~80m downstream of the base of the waterfall)	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Total Oil and Grease D	Inactive
TL-4	TIA Discharge End-of-Pipe	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226 Acute Lethality B D	Inactive
TL-5	Effluent from Doris Process Plant (tailings slurry/water)	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS	Monthly
			Cyanate and Thiocyanate	Quarterly
TL-6	Tailings Discharged into TIA (Solid Component) taken from a valve in the mill at the discharge end of the mill tailings pumps	Operations	Tonnage of dry tailings solids	Monthly during periods of discharge
			MT and T-Cd, T-Cr, T-Hg, T-Mo, T-Se, Total Inorganic Carbon and Total Metals by ICP-MS (must include Sulphur)	Sampled on a weekly basis with analyses carried out monthly on a composite sample of the TL-6 weekly samples
TL-7a	Detoxified tailings solids sent underground as backfill	Operations	Dry tonnage of detoxified tailings sent underground; Moisture content of backfill trucked underground	Monthly
TL-7b	Filtrate from TL-7a (Detoxified tailings sent underground as backfill)	Operations	Cyanate and Thiocyanate, WAD CN, Total Inorganic Carbon, Total Metals by ICP-MS (including Sulphur)	Monthly
TL-8	Reclaim water pumped from TIA to Mill Process water tank taken from a valve at the discharge end of the reclaim water pump	Operations	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl	Inactive
			D	Daily during periods of pumping

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
TL-9	Detox tailings reactor tank (650-TK-565)	Monitoring and reporting is captured within the Water Management Plan		Monitoring and reporting is captured within the Water Management Plan
TL-10	Water Column in deepest portion of Tail Lake and at a location away from the TIA Reclaim water floating pump house, sampled at surface, mid- depth and near bottom	Inactive		Inactive
TL-11	Seepage from Doris underground backfilled stopes	Operations	Visual inspection for seepage. If seepage present parameters to be monitored include N1 and pH, EC, Trace metals by ICP-MS, Alkalinity, Acidity, Sulphate, Total, Free and WAD CN	Survey Twice annually
TL-12	Doris Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, Total Metals by ICPMS, alkalinity, bromide, fluoride, sulphate, TSS, and Total and WAD Cyanide	Monthly
			D	Daily during periods of discharge
MMS-1	Madrid North Contact Water Pond	Construction, Operations, Care and Maintenance	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-2	Madrid South Primary Contact Water Pond	Construction, Operations, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-3	Madrid South Secondary Contact Water Pond	Construction, Operations, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-4a	Freshwater Intake at Windy Lake North	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods
MMS-4b	Freshwater Intake at Windy Lake South (Windy Camp)	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods
MMS-5	Discharge from Madrid South Fuel Storage facility	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge to tundra

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
MMS-6	Brine Mixing Facility	Operations during continuous pumping	G, N1, Chloride, Fluoride, Bromide, Sulphate, TDS, EC, Total Metals ICP-MS, alkalinity, and Total and WAD Cyanide	Sampled monthly during active pumping periods
MMS-7	Effluent from Madrid North Concentrator to TIA	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS	Sampled quarterly during active pumping periods
MMS-8	Discharge from Madrid North Fuel Storage Facility	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge to tundra
MMS-9	Site runoff from sediment controls during construction	Construction	TSS or Turbidity	Sampled daily during periods of discharge
MMS-10	Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, Total Metals ICP-MS, alkalinity, Fluoride, Bromide, Sulphate, TSS, and Total and WAD Cyanide	Monthly

Figure D1-1. 2AM-DOH1335 Sample Stations Location

Figure D1-2. 2AM-DOH1335 Sample Stations Location

Figure D1-3. 2AM-DOH1335 Sample Stations Location

SUMMARY OF MONTHLY MONITORING REPORTING [SEE PART I ITEM 12]

In 2019 commercial operations continued at Doris with continued efforts to stabilize mill throughput and optimize gold recovery. The installation of the gravity concentrators was completed in 2019 which improved gold recovery. Projects such as the installation of scavenger columns and improved resin circuits began in the mill to further improve gold recovery.

Civil construction activities included the completion of construction of the Roberts Bay Discharge System (RBDS) and installation of the associated underground mine dewatering and Tailings Impoundment Area (TIA) discharge pipelines and pumping infrastructure. The RBDS facilitates dewatering of the Doris mine and removal of excess water from the TIA to Roberts Bay. The ocean discharge pipeline with sunken diffuser and recirculation pipeline were successfully installed into Roberts Bay during the open water season. As part of this system, a Water Treatment Plant was constructed to remove Total Suspended Solids from underground mine water prior to discharge through the RBDS. No discharge occurred to Roberts Bay in 2019.

Earthworks began at the Madrid North site to support the commencement of mining of the Naartok East Crown Pillar and Madrid North underground decline. This included construction of the first kilometer of the Madrid North all-weather-road, the Madrid North Contact Water Pond, and construction of the Madrid North Waste Rock storage pad. Laydown space and access roads were constructed to support shop facilities, lunchroom/offices and wash car facilities. An overburden stockpile was established to store overburden removed during mining of the Naartok East Crown Pillar.

Underground waste development continued at Doris in 2019 with further advancement of the BTD decline and necessary support infrastructure. TMAC continued ore development with long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris, and continued ore sill development in the DCO. TMAC also continued waste development in the DCO for future mining horizons. Long hole blasting continued throughout 2019, with all ore production trucked to surface and processed through the mill or added to the stockpile. Construction of the DCO Vent Raise was completed to support underground ventilation requirements. Development of the Doris Central (DCN) decline continued in 2019. TMAC continued underground exploration diamond drilling in the BTD, DCO and DCN areas in 2019.

Ore development also occurred from surface in 2019 with the commencement of surface blasting and hauling of ore and waste from the Naartok East Crown Pillar Recovery (NECPR). Development of the Madrid North underground decline began in Q4 of 2019. Backfill and reclamation of the Doris Crown Pillar Trench was completed in 2019.

During 2019, TMAC collected data from the following active or seasonally active monitoring stations: TL-1, TL-2, TL-5, TL-6, TL-7a, TL-7b, TL-9, TL-11, TL-12, ST-1, ST-2, ST-4, ST-5, ST-6a, ST-6b, ST-7, ST-7a/MMS-4b, ST-8, ST-9, ST-10, ST-11, ST-12, MMS-1 and MMS-9.

Monitoring at stations ST-3 (Landfill Sump), ST-13 (Doris Contact Water Pond Pad U), MMS-4a (Freshwater intake at Windy Lake North), MMS-6 (Brine Mixing Facility) and MMS-8 (Madrid North Fuel Storage Facility) did not occur, as these facilities were not constructed as of 2019.

The Madrid North Concentrator was not constructed in 2019, therefore no effluent was discharged to the TIA from this facility and no monitoring occurred at station MMS-7. No monitoring at station MMS-10 (Madrid Mine Water Discharge) occurred as no mine water was pumped from Madrid underground workings in 2019.

No activities occurred at Madrid South in 2019. Therefore monitoring at stations MMS-2 (Madrid South Primary Contact Water Pond), MMS-3 (Madrid South Secondary Contact Water Pond) and MMS-5 (Madrid South Fuel Storage Facility) did not occur as these facilities were not constructed as of 2019.

Monitoring of the TIA was undertaken at monitoring station TL-1. Monitoring of the tailings deposited into the TIA continued at monitoring stations TL-5 and TL-6 in 2019. Monitoring of detoxified tailings backfilled underground was completed at monitoring stations TL-7a, TL-7b and TL-11. As described in the Hope Bay Water Management Plan, the Doris Sedimentation Pond (ST-1) was used as a collection pond for the water that accumulated in the Doris Contact Water Pond (ST-2) and the three underflow sumps (ST2-S1, ST2-S2 and ST2-S3). The water collected in ST-1 was then transferred to the TIA by pipeline. Dewatering of the TIA did not occur in 2019.

Dewatering of the Doris underground (TL-12) continued in 2019. This water was transferred to the TIA through the mill tailings pipeline and through the Doris Sedimentation Pond pipeline.

All monitoring was conducted in accordance with the Hope Bay Project Quality Assurance and Quality Control Plan (2019).

TMAC uses an external certified laboratory to carry out all analyses reported in the monthly and annual reports. The QA/QC data produced by ALS Canada Ltd. and Bureau Veritas Laboratories Inc. (formerly Maxxam Analytics) are used to determine the accuracy and precision of results in these reports.

Thermal monitoring was undertaken in 2019 at active ground temperature monitoring stations. Results of this monitoring are included in the annual Geotechnical Inspection report.

Conditions of the Doris North Diversion Berm's effectiveness during spring freshet, major rain events, and periods of sustained (non-frozen) precipitation were monitored and documented.

Details of all monitoring follows.

ST-1 Doris Sedimentation Pond

This facility was constructed and first used in 2011. In 2019, during open water season, all discharges from the facility were made directly to the TIA via pipeline as per Part F Item 17. All discharges from the facility were metered. Water quality samples were collected from an outlet on the discharge pump with the intake on the pump submerged approximately 0.25m below the water surface. If the pump was not running, samples were collected from the pond itself.

Water was transferred from ST-1 to the TIA beginning in June and continued into September. The final day of discharge from the Sedimentation Pond was September 27, 2019.

Volumes transferred to the TIA from ST-1 are summarized in Table D1-2. This includes water transferred from ST-2, ST2-S1, ST2-S2 and ST2-S3 to ST-1, as described above, and water transferred from the landfarm (ST-4) and fuel storage facility berms ST-5, ST-6a and ST-6b. Volumes presented also include water transferred from the Doris underground workings (TL-12), Madrid North Contact Water Pond (MMS-1) and Naartok East Crown Pillar Recovery Trench (NECPRT) to the Doris Sedimentation Pond for transfer to the TIA. Results of water quality samples, collected from ST-1, are summarized in Table D1-3.

Table D1-2. Summary of Monthly Water Management Volumes for Monitoring Station ST-1, June to September 2019

Month	Monthly Volume (m^3)	Cumulative Volume (m^3)*
June	10,835	10,835
July	71,813	82,648
August	67,993	150,641
September	54,845	205,486
Total Volume of Water Transferred from ST-1 to TIA in 2019		**205,486**

* Values rounded to nearest whole cubic metre.
Volumes presented includes water from transferred from ST-2, ST2-S1, ST2-S2, ST2-S3, ST-4, ST-5, ST-6a, ST-6b, MMS-1, TL-12 and NECPRT.

Table D1-3. Water Quality Monitoring Program Results for ST-1, June, July, September 2019

	Sample ID	ST1	ST1	ST1
	ALS ID	L2294423-1	L2306660-1	L2344399-1
	Date Sampled	2019-06-16 15:30	2019-07-17 17:30	2019-09-09 11:10
Parameter	**Units**		**Results**	
pH	pH	7.61	7.82	7.94
Total Suspended Solids	mg/L	<3.0	200	264
Chloride (Cl)	mg/L	1250	8380	10800
Cyanide, Total	mg/L	<0.0050	1.35	1.27
Ammonia, Total (as N)	mg/L	2.55	32.9	18.8
Nitrate (as N)	mg/L	1.45	39.3	25.9
Nitrite (as N)	mg/L	0.115	2.1	1.87
Sulfate (SO_4)	mg/L	144	882	1090
Aluminum (Al)-Total	mg/L	0.128	1.88	5.43
Antimony (Sb)-Total	mg/L	<0.00050	0.00158	0.0022
Arsenic (As)-Total	mg/L	<0.00050	0.00376	0.0101
Barium (Ba)-Total	mg/L	<0.020	0.062	0.061
Beryllium (Be)-Total	mg/L	<0.00020	<0.00050	<0.0020
Boron (B)-Total	mg/L	0.27	2.51	2.36
Cadmium (Cd)-Total	mg/L	0.000023	0.00022	0.00021
Calcium (Ca)-Total	mg/L	121	921	779
Chromium (Cr)-Total	mg/L	<0.0010	0.0027	0.0105
Cobalt (Co)-Total	mg/L	0.00038	0.0138	0.0168
Copper (Cu)-Total	mg/L	0.0039	0.628	0.925
Iron (Fe)-Total	mg/L	0.229	7.81	18.3
Lead (Pb)-Total	mg/L	<0.00050	0.00362	0.0157
Lithium (Li)-Total	mg/L	0.011	0.0985	0.093
Magnesium (Mg)-Total	mg/L	72.4	549	575
Manganese (Mn)-Total	mg/L	0.166	1.41	1.35
Mercury (Hg)-Total	mg/L	<0.0000050	<0.00025	<0.0000050

Sample ID		ST1	ST1	ST1
ALS ID		L2294423-1	L2306660-1	L2344399-1
Date Sampled		2019-06-16 15:30	2019-07-17 17:30	2019-09-09 11:10
Parameter	Units	Results		
Molybdenum (Mo)-Total	mg/L	0.0012	0.0115	0.0087
Nickel (Ni)-Total	mg/L	0.0011	0.0276	0.024
Potassium (K)-Total	mg/L	19.6	137	136
Selenium (Se)-Total	mg/L	<0.00010	0.00118	0.0018
Silver (Ag)-Total	mg/L	0.000026	0.00211	0.00356
Sodium (Na)-Total	mg/L	579	4360	4520
Thallium (Tl)-Total	mg/L	<0.000020	<0.000050	<0.00020
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.0020
Titanium (Ti)-Total	mg/L	<0.010	0.029	0.113
Uranium (U)-Total	mg/L	<0.00020	0.00056	0.00055
Vanadium (V)-Total	mg/L	<0.0010	0.0067	0.019
Zinc (Zn)-Total	mg/L	<0.0060	0.041	0.14
Alkalinity, Total (as $CaCO_3$)	mg/L	31.8	151	176
Oil and Grease	mg/L	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO

ST-2 Doris Contact Water Pond

This facility was constructed in 2011. In 2019, it was active between June and September. Samples from ST-2 were collected from a depth of 0.25 m below the water surface. All water from the Doris Contact Water Pond was directed to the Sedimentation Pond.

Water quality monitoring sampling at ST-2 occurred as per Schedule I of the water licence. Results of the sampling are presented in Table D1-4.

ST-4 Landfarm

Water quality samples were collected on June 17 from the Landfarm (ST-4) prior to discharge of water from this facility. Although this sample met the discharge criteria identified in Part F Item 18(b), a visible sheen was noted in this facility before dewatering was conducted. A second sample was collected on June 24 and exceeded the discharge criteria for Oil & Grease and Visible Sheen. No discharge to tundra occurred from this facility in 2019. A total of 48 m^3 was transferred from the Landfarm to the TIA. Results of Landfarm water sampling are presented in Table D1-5.

ST-5 Doris Plant Site Fuel Storage and Containment

Water from the Doris tank farm (ST-5) was sampled on June 2, 2019 prior to dewatering events and results met the discharge criteria outlined in Part F Item 18(b). Results of this sampling are presented in Table D1-6.

No discharge to tundra occurred from this facility in 2019. A total of 976 m^3 of water was transferred to the Sedimentation Control Pond for transfer to the TIA.

Table D1-4. Water Quality Monitoring Program Results for ST-2, June, July, September 2019

	Sample ID	ST2	ST2	ST2
	ALS ID	L2294423-2	L2306660-2	L2344399-2
	Date Sampled	2019-06-16 15:55	2019-07-17 17:50	2019-09-09 11:00
Parameter	**Units**		**Results**	
pH	pH	7.89	8.2	7.93
Total Suspended Solids	mg/L	4.5	5.4	24.8
Chloride (Cl)	mg/L	718	921	2090
Cyanide, Total	mg/L	0.842	26	22.1
Ammonia, Total (as N)	mg/L	7.62	14.9	25.9
Nitrate (as N)	mg/L	28.2	30.6	78.8
Nitrite (as N)	mg/L	0.454	0.449	0.598
Sulfate (SO_4)	mg/L	156	388	342
Aluminum (Al)-Total	mg/L	0.117	0.0473	0.369
Antimony (Sb)-Total	mg/L	<0.00050	0.00117	0.0007
Arsenic (As)-Total	mg/L	0.00158	0.00504	0.00198
Barium (Ba)-Total	mg/L	0.039	0.04	0.086
Beryllium (Be)-Total	mg/L	<0.00010	<0.00020	<0.00050
Boron (B)-Total	mg/L	0.16	0.42	0.4
Cadmium (Cd)-Total	mg/L	0.0000738	0.000122	0.000142
Calcium (Ca)-Total	mg/L	241	248	720
Chromium (Cr)-Total	mg/L	<0.0010	0.0013	0.0019
Cobalt (Co)-Total	mg/L	0.0109	0.0638	0.0541
Copper (Cu)-Total	mg/L	0.151	5.11	3.92
Iron (Fe)-Total	mg/L	0.554	9.16	5.07
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0133	0.013	0.03
Magnesium (Mg)-Total	mg/L	37.1	56.5	114
Manganese (Mn)-Total	mg/L	0.573	0.426	1.05
Mercury (Hg)-Total	mg/L	0.000008	<0.00010	0.0000142
Molybdenum (Mo)-Total	mg/L	0.0045	0.0146	0.01
Nickel (Ni)-Total	mg/L	0.0072	0.112	0.0896
Potassium (K)-Total	mg/L	17.2	33.6	40.9
Selenium (Se)-Total	mg/L	0.00112	0.00502	0.00466
Silver (Ag)-Total	mg/L	0.00079	0.0232	0.0189
Sodium (Na)-Total	mg/L	242	533	747
Thallium (Tl)-Total	mg/L	0.000019	<0.000020	<0.000050
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	0.019
Uranium (U)-Total	mg/L	0.00086	0.00166	0.00233
Vanadium (V)-Total	mg/L	0.00108	0.0015	<0.0025
Zinc (Zn)-Total	mg/L	<0.0050	<0.0060	<0.015
Alkalinity, Total (as $CaCO_3$)	mg/L	67.1	157	173
Oil and Grease	mg/L	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO

Table D1-5. Water Quality Monitoring Program Results for ST-4, June 2019

	Sample ID	ST4	ST4 ^	ST4-B	Part F Item 18(b)	
	ALS ID	L2294342-1	L2294342-1	L2298350-1	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
	Date Sampled	2019-06-17 16:15	2019-06-17 16:15	2019-06-24 16:00		
Parameter	**Units**	**Results**				
pH	pH	8.11	8.16	8.25	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	<3.0	4.8	26.1	50.0	100.0
Benzene	mg/L	<0.00050	<0.00050	<0.00050	0.37	0.37
Toluene	mg/L	<0.00045	<0.00045	<0.00045	0.002	0.002
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	0.09	0.09
Oil and Grease	mg/L	<5.0	<5.0	**404**	5	10
Oil And Grease (Visible Sheen)		NO	NO	**YES**	No Visible	No Visible
Lead (Pb)-Total	mg/L	0.000085	0.000079	0.000674	0.2	0.4
Ammonia, Total (as N)	mg/L	0.006	0.0051	0.0191		

Bold/shading *indicates exceedance of Part F Item 18(b) Maximum Authorized Concentration.*
^ Indicates duplicate sample.

Table D1-6. Water Quality Monitoring Program Results for ST-5, June 2019

	Sample ID	ST5	ST5 ^	Part F Item 18(b)	
	ALS ID	L2285777-1	L2285777-2	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
	Date Sampled	2019-06-02 17:15	2019-06-02 17:15		
Parameter	**Units**	**Results**			
pH	pH	8.14	8.15	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	11.2	10.4	50.0	100.0
Benzene	mg/L	<0.00050	<0.00050	0.37	0.37
Toluene	mg/L	<0.00045	<0.00045	0.002	0.002
Ethylbenzene	mg/L	<0.00050	<0.00050	0.09	0.09
Oil and Grease	mg/L	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	No Visible Sheen	No Visible Sheen
Lead (Pb)-Total	mg/L	0.00045	0.000461	0.2	0.4

Bold/shading *indicates exceedance of Part F Item 18(b) Maximum Authorized Concentration.*
^ Indicates duplicate sample.

ST-6a Roberts Bay Bulk Fuel Storage Facility

Water from the Roberts Bay 5ML tank farm (ST-6a) was sampled on June 2, July 10 and September 4, 2019 prior to discharge and met the discharge criteria outlined in Part F Item 18(b). Results of this sampling are presented in Table D1-7.

Notification of discharge from this facility was provided to the Inspector on May 16, 2019. Upon receipt of compliant results, a total of 457 m^3 of water was discharge to tundra (location 13W 432904 7563494) or used as dust suppression on site roads in 2019.

ST-6b Roberts Bay Bulk Fuel Storage Facility

Water from the Roberts Bay 4x5 ML tank farm (ST-6b) was sampled on June 2, 2019 prior to discharge and results exceeded the discharge criteria for Total Suspended Solids (TSS) and Oil & Grease outlined in Part F Item 18(b). A second sample collected on June 17, 2019 also exceeded the discharge limit for TSS and Oil & Grease Visible Sheen. An additional sample was collected on July 10, 2019 and met the discharge criteria for Oil & Grease; however exceeded the criteria for TSS. A sample collected September 4, 2019 met all discharge criteria outlined in Part F Item 18(b). Results of this monitoring are presented in Table D1-8. The exceedances of Oil & Grease are believed to be related to a spill which had occurred in the tank farm prior to freshet. The exceedances of TSS are believed to be related to vehicle traffic within the facility during maintenance of the fuel tanks at the time of sampling.

No discharge to tundra occurred from this facility in 2019. A total of 1,421 m^3 of water from this facility was transferred to the Sedimentation Control Pond for transfer to the TIA in 2019.

ST-7 and ST-7a/MMS-4b Freshwater Usage from Doris and Windy Lakes

Table D1-9 provides the volumes of water usage at the Doris and Madrid project areas as required under Part E Item 1 of water licence 2AM-DOH1335. The water extraction pump for Doris operations is located off the northwest shoreline of Doris Lake and the sampling station ST-7 is located within the Doris Lake pump house. In 2019, water from Doris Lake was not used for domestic consumption; all water for domestic consumption was obtained from Windy Lake at ST-7a (also referred to as MMS-4b in this licence and equivalent to location HOP-1 of the Regional Exploration Licence 2BE-HOP1222). Water for dust suppression in 2019 was obtained from Doris Lake, as well as from compliant containment berm effluent as approved by the Inspector. Underground development and construction occurred in support of the Doris mine and Madrid North mine; water was sourced from Doris Lake, for these purposes. Additionally, water was used from Doris Lake and Patch Lake for seasonal winter ice track construction in January, February and April. No water from Doris Lake was used in the mill for ore processing in 2019. Table D1-9 provides only water volumes used from lake sources and does not include water recycled from berms that would otherwise have been discharged to tundra as effluent.

Results of sampling at ST-7 at Doris Lake are provided in Table D1-10 and Table D1-11. Table D1-12 and Table D1-13 provide the results of water quality sampling for monitoring station ST-7a/MMS-4b (HOP-1) at Windy Lake in compliance with the requirements set out in Schedule I of water licence 2AM-DOH1335.

Table D1-7. Water Quality Monitoring Program Results for ST-6a, June, July, September 2019

Sample ID		ST6A	ST6A ^	ST6A	ST6A	Part F Item 18(b)	
ALS ID		L2285777-3	L2285777-4	L2308743-1	L2342747-1	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
Date Sampled		2019-06-02 11:10	2019-06-02 11:10	2019-07-10 10:05	2019-09-04 16:50		
Parameter	**Units**	**Results**					
pH	pH	8.4	8.38	8.3	8.42	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	21.8	42.6	7	<3.0	50.0	100.0
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.37	0.37
Toluene	mg/L	<0.00045	<0.00045	<0.00045	<0.00045	0.002	0.002
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.09	0.09
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	No Visible Sheen	No Visible Sheen
Lead (Pb)-Total	mg/L	0.000421	0.000474	0.000161	<0.000050	0.2	0.4

***Bold/shading** indicates exceedance of Part F Item 18(b) Maximum Authorized Concentration.*
^ Indicates duplicate sample.

Table D1-8. Water Quality Monitoring Program Results for ST-6b, June to July 2018

Sample ID		ST6B	ST6B ^	ST6B	ST-6B	ST-6B	Part F Item 18 (b)	
ALS ID		L2285545-1	L2285545-2	L2293408-1	L2308743-2	L2342747-2	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
Date Sampled		2019-06-02 11:50	2019-06-02 11:50	2019-06-17 16:40	2019-07-10 10:05	2019-09-04 17:20		
Parameter	**Units**	**Results**						
pH	pH	7.87	7.92	8.12	8.29	8.41	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	49	**57.4**	**522**	**131**	<3.0	50.0	100.0
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.37	0.37
Toluene	mg/L	0.00087	0.00073	0.00184	<0.00045	<0.00045	0.002	0.002
Ethylbenzene	mg/L	0.00156	0.00144	0.00085	<0.00050	<0.00050	0.09	0.09
Oil and Grease	mg/L	**9.5**	**8.1**	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	**YES**	NO	NO	No Visible Sheen	No Visible Sheen
Lead (Pb)-Total	mg/L	0.000719	0.000763	0.00601	0.00142	<0.000050	0.2	0.4

***Bold/shading** indicates exceedance of Part F Item 18(b) Maximum Authorized Concentration.*
^ Indicates duplicate sample.

Table D1-9. Doris North Water Usage in 2019

Month	Windy Lake (ST-7A)	Doris Lake (ST-7)					Patch Lake	Total Usage
	Domestic Water*	Domestic Water*	Surface Exploration	Industrial Usage**	Dust Suppression	Winter Track	Winter Track	
January	1,438	0	0	16	0	432	4,600	6,486
February	1,341	0	0	48	0	275	96	1,760
March	1,403	0	0	77	0	0	0	1,480
April	1,422	0	0	20	0	2	0	1,444
May	1,513	0	0	83	0	0	0	1,596
June	1,374	0	0	30	96	0	0	1,500
July	1,340	0	0	33	0	0	0	1,373
August	1,294	0	0	78	48	0	0	1,420
September	1,274	0	0	68	80	0	0	1,422
October	1,418	0	0	36	0	0	0	1,454
November	1,464	0	0	57	0	0	0	1,521
December	1,539	0	0	95	0	0	0	1,634
Annual Total	**16,820**	**0**	**0**	**641**	**224**	**709**	**4,600**	**23,090**
Annual Allowance	**43,800**	**1,930,000**				**60,000**		**2,033,800**

***Includes industrial uses such as underground mining, core processing, concrete batching, etc.*
Note: All values rounded to nearest whole cubic metre.

Table D1-10. Water Sampling Monitoring Program Results for January to May 2019 Taken from ST-7

	Sample ID	ST-7	ST-7	ST-7	ST-7	ST-7 ^	ST7
	ALS ID	L2217620-1	L2228562-1	L2239794-1	L2252153-1	L2252153-2	L2268396-1
	Date Sampled	2019-01-07 11:30	2019-02-04 10:50	2019-03-04 14:45	2019-04-01 11:30	2019-04-01 11:30	2019-05-06 14:15
Parameter	**Units**	**Results**					
pH	pH	7.58	7.36	7.27	7.16	7.29	7.34
Total Suspended Solids	mg/L	<3.0	4.3	<3.0	<3.0	<3.0	<3.0
Chloride (Cl)	mg/L	60.6	65.9	64.6	66.4	66.3	66.1
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Sample ID		ST-7	ST-7	ST-7	ST-7	ST-7 ^	ST7
ALS ID		L2217620-1	L2228562-1	L2239794-1	L2252153-1	L2252153-2	L2268396-1
Date Sampled		2019-01-07 11:30	2019-02-04 10:50	2019-03-04 14:45	2019-04-01 11:30	2019-04-01 11:30	2019-05-06 14:15
Parameter	**Units**	**Results**					
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	0.0325	0.0677	0.0638	0.0491	0.0806	0.0795
Nitrate (as N)	mg/L	0.0118	0.0087	0.011	0.14	0.14	0.0676
Nitrite (as N)	mg/L	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.003
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0245	0.0241	0.0224	0.0175	0.02	0.0258
Aluminum (Al)-Total	mg/L	0.0105	0.0067	0.0063	0.0076	0.0076	0.0098
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	9.12	8.97	9.36	10.1	9.68	9.73
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0016	0.0075	0.002	0.0017	0.0017	0.0017
Iron (Fe)-Total	mg/L	0.196	0.172	0.196	0.706	0.787	0.417
Lead (Pb)-Total	mg/L	<0.00050	0.00096	<0.00050	0.00091	0.00112	0.001
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	0.000057	<0.000050	<0.000050
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc (Zn)-Total	mg/L	<0.0050	0.0171	0.0052	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO
Chlorophyll-*a*	µg						

^ *Indicates duplicate sample.*

Table D1-11. Water Sampling Monitoring Program Results for June to December 2019 Taken from ST-7

	Sample ID	ST7	ST7	ST7	ST7	ST7	ST7	ST7
	ALS ID	L2285413-1	L2301867-1	L2328780-1	L2348932-1	L2365132-1	L2380662-1	L2394065-1
	Date Sampled	2019-06-03 12:10	2019-07-01 17:15	2019-08-12 14:15	2019-09-16 11:15	2019-10-14 13:20	2019-11-11 14:15	2019-12-09 13:50
Parameter	**Units**	**Results**						
pH	pH	7.83	7.51	7.78	7.59	7.88	7.68	7.33
Total Suspended Solids	mg/L	<3.0	4.5	6.2	3.3	5.1	<3.0	3
Chloride (Cl)	mg/L	65.2	54.5	47.4	49.5	48	43.9	54.9
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	0.0529	0.006	0.0063	<0.0050	<0.0050	<0.0050	0.009
Nitrate (as N)	mg/L	0.114	0.081	0.104	<0.0050	<0.0050	0.0585	<0.0050
Nitrite (as N)	mg/L	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	0.0803	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0303	0.0175	0.0154	0.0202	0.0226	0.0183	0.0182
Aluminum (Al)-Total	mg/L	0.008	0.145	0.0675	0.0554	0.11	0.0312	0.0192
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	9.91	7.93	7.04	7.15	6.97	7.56	7.96
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0016	0.0016	0.0017	0.0015	0.0018	0.0017	0.0016
Iron (Fe)-Total	mg/L	0.179	0.606	0.791	0.526	0.183	0.218	0.168
Lead (Pb)-Total	mg/L	0.00054	0.00087	<0.00050	0.00072	<0.00050	<0.00050	<0.00050
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	0.0000067	<0.0000050	0.0000102	0.0000062
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Selenium (Se)-Total	mg/L	0.000066	<0.000050	<0.000050	0.000061	0.00006	0.000052	<0.000050
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Sample ID		ST7	ST7	ST7	ST7	ST7	ST7	ST7
ALS ID		L2285413-1	L2301867-1	L2328780-1	L2348932-1	L2365132-1	L2380662-1	L2394065-1
Date Sampled		2019-06-03 12:10	2019-07-01 17:15	2019-08-12 14:15	2019-09-16 11:15	2019-10-14 13:20	2019-11-11 14:15	2019-12-09 13:50
Parameter	**Units**	**Results**						
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	NO
Chlorophyll-*a*	µg			4.24 **				

*** Result is average of three replicate samples collected at the same location DLN-REP1 = 4.62µg, DLN-REP2 = 5.59µg, DLN-REP3 = 5.7µg*

Table D1-12. Water Sampling Monitoring Program Results for January to June 2019 Taken from ST-7a/MMS-4b (HOP-1)

Sample ID		ST-7A	ST-7A	ST-7A	ST-7A	ST-7A ^	ST-7A	ST7A
ALS ID		L2217634-1	L2228563-1	L2239805-1	L2252112-1	L2252112-2	L2268421-1	L2285530-1
Date Sampled		2019-01-07 14:45	2019-02-04 13:30	2019-03-04 15:30	2019-04-01 16:00	2019-04-01 16:00	2019-05-06 16:15	2019-06-03 09:25
Parameter	**Units**	**Results**						
pH	pH	7.72	7.85	7.83	7.81	7.85	7.91	8.04
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Chloride (Cl)	mg/L			114	116	116	115	116
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	0.0088	0.0125	0.0134	0.012	0.0114	0.0056	0.0057
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0038	0.0036	0.0043	0.0041	0.0044	0.0045	0.0041
Aluminum (Al)-Total	mg/L	0.007	<0.0050	0.0056	0.0079	<0.0050	0.0059	0.0136
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	0.0000174	<0.0000050	<0.0000050	0.0000054
Calcium (Ca)-Total	mg/L	14.2	14.2	14.8	14.9	14.8	15.8	15.1
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

	Sample ID	ST-7A	ST-7A	ST-7A	ST-7A	ST-7A ^	ST-7A	ST7A
	ALS ID	L2217634-1	L2228563-1	L2239805-1	L2252112-1	L2252112-2	L2268421-1	L2285530-1
	Date Sampled	2019-01-07 14:45	2019-02-04 13:30	2019-03-04 15:30	2019-04-01 16:00	2019-04-01 16:00	2019-05-06 16:15	2019-06-03 09:25
Parameter	**Units**	**Results**						
Copper (Cu)-Total	mg/L	<0.0010	<0.0010	0.0011	0.002	0.0012	0.001	0.0026
Iron (Fe)-Total	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.032
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Mercury (Hg)-Total	mg/L	<0.0000050	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
Selenium (Se)-Total	mg/L	<0.000050	0.000063	<0.000050	<0.000050	<0.000050	<0.000050	0.000052
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	0.0069	<0.0050	<0.0050	0.0072
Biochemical Oxygen Demand (BOD_5)	mg/L	<2	2	<2.0	3	<2.0	<2.0	3
Fecal Coliforms	MPN/100mL	<1 *	<1 *	<1	<1	<1	<1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	NO

^ Indicates duplicate sample.
** Results from a separate Lab Work Order for Potable Water Station PDC10 (same location as ST-7a)*

Table D1-13. Water Sampling Monitoring Program Results for July to December 2019 Taken from ST-7a/MMS-4b (HOP-1)

	Sample ID	ST7A	ST7A	ST7A	ST-7A	ST-7A	ST-7A
	ALS ID	L2301856-1	L2328350-1	L2348890-1	L2365130-1	L2382813-1	L2395757-1
	Date Sampled	2019-07-01 14:50	2019-08-12 16:45	2019-09-16 16:40	2019-10-14 16:20	2019-11-13 17:30	2019-12-11 17:15
Parameter	**Units**	**Results**					
pH	pH	7.73	8.03	7.9	7.9	8.09	7.97
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Chloride (Cl)	mg/L	57.7	120	98.4	95.1	100	106
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.006	0.0083	0.0062	0.006	0.0027	0.0076
Aluminum (Al)-Total	mg/L	0.0855	0.155	0.117	0.0972	0.0178	0.0173
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00069	<0.00050
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000068	0.0000466
Calcium (Ca)-Total	mg/L	8.21	15.4	11.5	12.1	13	14
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0011	0.0013	0.002	0.001	0.0087	0.0638
Iron (Fe)-Total	mg/L	0.082	0.181	0.182	0.087	0.031	0.167
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0036
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	0.0000235	0.000016	<0.0000050	0.0000252
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0048
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000054
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	0.0064	<0.0050	0.0113	0.107

	Sample ID	ST7A	ST7A	ST7A	ST-7A	ST-7A	ST-7A
	ALS ID	L2301856-1	L2328350-1	L2348890-1	L2365130-1	L2382813-1	L2395757-1
	Date Sampled	2019-07-01 14:50	2019-08-12 16:45	2019-09-16 16:40	2019-10-14 16:20	2019-11-13 17:30	2019-12-11 17:15
Parameter	**Units**	**Results**					
Biochemical Oxygen Demand (BOD_5)	mg/L	3	<2.0	2	<2.0	3	<2.0
Fecal Coliforms	MPN/100mL	<1	<1	<1	<1	<1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO

ST-8 Discharge from Sewage Treatment Plant Bio-membrane

The Sewage Treatment Plant (STP) at Doris Camp is made up of two sewage treatment plant modules. Each plant has the capacity to treat wastewater for up to 180 personnel. Both units were utilized throughout 2019 to treat all domestic wastewater generated by the site.

Treated effluent samples were collected from the combined effluent holding tank of these two modules (ST-8) in 2019 to test the quality of the effluent to be discharged to the tundra, in accordance with Part F, Item 5(b) of the Licence. In-plant sampling facilitates year-round compliance evaluation of plant performance.

All effluent quality samples collected in 2019 were in compliance with the discharge criteria. All effluent quality monitoring results for ST-8 are provided in Table D1-14 and Table D1-15.

Treated effluent volumes released from ST-8 are metered daily and summary volumes reported in the monthly monitoring reports. In 2019 all treated effluent from ST-8 was discharged to the tundra west of the facility laydown areas (13W 432933 7559057) as approved by the Inspector. The monthly volumes of effluent discharged are presented in Table D1-16.

The sludge produced at the sewage treatment plant is sent to the TIA for disposal. The volume of sludge produced in 2019 is presented in Table D1-17.

ST-9 Runoff from Sewage Treatment Plant Discharge

In consultation with the Inspector during the 2009 inspection tour, the ST-9 sampling location was established (13W 430807 7559282). This point is east of Glenn Lake and down slope from the ST-8 tundra discharge location. Monthly monitoring was conducted at ST-9 June through September in 2019 in accordance with Schedule I of 2AM-DOH1335. The station is frozen during the remainder of the year. There is no water quality criteria specified in the licence for this monitoring station. Table D1-18 provides results of the 2019 seasonal monitoring.

ST-10 Site Runoff from Sediment Controls

Monitoring of Doris Site Runoff (ST-10) was conducted at the reclaimed Doris Crown Pillar Recovery Trench (DCPRT). Mining of the DCPRT was completed in 2018, and backfill and reclamation of this trench was completed in May 2019 prior to freshet. Monitoring of this area was conducted during freshet and the open water season and samples were collected when runoff was observed. Runoff was observed June 2 and June 10, 2019; no runoff was observed during the remainder of the open water season. Results of these samples were in compliance with the allowable criteria outlined in Part D Item 19 of the licence. Results of this monitoring are provided in Table D1-19.

No other earthworks were conducted in the Doris area in 2019 and no additional samples were collected.

ST-11 Reagent and Cyanide Storage Containment Area Sump

This facility was constructed and first used in 2017. The storage area is a lined berm area divided into two cells to allow separation of different chemical products. Each cell has a water collection sump to facilitate water management (ST-11a and ST-11b). Water accumulating in this facility will be discharged directly into the Tailings Impoundment Area (TIA). No water was transferred to the TIA from this facility in 2019 as not enough water accumulated to require dewatering.

Water quality samples were collected from each sump as per Schedule I of the water licence. Results of the sampling are presented in Table D1-20.

Table D1-14. Water Quality Monitoring Program Results for ST-8 (Sewage Treatment Plant), January to May 2019

	Sample ID	ST-8	ST-8	ST-8	ST-8 ^	ST-8	ST-8	Part F Item 5(b)	
	ALS ID	L2220240-1	L2231506-1	L2242656-1	L2242656-2	L2255203-1	L2272419-1	Maximum Average Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-01-16 06:50	2019-02-12 06:45	2019-03-12 06:50	2019-03-12 06:55	2019-04-09 07:00	2019-05-14 06:45		
Parameter	**Units**	**Results**							
pH	pH units	7.16	7.09	7.36	7.38	7.73	7.91	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	5.9	100	100
Fecal Coliforms	MPN/100mL	<1	<1	<1	<1	<1	<1	10,000	10,000
Biochemical Oxygen Demand (BOD5)	mg/L	5	7	3	3	7	3	80	160
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	No Visible Sheen	No Visible Sheen

***Bold/shading** indicates exceedance of Part F Item 5(b) Maximum Concentration.*
^ Indicates duplicate sample.

Table D1-15. Water Quality Monitoring Program Results for ST-8, June to December 2019

	Sample ID	ST-8	ST8	ST8	ST8	ST8	ST8	ST8	Part F Item 5(b)	
	ALS ID	L2289169-1	L2307067-1	L2323144-1	L2344432-1	L2361787-1	L2377240-1	L2394070-1	Maximum Average Concentratio n (mg/L)	Maximum Concentratio n of Any Grab Sample (mg/L)
	Date Sampled	2019-06-11 07:00	2019-07-09 06:50	2019-08-06 06:45	2019-09-10 06:50	2019-10-08 07:00	2019-11-05 07:00	2019-12-10 07:00		
Parameter	**Units**	**Results**								
pH	pH units	7.91	7.75	7.72	7.69	7.65	7.31	7.87	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	66	<3.0	100	100
Fecal Coliforms	MPN/100mL	<1	1	3	<1	<1	<1	<1	10,000	10,000
Biochemical Oxygen Demand (BOD5)	mg/L	2	6	2	2	2	8	<2.0	80	160
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	NO	No Visible Sheen	No Visible Sheen

***Bold/shading** indicates exceedance of Part F Item 5(b) Maximum Concentration.*

Table D1-16. Treated Effluent Released from the Doris Sewage Treatment Plant (ST-8), 2019

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	1,239	1,239
February	1,148	2,387
March	1,329	3,716
April	1,300	5,016
May	1,334	6,350
June	1,325	7,675
July	1,307	8,982
August	1,220	10,202
September	1,244	11,446
October	1,398	12,844
November	1,384	14,228
December	1,397	15,625
Total Volume of Treated Effluent Released 2019 (m^3)		**15,625**

** Values rounded to nearest whole cubic metre.*

Table D1-17. Volume of Sludge Removed from the Doris Sewage Treatment Plant, 2019

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	26.9	26.9
February	21.7	48.6
March	27.4	76.0
April	28.0	104.5
May	20.7	125.2
June	20.4	145.7
July	26.7	172.4
August*	20.6	192.9
September	19.0	211.9
October	24.2	236.1
November	23.8	259.9
December	29.8	289.7
Total Volume of Sludge Produced in 2019 (m^3)		**289.7**

** All sewage sludge reported to the TIA for disposal.*

Table D1-18. Water Quality Monitoring Program Results for ST-9, June to September 2019

	Sample ID	ST9	ST9 ^	ST9	ST9	ST9
	ALS ID	L2289169-2	L2289169-3	L2307067-2	L2323144-2	L2344432-2
	Date Sampled	2019-06-10 17:15	2019-06-10 17:15	2019-07-08 18:25	2019-08-05 17:30	2019-09-09 16:30
Parameter	**Units**	**Results**				
pH	pH	7.41	7.37	8.04	8.02	7.98
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	12.2
Biochemical Oxygen Demand (BOD_5)	mg/L	4	5	2	<2.0	<2.0
Fecal Coliforms	MPN/100mL	8	5	<1	1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO

^ Indicates duplicate sample.

Table D1-19. Water Quality Monitoring Program Results for ST-10, June 2019

	Sample ID	ST10-A	ST10-A	Part D Item 19	
	ALS ID	L2285552-1	L2289123-1	Maximum Average Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-06-02 16:00	2019-06-10 11:10		
Parameter	**Units**	**Results**			
pH	pH Units	7.94	8	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	<3.0	4	50	100
Oil and Grease	mg/L	<5.0	<5.0		
Oil And Grease (Visible Sheen)		NO	NO	No Visible Sheen	No Visible Sheen

***Bold/shading** indicates exceedance of Part D Item 9 Maximum Concentration.*

Table D1-20. Water Quality Monitoring Program Results for ST-11, June 2019

	Sample ID	ST11-A	ST11-A ^	ST11-B
	ALS ID	L2294346-1	L2294346-3	L2294346-2
	Date Sampled	2019-06-17 14:20	2019-06-17 14:20	2019-06-17 14:40
Parameter	**Units**	**Results**		
pH	pH	8.3	8.31	8.17
Total Suspended Solids	mg/L	<3.0	3.1	<3.0
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	0.0277	0.0266	0.0089
Aluminum (Al)-Total	mg/L	0.0839	0.0691	0.109
Arsenic (As)-Total	mg/L	0.00223	0.00225	0.00092
Cadmium (Cd)-Total	mg/L	<0.000010	0.0000079	0.0000087
Calcium (Ca)-Total	mg/L	28.6	30.4	25

Sample ID		ST11-A	ST11-A ^	ST11-B
ALS ID		L2294346-1	L2294346-3	L2294346-2
Date Sampled		2019-06-17 14:20	2019-06-17 14:20	2019-06-17 14:40
Parameter	**Units**	**Results**		
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0023	0.0021	0.0022
Iron (Fe)-Total	mg/L	0.125	0.075	0.165
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0126	0.0131	0.0048
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010
Selenium (Se)-Total	mg/L	0.00104	0.00101	0.000304
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO
Benzene	mg/L	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050

^ Indicates duplicate sample.

Hydrology Monitoring – Doris Lake Water Level and Ice Thickness (ST-12) and Doris Creek Flow (TL-2)

Lake level monitoring in Doris Lake (ST-12) and stream flow monitoring in Doris Creek (TL-2) was conducted in 2019 as outlined in Schedule I of the licence. Stations were visited throughout the open water season to perform water level surveys and manual discharge measurements. Water level surveys are performed using an engineer's level and stadia rod using a minimum of three local bench marks at each station. All bench marks are tied to geodetic elevation. Manual discharge measurements were performed using the velocity area method with a Hach FH950 electromagnetic current meter. Details regarding the standard methods used for installation of hydrometric stations, development of stage-discharge rating equations, and daily flow hydrographs can be found in the Doris North Project 2013 Hydrology Compliance Monitoring Report (ERM 2014).

<u>Doris Lake Station (ST-12)</u>

Doris Lake-2 monitoring station collected data from January 1st through to December 31st, 2019 and continues to collect data. In September of 2017, the Doris Lake monitoring location was moved to the north to facilitate the installation of two, year-round pressure transducers and to avoid potential interactions with mine construction. The new location was named Doris Lake-2 (13W 433547 7558601) and consists of two Solinst Leveloggers installed at depths of approximately 7 metres to monitor lake level year round. The Leveloggers are coupled with a Solinst Barologger, located at Doris Camp, to compensate for changes in atmospheric pressure. The Leveloggers and Barologger record a pressure reading every 15 minutes. ERM and TMAC personnel performed one under ice water level survey on April 15, and ten water level surveys between June 27 and September 22, 2019 to confirm the proper functioning of the pressure transducer.

A drift correction was applied retroactively to all 2019 data after end of year QA/QC identified that both sensors appeared to be sinking. It is likely that the sensors are still slowly settling on the lake bottom. Table D1-21 provides the results of this monitoring.

Ice thickness measurements were collected in April 2019 at monitoring station ST-12 as per Schedule I, Table 2. Ice thickness of Doris Lake was 165 cm.

Doris Creek Flow (TL-2)

The Doris Creek stream flow monitoring station TL-2 (13W 434059 7559504) was reactivated on June 21 after being deactivated during the winter. The station uses an INW PT2X vented pressure transducer, recording water level readings every 15 minutes. The station operated during the open water season until September 22, when the station was deactivated for winter. During the 2019 open water season, ERM and TMAC personnel made a combined 11 visits to the station. Water level (stage) measured by the pressure transducer every 15 minutes was converted to discharge using a stage-discharge curve, also known as a rating curve. The rating curve at TL-2 is well established, with small changes from year to year due to aggradation and scour of the channel. A small adjustment for the 2019 rating curve was made to account for minor scour and erosion around the station, which is consistent with inter-annual variability observed at TL-2. Flow during periods that were not observed during the 2019 open water season was estimated using a linear regression between Doris Lake water level and monitored flow at TL-2 from June 13 to 20 and September 23 to November 8. It is estimated that there is no flow in Doris Creek prior to June 13 or after November 8. Discharge at the TL-2 hydrometric monitoring station is reported as mean daily discharge in cubic meters per second (m^3/s). Table D1-22 provides the results of this monitoring.

TL-1 TIA Monitoring

This section presents the results of monitoring of the Tailings Impoundment Area (TIA) as per the applicable sections of Part F (Conditions Applying to Waste Deposit and Waste Management), Part I (Conditions Applying to General and Aquatic Effects Monitoring) and Schedule I of the water licence.

Dewatering of the TIA was not conducted in 2019. Tailings deposition into the TIA continued throughout the year. Reclaim water was utilized to support the milling process. Table D1-23 provides the volume of reclaim water obtained from the TIA for process water in 2019.

Water quality samples were collected at the TIA Reclaim Pipeline monitoring station TL-1 from January to December from a sample port on the reclaim pump. Sampling results are provided in Table D1-24 and Table D1-25.

TL-5, TL6 and TL7a/b Tailings Monitoring

This section presents the results of monitoring of the Tailings as per the applicable sections of Part I (Conditions Applying to General and Aquatic Effects Monitoring) and Schedule I of the water licence.

Samples of effluent from the Process Plant (TL-5) were collected from January to December 2019. These samples were collected monthly from the tailings thickener tank inside the Process Plant prior to discharge to the Tailings Impoundment Area. A clean container was used to collect a representative sample of tailings material from the tailings thickener tank and the solid material allowed to settle. The remaining supernatant (the liquid effluent of the discharged tailings) was collected and submitted for laboratory analysis. Results of monitoring conducted at TL-5 are presented in Table D1-26 and Table D1-27.

Table D1-21. Summary of Doris Lake Mean Daily Water Levels, in Metres above Sea Level (masl), 2019

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	21.699	21.706	21.699	21.689	21.706	21.702	22.389	21.965	21.908	21.813	21.752	21.747
2	21.700	21.705	21.692	21.699	21.701	21.706	22.369	21.955	21.906	21.810	21.751	21.747
3	21.694	21.704	21.689	21.705	21.703	21.711	22.345	21.956	21.901	21.814	21.748	21.745
4	21.697	21.702	21.687	21.699	21.704	21.714	22.323	21.946	21.898	21.812	21.748	21.745
5	21.700	21.701	21.691	21.698	21.703	21.718	22.301	21.937	21.896	21.810	21.746	21.749
6	21.704	21.697	21.690	21.703	21.700	21.725	22.281	21.930	21.894	21.808	21.744	21.745
7	21.704	21.696	21.689	21.704	21.698	21.730	22.267	21.924	21.888	21.804	21.748	21.748
8	21.705	21.698	21.685	21.695	21.703	21.736	22.253	21.922	21.887	21.803	21.738	21.750
9	21.703	21.696	21.693	21.695	21.702	21.745	22.252	21.922	21.885	21.799	21.740	21.745
10	21.710	21.689	21.690	21.691	21.697	21.755	22.249	21.917	21.875	21.797	21.742	21.749
11	21.714	21.696	21.689	21.698	21.697	21.762	22.239	21.915	21.877	21.804	21.737	21.746
12	21.705	21.700	21.687	21.699	21.698	21.787	22.227	21.909	21.868	21.807	21.731	21.743
13	21.708	21.693	21.684	21.705	21.697	21.820	22.218	21.906	21.867	21.792	21.734	21.745
14	21.712	21.687	21.689	21.708	21.696	21.877	22.206	21.904	21.864	21.800	21.732	21.742
15	21.707	21.696	21.698	21.710	21.697	21.927	22.195	21.901	21.866	21.801	21.735	21.742
16	21.704	21.698	21.691	21.709	21.699	22.062	22.184	21.900	21.858	21.799	21.734	21.741
17	21.703	21.704	21.691	21.707	21.701	22.290	22.168	21.898	21.861	21.794	21.737	21.744
18	21.701	21.705	21.690	21.708	21.699	22.437	22.154	21.898	21.859	21.789	21.733	21.747
19	21.700	21.701	21.691	21.705	21.699	22.524	22.142	21.896	21.857	21.785	21.736	21.744
20	21.703	21.703	21.679	21.704	21.696	22.571	22.129	21.896	21.856	21.783	21.745	21.745
21	21.704	21.698	21.693	21.704	21.698	22.596	22.115	21.899	21.856	21.779	21.741	21.741
22	21.708	21.687	21.682	21.707	21.699	22.600	22.102	21.899	21.854	21.775	21.739	21.739
23	21.708	21.696	21.692	21.704	21.699	22.587	22.088	21.898	21.851	21.775	21.737	21.744
24	21.709	21.699	21.699	21.705	21.698	22.568	22.071	21.909	21.847	21.773	21.735	21.734
25	21.712	21.695	21.693	21.702	21.700	22.546	22.056	21.909	21.845	21.763	21.741	21.735
26	21.709	21.690	21.685	21.705	21.696	22.521	22.043	21.914	21.838	21.767	21.740	21.735
27	21.703	21.688	21.692	21.701	21.696	22.497	22.030	21.914	21.832	21.762	21.745	21.728
28	21.705	21.699	21.692	21.706	21.697	22.469	22.017	21.911	21.828	21.763	21.743	21.737
29	21.709		21.683	21.707	21.696	22.442	22.003	21.915	21.823	21.768	21.733	21.736

Date	January	February	March	April	May	June	July	August	September	October	November	December
30	21.711		21.685	21.707	21.698	22.413	21.988	21.913	21.821	21.754	21.740	21.744
31	21.708		21.694		21.699		21.975	21.911		21.751		21.731
Minimum	21.705	21.698	21.690	21.703	21.699	22.118	22.173	21.916	21.866	21.789	21.740	21.742
Maximum	21.714	21.706	21.699	21.710	21.706	22.600	22.389	21.965	21.908	21.814	21.752	21.750
Mean	21.694	21.687	21.679	21.689	21.696	21.702	21.975	21.896	21.821	21.751	21.731	21.728

Note: A correction was made to the Doris Lake elevation data after submission of the December 2019 Monthly SNP Monitoring report to account for settling of the transducer which resulted in the water level being offset by 1cm.

Table D1-22. Summary of Doris Creek (TL-2) Daily Flow Rate, in Cubic Metres per Second (m^3/s), 2019

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	*0*	*0*	*0*	*0*	*0*	*0*	4.097	1.047	0.693	*0.357*	*0.025*	*0*
2	*0*	*0*	*0*	*0*	*0*	*0*	3.901	0.997	0.688	*0.346*	*0.022*	*0*
3	*0*	*0*	*0*	*0*	*0*	*0*	3.706	0.960	0.680	*0.359*	*0.019*	*0*
4	*0*	*0*	*0*	*0*	*0*	*0*	3.498	0.947	0.669	*0.352*	*0.017*	*0*
5	*0*	*0*	*0*	*0*	*0*	*0*	3.313	0.912	0.662	*0.348*	*0.015*	*0*
6	*0*	*0*	*0*	*0*	*0*	*0*	3.129	0.874	0.652	*0.338*	*0.013*	*0*
7	*0*	*0*	*0*	*0*	*0*	*0*	3.014	0.839	0.636	*0.324*	*0.011*	*0*
8	*0*	*0*	*0*	*0*	*0*	*0*	2.890	0.814	0.628	*0.321*	*0.010^*	*0*
9	*0*	*0*	*0*	*0*	*0*	*0*	2.895	0.813	0.623	*0.305*	*0*	*0*
10	*0*	*0*	*0*	*0*	*0*	*0*	2.871	0.791	0.592	*0.299*	*0*	*0*
11	*0*	*0*	*0*	*0*	*0*	*0*	2.786	0.779	0.593	*0.324*	*0*	*0*
12	*0*	*0*	*0*	*0*	*0*	*0*	2.698	0.755	0.567	*0.336*	*0*	*0*
13	*0*	*0*	*0*	*0*	*0*	*0.010**	2.600	0.735	0.557	*0.281*	*0*	*0*
14	*0*	*0*	*0*	*0*	*0*	*0.042*	2.522	0.726	0.546	*0.247*	*0*	*0*
15	*0*	*0*	*0*	*0*	*0*	*0.176*	2.433	0.714	0.555	*0.217*	*0*	*0*
16	*0*	*0*	*0*	*0*	*0*	*0.736*	2.346	0.709	0.533	*0.191*	*0*	*0*
17	*0*	*0*	*0*	*0*	*0*	*3.084*	2.236	0.703	0.536	*0.168*	*0*	*0*
18	*0*	*0*	*0*	*0*	*0*	*4.844*	2.149	0.694	0.532	*0.148*	*0*	*0*
19	*0*	*0*	*0*	*0*	*0*	*5.881*	2.057	0.684	0.527	*0.130*	*0*	*0*
20	*0*	*0*	*0*	*0*	*0*	*6.443*	1.965	0.680	0.520	*0.114*	*0*	*0*

Date	January	February	March	April	May	June	July	August	September	October	November	December
21	*0*	*0*	*0*	*0*	*0*	6.904	1.869	0.685	0.510	*0.101*	*0*	*0*
22	*0*	*0*	*0*	*0*	*0*	6.870	1.768	0.680	0.500	*0.089*	*0*	*0*
23	*0*	*0*	*0*	*0*	*0*	6.735	1.664	0.708	*0.499*	*0.078*	*0*	*0*
24	*0*	*0*	*0*	*0*	*0*	6.444	1.552	0.731	*0.486*	*0.069*	*0*	*0*
25	*0*	*0*	*0*	*0*	*0*	6.142	1.476	0.732	*0.477*	*0.060*	*0*	*0*
26	*0*	*0*	*0*	*0*	*0*	5.842	1.413	0.746	*0.451*	*0.053*	*0*	*0*
27	*0*	*0*	*0*	*0*	*0*	5.459	1.345	0.742	*0.430*	*0.047*	*0*	*0*
28	*0*	*0*	*0*	*0*	*0*	5.085	1.286	0.733	*0.413*	*0.041*	*0*	*0*
29	*0*		*0*	*0*	*0*	4.688	1.222	0.732	*0.396*	*0.036*	*0*	*0*
30	*0*		*0*	*0*	*0*	4.356	1.154	0.721	*0.386*	*0.032*	*0*	*0*
31	*0*		*0*		*0*		1.092	0.712		*0.028*	*0*	*0*
Minimum	0	0	0	0	0	4.430	2.353	0.777	0.551	0.198	4.430	0
Maximum	0	0	0	0	0	6.904	4.097	1.047	0.693	0.359	6.904	0
Mean	0	0	0	0	0	0.010	1.092	0.680	0.386	0.028	0.010	0

Note: Estimated and modelled values are italicized. Estimated data were determined using linear regression with Doris Lake elevations.
Monitored data were observed using stage data collected by the TL-2 pressure transducer, converted to discharge using a rating curve that was developed using stage and discharge measurements from 2017-2019.
**Assumed start of flow.*
^Assumed end of flow

Table D1-23. Volume of Reclaim Water Used to Support Mill Processing, 2019

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	64,572	64,572
February	57,207	121,779
March	69,824	191,603
April	60,913	252,516
May	61,908	314,425
June	57,603	372,028
July	69,389	441,417
August	79,005	520,422
September	84,230	604,652
October	82,918	687,570
November	77,744	765,314
December	76,670	841,984
Volume of Reclaim Water Used in Mill Processing, 2019 (m^3)		**841,984**

** Values rounded to nearest whole cubic metre.*

Samples of the tailings solids (TL-6) were collected weekly from the tailings thickener tank inside the Process Plant from January to December 2019. A clean container was used to collect a representative sample of tailings material from the tailings thickener tank and the solid material allowed to settle in the container. The supernatant was then discarded and the solid materials transferred into a clean Ziploc bag and refrigerated until four weekly samples had been collected. These weekly samples were then combined to create a composite sample which was submitted for laboratory analysis. Table D1-28 and Table D1-29 provide results for monitoring conducted at TL-6.

Detoxified tailings solids (TL-7a) were collected monthly from January to December 2019 from the discharge compartment of the detox filter press inside the Process Plant (Table D1-30 and Table D1-31). Filtrate from the detoxified solids (TL-7b) was collected monthly from January to December 2019 from the receiving filtrate tank for the detox filter press inside the Process Plant (Table D1-32 and Table D1-33).

TL-11 Underground Seepage Monitoring

Visual inspections were conducted of all safely accessible backfilled underground stopes in May and December 2019 to identify seepage (TL-11) from the stopes. Twelve stopes were surveyed during the May inspection and fifteen stopes were surveyed during the December inspection. In May, no flowing water was observed during the inspection; however, pooling water was sampled at six stope locations to provide additional characterization of water underground near backfilled materials. In December, two flowing seeps were identified and samples were collected at each location. Results of this sampling is provided in Table D1-34 and Table D1-35.

Table D1-24. Water Quality in the Tailings Impoundment Area (TL-1), January to June 2019

	Sample ID	TL-1	TL-1	TL-1	TL-1	TL-1	TL-1
	ALS ID	L2220245-1	L2228573-1	L2239818-1	L2251915-1	L2268431-1	L2285479-1
	Date Sampled	2019-01-15 15:45	2019-02-04 17:00	2019-03-04 16:40	2019-04-01 17:15	2019-05-06 17:15	2019-06-03 11:20
Parameter	**Units**	**Results**					
pH	pH	7.83	7.78	7.84	7.7	8.03	8.12
Total Suspended Solids	mg/L	18	13.9	14.7	5	6.7	6.8
Total Dissolved Solids	mg/L	2170	2380	2560	2690	3050	3340
Chloride (Cl)	mg/L	861	934	967	1080	1200	1300
Cyanide, Free	mg/L	<0.0050	<0.0050	0.0057	0.0145	0.0402	0.043
Cyanide, Total	mg/L	0.116	0.131	0.158	0.193	0.285	0.321
Ammonia, Total (as N)	mg/L	3.57	4.34	4.35	5.21	5.91	6.35
Nitrate (as N)	mg/L	2.61	2.63	2.55	2.58	2.54	2.65
Nitrite (as N)	mg/L	0.242	0.21	0.123	0.081	0.089	0.182
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	<0.30	<0.30	0.0611	0.0631	0.0774	0.0628
Aluminum (Al)-Total	mg/L	0.263	0.127	0.094	0.0758	0.1	0.101
Arsenic (As)-Total	mg/L	0.00118	0.00115	0.00118	0.00111	0.00115	0.00116
Cadmium (Cd)-Total	mg/L	<0.000010	<0.000025	<0.000025	0.000011	<0.000025	<0.000025
Calcium (Ca)-Total	mg/L	114	133	132	136	155	157
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0433	0.0518	0.0468	0.0478	0.0696	0.00414
Iron (Fe)-Total	mg/L	0.434	0.423	0.454	0.49	0.575	0.731
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)-Total	mg/L	56.2	60.3	70.7	67.6	83.1	87.9
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0029	0.0027	0.0028	0.0028	0.0033	0.0035
Nickel (Ni)-Total	mg/L	0.009	0.0089	0.0094	0.0097	0.012	0.0125
Potassium (K)-Total	mg/L	29.4	31.1	34.5	33.5	38.5	42.8
Selenium (Se)-Total	mg/L	0.00042	0.00033	<0.00025	0.0003	0.00033	0.00043

Sample ID		TL-1	TL-1	TL-1	TL-1	TL-1	TL-1
ALS ID		L2220245-1	L2228573-1	L2239818-1	L2251915-1	L2268431-1	L2285479-1
Date Sampled		2019-01-15 15:45	2019-02-04 17:00	2019-03-04 16:40	2019-04-01 17:15	2019-05-06 17:15	2019-06-03 11:20
Parameter	**Units**	**Results**					
Silver (Ag)-Total	mg/L	<0.000020	<0.000050	<0.000050	0.000024	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	575	611	690	718	815	863
Thallium (Tl)-Total	mg/L	<0.000020	<0.000050	<0.000050	<0.000020	<0.000050	<0.000050
Zinc (Zn)-Total	mg/L	<0.0060	<0.015	<0.015	<0.0060	<0.015	<0.015
Fecal Coliforms	MPN/100mL	<1	<1	<1	<1	<1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Oxygen	mg/L						
Redox Potential	mV						
Biochemical Oxygen Demand (BOD5)	mg/L						

Table D1-25. Water Quality in the Tailings Impoundment Area (TL-1), July to December 2019

Sample ID		TL1	TL1	TL1	TL1	TL1	TL1
ALS ID		L2302035-1	L2328733-1	L2344372-1	L2361751-1	L2377613-1	L2391132-1
Date Sampled		2019-07-01 16:35	2019-08-12 18:00	2019-09-09 17:26	2019-10-07 15:30	2019-11-04 17:00	2019-12-02 16:15
Parameter	**Units**	**Results**					
pH	pH	8.1	8.17	8.42	8.23	8.16	7.88
Total Suspended Solids	mg/L	4.9	16	23.1	19.2	15.6	19.8
Total Dissolved Solids	mg/L	3450	2610	2890	2740	3200	3650
Chloride (Cl)	mg/L	1320	1140	1220	1120	1340	1460
Cyanide, Free	mg/L	0.0266	0.0156	0.0163	0.0145	<0.0050	<0.0050

Sample ID		TL1	TL1	TL1	TL1	TL1	TL1
ALS ID		L2302035-1	L2328733-1	L2344372-1	L2361751-1	L2377613-1	L2391132-1
Date Sampled		2019-07-01 16:35	2019-08-12 18:00	2019-09-09 17:26	2019-10-07 15:30	2019-11-04 17:00	2019-12-02 16:15
Parameter	**Units**	**Results**					
Cyanide, Total	mg/L	0.326	0.0406	0.0482	0.0657	0.0542	0.312
Ammonia, Total (as N)	mg/L	6.11	4.59	4.46	4.33	4.66	7.04
Nitrate (as N)	mg/L	2.28	3.46	3.24	2.88	3.45	3.91
Nitrite (as N)	mg/L	0.099	0.188	0.192	0.179	0.146	0.206
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
Phosphorus (P)-Total	mg/L	0.0592	<0.30	0.0565	<0.30	<0.30	<0.30
Aluminum (Al)-Total	mg/L	0.069	0.0992	0.221	0.23	0.122	0.315
Arsenic (As)-Total	mg/L	0.0013	0.00086	0.00111	0.00098	0.00106	0.00157
Cadmium (Cd)-Total	mg/L	<0.000025	0.000015	<0.000025	0.000013	<0.000025	<0.000025
Calcium (Ca)-Total	mg/L	162	127	140	121	151	151
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	0.0096	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	0.0682	0.083	0.0824	0.0713	0.0695	0.0938
Iron (Fe)-Total	mg/L	0.666	0.502	2.08	0.644	0.48	0.89
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium (Mg)-Total	mg/L	87.8	75	84.9	75.3	88.8	93
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	0.0000255	0.0000125	0.0000062
Molybdenum (Mo)-Total	mg/L	0.0036	0.0032	0.0063	0.0048	0.0058	0.0101
Nickel (Ni)-Total	mg/L	0.013	0.0084	0.0088	0.0085	0.007	0.0108
Potassium (K)-Total	mg/L	43.3	28.8	34.2	32.7	36	41.8
Selenium (Se)-Total	mg/L	0.00042	0.00032	0.00026	0.00038	0.00031	0.00052
Silver (Ag)-Total	mg/L	0.000051	0.000178	0.000061	0.000033	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	861	695	784	750	817	915
Thallium (Tl)-Total	mg/L	<0.000050	<0.000020	<0.000050	<0.000020	<0.000050	<0.000050
Zinc (Zn)-Total	mg/L	<0.015	<0.0060	<0.015	<0.0060	<0.015	<0.015
Fecal Coliforms	MPN/100mL	<1	<1	<1	<1	<1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Sample ID		TL1	TL1	TL1	TL1	TL1	TL1
ALS ID		L2302035-1	L2328733-1	L2344372-1	L2361751-1	L2377613-1	L2391132-1
Date Sampled		2019-07-01 16:35	2019-08-12 18:00	2019-09-09 17:26	2019-10-07 15:30	2019-11-04 17:00	2019-12-02 16:15
Parameter	**Units**	**Results**					
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Oxygen	mg/L						
Redox Potential	mV		202				
Biochemical Oxygen Demand (BOD5)	mg/L		3.7				

Table D1-26. Effluent from Process Plant Tailings Slurry Water (TL-5), January to June 2019

Sample ID		TL-5	TL-5	TL-5	TL-5 ^	TL-5	TL5	TL5
ALS ID		L2217608-1	L2228565-1	L2239803-1	L2239803-2	L2256607-1	L2268345-1	L2285440-1
Date Sampled		2019-01-06 09:40	2019-02-03 16:00	2019-03-03 14:00	2019-03-03 14:00	2019-04-10 14:20	2019-05-05 17:00	2019-06-02 10:15
Parameter	**Units**	**Results**						
pH	pH Units	8.34	8.22	8.13	8.14	8.24	7.99	8.2
Total Suspended Solids	mg/L	24.4	21.1	31.1	38.1	23	30.6	22.5
Cyanide, Free	mg/L	1.75	5.38	1.08	1.13	0.546	0.31	0.121
Cyanide, Total	mg/L	5.69	16	3.47	3.56	4.75	4.17	3.99
Cyanide, WAD	mg/L	1.9	6.62	1.31	1.4	0.656	0.33	0.229
Ammonia, Total (as N)	mg/L	13.1	24.9	36.6	36.6	31	33.8	30.1
Nitrate (as N)	mg/L	8.42	6.66	17.2	17.9	25.1	19.7	9.18
Nitrite (as N)	mg/L	0.393	0.294	0.559	0.408	0.693	0.795	0.52
Sulfate (SO_4)	mg/L	1250	1480	1860	1940	1930	2230	2310
Aluminum (Al)-Total	mg/L	0.104	0.071	0.112	0.145	0.245	0.369	0.177
Antimony (Sb)-Total	mg/L	0.00119	0.0011	0.00209	0.00202	0.00169	0.00258	0.0024

	Sample ID	TL-5	TL-5	TL-5	TL-5 ^	TL-5	TL5	TL5
	ALS ID	L2217608-1	L2228565-1	L2239803-1	L2239803-2	L2256607-1	L2268345-1	L2285440-1
	Date Sampled	2019-01-06 09:40	2019-02-03 16:00	2019-03-03 14:00	2019-03-03 14:00	2019-04-10 14:20	2019-05-05 17:00	2019-06-02 10:15
Parameter	Units	Results						
Arsenic (As)-Total	mg/L	0.00153	0.0019	0.00207	0.00197	0.00316	0.0305	0.0027
Barium (Ba)-Total	mg/L	0.0177	0.0214	0.0305	0.0316	0.0287	0.0367	0.0407
Beryllium (Be)-Total	mg/L	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Bismuth (Bi)-Total	mg/L	<0.00025	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050
Boron (B)-Total	mg/L	0.495	0.48	0.683	0.685	0.669	0.836	0.79
Cadmium (Cd)-Total	mg/L	<0.000025	<0.000050	<0.000025	<0.000025	0.000028	0.000313	<0.000050
Calcium (Ca)-Total	mg/L	138	125	158	159	162	162	120
Cesium (Cs)-Total	mg/L	0.000072	<0.00010	<0.000050	<0.000050	0.000339	0.000348	0.00022
Chromium (Cr)-Total	mg/L	<0.00050	<0.0010	0.00118	0.00098	<0.0011	0.00291	<0.0010
Cobalt (Co)-Total	mg/L	0.0275	0.0245	0.0231	0.0232	0.0262	0.0244	0.0203
Copper (Cu)-Total	mg/L	2.37	4.91	0.103	0.126	0.131	0.501	0.194
Iron (Fe)-Total	mg/L	1.96	3.16	1.12	1.12	3.06	8.46	1.7
Lead (Pb)-Total	mg/L	<0.00025	<0.00050	0.00036	0.00028	0.00033	0.0278	0.00082
Lithium (Li)-Total	mg/L	0.0291	0.037	0.0533	0.0533	0.0433	0.0582	0.053
Magnesium (Mg)-Total	mg/L	66.7	64.9	83.1	83.2	98.9	101	93.5
Manganese (Mn)-Total	mg/L	0.189	0.228	0.27	0.271	0.221	0.248	0.149
Mercury (Hg)-Total	mg/L	<0.00025	<0.000025	<0.000025	<0.000025	<0.000025	<0.00010	<0.000025
Molybdenum (Mo)-Total	mg/L	0.0093	0.00959	0.0138	0.0136	0.0138	0.0159	0.0333
Nickel (Ni)-Total	mg/L	0.0931	0.083	0.108	0.11	0.139	0.0968	0.0578
Phosphorus (P)-Total	mg/L	<0.25	<0.50	<0.25	<0.25	<0.25	0.51	<0.50
Potassium (K)-Total	mg/L	65.8	53	93.7	94.4	94.4	99	95.2
Rubidium (Rb)-Total	mg/L	0.015	0.0128	0.0319	0.0321	0.0353	0.043	0.0272
Selenium (Se)-Total	mg/L	0.00166	0.00154	0.00084	0.00089	0.00188	0.00174	0.00212
Silicon (Si)-Total	mg/L	1.64	1.6	2.21	2.25	1.66	2.42	2.2
Silver (Ag)-Total	mg/L	0.000305	0.00178	<0.000050	<0.000050	0.000175	0.000572	0.00014
Sodium (Na)-Total	mg/L	1040	1310	1620	1620	1610	1850	1890

Sample ID		TL-5	TL-5	TL-5	TL-5 ^	TL-5	TL5	TL5
ALS ID		L2217608-1	L2228565-1	L2239803-1	L2239803-2	L2256607-1	L2268345-1	L2285440-1
Date Sampled		2019-01-06 09:40	2019-02-03 16:00	2019-03-03 14:00	2019-03-03 14:00	2019-04-10 14:20	2019-05-05 17:00	2019-06-02 10:15
Parameter	**Units**	**Results**						
Strontium (Sr)-Total	mg/L	0.782	0.855	1.03	1.04	1.11	1.27	1.14
Tellurium (Te)-Total	mg/L	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Thallium (Tl)-Total	mg/L	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010
Thorium (Th)-Total	mg/L	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Tin (Sn)-Total	mg/L	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010
Titanium (Ti)-Total	mg/L	<0.0015	<0.0030	<0.0015	<0.0015	<0.0015	0.0085	<0.0030
Tungsten (W)-Total	mg/L	0.00244	0.0021	0.00261	0.00275	0.0029	0.00285	0.0028
Uranium (U)-Total	mg/L	0.00053	0.00043	0.000452	0.000484	0.000605	0.000586	0.00081
Vanadium (V)-Total	mg/L	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050
Zinc (Zn)-Total	mg/L	<0.015	<0.030	<0.015	<0.015	<0.015	0.136	<0.030
Zirconium (Zr)-Total	mg/L	<0.00030	<0.00060	<0.00030	<0.00030	<0.00030	<0.00030	<0.0020
Cyanate	mg/L	11.7	45.3	72.9	76.2	52.8	42.3	57
Thiocyanate	mg/L	10.5	14.4	27.2	27.2	17.9	19.1	17.3

^ *Indicates duplicate sample.*

Table D1-27. Effluent from Process Plant Tailings Slurry Water (TL-5), July to December 2019

Sample ID		TL5	TL5	TL5	TL5	TL5	TL5
ALS ID		L2307093-1	L2327981-1	L2344220-1	L2361827-1	L2377610-1	L2394082-1
Date Sampled		2019-07-07 11:00	2019-08-11 19:10	2019-09-08 16:45	2019-10-05 16:40	2019-11-03 15:45	2019-12-08 15:05
Parameter	**Units**	**Results**					
pH	pH Units	8.39	6.22	8.22	8.32	8.36	8.34
Total Suspended Solids	mg/L	20.7	45.8	30	21.2	12.8	26.4
Cyanide, Free	mg/L	0.738	<0.0050	0.013	0.076	0.33	0.11
Cyanide, Total	mg/L	5.64	<0.0050	3.77	2.68	5.36	2.16
Cyanide, WAD	mg/L	1.4	<0.0050	0.027	0.131	0.41	<0.10

Sample ID		TL5	TL5	TL5	TL5	TL5	TL5
ALS ID		L2307093-1	L2327981-1	L2344220-1	L2361827-1	L2377610-1	L2394082-1
Date Sampled		2019-07-07 11:00	2019-08-11 19:10	2019-09-08 16:45	2019-10-05 16:40	2019-11-03 15:45	2019-12-08 15:05
Parameter	**Units**	**Results**					
Ammonia, Total (as N)	mg/L	21.7	27.8	32.5	32.2	38	28.3
Nitrate (as N)	mg/L	11	8.65	12.5	10.7	11.2	11.2
Nitrite (as N)	mg/L	0.336	0.455	0.587	0.584	0.501	0.572
Sulfate (SO_4)	mg/L	1750	2870	2540	2180	2100	1980
Aluminum (Al)-Total	mg/L	0.286	<0.15	0.384	0.116	0.152	0.332
Antimony (Sb)-Total	mg/L	0.0024	<0.0050	0.0031	0.00252	0.00435	0.00405
Arsenic (As)-Total	mg/L	0.0096	<0.0050	0.0216	0.00186	0.00689	0.0166
Barium (Ba)-Total	mg/L	0.0339	0.0795	0.0402	0.0275	0.0242	0.0312
Beryllium (Be)-Total	mg/L	<0.0010	<0.0050	<0.0010	<0.00050	<0.00050	<0.00050
Bismuth (Bi)-Total	mg/L	<0.00050	<0.0025	<0.00050	<0.00025	<0.00025	<0.00025
Boron (B)-Total	mg/L	0.77	0.79	0.76	0.597	0.667	0.824
Cadmium (Cd)-Total	mg/L	0.000231	0.00211	0.000431	<0.000090	<0.000050	0.000047
Calcium (Ca)-Total	mg/L	151	139	113	124	128	133
Cesium (Cs)-Total	mg/L	0.0003	<0.00050	0.00013	0.000164	<0.000050	0.000214
Chromium (Cr)-Total	mg/L	0.0014	<0.0050	0.0016	0.00067	0.00095	0.00298
Cobalt (Co)-Total	mg/L	0.0292	0.0069	0.0209	0.00896	0.00977	0.0184
Copper (Cu)-Total	mg/L	1.51	158	0.301	0.117	0.553	0.0362
Iron (Fe)-Total	mg/L	4.5	<0.50	8.12	1.45	2.29	2.14
Lead (Pb)-Total	mg/L	0.0108	<0.0025	0.0157	0.00055	0.00205	0.00062
Lithium (Li)-Total	mg/L	0.046	0.077	0.047	0.0344	0.0385	0.0682
Magnesium (Mg)-Total	mg/L	98.2	78.5	87.2	83.6	84.7	120
Manganese (Mn)-Total	mg/L	0.235	1.35	0.154	0.2	0.145	0.14
Mercury (Hg)-Total	mg/L	0.000055	0.00056	0.000047	0.0000086	0.0000154	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0465	0.0181	0.0808	0.111	0.0616	0.0446
Nickel (Ni)-Total	mg/L	0.12	3.51	0.016	0.0445	0.0408	0.125
Phosphorus (P)-Total	mg/L	<0.50	<2.5	<0.50	0.51	<0.25	0.51

	Sample ID	TL5	TL5	TL5	TL5	TL5	TL5
	ALS ID	L2307093-1	L2327981-1	L2344220-1	L2361827-1	L2377610-1	L2394082-1
	Date Sampled	2019-07-07 11:00	2019-08-11 19:10	2019-09-08 16:45	2019-10-05 16:40	2019-11-03 15:45	2019-12-08 15:05
Parameter	**Units**	**Results**					
Potassium (K)-Total	mg/L	84.8	67.2	85.4	72.4	61.5	94
Rubidium (Rb)-Total	mg/L	0.0278	0.021	0.0221	0.0235	0.015	0.0319
Selenium (Se)-Total	mg/L	0.00298	0.0028	0.00385	0.0057	0.00578	0.00227
Silicon (Si)-Total	mg/L	2.3	<5.0	2.4	1.8	1.71	2.08
Silver (Ag)-Total	mg/L	0.00033	<0.00050	0.00039	<0.000050	0.000164	0.0001
Sodium (Na)-Total	mg/L	1560	1870	2100	1730	1780	1770
Strontium (Sr)-Total	mg/L	1.2	1.1	1.03	0.996	0.966	1.29
Tellurium (Te)-Total	mg/L	<0.0020	<0.010	<0.0020	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	mg/L	<0.00010	<0.00050	<0.00010	<0.000050	<0.000050	<0.000050
Thorium (Th)-Total	mg/L	<0.0010	<0.0050	<0.0010	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	<0.0010	<0.0050	<0.0010	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.0048	<0.015	0.0108	<0.0018	0.0018	0.0027
Tungsten (W)-Total	mg/L	0.0025	<0.0050	0.0062	0.00588	0.00947	0.00862
Uranium (U)-Total	mg/L	0.00049	<0.00050	0.00059	0.000267	0.000261	0.00059
Vanadium (V)-Total	mg/L	<0.0050	<0.025	<0.0050	<0.0025	<0.0025	<0.0025
Zinc (Zn)-Total	mg/L	0.083	0.29	0.286	<0.015	<0.015	<0.015
Zirconium (Zr)-Total	mg/L	<0.0020	<0.010	<0.0020	<0.0010	<0.0010	<0.0010
Cyanate	mg/L	28.2	51.1	55	77.1	53.5	63.4
Thiocyanate	mg/L	13	0.62	20.3	10.5	21	22.5

Table D1-28. Effluent from Process Plant Tailings Slurry Solids (TL-6), January to May 2019

	Sample ID	TL6	TL6	TL6	TL6	TL6	TL6 ^
	ALS ID	B910233	B914932	B925906	B929338	B936614	B936614
	Date Sampled	2019-01-07	2019-02-03	2019-03-03	2019-04-10	2019-05-06	2019-05-06
Parameter	**Units**	**Results**					
Aluminum (Al)	%	0.54	0.46	0.52	0.53	0.73	0.72
Antimony (Sb)	mg/kg	<0.1	0.1	<0.1	5	<0.1	<0.1
Arsenic (As)	mg/kg	6.4	16.8	12.5	169	13.4	11.3
Barium (Ba)	mg/kg	5	5	7	13	52	17
Bismuth (Bi)	mg/kg	<0.1	<0.1	<0.1	9.4	0.1	<0.1
Boron (B)	mg/kg	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	<0.1	0.1	<0.1	0.1	0.1	<0.1
Calcium (Ca)	%	3.56	3.13	3.29	3.5	2.64	2.63
Chromium (Cr)	mg/kg	54	37	51	60	63	72
Cobalt (Co)	mg/kg	8.7	11.3	11.7	12	11.7	11.5
Copper (Cu)	mg/kg	25.8	92.6	37.1	82.1	70.2	55.4
Iron (Fe)	%	3.73	3.44	3.43	4.09	3.55	3.53
Lead (Pb)	mg/kg	1.5	4	3.8	44	9.8	8.7
Magnesium (Mg)	%	1.08	1	1.07	1.18	1.3	1.29
Manganese (Mn)	mg/kg	1050	973	934	1020	830	865
Mercury (Hg)	mg/kg	<0.01	0.02	<0.01	0.23	<0.01	<0.01
Molybdenum (Mo)	mg/kg	0.3	0.4	0.3	0.5	0.5	0.4
Nickel (Ni)	mg/kg	18	21.9	22.6	22.1	20.4	20.6
Phosphorus (P)	mg/kg	0.029	0.023	0.027	0.032	0.031	0.029
Potassium (K)	%	0.04	0.04	0.04	0.05	0.05	0.05
Selenium (Se)	mg/kg	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Silver (Ag)	mg/kg	0.2	0.3	0.5	1	0.3	0.5
Sodium (Na)	%	0.061	0.057	0.069	0.063	0.105	0.095
Strontium (Sr)	mg/kg	18	16	17	18	18	17
Tellurium (Te)	mg/kg	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
Thallium (Tl)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Sample ID		TL6	TL6	TL6	TL6	TL6	TL6 ^
ALS ID		B910233	B914932	B925906	B929338	B936614	B936614
Date Sampled		2019-01-07	2019-02-03	2019-03-03	2019-04-10	2019-05-06	2019-05-06
Parameter	**Units**	**Results**					
Thorium (Th)	mg/kg	0.1	0.7	0.2	1.1	0.4	0.4
Titanium (Ti)	%	0.003	0.008	0.008	0.008	0.036	0.038
Tungsten (W)	mg/kg	0.7	0.2	0.3	0.6	0.4	0.4
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	17	17	18	19	26	27
Zinc (Zn)	mg/kg	31	43	42	52	55	50
$CaCO_3$ Equiv. (Kg $CaCO_3$/T)	kg/T	158	110.2	125.2	156.8	113	98.64
CO_2	wt%	6.95	4.85	5.51	6.9	4.97	4.34
Sulphur (S)	%	0.07	0.2	0.14	0.32	0.21	0.2

^ *Indicates duplicate sample.*

Table D1-29. Effluent from Process Plant Tailings Slurry Solids (TL-6), June to December 2019

Sample ID		TL6	TL6	TL6	TL6	TL6	TL6	TL6
ALS ID		B945612	B959350	B969604	B980380	B990946	B999581	B9A8364
Date Sampled		2019-06-03	2019-07-07	2019-08-12	2019-09-08	2019-10-13	2019-11-03	2019-12-08
Parameter	**Units**	**Results**						
Aluminum (Al)	%	0.73	0.65	0.74	1.08	0.92	1.05	0.92
Antimony (Sb)	mg/kg	0.1	<0.1	0.3	0.2	0.1	0.4	0.4
Arsenic (As)	mg/kg	22.5	16	11.9	9	11.1	54.8	52.6
Barium (Ba)	mg/kg	17	8	10	14	14	12	13
Bismuth (Bi)	mg/kg	0.1	<0.1	0.1	<0.1	0.1	0.1	0.3
Boron (B)	mg/kg	<20	<20	<20	<20	<20	47	<20
Cadmium (Cd)	mg/kg	0.2	0.2	0.1	0.1	0.1	0.7	0.2
Calcium (Ca)	%	3.86	3.86	2.44	3.05	3.14	4.86	4.73
Chromium (Cr)	mg/kg	53	41	48	62	65	73	114
Cobalt (Co)	mg/kg	17.4	14	11.9	13.2	13	20.9	16.5

	Sample ID	TL6	TL6	TL6	TL6	TL6	TL6	TL6
	ALS ID	B945612	B959350	B969604	B980380	B990946	B999581	B9A8364
	Date Sampled	2019-06-03	2019-07-07	2019-08-12	2019-09-08	2019-10-13	2019-11-03	2019-12-08
Parameter	**Units**				**Results**			
Copper (Cu)	mg/kg	98.7	99.2	638	69.9	91.1	135	89.7
Iron (Fe)	%	4.51	4.54	3.6	4.43	4.03	5.46	5.03
Lead (Pb)	mg/kg	11	7.3	14.2	11.7	9.4	42.6	11.6
Magnesium (Mg)	%	1.38	1.3	1.23	1.57	1.48	2.12	1.77
Manganese (Mn)	mg/kg	1130	1230	728	950	896	1370	1400
Mercury (Hg)	mg/kg	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (Mo)	mg/kg	0.4	0.4	0.3	0.8	1	1.1	0.9
Nickel (Ni)	mg/kg	28.2	21.7	17.5	20.1	22	52.8	57.7
Phosphorus (P)	mg/kg	0.031	0.036	0.039	0.045	0.032	0.042	0.045
Potassium (K)	%	0.09	0.04	0.05	0.08	0.06	0.09	0.07
Selenium (Se)	mg/kg	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5
Silver (Ag)	mg/kg	0.6	0.3	0.3	0.3	0.2	0.9	0.4
Sodium (Na)	%	0.082	0.085	0.088	0.126	0.114	0.15	0.109
Strontium (Sr)	mg/kg	51	20	15	19	18	40	43
Tellurium (Te)	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium (Tl)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thorium (Th)	mg/kg	0.5	0.2	0.5	0.6	0.2	0.2	0.2
Titanium (Ti)	%	0.022	0.011	0.037	0.05	0.036	0.033	0.008
Tungsten (W)	mg/kg	0.4	0.4	0.8	0.8	0.8	0.9	0.7
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	25	20	26	39	39	38	29
Zinc (Zn)	mg/kg	71	71	74	67	65	135	60
$CaCO_3$ Equiv. (Kg $CaCO_3$/T)	kg/T	158.2	171.8	97.05	108.6	128.2	202.7	220.2
CO_2	wt%	6.96	7.56	4.27	4.78	5.64	8.92	9.69
Sulphur (S)	%	0.35	0.25	0.3	0.22	0.24	0.55	0.38

Table D1-30. Detoxified Tailings Solids (TL-7a), January to June 2019

Sample ID		TL7A	TL7A	TL7A	TL7A	TL7A	TL7A^	TL7A
ALS ID		B910230	B914934	B925908	B929340	B936612	B936612	B945617
Date Sampled		2019-01-07	2019-02-10	2019-03-03	2019-04-10	2019-05-05	2019-05-05	2019-06-02
Parameter	**Units**	**Results**						
Aluminum (Al)	%	0.58	0.62	0.65	0.68	0.74	0.73	0.88
Antimony (Sb)	mg/kg	0.5	0.5	1.2	4.6	1.2	1.1	0.9
Arsenic (As)	mg/kg	490	458	665	808	495	512	598
Barium (Ba)	mg/kg	8	8	9	11	20	15	10
Bismuth (Bi)	mg/kg	1.3	1.2	2.2	4.6	2.7	2.8	2.6
Boron (B)	mg/kg	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.6	1	1.2	3.5	4	3.8	3.4
Calcium (Ca)	%	3.38	3.69	3.57	3.15	2.82	2.82	3.67
Chromium (Cr)	mg/kg	80	61	85	88	69	74	70
Cobalt (Co)	mg/kg	228	226	289	283	200	203	219
Copper (Cu)	mg/kg	4610	4470	5060	9440	3980	4040	5480
Iron (Fe)	%	14.5	11.9	16.3	16.9	14.2	14.6	15.9
Lead (Pb)	mg/kg	48.6	266	134	504	374	395	362
Magnesium (Mg)	%	1.12	1.17	1.1	1.14	1.21	1.2	1.45
Manganese (Mn)	mg/kg	1090	1180	1140	1030	999	992	1260
Mercury (Hg)	mg/kg	0.03	0.04	0.04	0.14	0.08	0.07	0.07
Molybdenum (Mo)	mg/kg	2.2	2.4	2.7	2.7	2.6	2.6	2.7
Nickel (Ni)	mg/kg	180	206	257	244	164	172	199
Phosphorus (P)	%	0.026	0.025	0.028	0.024	0.035	0.035	0.032
Potassium (K)	%	0.05	0.05	0.06	0.06	0.07	0.07	0.06
Selenium (Se)	mg/kg	7.3	6	9.9	10.4	9	9.2	9.7
Silver (Ag)	mg/kg	12.9	14	20.1	51.3	18.1	17.7	25.3
Sodium (Na)	%	0.231	0.278	0.227	0.262	0.249	0.294	0.493
Strontium (Sr)	mg/kg	19	20	23	22	21	19	26
Tellurium (Te)	mg/kg	2.5	2.3	3.9	3.7	2.2	2.3	4.1
Thallium (Tl)	mg/kg	0.2	0.3	0.4	0.6	0.6	0.5	0.4

	Sample ID	TL7A	TL7A	TL7A	TL7A	TL7A	TL7A^	TL7A
	ALS ID	B910230	B914934	B925908	B929340	B936612	B936612	B945617
	Date Sampled	2019-01-07	2019-02-10	2019-03-03	2019-04-10	2019-05-05	2019-05-05	2019-06-02
Parameter	Units	Results						
Thorium (Th)	mg/kg	0.2	0.4	0.5	0.3	3.2	0.6	0.2
Titanium (Ti)	%	0.005	0.006	0.008	0.016	0.033	0.032	0.015
Tungsten (W)	mg/kg	2.6	1	1.5	2.1	2.8	2.8	1.3
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	19	21	23	26	23	23	29
Zinc (Zn)	mg/kg	241	524	522	1700	1620	1610	1720
Moisture	%	18	21	22	23	21	22	25.6
$CaCO_3$ Equiv. (Kg $CaCO_3$/T)	kg/T	160	170.9	139.6	125.2	122.5	123.9	143.4
CO_2	wt%	7.04	7.52	6.14	5.51	5.39	5.45	6.31
Sulphur (S)	wt%	11.65	9.64	15.25	14.36	11.59	12.45	13.1

^ *Indicates duplicate sample.*

Table D1-31. Detoxified Tailings Solids (TL-7a), July to December 2019

	Sample ID	TL7A	TL7A	TL7A	TL7A	TL7A	TL7A
	ALS ID	B959353	B969606	B980383	B990943	B999582	B9A8370
	Date Sampled	2019-07-07	2019-08-11	2019-09-08	2019-10-05	2019-11-03	2019-12-08
Parameter	Units	Results					
Aluminum (Al)	%	0.76	0.52	0.68	0.51	0.61	0.81
Antimony (Sb)	mg/kg	1.5	1.4	1.2	1.1	1	1.2
Arsenic (As)	mg/kg	656	451	579	565	1010	1000
Barium (Ba)	mg/kg	11	7	10	9	8	12
Bismuth (Bi)	mg/kg	5.1	5.3	4.8	3.9	3.2	6.2
Boron (B)	mg/kg	<20	<20	<20	<20	24	<20
Cadmium (Cd)	mg/kg	7.1	6.1	5.3	3.5	2.7	3.5
Calcium (Ca)	%	2.51	1.7	2.53	2.51	3.46	2.84
Chromium (Cr)	mg/kg	67	64	72	66	334	359
Cobalt (Co)	mg/kg	297	278	348	307	286	209

Sample ID		TL7A	TL7A	TL7A	TL7A	TL7A	TL7A
ALS ID		B959353	B969606	B980383	B990943	B999582	B9A8370
Date Sampled		2019-07-07	2019-08-11	2019-09-08	2019-10-05	2019-11-03	2019-12-08
Parameter	**Units**	**Results**					
Copper (Cu)	mg/kg	5760	8780	6340	9170	4590	2920
Iron (Fe)	%	20.6	19.8	22.6	20.8	20.9	19.1
Lead (Pb)	mg/kg	851	776	448	385	259	183
Magnesium (Mg)	%	1.06	0.82	1.08	0.92	1.27	1.42
Manganese (Mn)	mg/kg	953	541	878	846	979	1040
Mercury (Hg)	mg/kg	0.16	0.08	0.08	0.06	0.06	0.06
Molybdenum (Mo)	mg/kg	3.4	3.4	4.3	5.1	4.3	4.6
Nickel (Ni)	mg/kg	199	188	215	219	318	346
Phosphorus (P)	%	0.032	0.025	0.028	0.024	0.026	0.026
Potassium (K)	%	0.06	0.04	0.06	0.05	0.06	0.07
Selenium (Se)	mg/kg	16.2	19	14.9	15.8	14.4	13
Silver (Ag)	mg/kg	15.2	16.3	17.7	16.7	15.3	16.6
Sodium (Na)	%	0.29	0.406	0.207	0.297	0.248	0.294
Strontium (Sr)	mg/kg	18	12	19	20	30	35
Tellurium (Te)	mg/kg	4.3	4.5	5.6	4.5	3.5	5.3
Thallium (Tl)	mg/kg	0.6	0.9	1	0.6	0.5	0.2
Thorium (Th)	mg/kg	0.6	0.4	0.7	0.3	0.1	0.2
Titanium (Ti)	%	0.018	0.025	0.027	0.016	0.018	0.015
Tungsten (W)	mg/kg	1.7	3.6	3.8	5.5	4	4.2
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	26	19	27	23	23	28
Zinc (Zn)	mg/kg	3920	2940	2090	1710	1250	1080
Moisture	%	19	19	20	23	54	21
$CaCO_3$ Equiv. (Kg $CaCO_3$/T)	kg/T	97.73	64.32	113.2	115.7	137.1	126.4
CO_2	wt%	4.3	2.83	4.98	5.09	6.03	5.56
Sulphur (S)	wt%	21.72	20.62	22.08	24.69	21.77	21.48

Table D1-32. Detoxified Tailings Solids (TL-7b), January to June 2019

Sample ID		TL-7b	TL-7b	TL-7b	TL-7b	TL-7b	TL-7b^	TL-7b
ALS ID		L2223176-1	L2231509-1	L2239798-1	L2256606-1	L2268411-1	L2268411-2	L2285448-1
Date Sampled		2019-01-21 10:00	2019-02-10 15:45	2019-03-03 13:30	2019-04-10 14:30	2019-05-05 17:45	2019-05-05 17:45	2019-06-02 0:00
Parameter	**Units**	**Results**						
Cyanate	mg/L	311	416	516	510	305	306	570
Thiocyanate	mg/L	319	146	20.3	17.8	12.2	12.5	313
Cyanide, WAD	mg/L	0.263	0.0633	0.108	0.179	0.114	0.113	0.478
Aluminum (Al)-Total	mg/L	0.84	<0.15	0.435	0.65	0.44	0.4	0.29
Antimony (Sb)-Total	mg/L	0.0125	0.0059	0.0188	0.0088	0.0116	0.0114	0.0177
Arsenic (As)-Total	mg/L	0.167	0.0223	0.121	0.0605	0.0592	0.062	0.113
Barium (Ba)-Total	mg/L	0.035	0.0542	0.0579	0.0476	0.0706	0.0676	0.0525
Beryllium (Be)-Total	mg/L	<0.0050	<0.0050	<0.0020	<0.0050	<0.0050	<0.0050	<0.0050
Boron (B)-Total	mg/L	1.01	1.07	1.18	1.03	0.89	0.9	1.22
Cadmium (Cd)-Total	mg/L	<0.00025	<0.00025	<0.00010	<0.00025	<0.00025	<0.00025	<0.00025
Calcium (Ca)-Total	mg/L	35.9	55.6	47.5	74.2	72.3	71.2	41.4
Chromium (Cr)-Total	mg/L	0.0064	<0.0050	0.0051	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt (Co)-Total	mg/L	0.151	0.0486	0.075	0.0478	0.035	0.0357	0.126
Copper (Cu)-Total	mg/L	10.4	5.22	8.53	7.15	5.97	5.8	9.41
Iron (Fe)-Total	mg/L	13.2	<0.50	3.09	5.74	2.32	2.31	1.68
Lead (Pb)-Total	mg/L	0.0067	0.0063	0.0031	0.0152	0.0085	0.005	0.0033
Lithium (Li)-Total	mg/L	<0.050	<0.050	0.039	<0.050	0.059	0.059	0.055
Magnesium (Mg)-Total	mg/L	45.2	40.9	47.1	50.3	56	55.4	49.7
Manganese (Mn)-Total	mg/L	0.252	0.202	0.206	0.348	0.41	0.404	0.129
Molybdenum (Mo)-Total	mg/L	0.0652	0.0235	0.0369	0.0395	0.0525	0.0482	0.0658
Nickel (Ni)-Total	mg/L	0.052	<0.025	0.028	0.031	<0.025	<0.025	<0.025
Potassium (K)-Total	mg/L	67.4	46.8	64.1	48.3	67.7	66.5	69.4
Selenium (Se)-Total	mg/L	0.007	0.0053	0.0099	0.0151	0.007	0.0095	0.0083
Silver (Ag)-Total	mg/L	0.0397	0.00333	0.00837	0.00789	0.00385	0.00388	0.00783
Sodium (Na)-Total	mg/L	10200	5660	9650	7310	8900	8990	10600

Sample ID		TL-7b	TL-7b	TL-7b	TL-7b	TL-7b	TL-7b^	TL-7b
ALS ID		L2223176-1	L2231509-1	L2239798-1	L2256606-1	L2268411-1	L2268411-2	L2285448-1
Date Sampled		2019-01-21 10:00	2019-02-10 15:45	2019-03-03 13:30	2019-04-10 14:30	2019-05-05 17:45	2019-05-05 17:45	2019-06-02 0:00
Parameter	**Units**	**Results**						
Sulfur (S) - Total	mg/L		3890	6860	4710	5920	5920	7270
Thallium (Tl)-Total	mg/L	<0.00050	<0.00050	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	<0.0050	<0.0050	<0.0020	<0.0050	<0.0050	<0.0050	<0.0050
Titanium (Ti)-Total	mg/L	<0.015	<0.015	<0.0060	<0.017	<0.030	<0.030	<0.015
Uranium (U)-Total	mg/L	0.00127	<0.00050	0.00041	0.00066	<0.00050	<0.00050	0.00113
Vanadium (V)-Total	mg/L	<0.025	<0.025	<0.010	<0.025	<0.025	<0.025	<0.025
Zinc (Zn)-Total	mg/L	<0.15	<0.15	<0.060	<0.15	<0.15	<0.15	<0.15

^ *Indicates duplicate sample.*

Table D1-33. Detoxified Tailings Solids (TL-7b), July to December 2019

Sample ID		TL-7b	TL-7b	TL-7b	TL-7b	TL-7b	TL-7b
ALS ID		L2307036-1	L2328804-1	L2344190-1	L2361805-1	L2377266-1	L2394097-1
Date Sampled		2019-07-07 10:40	2019-08-11 18:50	2019-09-08 16:45	2019-10-05 17:05	2019-11-03 15:30	2019-12-08 15:30
Parameter	**Units**	**Results**					
Cyanate	mg/L	0.76	0.52	0.68	0.51	0.61	0.81
Thiocyanate	mg/L	1.5	1.4	1.2	1.1	1	1.2
Cyanide, WAD	mg/L	656	451	579	565	1010	1000
Aluminum (Al)-Total	mg/L	11	7	10	9	8	12
Antimony (Sb)-Total	mg/L	5.1	5.3	4.8	3.9	3.2	6.2
Arsenic (As)-Total	mg/L	<20	<20	<20	<20	24	<20
Barium (Ba)-Total	mg/L	7.1	6.1	5.3	3.5	2.7	3.5
Beryllium (Be)-Total	mg/L	2.51	1.7	2.53	2.51	3.46	2.84
Boron (B)-Total	mg/L	67	64	72	66	334	359
Cadmium (Cd)-Total	mg/L	297	278	348	307	286	209
Calcium (Ca)-Total	mg/L	5760	8780	6340	9170	4590	2920

Sample ID		TL-7b	TL-7b	TL-7b	TL-7b	TL-7b	TL-7b
ALS ID		L2307036-1	L2328804-1	L2344190-1	L2361805-1	L2377266-1	L2394097-1
Date Sampled		2019-07-07 10:40	2019-08-11 18:50	2019-09-08 16:45	2019-10-05 17:05	2019-11-03 15:30	2019-12-08 15:30
Parameter	**Units**	**Results**					
Chromium (Cr)-Total	mg/L	20.6	19.8	22.6	20.8	20.9	19.1
Cobalt (Co)-Total	mg/L	851	776	448	385	259	183
Copper (Cu)-Total	mg/L	1.06	0.82	1.08	0.92	1.27	1.42
Iron (Fe)-Total	mg/L	953	541	878	846	979	1040
Lead (Pb)-Total	mg/L	0.16	0.08	0.08	0.06	0.06	0.06
Lithium (Li)-Total	mg/L	3.4	3.4	4.3	5.1	4.3	4.6
Magnesium (Mg)-Total	mg/L	199	188	215	219	318	346
Manganese (Mn)-Total	mg/L	0.032	0.025	0.028	0.024	0.026	0.026
Molybdenum (Mo)-Total	mg/L	0.06	0.04	0.06	0.05	0.06	0.07
Nickel (Ni)-Total	mg/L	16.2	19	14.9	15.8	14.4	13
Potassium (K)-Total	mg/L	15.2	16.3	17.7	16.7	15.3	16.6
Selenium (Se)-Total	mg/L	0.29	0.406	0.207	0.297	0.248	0.294
Silver (Ag)-Total	mg/L	18	12	19	20	30	35
Sodium (Na)-Total	mg/L	4.3	4.5	5.6	4.5	3.5	5.3
Sulfur (S) - Total	mg/L	0.6	0.9	1	0.6	0.5	0.2
Thallium (Tl)-Total	mg/L	0.6	0.4	0.7	0.3	0.1	0.2
Tin (Sn)-Total	mg/L	0.018	0.025	0.027	0.016	0.018	0.015
Titanium (Ti)-Total	mg/L	1.7	3.6	3.8	5.5	4	4.2
Uranium (U)-Total	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)-Total	mg/L	26	19	27	23	23	28
Zinc (Zn)-Total	mg/L	3920	2940	2090	1710	1250	1080

Table D1-34. Detoxified Tailings Solids (TL-11), May 2019

Sample ID		TL11-A	TL11-B	TL11-C	TL11-C ^	TL11-D	TL11-E	TL11-F
ALS ID		L2280421-1	L2280421-2	L2280421-3	L2280421-5	L2280421-4	L2282417-1	L2282417-2
Date Sampled		2019-05-27 10:35	2019-05-27 10:55	2019-05-27 11:20	2019-05-27 11:20	2019-05-27 11:45	2019-05-29 10:20	2019-05-29 11:00
Parameter	**Units**	**Results**						
pH	pH	5.84	7.19	7.15	7.06	7.95	7.52	7.21
Conductivity	µS/cm	79500	84200	58400	60400	3610	50000	67900
Cyanide, Free	mg/L	0.0087	0.0051	<0.0050	<0.0050	0.0061	0.0122	0.0095
Cyanide, Total	mg/L	0.0727	0.173	0.0737	0.0839	0.0524	0.152	0.0509
Cyanide, WAD	mg/L	0.0105	0.0177	<0.0050	<0.0050	0.0069	0.0256	0.0112
Ammonia, Total (as N)	mg/L	284	352	219	217	29	180	308
Nitrate (as N)	mg/L	474	429	278	257	35.4	206	391
Nitrite (as N)	mg/L	7.21	21.4	8.53	7.84	15.5	6.52	8.19
Sulfate (SO_4)	mg/L	1210	1070	1340	1260	112	1090	1070
Aluminum (Al)-Dissolved	mg/L	<0.050	<0.050	<0.050	<0.050	0.0118	<0.050	<0.050
Antimony (Sb)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.00039	<0.0050	<0.0050
Arsenic (As)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.00135	<0.0050	<0.0050
Barium (Ba)-Dissolved	mg/L	0.256	0.455	0.197	0.201	0.0215	0.139	0.215
Beryllium (Be)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.000040	<0.0010	<0.0010
Bismuth (Bi)-Dissolved	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.00010	<0.0025	<0.0025
Boron (B)-Dissolved	mg/L	3.08	3.8	3.07	3.07	0.151	3.47	2.72
Cadmium (Cd)-Dissolved	mg/L	0.034	0.0119	0.00857	0.00723	<0.000010	0.00328	0.0101
Calcium (Ca)-Dissolved	mg/L	9620	9280	4990	5160	144	3700	6690
Chromium (Cr)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0154	<0.0050	<0.0050
Cobalt (Co)-Dissolved	mg/L	0.213	0.0331	0.0892	0.0836	0.00246	0.0257	0.115
Copper (Cu)-Dissolved	mg/L	0.254	0.249	0.246	0.234	0.0151	0.069	0.371
Iron (Fe)-Dissolved	mg/L	<0.50	<0.50	<0.50	<0.50	0.025	<0.50	<0.50
Lead (Pb)-Dissolved	mg/L	0.0068	<0.0025	<0.0025	<0.0025	<0.00010	<0.0025	<0.0025
Lithium (Li)-Dissolved	mg/L	0.317	0.209	0.202	0.199	0.0287	0.131	0.182
Magnesium (Mg)-Dissolved	mg/L	1500	1820	1200	1270	43.1	858	1130

Sample ID		TL11-A	TL11-B	TL11-C	TL11-C ^	TL11-D	TL11-E	TL11-F
ALS ID		L2280421-1	L2280421-2	L2280421-3	L2280421-5	L2280421-4	L2282417-1	L2282417-2
Date Sampled		2019-05-27 10:35	2019-05-27 10:55	2019-05-27 11:20	2019-05-27 11:20	2019-05-27 11:45	2019-05-29 10:20	2019-05-29 11:00
Parameter	**Units**	**Results**						
Manganese (Mn)-Dissolved	mg/L	9.95	8.2	7.63	7.67	0.0597	3.61	6.97
Mercury (Hg)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Molybdenum (Mo)-Dissolved	mg/L	0.0216	0.0645	0.0289	0.0289	0.00426	0.0214	0.0155
Nickel (Ni)-Dissolved	mg/L	0.352	0.154	0.184	0.179	0.0016	0.108	0.293
Phosphorus (P)-Dissolved	mg/L	<2.5	<2.5	<2.5	<2.5	<0.10	<2.5	<2.5
Potassium (K)-Dissolved	mg/L	495	576	342	361	38.6	237	379
Selenium (Se)-Dissolved	mg/L	0.013	0.0048	0.0097	0.0076	0.00187	0.005	0.0058
Silicon (Si)-Dissolved	mg/L	2.9	<2.5	4.5	3	4.16	3.2	2.6
Silver (Ag)-Dissolved	mg/L	0.0125	0.00952	0.00555	0.00526	0.000088	0.00258	0.0144
Sodium (Na)-Dissolved	mg/L	10300	11700	7670	8060	421	6710	8180
Strontium (Sr) - Dissolved	mg/L	28	32	19.2	19.7	1.06	17.2	22.3
Sulphur (S)-Dissolved	mg/L	593	563	601	610	52	499	509
Thallium (Tl)-Dissolved	mg/L	0.0009	<0.00050	<0.00050	<0.00050	<0.000020	<0.00050	<0.00050
Tin (Sn)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.00020	<0.0050	<0.0050
Titanium (Ti)-Dissolved	mg/L	<0.015	<0.015	<0.015	<0.015	<0.00060	<0.015	<0.015
Uranium (U)-Dissolved	mg/L	0.00311	0.00129	0.00191	0.00184	0.000229	0.00186	0.00255
Vanadium (V)-Dissolved	mg/L	<0.025	<0.025	<0.025	<0.025	0.0042	<0.025	<0.025
Zinc (Zn)-Dissolved	mg/L	1.29	0.105	0.207	0.185	0.0082	1.24	0.419
Zirconium (Zr)-Dissolved	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.00030	<0.0030	<0.0030
Alkalinity, Total (as $CaCO_3$)	mg/L	2.6	75.2	72.7	78.2	98	88.2	62.4
Acidity as $CaCO_3$	mg/L	99	134	91.1	80.9	6.8	65.3	104

^ Indicates duplicate sample.
Note: No seepage was observed during the May seepage survey of backfilled stopes. Samples collected in May 2019 were collected from pooling water at the base of backfilled stopes.

Table D1-35. Seepage from Underground Backfilled Stopes (TL-11), December 2019

Sample ID		TL11-A	TL11-A ^	TL11-B
ALS ID		L2397363-1	L2397363-2	L2397363-3
Date Sampled		2019-12-15 10:50	2019-12-15 10:50	2019-12-15 11:15
Parameter	**Units**		**Results**	
pH	pH	8.02	8.03	8.01
Conductivity	µS/cm	25400	25200	27400
Cyanide, Free	mg/L	<0.010	<0.010	0.0088
Cyanide, Total	mg/L	0.246	0.243	0.0313
Cyanide, WAD	mg/L	<0.010	<0.010	0.0098
Ammonia, Total (as N)	mg/L	10.3	10.3	17.4
Nitrate (as N)	mg/L	13.7	13.7	16.3
Nitrite (as N)	mg/L	0.717	0.716	0.603
Sulfate (SO_4)	mg/L	1160	1160	1270
Aluminum (Al)-Dissolved	mg/L	<0.020	<0.020	<0.020
Antimony (Sb)-Dissolved	mg/L	<0.0020	<0.0020	0.0032
Arsenic (As)-Dissolved	mg/L	0.0052	0.0048	<0.0020
Barium (Ba)-Dissolved	mg/L	0.0307	0.0317	0.0539
Beryllium (Be)-Dissolved	mg/L	<0.00040	<0.00040	<0.00040
Bismuth (Bi)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010
Boron (B)-Dissolved	mg/L	2.36	2.36	2.39
Cadmium (Cd)-Dissolved	mg/L	0.00032	0.00018	0.00056
Calcium (Ca)-Dissolved	mg/L	457	457	517
Chromium (Cr)-Dissolved	mg/L	<0.0020	<0.0020	<0.0020
Cobalt (Co)-Dissolved	mg/L	0.0305	0.0303	0.0571
Copper (Cu)-Dissolved	mg/L	0.0393	0.0375	0.101
Iron (Fe)-Dissolved	mg/L	<0.20	<0.20	<0.20
Lead (Pb)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	0.097	0.094	0.092
Magnesium (Mg)-Dissolved	mg/L	628	627	595
Manganese (Mn)-Dissolved	mg/L	1.45	1.44	1.48
Mercury (Hg)-Dissolved	mg/L	0.000013	<0.0000050	0.0000073
Molybdenum (Mo)-Dissolved	mg/L	0.0062	0.0063	0.0063
Nickel (Ni)-Dissolved	mg/L	0.082	0.079	0.12
Phosphorus (P)-Dissolved	mg/L	<1.0	<1.0	<1.0
Potassium (K)-Dissolved	mg/L	149	149	137
Selenium (Se)-Dissolved	mg/L	0.0012	0.0012	<0.0010
Silicon (Si)-Dissolved	mg/L	3.7	3.6	3.6
Silver (Ag)-Dissolved	mg/L	<0.00020	<0.00020	0.00022
Sodium (Na)-Dissolved	mg/L	4690	4780	4480
Strontium (Sr) - Dissolved	mg/L	5.99	5.81	6.21
Sulphur (S)-Dissolved	mg/L	420	436	450

	Sample ID	TL11-A	TL11-A ^	TL11-B
	ALS ID	L2397363-1	L2397363-2	L2397363-3
	Date Sampled	2019-12-15 10:50	2019-12-15 10:50	2019-12-15 11:15
Parameter	**Units**		**Results**	
Thallium (Tl)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	<0.0020	<0.0020	<0.0020
Titanium (Ti)-Dissolved	mg/L	<0.0060	<0.0060	<0.0060
Uranium (U)-Dissolved	mg/L	0.00028	0.00028	0.00059
Vanadium (V)-Dissolved	mg/L	<0.010	<0.010	<0.010
Zinc (Zn)-Dissolved	mg/L	0.026	0.03	0.094
Zirconium (Zr)-Dissolved	mg/L	<0.0040	<0.0040	<0.0040
Alkalinity, Total (as $CaCO_3$)	mg/L	227	226	259
Acidity as $CaCO_3$	mg/L	13.5	13.5	20

^ *Indicates duplicate sample.*

TL-12 Monitoring of Underground Dewatering

Dewatering of the Doris underground workings continued in 2019. Groundwater inflow accumulating underground from mine development occurring in the Doris Connector and Doris Central zones was discharged to the Tailings Impoundment Area. Table D-36 provides the dewatering volumes for the Doris mine in 2019. Water quality samples were collected weekly from the discharge line and submitted for laboratory analysis as outlined in Schedule I of the water licence. Results of this sampling is provided in Table D1-37 through Table D1-42.

Table D1-36. Doris Underground Mine Dewatering, 2019

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	20,108	20,108
February	18,985	39,093
March	33,823	72,916
April	23,432	96,348
May	25,656	122,004
June	27,370	149,374
July	28,347	177,721
August	29,359	207,080
September	30,408	237,488
October	31,493	268,981
November	40,140	309,121
December	72,904	382,025
Volume of Mine Water Dewatering for Doris Mine, 2019 (m^3)		**382,025**

* *Values rounded to nearest whole cubic metre.*

Table D1-37. Water Sampling Monitoring Program Results for January to February 2019 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12^	TL12	TL12
ALS ID		L2217611-1	L2220230-1	L2223290-1	L2225900-1	L2231528-1	L2231528-2	L2233863-1	L2236882-1
Date Sampled		2019-01-07 09:50	2019-01-14 17:45	2019-01-21 14:00	2019-01-29 07:00	2019-02-11 15:15	2019-02-11 15:15	2019-02-19 06:15	2019-02-25 13:05
Parameter	**Units**	**Results**							
pH	pH	7.75	7.75	7.71	7.72	7.62	7.61	7.6	7.78
Conductivity	µS/cm	38000				39700	39600		
Total Suspended Solids	mg/L	623	4800	7600	799	5600	5080	900	8160
Total Dissolved Solids	mg/L	25300	26600	24000	27700	26900	27500	25600	24000
Chloride (Cl)	mg/L	14500	12200	14100	13800	15000	15100	13700	13600
Bromide (Br)	mg/L	56.1				52.3	52.6		
Fluoride (F)	mg/L	<2.0				<2.0	<2.0		
Cyanide, Total	mg/L	0.0519	0.0602	0.161	0.0316	0.175	0.16	0.0289	0.0624
Cyanide, WAD	mg/L	0.0159				0.0252	0.0264		
Ammonia, Total (as N)	mg/L	13.2	17.1	29.8	12.7	123	121	13.4	17.4
Nitrate (as N)	mg/L	13.8	14.2	51.5	13.9	128	128	12.2	14.9
Nitrite (as N)	mg/L	1.49				4.4	4.61		
Sulfate (SO_4)	mg/L	1380				1400	1400		
Aluminum (Al)-Total	mg/L	17	21.3	221	15.5	129	132	37.3	85.4
Antimony (Sb)-Total	mg/L	<0.0020	0.0014	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Arsenic (As)-Total	mg/L	0.0099	0.0153	0.208	0.0115	0.0511	0.0518	0.0204	0.0594
Barium (Ba)-Total	mg/L	0.0603	0.0756	0.179	0.065	0.148	0.151	0.0655	0.108
Beryllium (Be)-Total	mg/L	<0.0020	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Total	mg/L	<0.0010	<0.00050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Boron (B)-Total	mg/L	3.59	3.47	3.45	3.38	3.59	3.68	3.62	3.53
Cadmium (Cd)-Total	mg/L	<0.00010	0.000328	0.00165	<0.00025	0.00099	0.00108	0.00029	0.0008
Calcium (Ca)-Total	mg/L	1440	1190	1580	1260	1710	1760	1140	1340
Cesium (Cs)-Total	mg/L	0.00131	0.00148	0.00283	0.001	0.00277	0.00273	0.00115	0.00161
Chromium (Cr)-Total	mg/L	0.0115	0.0286	0.221	0.0205	0.0749	0.0787	0.0427	0.119
Cobalt (Co)-Total	mg/L	0.0195	0.0256	0.311	0.0221	0.144	0.144	0.0447	0.113

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12^	TL12	TL12
ALS ID		L2217611-1	L2220230-1	L2223290-1	L2225900-1	L2231528-1	L2231528-2	L2233863-1	L2236882-1
Date Sampled		2019-01-07 09:50	2019-01-14 17:45	2019-01-21 14:00	2019-01-29 07:00	2019-02-11 15:15	2019-02-11 15:15	2019-02-19 06:15	2019-02-25 13:05
Parameter	**Units**	**Results**							
Copper (Cu)-Total	mg/L	0.094	0.192	2.14	0.131	0.432	0.446	0.204	0.578
Iron (Fe)-Total	mg/L	51.4	66.5	814	57.6	473	464	124	369
Lead (Pb)-Total	mg/L	0.0183	0.0291	0.294	0.0151	0.201	0.209	0.0281	0.106
Lithium (Li)-Total	mg/L	0.147	0.153	0.276	0.143	0.231	0.236	0.151	0.199
Magnesium (Mg)-Total	mg/L	899	832	1040	846	1050	1030	889	912
Manganese (Mn)-Total	mg/L	3.22	3.34	17	3.03	10.5	10.6	4.66	10.2
Mercury (Hg)-Total	mg/L					<0.00010	<0.00010		
Molybdenum (Mo)-Total	mg/L	0.0049	0.00875	0.0327	0.0085	0.0153	0.0155	0.0064	0.0138
Nickel (Ni)-Total	mg/L	0.016	0.0284	0.2	<0.025	0.071	0.066	0.035	0.089
Phosphorus (P)-Total	mg/L	<1.0	0.96	9.3	<2.5	6.3	5.7	<2.5	5.8
Potassium (K)-Total	mg/L	204	203	207	183	216	212	215	203
Rubidium (Rb)-Total	mg/L	0.111	0.114	0.133	0.107	0.143	0.141	0.109	0.109
Selenium (Se)-Total	mg/L	<0.0010	<0.00050	0.0059	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Silicon (Si)-Total	mg/L	26.7	27.2	190	22.1	126	125	40.9	88.5
Silver (Ag)-Total	mg/L	0.00025	0.00062	0.00565	<0.00050	0.00164	0.00162	0.00053	0.00229
Sodium (Na)-Total	mg/L	6860	6730	6390	6300	7160	7040	6560	6690
Strontium (Sr)-Total	mg/L	15.4	15.1	14.5	15.2	13.8	13.9	13.8	14.4
Tellurium (Te)-Total	mg/L	<0.0040	<0.0020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thallium (Tl)-Total	mg/L	<0.00020	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thorium (Th)-Total	mg/L	<0.0020	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tin (Sn)-Total	mg/L	<0.0020	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium (Ti)-Total	mg/L	0.345	0.406	3.29	0.342	1.5	1.51	0.763	1.45
Tungsten (W)-Total	mg/L	<0.0020	0.0038	0.0106	<0.0050	0.0091	0.0084	<0.0050	0.008
Uranium (U)-Total	mg/L	0.00037	0.00034	0.00068	<0.00050	0.00054	<0.00050	<0.00050	<0.00050
Vanadium (V)-Total	mg/L	0.041	0.0592	0.582	0.048	0.305	0.312	0.101	0.247
Zinc (Zn)-Total	mg/L	0.186	0.25	2.16	0.19	1.1	1.13	0.31	0.8

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12^	TL12	TL12
ALS ID		L2217611-1	L2220230-1	L2223290-1	L2225900-1	L2231528-1	L2231528-2	L2233863-1	L2236882-1
Date Sampled		2019-01-07 09:50	2019-01-14 17:45	2019-01-21 14:00	2019-01-29 07:00	2019-02-11 15:15	2019-02-11 15:15	2019-02-19 06:15	2019-02-25 13:05
Parameter	**Units**	**Results**							
Zirconium (Zr)-Total	mg/L	0.0154	0.00265	0.0066	0.0037	0.0033	0.0041	<0.0030	0.0042
Alkalinity, Total (as $CaCO_3$)	mg/L	171				190	190		

^ *Indicates duplicate sample.*

Table D1-38. Water Sampling Monitoring Program Results for March to April 2019 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2239810-1	L2243339-1	L2245892-1	L2249282-1	L2251910-1	L2255202-1	L2258768-1	L2261435-1	L2264745-1
Date Sampled		2019-03-04 09:35	2019-03-11 15:15	2019-03-18 9:30	2019-03-25 14:00	2019-04-01 09:30	2019-04-08 17:20	2019-04-15 16:45	2019-04-22 10:30	2019-04-29 11:30
Parameter	**Units**	**Results**								
pH	pH	7.77	7.68	7.75	7.73	7.78	7.78	7.83	7.76	7.81
Conductivity	µS/cm	37400				35500				
Total Suspended Solids	mg/L	1350	1800	6450	16700	570	6000	5820	9080	1310
Total Dissolved Solids	mg/L	27400	23400	24900	26200	25100	27200	24600	25700	30900
Chloride (Cl)	mg/L	11500	12900	13700	13900	12600	13600	11400	12800	13600
Bromide (Br)	mg/L	43.2				47.7				
Fluoride (F)	mg/L	<2.0				<2.0				
Cyanide, Total	mg/L	0.0909	0.069	0.0616	0.0572	0.0267	0.0325	0.0474	0.0378	0.0572
Cyanide, WAD	mg/L	0.0104				0.0207				
Ammonia, Total (as N)	mg/L	8.07	25.2	7.78	15.5	8.67	7.62	20.6	14.6	9.7
Nitrate (as N)	mg/L	5.99	25.8	6.24	19.5	7.11	6.14	20.5	14.4	9.67
Nitrite (as N)	mg/L	0.86				0.81				
Sulfate (SO_4)	mg/L	1070				1290				
Aluminum (Al)-Total	mg/L	40.4	81.4	50.6	34.5	15.6	94.4	143	38.6	22.9
Antimony (Sb)-Total	mg/L	<0.0050	<0.0050	0.0015	<0.0050	<0.0020	<0.0020	0.0021	<0.0050	<0.0020

	Sample ID	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
	ALS ID	L2239810-1	L2243339-1	L2245892-1	L2249282-1	L2251910-1	L2255202-1	L2258768-1	L2261435-1	L2264745-1
	Date Sampled	2019-03-04 09:35	2019-03-11 15:15	2019-03-18 9:30	2019-03-25 14:00	2019-04-01 09:30	2019-04-08 17:20	2019-04-15 16:45	2019-04-22 10:30	2019-04-29 11:30
Parameter	**Units**					**Results**				
Arsenic (As)-Total	mg/L	0.032	0.0735	0.0459	0.0124	0.0124	0.122	0.214	0.0414	0.016
Barium (Ba)-Total	mg/L	0.0602	0.0913	0.0672	0.105	0.0495	0.0859	0.124	0.0575	0.0655
Beryllium (Be)-Total	mg/L	<0.0050	<0.0050	<0.0010	<0.0050	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020
Bismuth (Bi)-Total	mg/L	<0.0025	<0.0025	<0.00050	<0.0025	<0.0010	<0.0010	<0.0010	<0.0025	<0.0010
Boron (B)-Total	mg/L	3.66	3.15	3.46	3.19	3.56	3.33	2.93	3.53	3.46
Cadmium (Cd)-Total	mg/L	<0.00025	0.0009	0.000451	0.00086	0.00018	0.00136	0.00225	0.00037	0.00018
Calcium (Ca)-Total	mg/L	1170	1090	1160	1270	1090	1340	1380	1130	1180
Cesium (Cs)-Total	mg/L	0.00154	0.0018	0.00125	0.0013	0.00099	0.00168	0.00234	0.00156	0.00104
Chromium (Cr)-Total	mg/L	0.0627	0.105	0.0593	0.0246	0.0211	0.0991	0.162	0.0469	0.0314
Cobalt (Co)-Total	mg/L	0.0485	0.114	0.0704	0.0375	0.0215	0.167	0.279	0.0626	0.0243
Copper (Cu)-Total	mg/L	0.492	0.679	0.404	0.17	0.109	0.646	1.21	0.312	0.239
Iron (Fe)-Total	mg/L	116	323	198	128	58.9	460	702	155	59.5
Lead (Pb)-Total	mg/L	0.0328	0.0839	0.0633	0.0362	0.0142	0.104	0.163	0.0311	0.0146
Lithium (Li)-Total	mg/L	0.167	0.18	0.17	0.152	0.153	0.209	0.219	0.154	0.158
Magnesium (Mg)-Total	mg/L	925	834	868	887	806	887	775	913	871
Manganese (Mn)-Total	mg/L	4.11	7.8	5.85	7.19	3.04	12	16.3	5.31	3.15
Mercury (Hg)-Total	mg/L	<0.000050				<0.0000050				
Molybdenum (Mo)-Total	mg/L	0.0083	0.0167	0.00949	0.0089	0.0049	0.0127	0.021	0.0069	0.0075
Nickel (Ni)-Total	mg/L	0.045	0.092	0.0514	0.032	0.023	0.09	0.161	0.044	0.025
Phosphorus (P)-Total	mg/L	<2.5	3.8	2.78	<2.5	<1.0	5.3	8.6	<2.5	<1.0
Potassium (K)-Total	mg/L	193	173	202	198	195	191	168	194	200
Rubidium (Rb)-Total	mg/L	0.104	0.1	0.102	0.111	0.0992	0.102	0.099	0.1	0.106
Selenium (Se)-Total	mg/L	<0.0025	<0.0025	0.00129	<0.0025	<0.0010	0.0025	0.0047	<0.0025	<0.0010
Silicon (Si)-Total	mg/L	50.8	84.8	55.3	37.3	20.8	89.9	130	41.6	34.6
Silver (Ag)-Total	mg/L	0.00138	0.00234	0.00158	0.00087	0.00071	0.00289	0.00554	0.00137	0.00088
Sodium (Na)-Total	mg/L	6940	5600	6360	6850	6780	6560	5680	6300	6490

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2239810-1	L2243339-1	L2245892-1	L2249282-1	L2251910-1	L2255202-1	L2258768-1	L2261435-1	L2264745-1
Date Sampled		2019-03-04 09:35	2019-03-11 15:15	2019-03-18 9:30	2019-03-25 14:00	2019-04-01 09:30	2019-04-08 17:20	2019-04-15 16:45	2019-04-22 10:30	2019-04-29 11:30
Parameter	**Units**	**Results**								
Strontium (Sr)-Total	mg/L	14.7	13.4	12.9	13.2	12.8	13.1	12.7	14.6	15.3
Tellurium (Te)-Total	mg/L	<0.010	<0.010	<0.0020	<0.010	<0.0040	<0.0040	<0.0040	<0.010	<0.0040
Thallium (Tl)-Total	mg/L	<0.00050	<0.00050	<0.00010	<0.00050	<0.00020	<0.00020	<0.00020	<0.00050	<0.00020
Thorium (Th)-Total	mg/L	<0.0050	<0.0050	<0.0010	<0.0050	<0.0020	<0.0020	0.0024	<0.0050	<0.0020
Tin (Sn)-Total	mg/L	<0.0050	<0.0050	<0.0010	<0.0050	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020
Titanium (Ti)-Total	mg/L	1.13	1.72	0.946	0.354	0.314	1.75	3.39	1.02	0.926
Tungsten (W)-Total	mg/L	<0.0050	0.0076	0.0087	<0.0050	0.0073	0.014	0.0205	0.0065	0.0089
Uranium (U)-Total	mg/L	<0.00050	0.0005	0.00049	<0.00050	0.00045	0.00048	0.0009	0.00056	0.00044
Vanadium (V)-Total	mg/L	0.122	0.238	0.142	0.082	0.044	0.266	0.411	0.108	0.068
Zinc (Zn)-Total	mg/L	0.31	0.72	0.59	0.61	0.2	1.09	1.76	0.37	0.17
Zirconium (Zr)-Total	mg/L	0.0091	0.0039	0.00224	<0.0030	0.002	0.005	0.0093	0.0041	<0.015
Alkalinity, Total (as $CaCO_3$)	mg/L	167				196				

Table D1-39. Water Sampling Monitoring Program Results for May to June 2019 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2268357-1	L2272424-1	L2276200-1	L2280569-1	L2285495-1	L2289137-1	L2294308-1	L2298229-1
Date Sampled		2019-05-06 15:15	2019-05-13 15:20	2019-05-20 9:25	2019-05-27 14:30	2019-06-03 15:25	2019-06-10 13:30	2019-06-17 13:11	2019-06-24 14:05
Parameter	**Units**	**Results**							
pH	pH	7.69	7.72	7.77	7.77	7.68	7.77	7.81	7.79
Conductivity	µS/cm	35800				33500			
Total Suspended Solids	mg/L	6610	10800	1230	1540	3240	6590	18600	3810
Total Dissolved Solids	mg/L	25700	28800	22600	28200	25600	26600	26600	25600
Chloride (Cl)	mg/L	13000	13600	12000	12700	12700	13300	11800	11600
Bromide (Br)	mg/L	47.2				43.9			

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2268357-1	L2272424-1	L2276200-1	L2280569-1	L2285495-1	L2289137-1	L2294308-1	L2298229-1
Date Sampled		2019-05-06 15:15	2019-05-13 15:20	2019-05-20 9:25	2019-05-27 14:30	2019-06-03 15:25	2019-06-10 13:30	2019-06-17 13:11	2019-06-24 14:05
Parameter	**Units**	**Results**							
Fluoride (F)	mg/L	<2.0				<2.0			
Cyanide, Total	mg/L	0.11	0.0744	0.0385	0.0616	0.0752	0.0826	0.0474	0.0552
Cyanide, WAD	mg/L	0.0297				0.01			
Ammonia, Total (as N)	mg/L	33.9	42.1	16	19.7	34.7	28.3	22.9	21.2
Nitrate (as N)	mg/L	39.5	49.9	16.4	22.6	40.1	31.3	27.2	23.3
Nitrite (as N)	mg/L	4.85				4.47			
Sulfate (SO_4)	mg/L	1260				1180			
Aluminum (Al)-Total	mg/L	121	233	27.3	47.6	31.9	139	105	36.5
Antimony (Sb)-Total	mg/L	0.0029	0.0032	<0.0020	0.0034	0.003	<0.0020	0.0027	<0.0020
Arsenic (As)-Total	mg/L	0.0709	0.281	0.0202	0.0775	0.0519	0.126	0.0879	0.035
Barium (Ba)-Total	mg/L	0.141	0.219	0.0664	0.109	0.131	0.145	0.157	0.0862
Beryllium (Be)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/L	<0.0010	0.0011	<0.0010	0.0013	<0.0010	0.0012	0.0025	<0.0010
Boron (B)-Total	mg/L	3.38	3.32	2.93	3.21	2.95	3.24	3.15	3.2
Cadmium (Cd)-Total	mg/L	0.00103	0.00252	0.00044	0.00101	0.00063	0.00129	0.00176	0.00042
Calcium (Ca)-Total	mg/L	1430	2300	1160	1580	1420	1570	1970	1160
Cesium (Cs)-Total	mg/L	0.00203	0.00233	0.00127	0.00171	0.00183	0.00175	0.00201	0.0016
Chromium (Cr)-Total	mg/L	0.0957	0.209	0.0289	0.0847	0.0423	0.202	0.101	0.0492
Cobalt (Co)-Total	mg/L	0.159	0.388	0.0403	0.0876	0.0484	0.193	0.145	0.0579
Copper (Cu)-Total	mg/L	0.751	1.52	0.181	0.545	0.265	1.19	0.78	0.372
Iron (Fe)-Total	mg/L	486	1010	103	391	187	501	634	201
Lead (Pb)-Total	mg/L	0.157	0.242	0.022	0.193	0.0869	0.107	0.269	0.0538
Lithium (Li)-Total	mg/L	0.239	0.305	0.151	0.17	0.136	0.228	0.219	0.161
Magnesium (Mg)-Total	mg/L	853	985	785	872	776	853	824	789
Manganese (Mn)-Total	mg/L	10.4	22.6	3.79	14.7	6.5	11.4	24.4	7.03
Mercury (Hg)-Total	mg/L	<0.00050				<0.000050			

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2268357-1	L2272424-1	L2276200-1	L2280569-1	L2285495-1	L2289137-1	L2294308-1	L2298229-1
Date Sampled		2019-05-06 15:15	2019-05-13 15:20	2019-05-20 9:25	2019-05-27 14:30	2019-06-03 15:25	2019-06-10 13:30	2019-06-17 13:11	2019-06-24 14:05
Parameter	**Units**	**Results**							
Molybdenum (Mo)-Total	mg/L	0.0179	0.0324	0.0085	0.0164	0.0136	0.0268	0.0148	0.0114
Nickel (Ni)-Total	mg/L	0.096	0.219	0.037	0.109	0.064	0.16	0.115	0.052
Phosphorus (P)-Total	mg/L	6.7	12.6	1.3	7.9	4.3	6	16.8	4.2
Potassium (K)-Total	mg/L	184	203	168	193	182	185	171	176
Rubidium (Rb)-Total	mg/L	0.109	0.122	0.0913	0.103	0.113	0.103	0.1	0.0935
Selenium (Se)-Total	mg/L	0.0022	0.0055	<0.0010	0.0014	<0.0010	0.0026	0.0013	<0.0010
Silicon (Si)-Total	mg/L	112	205	31.2	53.7	41.2	134	107	40.2
Silver (Ag)-Total	mg/L	0.00336	0.00809	0.0007	0.00241	0.0033	0.00818	0.00988	0.00196
Sodium (Na)-Total	mg/L	5840	5870	5700	5940	5690	5240	5640	5860
Strontium (Sr)-Total	mg/L	12.7	13.9	12.6	13.4	12.3	13	12.5	11.6
Tellurium (Te)-Total	mg/L	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/L	<0.00020	0.00021	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thorium (Th)-Total	mg/L	<0.0020	0.0025	<0.0020	<0.0020	<0.0020	<0.0020	0.002	<0.0020
Tin (Sn)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Titanium (Ti)-Total	mg/L	1.31	2.92	0.5	0.54	0.324	3.03	0.75	0.725
Tungsten (W)-Total	mg/L	0.0167	0.0302	0.0057	0.0186	0.012	0.0294	0.0152	0.0052
Uranium (U)-Total	mg/L	0.00056	0.00079	0.00042	0.00056	0.0006	0.00084	0.00091	0.00057
Vanadium (V)-Total	mg/L	0.315	0.586	0.074	0.135	0.088	0.379	0.257	0.1
Zinc (Zn)-Total	mg/L	1.1	2.24	0.322	0.697	0.455	1.09	1.24	0.451
Zirconium (Zr)-Total	mg/L	0.0054	0.0056	0.0018	0.0073	<0.0040	0.0065	0.0068	<0.0040
Alkalinity, Total (as $CaCO_3$)	mg/L	230				174			

Table D1-40. Water Sampling Monitoring Program Results for July to August 2019 Taken from TL-12

	Sample ID	TL12	TL12	TL12	TL12	TL12	TL12	TL12
	ALS ID	L2301996-1	L2307045-1	L2315460-1	L2319758-1	L2323192-1	L2327971-1	L2337326-1
	Date Sampled	2019-07-01 10:00	2019-07-08 10:20	2019-07-22 11:00	2019-07-29 9:40	2019-08-05 10:10	2019-08-12 18:40	2019-08-26 11:40
Parameter	**Units**	**Results**						
pH	pH	7.82	7.83	7.8	7.62	7.78	7.81	7.92
Conductivity	µS/cm	30500					30700	
Total Suspended Solids	mg/L	908	1740	21300	59.1	37.6	1910	5140
Total Dissolved Solids	mg/L	28100	23000	24800	25700	23100	22600	4760
Chloride (Cl)	mg/L	11200	11800	9990	9470	9920	11500	10600
Bromide (Br)	mg/L	43.1					45.2	
Fluoride (F)	mg/L	<2.0					<2.0	
Cyanide, Total	mg/L	0.0462	0.167	0.198	0.0406	0.0612	0.101	0.0603
Cyanide, WAD	mg/L	<0.0050					0.0055	
Ammonia, Total (as N)	mg/L	14.3	11.6	10.9	90.5	72.4	33.1	19
Nitrate (as N)	mg/L	14.8	12.9	8.3	108	85.1	35.9	17.6
Nitrite (as N)	mg/L	1.3					2.54	
Sulfate (SO_4)	mg/L	1140					1150	
Aluminum (Al)-Total	mg/L	19.7	14.7	52.2	0.436	0.544	7.07	40.1
Antimony (Sb)-Total	mg/L	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/L	0.0227	0.0298	0.0298	0.0028	<0.0020	0.0104	0.0348
Barium (Ba)-Total	mg/L	0.0653	0.0689	0.12	0.0912	0.0738	0.0796	0.0872
Beryllium (Be)-Total	mg/L	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/L	<0.0010	<0.0010	<0.0025	<0.0010	<0.0010	<0.0010	0.001
Boron (B)-Total	mg/L	3.13	2.71	3.2	2.49	2.37	2.88	3.06
Cadmium (Cd)-Total	mg/L	0.00018	0.00034	0.00102	0.00079	0.00049	0.00023	0.00051
Calcium (Ca)-Total	mg/L	971	990	1500	1720	1250	955	1030
Cesium (Cs)-Total	mg/L	0.0014	0.0013	0.00096	0.00084	0.0008	0.00067	0.00138
Chromium (Cr)-Total	mg/L	0.0367	0.0287	0.064	<0.0020	<0.0020	0.009	0.0432
Cobalt (Co)-Total	mg/L	0.0303	0.0334	0.0677	0.0216	0.0096	0.0153	0.0557

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2301996-1	L2307045-1	L2315460-1	L2319758-1	L2323192-1	L2327971-1	L2337326-1
Date Sampled		2019-07-01 10:00	2019-07-08 10:20	2019-07-22 11:00	2019-07-29 9:40	2019-08-05 10:10	2019-08-12 18:40	2019-08-26 11:40
Parameter	**Units**	**Results**						
Copper (Cu)-Total	mg/L	0.235	0.517	1.05	0.103	0.059	0.395	0.526
Iron (Fe)-Total	mg/L	72.4	73.9	334	1.88	1.75	46.1	230
Lead (Pb)-Total	mg/L	0.0141	0.0285	0.209	0.0027	0.0017	0.0369	0.0997
Lithium (Li)-Total	mg/L	0.131	0.111	0.171	0.101	0.088	0.118	0.143
Magnesium (Mg)-Total	mg/L	704	726	771	678	542	671	720
Manganese (Mn)-Total	mg/L	2.86	3.39	14.9	2.21	1.53	2.93	7.78
Mercury (Hg)-Total	mg/L	<0.0000050					0.000013	
Molybdenum (Mo)-Total	mg/L	0.0123	0.0077	0.0172	0.0132	0.0124	0.0075	0.0097
Nickel (Ni)-Total	mg/L	0.035	0.031	0.058	0.055	0.032	0.016	0.048
Phosphorus (P)-Total	mg/L	<1.0	1.2	12.9	<1.0	<1.0	1.6	5.5
Potassium (K)-Total	mg/L	178	172	176	177	150	163	161
Rubidium (Rb)-Total	mg/L	0.0916	0.092	0.089	0.108	0.0894	0.0888	0.0861
Selenium (Se)-Total	mg/L	0.001	<0.0010	<0.0025	0.0021	<0.0010	<0.0010	<0.0010
Silicon (Si)-Total	mg/L	28.4	20.4	52.7	4.3	3.9	11.1	46.6
Silver (Ag)-Total	mg/L	0.0009	0.00115	0.0051	0.00029	<0.00020	0.00094	0.00166
Sodium (Na)-Total	mg/L	5730	5360	5420	5120	4370	5180	5270
Strontium (Sr)-Total	mg/L	12	11.5	12.6	11.2	9.27	11	10.7
Tellurium (Te)-Total	mg/L	<0.0040	<0.0040	<0.010	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/L	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020
Thorium (Th)-Total	mg/L	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	mg/L	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020
Titanium (Ti)-Total	mg/L	0.652	0.255	0.41	0.0091	0.0149	<0.072	0.388
Tungsten (W)-Total	mg/L	0.0076	0.0044	0.0075	0.0025	0.0027	0.0031	0.0065
Uranium (U)-Total	mg/L	0.0006	0.00057	0.00077	0.00055	0.00045	0.00045	0.00067
Vanadium (V)-Total	mg/L	0.06	0.049	0.152	<0.010	<0.010	0.018	0.117

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2301996-1	L2307045-1	L2315460-1	L2319758-1	L2323192-1	L2327971-1	L2337326-1
Date Sampled		2019-07-01 10:00	2019-07-08 10:20	2019-07-22 11:00	2019-07-29 9:40	2019-08-05 10:10	2019-08-12 18:40	2019-08-26 11:40
Parameter	Units	Results						
Zinc (Zn)-Total	mg/L	0.217	0.333	0.88	0.21	0.492	0.15	0.555
Zirconium (Zr)-Total	mg/L	<0.0040	<0.0040	<0.010	<0.0040	<0.0040	<0.0040	<0.0040
Alkalinity, Total (as $CaCO_3$)	mg/L	191					188	

Table D1-41. Water Sampling Monitoring Program Results for September to October 2019 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2342721-1	L2344199-1	L2348937-1	L2353077-1	L2357463-1	L2361821-1	L2365124-1	L2369104-1	L2373272-1
Date Sampled		2019-09-04 16:20	2019-09-09 11:20	2019-09-16 15:40	2019-09-23 11:00	2019-09-30 11:00	2019-10-07 10:45	2019-10-14 14:15	2019-10-21 13:40	2019-10-28 14:30
Parameter	Units	Results								
pH	pH	7.82	3.54	7.86	7.88	7.91	7.84	7.67	7.75	7.87
Conductivity	µS/cm		33300				31500			
Total Suspended Solids	mg/L	10600	10900	4350	1200	3300	16800	2110	793	12600
Total Dissolved Solids	mg/L	21800	22600	21000	23300	21800	21800	19000	21100	17400
Chloride (Cl)	mg/L	11100	11000	11200	11700	11300	11000	11400	11600	9690
Bromide (Br)	mg/L		42.5				40.8			
Fluoride (F)	mg/L		<2.0				<2.0			
Cyanide, Total	mg/L	0.244	1.72	0.0886	0.0668	0.462	1.38	0.187	0.315	0.248
Cyanide, WAD	mg/L		0.0072				<0.0050			
Ammonia, Total (as N)	mg/L	30.5	27.5	16.5	12.2	48.5	16.5	50.7	52.2	30.8
Nitrate (as N)	mg/L	34.5	354	16.8	11.3	49	16.3	53.7	61.3	33.4
Nitrite (as N)	mg/L		2.09				1.46			
Sulfate (SO_4)	mg/L		1130				1100			
Aluminum (Al)-Total	mg/L	19.8	259	19.9	14.6	24.7	48.5	44.9	11.2	154

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2342721-1	L2344199-1	L2348937-1	L2353077-1	L2357463-1	L2361821-1	L2365124-1	L2369104-1	L2373272-1
Date Sampled		2019-09-04 16:20	2019-09-09 11:20	2019-09-16 15:40	2019-09-23 11:00	2019-09-30 11:00	2019-10-07 10:45	2019-10-14 14:15	2019-10-21 13:40	2019-10-28 14:30
Parameter	**Units**	**Results**								
Antimony (Sb)-Total	mg/L	0.0024	0.0034	<0.0020	<0.0020	<0.0020	0.0021	0.002	0.0021	0.0022
Arsenic (As)-Total	mg/L	0.0228	0.539	0.014	0.0152	0.0221	0.133	0.0446	0.0768	0.211
Barium (Ba)-Total	mg/L	0.108	0.168	0.0817	0.0532	0.0651	0.0934	0.117	0.0772	0.187
Beryllium (Be)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/L	0.0013	0.0085	0.0013	<0.0010	<0.0010	0.0032	<0.0010	<0.0010	0.0013
Boron (B)-Total	mg/L	3.01	3.11	2.83	3.11	3.22	2.79	2.69	2.99	2.84
Cadmium (Cd)-Total	mg/L	0.00065	0.00672	0.00033	0.0003	0.00043	0.0016	0.00045	0.00045	0.00165
Calcium (Ca)-Total	mg/L	1180	1280	998	976	927	1180	1080	1160	1240
Cesium (Cs)-Total	mg/L	0.00087	0.00294	0.00093	0.00114	0.00111	0.00076	0.00117	0.00063	0.00232
Chromium (Cr)-Total	mg/L	0.0349	0.516	0.0255	0.022	0.0494	0.0904	0.0484	0.0318	0.121
Cobalt (Co)-Total	mg/L	0.0477	0.501	0.0361	0.0211	0.0358	0.108	0.0635	0.0378	0.22
Copper (Cu)-Total	mg/L	1.06	11.9	0.352	0.307	0.712	5.07	1.11	1.53	1.79
Iron (Fe)-Total	mg/L	246	889	203	63.1	74.9	304	152	44.7	644
Lead (Pb)-Total	mg/L	0.134	0.528	0.0695	0.0233	0.0549	0.27	0.0366	0.0155	0.154
Lithium (Li)-Total	mg/L	0.133	0.321	0.124	0.122	0.136	0.154	0.143	0.116	0.23
Magnesium (Mg)-Total	mg/L	839	935	732	731	784	799	684	694	804
Manganese (Mn)-Total	mg/L	9.71	15.9	7.43	2.92	3.09	9.6	4.22	2.31	13.3
Mercury (Hg)-Total	mg/L		<0.00010				0.0000065			
Molybdenum (Mo)-Total	mg/L	0.0098	0.0453	0.0074	0.0063	0.0097	0.0115	0.0176	0.013	0.0236
Nickel (Ni)-Total	mg/L	0.046	0.44	0.03	0.018	0.212	0.101	0.059	0.068	0.153
Phosphorus (P)-Total	mg/L	7.7	9.7	4.9	1	<1.0	6.6	2	<1.0	9.3
Potassium (K)-Total	mg/L	182	176	170	170	177	168	183	187	166
Rubidium (Rb)-Total	mg/L	0.0959	0.0961	0.0911	0.0838	0.0929	0.0849	0.1	0.0873	0.1
Selenium (Se)-Total	mg/L	0.0054	0.0117	0.0012	0.0012	<0.0010	0.002	<0.0010	0.0017	0.0037
Silicon (Si)-Total	mg/L	22.1	232	23.7	21.8	33.5	60.2	57.3	17.9	148
Silver (Ag)-Total	mg/L	0.00315	0.0325	0.00142	0.00087	0.00121	0.0076	0.00234	0.00296	0.00418

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2342721-1	L2344199-1	L2348937-1	L2353077-1	L2357463-1	L2361821-1	L2365124-1	L2369104-1	L2373272-1
Date Sampled		2019-09-04 16:20	2019-09-09 11:20	2019-09-16 15:40	2019-09-23 11:00	2019-09-30 11:00	2019-10-07 10:45	2019-10-14 14:15	2019-10-21 13:40	2019-10-28 14:30
Parameter	**Units**	**Results**								
Sodium (Na)-Total	mg/L	5980	5710	5800	5700	6110	5560	5030	5600	5270
Strontium (Sr)-Total	mg/L	11.2	11	10.6	11.8	12.4	11.4	11.6	12.3	10.1
Tellurium (Te)-Total	mg/L	<0.0040	0.0085	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/L	<0.00020	0.00079	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thorium (Th)-Total	mg/L	<0.0020	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0039
Tin (Sn)-Total	mg/L	<0.0020	0.0022	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Titanium (Ti)-Total	mg/L	0.0808	3.19	0.139	0.251	0.449	0.501	0.727	0.188	1.34
Tungsten (W)-Total	mg/L	0.0046	0.0243	0.0038	0.0029	0.0031	0.0055	0.004	0.0037	0.0099
Uranium (U)-Total	mg/L	0.00065	0.00076	0.00044	0.00042	0.00048	0.00064	0.00063	0.00043	0.00119
Vanadium (V)-Total	mg/L	0.063	0.914	0.065	0.055	0.089	0.169	0.158	0.043	0.446
Zinc (Zn)-Total	mg/L	0.541	3.87	0.373	0.188	0.757	0.941	0.393	0.167	1.4
Zirconium (Zr)-Total	mg/L	<0.0040	0.0057	0.0048	<0.0040	<0.0040	0.0058	<0.0040	<0.0040	0.0057
Alkalinity, Total (as $CaCO_3$)	mg/L		<1.0				175			

Table D1-42. Water Sampling Monitoring Program Results for November to December 2019 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL-12A	TL-12A
ALS ID		L2377605-1	L2380649-1	L2384190-1	L2387742-1	L2391161-1	L2394106-1	L2394106-2	L2397389-1
Date Sampled		2019-11-04 16:15	2019-11-11 10:45	2019-11-18 17:25	2019-11-25 16:30	2019-12-02 14:30	2019-12-09 11:05	2019-12-09 11:35	2019-12-16 16:30
Parameter	**Units**	**Results**							
pH	pH	7.82	7.88	7.82	7.82	7.87	7.91	8	7.97
Conductivity	µS/cm	29800				27000			
Total Suspended Solids	mg/L	1070	1560	6760	279	4430	4680	90.8	268
Total Dissolved Solids	mg/L	21500	20000	20300	20700	19600	20000	17700	18500

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL-12A	TL-12A
ALS ID		L2377605-1	L2380649-1	L2384190-1	L2387742-1	L2391161-1	L2394106-1	L2394106-2	L2397389-1
Date Sampled		2019-11-04 16:15	2019-11-11 10:45	2019-11-18 17:25	2019-11-25 16:30	2019-12-02 14:30	2019-12-09 11:05	2019-12-09 11:35	2019-12-16 16:30
Parameter	**Units**	**Results**							
Chloride (Cl)	mg/L	11900	11100	10500	11200	9000	10300	9280	10500
Bromide (Br)	mg/L	43.6				31.9			
Fluoride (F)	mg/L	<2.0				<2.0			
Cyanide, Total	mg/L	0.0926	0.0895	0.451	0.6	0.108	0.0868	0.0781	0.074
Cyanide, WAD	mg/L	<0.0050				0.0246			
Ammonia, Total (as N)	mg/L	20.9	15.7	16.9	66.7	25.5	11.7	13	14.7
Nitrate (as N)	mg/L	20.9	16.8	18.3	63.9	26.7	11.3	13.6	15.3
Nitrite (as N)	mg/L	1.15				2.5			
Sulfate (SO_4)	mg/L	1200				912			
Aluminum (Al)-Total	mg/L	49.1	29.6	157	6.68	40.5	56.6	2.69	5.56
Antimony (Sb)-Total	mg/L	<0.0020	0.0019	<0.0020	<0.0020	0.0026	<0.0020	<0.0010	<0.0020
Arsenic (As)-Total	mg/L	0.107	0.0775	0.437	0.0066	0.0892	0.144	0.0047	0.0392
Barium (Ba)-Total	mg/L	0.0985	0.0647	0.123	0.0579	0.0959	0.0945	0.0458	0.0576
Beryllium (Be)-Total	mg/L	<0.0020	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020
Bismuth (Bi)-Total	mg/L	<0.0010	<0.00050	0.0025	<0.0010	<0.0010	0.0019	<0.00050	<0.0010
Boron (B)-Total	mg/L	2.91	3.19	2.88	3.02	2.76	3.08	2.44	2.88
Cadmium (Cd)-Total	mg/L	0.00072	0.00046	0.00231	<0.00010	0.00079	0.0014	<0.000050	0.00014
Calcium (Ca)-Total	mg/L	894	878	1060	852	810	996	632	774
Cesium (Cs)-Total	mg/L	0.00106	0.00073	0.00228	0.00092	0.00116	0.00092	0.00041	0.00037
Chromium (Cr)-Total	mg/L	0.055	0.0398	0.234	0.0144	0.0505	0.0962	0.0045	0.0122
Cobalt (Co)-Total	mg/L	0.0839	0.0578	0.29	0.0099	0.081	0.113	0.005	0.0154
Copper (Cu)-Total	mg/L	0.78	0.809	4.12	0.127	1.22	2.09	0.112	0.332
Iron (Fe)-Total	mg/L	201	118	572	17.1	189	263	8.06	23.8
Lead (Pb)-Total	mg/L	0.0513	0.0331	0.16	0.0038	0.0555	0.131	0.00413	0.0075
Lithium (Li)-Total	mg/L	0.139	0.143	0.212	0.118	0.139	0.164	0.098	0.118
Magnesium (Mg)-Total	mg/L	787	647	761	756	599	674	577	690

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL-12A	TL-12A
ALS ID		L2377605-1	L2380649-1	L2384190-1	L2387742-1	L2391161-1	L2394106-1	L2394106-2	L2397389-1
Date Sampled		2019-11-04 16:15	2019-11-11 10:45	2019-11-18 17:25	2019-11-25 16:30	2019-12-02 14:30	2019-12-09 11:05	2019-12-09 11:35	2019-12-16 16:30
Parameter	**Units**	**Results**							
Manganese (Mn)-Total	mg/L	5.66	3.52	11.5	1.68	4.73	7.53	1.18	1.69
Mercury (Hg)-Total	mg/L	<0.0000050				<0.00010			
Molybdenum (Mo)-Total	mg/L	0.0111	0.0106	0.0276	0.0096	0.0144	0.0123	0.00514	0.0059
Nickel (Ni)-Total	mg/L	0.081	0.0631	0.289	0.021	0.061	0.108	0.0079	0.03
Phosphorus (P)-Total	mg/L	3.4	1.49	6.2	<1.0	2.3	5.7	<0.50	<1.0
Potassium (K)-Total	mg/L	167	161	165	190	144	160	148	165
Rubidium (Rb)-Total	mg/L	0.0929	0.0843	0.0943	0.0918	0.0813	0.0787	0.0682	0.0807
Selenium (Se)-Total	mg/L	0.0015	0.00185	0.0063	<0.0010	0.0024	0.0023	<0.00050	<0.0010
Silicon (Si)-Total	mg/L	55	39.8	156	13.5	48.7	67.9	8	10.2
Silver (Ag)-Total	mg/L	0.00185	0.00188	0.013	0.00061	0.0101	0.00668	0.00033	0.00128
Sodium (Na)-Total	mg/L	5760	5100	4990	5770	4680	5040	4600	5370
Strontium (Sr)-Total	mg/L	10.2	10.2	9.78	10.2	9.18	10.4	8.4	9.53
Tellurium (Te)-Total	mg/L	<0.0040	<0.0020	<0.0040	<0.0040	<0.0040	<0.0040	<0.0020	<0.0040
Thallium (Tl)-Total	mg/L	<0.00020	<0.00010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00010	<0.00020
Thorium (Th)-Total	mg/L	<0.0020	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020
Tin (Sn)-Total	mg/L	<0.0020	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020
Titanium (Ti)-Total	mg/L	0.72	0.602	3.53	0.28	0.522	0.911	0.0463	0.081
Tungsten (W)-Total	mg/L	0.0045	0.0044	0.0255	0.012	0.026	0.0079	0.003	0.0086
Uranium (U)-Total	mg/L	0.00057	0.00039	0.00066	0.00038	0.00064	0.00073	0.00022	0.00038
Vanadium (V)-Total	mg/L	0.161	0.107	0.65	0.029	0.13	0.215	0.0091	0.018
Zinc (Zn)-Total	mg/L	0.467	0.324	1.61	<0.060	0.516	0.732	1.41	0.579
Zirconium (Zr)-Total	mg/L	<0.0040	0.0024	0.0051	<0.0040	<0.0040	0.0041	<0.0020	<0.0040
Alkalinity, Total (as $CaCO_3$)	mg/L	224				211			

In December 2019, underground pumping rates periodically exceeded 2000m^3/day and TMAC provided notice to the Inspector on January 8, 2020 as outlined in Module A of the Hope Bay Groundwater Management Plan. The increased pumping rate was attributed to the installation of an additional pump that allowed for increased dewatering of water being stored in various areas of the mine. Three diamond drill holes were also intersected temporarily increasing inflow rates. Diamond drill holes are routinely encountered during mining activities and are plugged and grouted immediately upon discovery. No discernible decrease in water level was observed in Doris Lake in December. Water level elevations remained consistent with past variations during December.

MMS-1 Madrid North Contact Water Pond

The Madrid North Contact Water Pond (MMS-1) was constructed in 2019 to support the commencement of mining activities at the Madid North site. The pond incorporates a rockfill berm with a geomembrane liner anchored to bedrock to capture contact water runoff from the Madrid North Waste Rock storage pad. Contact water is then transferred from the Contact Water Pond to the TIA.

Water quality samples were collected from this facility in August and September 2019 and results met the criteria outlined in Part F Item 18(a) of the licence. Results of this sampling is provided in Table D1-43. In 2019, all water accumulating in this facility was transferred to the TIA via water truck. A total of 144 m^3 of water was transferred to the TIA from this facility in 2019.

Table D1-43. Water Quality Monitoring Program Results for MMS-1, August, September 2019

	Sample ID	MMS-1	MMS-1	Part F Item 18(a)	
	ALS ID	L2328632-1	L2348922-1	Maximum Monthly Mean Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-08-04 15:45	2019-09-15 11:20		
Parameter	Units	Results			
pH	pH Units	7.94	8.02	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	40.8	21.1	50	100
Chloride (Cl)	mg/L	83.8	37.1		
Cyanide, Total	mg/L	<0.0050	<0.0050		
Ammonia, Total (as N)	mg/L	0.15	0.0802		
Nitrate (as N)	mg/L	1.82	0.906		
Nitrite (as N)	mg/L	0.0369	0.0317		
Sulfate (SO_4)	mg/L	70.9	36		
Aluminum (Al)-Total	mg/L	3.82	1.31		
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050		
Arsenic (As)-Total	mg/L	0.0162	0.0501	0.5	1
Barium (Ba)-Total	mg/L	0.031	<0.020		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10		
Cadmium (Cd)-Total	mg/L	0.000021	0.0000196		
Calcium (Ca)-Total	mg/L	28.7	32.9		
Chromium (Cr)-Total	mg/L	0.0165	0.0047		
Cobalt (Co)-Total	mg/L	0.003	0.00244		
Copper (Cu)-Total	mg/L	0.0105	0.0134		
Iron (Fe)-Total	mg/L	4.91	1.57		

	Sample ID	MMS-1	MMS-1	Part F Item 18(a)	
	ALS ID	L2328632-1	L2348922-1	Maximum Monthly Mean Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-08-04 15:45	2019-09-15 11:20		
Parameter	Units	Results			
Lead (Pb)-Total	mg/L	0.00138	0.0005		
Lithium (Li)-Total	mg/L	0.0069	0.0029		
Magnesium (Mg)-Total	mg/L	11.6	6.03		
Manganese (Mn)-Total	mg/L	0.105	0.0515		
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050		
Molybdenum (Mo)-Total	mg/L	0.0028	<0.0010		
Nickel (Ni)-Total	mg/L	0.0084	0.0062	0.5	1
Potassium (K)-Total	mg/L	7.6	3.4		
Selenium (Se)-Total	mg/L	0.000592	0.00035		
Silver (Ag)-Total	mg/L	<0.000020	<0.000020		
Sodium (Na)-Total	mg/L	66.9	19.2		
Thallium (Tl)-Total	mg/L	0.000032	0.000013		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050		
Titanium (Ti)-Total	mg/L	0.18	0.053		
Uranium (U)-Total	mg/L	0.00129	0.00075		
Vanadium (V)-Total	mg/L	0.0132	0.00534		
Zinc (Zn)-Total	mg/L	0.0135	0.0124		
Alkalinity, Total (as $CaCO_3$)	mg/L	74.1	124		
Oil and Grease	mg/L	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	No Visible Sheen	No Visible Sheen

MMS-9 Site Runoff from Sediment Controls

Monitoring of Madrid Site Runoff (MMS-9) was conducted at the Madrid site in 2019. This included monitoring of the first kilometer of the Madrid North All-Weather Road, Madrid Contact Water Pond, and overburden stockpile and access roads associated with the Naartok East Crown Pillar Recovery Trench.

Water quality samples were collected in areas where runoff was observed from Madrid North infrastructure and compared to the criteria outlined in Part D Item 9 of the licence. Location information of each sample is provided in Table D1-44. Results of this sampling are provided in Table D1-45 through Table D1-47.

Table D1-44. MMS-9 Sample Locations, 2019

Station Name	Location Coordinate	Infrastructure Component
MMS-9A	13W 433539 7550526	Naartok East Crown Pillar Access Road
MMS-9B	13W 433355 7550465	Madrid All Weather Road KM1
MMS-9C	13W 433648 7550564	Naartok East Crown Pillar Access Road
MMS-9D	13W 433708 7550607	Naartok East Crown Pillar Access Road
MMS-9E	13W 433166 7549862	Madrid North Contact Water Pond
MMS-9F	13W 433560 7550539	Naartok East Crown Pillar Access Road
MMS-9G	13W 433126 7550477	Madrid Overburden Stockpile
MMS-9H	13W 433161 7550462	Madrid Overburden Stockpile

One sample collected from location MMS-9C (Naartok East Crown Pillar Access Road) on June 15 exceeded the allowable *Maximum Concentration of Any Grab Sample* for Total Suspended Solids (TSS) outlined in Part D Item 9 of the licence. In response to the high TSS observed in this sample, additional silt fence and coco-matting were placed on the tundra downstream of the runoff. A rock berm was also constructed to manage runoff from the construction area. An additional sample collected on June 16 was below the criteria for TSS demonstrating the sediment control barriers were effective. No additional runoff was observed at this location in 2019.

One sample collected from location MMS-9G (Madrid Overburden Stockpile) on July 7 exceeded the criteria for TSS outlined in Part D Item 9. In response to the high TSS additional material was added to the rock berm which had been constructed at the toe of the overburden stockpile to manage runoff and silt fencing was installed immediately downstream of the observed runoff. No additional runoff was observed following these installations.

Table D1-45. Water Sampling Monitoring Program Results for MMS-9A and MMS-9B, 2019

	Sample ID	MMS-9A	MMS9-A	MMS-9B	MMS9-B	MMS9-B	MMS9-B	Part D Item 9	
	ALS ID	L2285473-1	L2289185-1	L2285473-2	L2289185-2	L2298335-1	L2303143-1	Maximum Average Concentration (mg/L	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-06-02 15:15	2019-06-10 15:55	2019-06-02 15:45	2019-06-10 15:15	2019-06-24 10:10	2019-06-30 11:20		
Parameter	Units	Results							
pH	pH	7.87	7.66	7.83	7.79	7.91	7.5	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	79.9	<3	33.5	3.5	<3	31.8	50	100
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	No Visible Sheen	No Visible Sheen

Table D1-46. Water Sampling Monitoring Program Results for MMS-9C, MMS-9D and MMS-9E, 2019

	Sample ID	MMS9-C	MMS9-C	MMS9-D	MMS9-D	MMS9-E	MMS9-E	Part D Item 9	
	ALS ID	L2293399-1	L2293399-3	L2293399-2	L2293399-4	L2295539-1	L2291711-1	Maximum Average Concentration (mg/L	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-06-15 21:05	2019-06-16 18:15	2019-06-15 21:30	2019-06-16 18:20	2019-06-19 18:15	2019-06-12 18:30		
Parameter	Units	Results							
pH	pH	6.47	6.85	6.96	7.06	7.78	6.93	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	**327**	39.7	34.9	8.9	<3	20	50	100
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	No Visible Sheen	No Visible Sheen

Bold/shading *indicates exceedance of Part D Item 9 Maximum Concentration.*

Table D1-47. Water Sampling Monitoring Program Results for MMS-9F, MMS-9G, and MMS-9H, 2019

	Sample ID	MMS9-F	MMS9-F	MMS9-F	MMS9-F	MMS9-G	MMS9-H	Part D Item 9	
	ALS ID	L2298335-2	L2303143-2	L2307062-1	L2337310-1	L2315432-1	L2315432-2	Maximum Average Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
	Date Sampled	2019-06-24 18:15	2019-06-30 11:50	2019-07-07 10:55	2019-08-23 16:00	2019-07-22 17:30	2019-07-22 17:20		
Parameter	Units	Results							
pH	pH	8.03	7.79	8.07	7.93	7.53	7.44	6.0-9.5	6.0-9.5
Total Suspended Solids	mg/L	6.9	7.8	<3.0	87.6	**4210**	9.3	50	100
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	No Visible Sheen	No Visible Sheen

Bold/shading *indicates exceedance of Part D Item 9 Maximum Concentration.*

Appendix D.2. 2BE-HOP1222

Appendix D.2. 2BE-HOP1222

Table D2-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BE-HOP1222. The location of each sampling point is illustrated in Figure D2-1 below.

Table D2-1. 2BE-HOP1222 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
HOP-1	Raw water supply intake at Windy Lake	B, G, Oil and Grease	Monthly (when in use for Doris)
		D	Daily during periods of pumping
HOP-2*	WWTF effluent discharge at the surge tank prior to being pumped over the ridge east of the Windy Camp Facilities	G, B, MT, Oil and Grease	Monthly
		D	Daily during periods of discharge
HOP-3*	WWTF effluent at a point of entry into Windy lake	G, B, Oil and Grease	Monthly
		Acute Lethality	Annually
		D	Daily during periods of discharge
HOP-4*	Effluent from the Landfarm Treatment Facility pumped to the WWTF surge tank	B, G, Oil and Grease	Once before any discharge, daily when discharging onto the tundra
		D	Daily during periods of discharge
HOP-5*	Effluent from the Bulk Fuel Storage Facility located at the Windy Camp, prior to release	G, MT, HC, TPH, PAH, Nitrate, Nitrite, Total Phenols, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-6*	Effluent from the Bulk Fuel Storage Facility located at the Patch Lake location, prior to release to a location approved by an Inspector	G, MT, HC, Oil and Grease Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-7A, B, and D	Discharge from Quarries A, B, and D respectively	G, N1, MT, Total Sulphate, Alkalinity, Oil and Grease, Electrical Conductivity and Reduction potential (Eh)	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-8*	Effluent from the Bulk Fuel Storage Facility located at the new Windy Camp location, prior to release to a location approved by an Inspector	G, MT, HC, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	G, MT, Electrical Conductivity, Oil and Grease	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

** Station not in use at this time.*

Figure D2-1. 2BE-HOP1222 Sample Stations Locations

SUMMARY OF MONITORING INFORMATION

The following tables summarize the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BE-HOP1222.

The camp water treatment and wastewater treatment facility (WWTF) permitted under this licence were not operational in 2019, therefore no sampling was conducted at monitoring stations HOP-1 (freshwater intake), HOP-2 (WWTF discharge), or HOP-3 (point of entry of WWTF discharge to Windy Lake). Water was utilized from Windy Lake for domestic consumption at Doris Camp and the monitoring station ST-7a/MMS-4b (HOP-1) was sampled for the monitoring criteria under the Doris North Water Licence 2AM-DOH1335. For the ST-7a/MMS-4b results see Table D1-12 and Table D1-13 in Appendix D.1 of this report. The Landfarm at Windy Camp (HOP-4) was dismantled in 2008, so no sampling was conducted at this monitoring station.

The bulk fuel storage tanks at Windy Camp were moved to Doris Camp in winter 2009 for use there, and the bulk fuel storage berm (HOP-5) was dismantled in 2012. The bulk fuel storage berm at Patch Lake laydown (HOP-6) was also dismantled in 2012. No sampling was conducted at either of these monitoring stations.

No sampling occurred at monitoring stations HOP-7A HOP-7B, or HOP-7D (located in Quarries A, B, and D, respectively) during 2019 because no discharge occurred from these locations.

On-ice exploration drilling was conducted in the licence area in 2019 on Patch Lake. Water quality samples were collected to establish water quality prior to, and upon completion of, this on-ice drilling program as outlined in Part F Item 7 and Part J Item 7 of the licence. On-land exploration drilling was also conducted in the licence area in 2019. Results of pre and post on-icing drilling water quality samples are presented in Table D2-2 and Table D2-3.

Table D2-2. Water Quality Sampling Patch Lake Prior to On-Ice Drilling, January 2019

	Sample ID	PLA	PLB	PLC	PLC ^	PLD	PLE
	ALS ID	L2217538-1	L2217538-2	L2217538-3	L2217538-6	L2217538-4	L2217538-5
	Date Sampled	2019-01-06 12:00	2019-01-06 12:45	2019-01-06 13:30	2019-01-06 13:30	2019-01-06 14:20	2019-01-06 14:40
Parameter	**Units**	**Results**					
Conductivity	μS/cm	385	383	380	392	375	446
Hardness (as $CaCO_3$)	mg/L	69.4	73.3	73.2	72.5	71.6	83.6
pH	pH	7.74	7.6	7.68	7.7	7.69	7.73
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Aluminum (Al)-Total	mg/L	0.0385	0.037	0.041	0.0519	0.0425	0.0454
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	12.4	12.6	12.5	12.6	12.4	14.5
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	0.0013	0.0014	0.0014	0.0018	0.0013	0.0018
Iron (Fe)-Total	mg/L	0.075	<0.030	<0.030	0.037	<0.030	0.04
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0054	0.0054	0.0054	0.0054	0.0053	0.0062
Magnesium (Mg)-Total	mg/L	9.32	10.2	10.2	9.99	9.85	11.5
Manganese (Mn)-Total	mg/L	0.00304	0.00262	0.00298	0.00328	0.00335	0.00401
Mercury (Hg)-Total	mg/L	<0.0000050	0.0000063	0.0000106	<0.0000050	0.0000099	0.0000123
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	3.2	3.4	3.4	3.4	3.4	3.9

Sample ID		PLA	PLB	PLC	PLC ^	PLD	PLE
ALS ID		L2217538-1	L2217538-2	L2217538-3	L2217538-6	L2217538-4	L2217538-5
Date Sampled		2019-01-06 12:00	2019-01-06 12:45	2019-01-06 13:30	2019-01-06 13:30	2019-01-06 14:20	2019-01-06 14:40
Parameter	**Units**	**Results**					
Selenium (Se)-Total	mg/L	0.000053	0.000051	<0.000050	<0.000050	<0.000050	0.000054
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	41.3	44.9	44.9	44.9	44.1	51.3
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO

^ Indicates duplicate sample.

Table D2-3. Water Quality Sampling Patch Lake Post On-Ice Drilling, May 2019

Sample ID		PLA	PLB	PLC	PLD	PLE	PLF	PLG	PLG ^
ALS ID		L2272441-1	L2272441-2	L2272441-3	L2272441-4	L2272441-5	L2272441-6	L2272441-7	L2272441-8
Date Sampled		2019-05-12 15:00	2019-05-12 15:30	2019-05-12 15:45	2019-05-12 17:00	2019-05-12 17:15	2019-05-12 16:00	2019-05-12 16:15	2019-05-12 16:15
Parameter	**Units**	**Results**							
Conductivity	µS/cm	457	473	452	450	487	405	392	391
Hardness (as $CaCO_3$)	mg/L	91.3	93.1	87.7	87.8	95.6	77.7	76.2	74.8
pH	pH	7.77	7.72	7.74	7.73	7.76	7.72	7.65	7.72
Total Suspended Solids	mg/L	19.6	8.2	17.4	<3.0	<3.0	<3.0	<3.0	<3.0
Aluminum (Al)-Total	mg/L	0.0215	0.0188	0.0189	0.0234	0.0243	0.033	0.0288	0.0285
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Sample ID		PLA	PLB	PLC	PLD	PLE	PLF	PLG	PLG ^
ALS ID		L2272441-1	L2272441-2	L2272441-3	L2272441-4	L2272441-5	L2272441-6	L2272441-7	L2272441-8
Date Sampled		2019-05-12 15:00	2019-05-12 15:30	2019-05-12 15:45	2019-05-12 17:00	2019-05-12 17:15	2019-05-12 16:00	2019-05-12 16:15	2019-05-12 16:15
Parameter	**Units**	**Results**							
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	15	15.7	15.1	14.9	16.4	13.3	12.9	12.8
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	0.0018	0.0017	0.0016	0.0017	0.0018	0.0016	0.0015	0.0015
Iron (Fe)-Total	mg/L	<0.030	0.035	<0.030	0.031	0.038	<0.030	<0.030	<0.030
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0064	0.0066	0.0064	0.0063	0.0068	0.0057	0.0054	0.0054
Magnesium (Mg)-Total	mg/L	13.1	13.1	12.1	12.3	13.3	10.8	10.7	10.4
Manganese (Mn)-Total	mg/L	0.00393	0.00645	0.00352	0.00349	0.00491	0.00255	0.00225	0.00217
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	4.6	4.6	4.4	4.1	4.7	3.8	3.7	3.7
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	57.4	58.8	54.2	54.5	58.3	49.3	46.9	46.5
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Sample ID		PLA	PLB	PLC	PLD	PLE	PLF	PLG	PLG ^
ALS ID		L2272441-1	L2272441-2	L2272441-3	L2272441-4	L2272441-5	L2272441-6	L2272441-7	L2272441-8
Date Sampled		2019-05-12 15:00	2019-05-12 15:30	2019-05-12 15:45	2019-05-12 17:00	2019-05-12 17:15	2019-05-12 16:00	2019-05-12 16:15	2019-05-12 16:15
Parameter	**Units**	**Results**							
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	NO	NO

^ *Indicates duplicate sample.*

Quantities of Water Utilized for Camp, Drilling and Other Purposes

Water used from Windy Lake for domestic purposes at Doris Camp is reported under monitoring station ST-7a/MMS-4b of water licence 2AM-DOH1335. For the ST-7a/MMS-4b water use see Table D1-9 in Appendix D.1 of this report.

No water was used in 2019 from Windy Lake for dust suppression on the Doris-Windy All-Weather Road. Water for dust suppression was used from Doris Lake and is reported under the 2AM-DOH1335 licence.

A total of 2,457 m^3 of water was used to support surface exploration in 2019 and was sourced from water bodies proximal to the drilling targets. Water was sourced from Patch Lake, Windy Lake, Doris Lake, Milk Bottle Lake, Kamik Lake, Too Lake, Stickleback Lake, Domani Lake and Aimaokatalok Lake. Location coordinates of all water source locations used to support exploration drilling in 2019 are provided in Table D2-4. Daily water utilization is provided in Table D2-5.

Table D2-4. Water Source Locations, 2019

Lake	Location Coordinate
Patch Lake	13W 434265 7550023
Windy Lake	13W 432626 7550477
Doris Lake	13W 433525 7558727
Milk Bottle Lake	13W 433754 7535755
Kamik Lake	13W 434664 7533990
Too Lake	13W 443782 7492790
Stickleback Lake	13W 441658 7503583
Domani Lake	13W 442671 7502506
Aimaokatalok Lake	13W 440965 7504931

Table D2-5. Volume of Water Utilized for Drilling and Dust Suppression Purposes, 2019

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
January			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	7	7
27	0	2	2
28	0	1	1
29	0	5	5
30	0	4	4
31	0	12	12
February			
01	0	0	0
02	0	14	14
03	0	13	13
04	0	9	9
05	0	19	19
06	0	13	13
07	0	38	38
08	0	31	31
09	0	8	8
10	0	11	11
11	0	11	11
12	0	13	13
13	0	4	4
14	0	5	5
15	0	5	5
16	0	5	5
17	0	13	13
18	0	10	10
19	0	4	4
20	0	4	4
21	0	4	4
22	0	7	7

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
23	0	9	9
24	0	3	3
25	0	7	7
26	0	8	8
27	0	9	9
28	0	4	4
March			
01	0	10	10
02	0	10	10
03	0	12	12
04	0	25	25
05	0	30	30
06	0	13	13
07	0	7	7
08	0	13	13
09	0	5	5
10	0	18	18
11	0	21	21
12	0	8	8
13	0	11	11
14	0	32	32
15	0	13	13
16	0	13	13
17	0	7	7
18	0	10	10
19	0	15	15
20	0	8	8
21	0	9	9
22	0	9	9
23	0	7	7
24	0	7	7
25	0	9	9
26	0	16	16
27	0	13	13
28	0	4	4
29	0	7	7
30	0	11	11
31	0	9	9

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
April			
01	0	20	20
02	0	19	19
03	0	23	23
04	0	50	50
05	0	59	59
06	0	27	27
07	0	14	14
08	0	26	26
09	0	11	11
10	0	36	36
11	0	42	42
12	0	16	16
13	0	21	21
14	0	63	63
15	0	26	26
16	0	25	25
17	0	15	15
18	0	20	20
19	0	30	30
20	0	15	15
21	0	17	17
22	0	18	18
23	0	14	14
24	0	13	13
25	0	17	17
26	0	33	33
27	0	27	27
28	0	8	8
29	0	15	15
30	0	22	22
May			
01	0	13	13
02	0	10	10
03	0	14	14
04	0	6	6
05	0	8	8
06	0	14	14
07	0	9	9
08	0	3	3
09	0	0	0

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
June			
01	0	0	0
02	0	0	0
03	0	32	32
04	0	0	0
05	0	2	2
06	0	10	10
07	0	7	7
08	0	12	12
09	0	9	9
10	0	5	5
11	0	6	6
12	0	5	5
13	0	8	8
14	0	6	6
15	0	2	2
16	0	5	5
17	0	3	3
18	0	0	0

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
19	0	8	8
20	0	8	8
21	0	14	14
22	0	5	5
23	0	5	5
24	0	5	5
25	0	5	5
26	0	6	6
27	0	5	5
28	0	5	5
29	0	4	4
30	0	3	3
July			
01	0	9	9
02	0	8	8
03	0	7	7
04	0	11	11
05	0	5	5
06	0	8	8
07	0	12	12
08	0	14	14
09	0	6	6
10	0	9	9
11	0	4	4
12	0	4	4
13	0	3	3
14	0	8	8
15	0	2	2
16	0	25	25
17	0	4	4
18	0	2	2
19	0	2	2
20	0	6	6
21	0	2	2
22	0	11	11
23	0	1	1
24	0	1	1
25	0	6	6
26	0	3	3
27	0	7	7
28	0	4	4

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
29	0	5	5
30	0	3	3
31	0	5	5
August			
01	0	7	7
02	0	4	4
03	0	3	3
04	0	2	2
05	0	5	5
06	0	5	5
07	0	3	3
08	0	5	5
09	0	4	4
10	0	3	3
11	0	3	3
12	0	1	1
13	0	6	6
14	0	4	4
15	0	3	3
16	0	5	5
17	0	4	4
18	0	5	5
19	0	6	6
20	0	6	6
21	0	3	3
22	0	4	4
23	0	3	3
24	0	3	3
25	0	3	3
26	0	5	5
27	0	5	5
28	0	3	3
29	0	2	2
30	0	2	2
31	0	4	4
September			
01	0	4	4
02	0	4	4
03	0	4	4
04	0	3	3
05	0	1	1

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
06	0	2	2
07	0	5	5
08	0	11	11
09	0	6	6
10	0	8	8
11	0	8	8
12	0	5	5
13	0	7	7
14	0	11	11
15	0	10	10
16	0	7	7
17	0	9	9
18	0	5	5
19	0	8	8
20	0	8	8
21	0	8	8
22	0	3	3
23	0	11	11
24	0	19	19
25	0	7	7
26	0	5	5
27	0	9	9
28	0	12	12
29	0	12	12
30	0	9	9
October			
01	0	7	7
02	0	6	6
03	0	2	2
04	0	7	7
05	0	4	4
06	0	2	2
07	0	1	1
08	0	3	3
09	0	9	9
10	0	3	3
11	0	5	5
12	0	7	7
13	0	7	7
14	0	2	2
15	0	3	3

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
16	0	2	2
17	0	3	3
18	0	5	5
19	0	6	6
20	0	2	2
21	0	5	5
22	0	5	5
23	0	3	3
24	0	7	7
25	0	7	7
26	0	5	5
27	0	2	2
28	0	2	2
29	0	5	5
30	0	3	3
31	0	3	3
November			
01	0	5	5
02	0	3	3
03	0	3	3
04	0	4	4
05	0	3	3
06	0	0	0
07	0	0	0
08	0	0	0
09	0	3	3
10	0	5	5
11	0	4	4
12	0	6	6
13	0	5	5
14	0	4	4
15	0	7	7
16	0	6	6
17	0	5	5
18	0	5	5
19	0	6	6
20	0	4	4
21	0	4	4
22	0	3	3
23	0	4	4
24	0	6	6

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
25	0	2	2
26	0	0	0
27	0	1	1
28	0	0	0
29	0	0	0
30	0	0	0
December			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0

Note: Values rounded to nearest whole cubic metre.

Hydrology Monitoring – Windy Lake Water Level

Windy Lake water level monitoring was conducted in 2019 as outlined in Part J Item 9 of the licence. In 2019, the station was relocated to the north end of Windy Lake (13W 431404 7554948) to facilitate discharge measurements of the Windy Lake outflow and water level monitoring as outlined in the Hope Bay Aquatic Effects Monitoring Plan. The water level station was reactivated on June 24 after being deactivated during the winter. The station uses an INW PT2X vented pressure transducer with water level readings recorded every 15 minutes. The station operated throughout the open water season until September 20, when the station was deactivated for winter. ERM and TMAC personnel performed one under ice water level survey on April 15, and then ten water level surveys between June 24 and September 20. Data were analysed and mean daily water level in meters above sea level developed for the period of record and are shown in Table D2-6.

Quantity of Effluent Discharged

Windy Camp was closed throughout 2019 therefore no discharges occurred related to the waste water treatment facility (WWTF) at monitoring station HOP-2.

No discharges occurred at the Windy Camp bulk fuel storage facility (HOP-5) in 2019 as this facility was decommissioned in 2012 and the containment berm removed.

No discharges occurred at the Patch Lake bulk fuel storage facility (HOP-6) in 2019 as this facility was decommissioned and the berm removed in 2012.

Volume of Sludge Removed from Sewage Disposal Facility

No sludge was removed from the Windy Camp WWTF in 2019 because this facility was not operational and the camp was closed.

Results of Toxicity Testing

TMAC did not perform toxicity testing to demonstrate the non-acute toxicity of the effluent discharged from the WWTF at HOP-3 (at a point of entry to Windy Lake), as the camp is closed and no effluent was discharged (this facility has been removed). The testing is normally conducted in accordance with the following test procedures:

1. Acute lethality to Rainbow Trout, Oncorhynchus mykiss (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13); and
2. Acute lethality to the crustacean, Daphnia magna (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14).

Table D2-6. Summary of Windy Lake Mean Daily Water Levels, in Metres above Sea Level (masl), 2019

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.489	18.375	18.331	*18.248*	*18.209*	*18.209*
2	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.488	18.372	18.327	*18.244*	*18.209*	*18.209*
3	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.485	18.369	18.322	*18.249*	*18.209*	*18.209*
4	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.479	18.366	18.321	*18.246*	*18.209*	*18.209*
5	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.473	18.363	18.319	*18.245*	*18.209*	*18.209*
6	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.468	18.360	18.315	*18.241*	*18.209*	*18.209*
7	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.469	18.357	18.312	*18.235*	*18.209*	*18.209*
8	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.468	18.354	18.312	*18.233*	*18.209*	*18.209*
9	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.475	18.351	18.309	*18.225*	*18.209*	*18.209*
10	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.474	18.348	18.305	*18.221*	*18.209*	*18.209*
11	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.470	18.347	18.307	*18.234*	*18.209*	*18.209*
12	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.466	18.345	18.303	*18.240*	*18.209*	*18.209*
13	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.465	18.346	18.300	*18.209*	*18.209*	*18.209*
14	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.275*	18.461	18.345	18.300	*18.209*	*18.209*	*18.209*
15	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.340*	18.458	18.344	18.303	*18.209*	*18.209*	*18.209*
16	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.406*	18.450	18.345	18.297	*18.209*	*18.209*	*18.209*
17	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.472*	18.446	18.343	18.299	*18.209*	*18.209*	*18.209*
18	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.499*	18.440	18.342	18.297	*18.209*	*18.209*	*18.209*
19	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.514*	18.436	18.340	18.296	*18.209*	*18.209*	*18.209*
20	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.522*	18.429	18.341	18.293	*18.209*	*18.209*	*18.209*
21	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.528*	18.425	18.338	*18.292*	*18.209*	*18.209*	*18.209*
22	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.528*	18.420	18.342	*18.290*	*18.209*	*18.209*	*18.209*
23	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	*18.526*	18.412	18.345	*18.289*	*18.209*	*18.209*	*18.209*
24	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.522	18.406	18.352	*18.286*	*18.209*	*18.209*	*18.209*
25	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.518	18.399	18.350	*18.284*	*18.209*	*18.209*	*18.209*
26	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.514	18.394	18.351	*18.278*	*18.209*	*18.209*	*18.209*
27	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.510	18.390	18.348	*18.272*	*18.209*	*18.209*	*18.209*
28	*18.209*	*18.209*	*18.209*	*18.209*	*18.209*	18.502	18.387	18.345	*18.267*	*18.209*	*18.209*	*18.209*

Date	January	February	March	April	May	June	July	August	September	October	November	December
29	*18.209*		*18.209*	*18.209*	*18.209*	18.495	18.384	18.345	*18.262*	*18.209*	*18.209*	*18.209*
30	*18.209*		*18.209*	*18.209*	*18.209*	18.491	18.381	18.341	*18.258*	*18.209*	*18.209*	*18.209*
31	*18.209*		*18.209*		*18.209*		18.378	18.334		*18.209*		*18.209*
Minimum	18.209	18.209	18.209	18.209	18.209	18.363	18.441	18.350	18.298	18.221	18.209	18.209
Maximum	18.209	18.209	18.209	18.209	18.209	18.528	18.489	18.375	18.331	18.249	18.209	18.209
Mean	18.209	18.209	18.209	18.209	18.209	18.209	18.378	18.334	18.258	18.209	18.209	18.209

Note: Estimated and modelled values are italicized.

Appendix D.3. 2BB-MAE1727

Appendix D.3. 2BB-MAE1727

Table D3-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BB-MAE1727. Sample station locations have not yet been established at this time as work has not commenced under this licence. Sample points and discharge locations for SNP stations under this licence will be established in consultation with the Inspector. The proposed sample point locations for SNP Stations MAE-14, MAE-15 and MAE-16 are illustrated in Figure D3-1 below.

Table D3-1. 2BB-MAE1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
MAE-01*	Madrid North, Freshwater intake at Windy Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-02*	Madrid South, Freshwater intake at Patch Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-03*	Freshwater intake at other Lakes	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-04*	Madrid North Pollution Control Pond (PCP) Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-05*	Madrid South Pollution Control Pond No.1 Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-06*	Madrid South Pollution Control Pond No.2 Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
MAE-07*	Madrid North Fuel Storage Area Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-08*	Madrid North Fuel Transfer Station Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-09*	Madrid South Fuel Storage Area Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-10*	Madrid South Fuel Transfer Station Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-11*	Quarry G Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
MAE-12*	Quarry H Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-13*	Quarry I Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-14*	Windy Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
MAE-15*	Patch Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
MAE-16*	Wolverine Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
Drill Sites	Under-ice sampling before and after drilling	pH, TSS, Electrical Conductivity, Total Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Hg, Pb, Li, Mn, Mo, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of pumping
Mine Sumps*	Water from Madrid South Underground Mine Water Sumps during periods of Water inflow	Total Dissolved Solids, pH, Electrical Conductivity, Chloride, Total Ammonia and Nitrate, Alkalinity, Sulfate, Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Three times per year

** Station not in use at this time.*

Figure D3-1. 2BB-MAE1727 Sample Stations Locations

SUMMARY OF MONITORING INFORMATION

The following summarizes the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BB-MAE1727.

No activity occurred at the Madrid North or Madrid South sites under this licence in 2019. Monitoring was not undertaken at monitoring stations MAE-01 (Madrid North Windy Lake Freshwater intake), MAE-02 (Madrid South Patch Lake Freshwater intake) or MAE-03 (Freshwater intake at other lakes) as no water was obtained from these locations for use under this licence. No water was used for domestic, drilling or all other purposes and no waste was deposited under this licence in 2019. Location coordinates of all water sources and locations of waste deposit will be reported as required.

Monitoring of the Madrid North Contact Water Pond was conducted under water licence 2AM-DOH1335 (MMS-1). Results of this monitoring are presented in Appendix D.1 of this report. No discharge occurred and no monitoring was conducted at MAE-05 (Madrid South Pollution Control Pond No.1) or MAE-06 (Madrid South Pollution Control Pond No.2) as these facilities have not yet been constructed.

The Fuel Storage Areas and Transfer Stations at Madrid North (MAE-07 and MAE-08) and Madrid South (MAE-09 and MAE-10) have not yet been constructed. No water quality monitoring was conducted and no discharge occurred at these sampling locations.

Quarrying activities have not yet been undertaken at Quarry G (MAE-11), Quarry H (MAE-12) or Quarry I (MAE-13). No sampling or discharge was required for these monitoring locations in 2019.

No sampling was conducted at lakes located immediately downgradient of Madrid North and Madrid South Pollution Control Pond discharge locations (MAE-14, Windy Lake; MAE-15, Patch Lake; MAE-16, Wolverine Lake). The Madrid North Contact Water Pond is monitored under water licence 2AM-DOH1335 and the Madrid South Pollution Control Ponds have not yet been constructed.

Underground mining began at Madrid North in Q4 of 2019 under water licence 2AM-DOH1335. Underground mining has not yet commenced at Madrid South. No water was discharged from underground sumps at Madrid North in 2019 and no water quality monitoring was conducted.

On-ice surface exploration was not conducted in the licence area in 2019, therefore under-ice water quality sampling was not required. On-ice surface exploration activities conducted in 2019 were monitored under water licence 2BE-HOP1222. Results of this monitoring are provided in Appendix D.2.

Appendix D.4. 2BB-BOS1727

Appendix D.4. 2BB-BOS1727

Table D4-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BB-BOS1727. The location of each sampling point is illustrated in Figure D4-1 below.

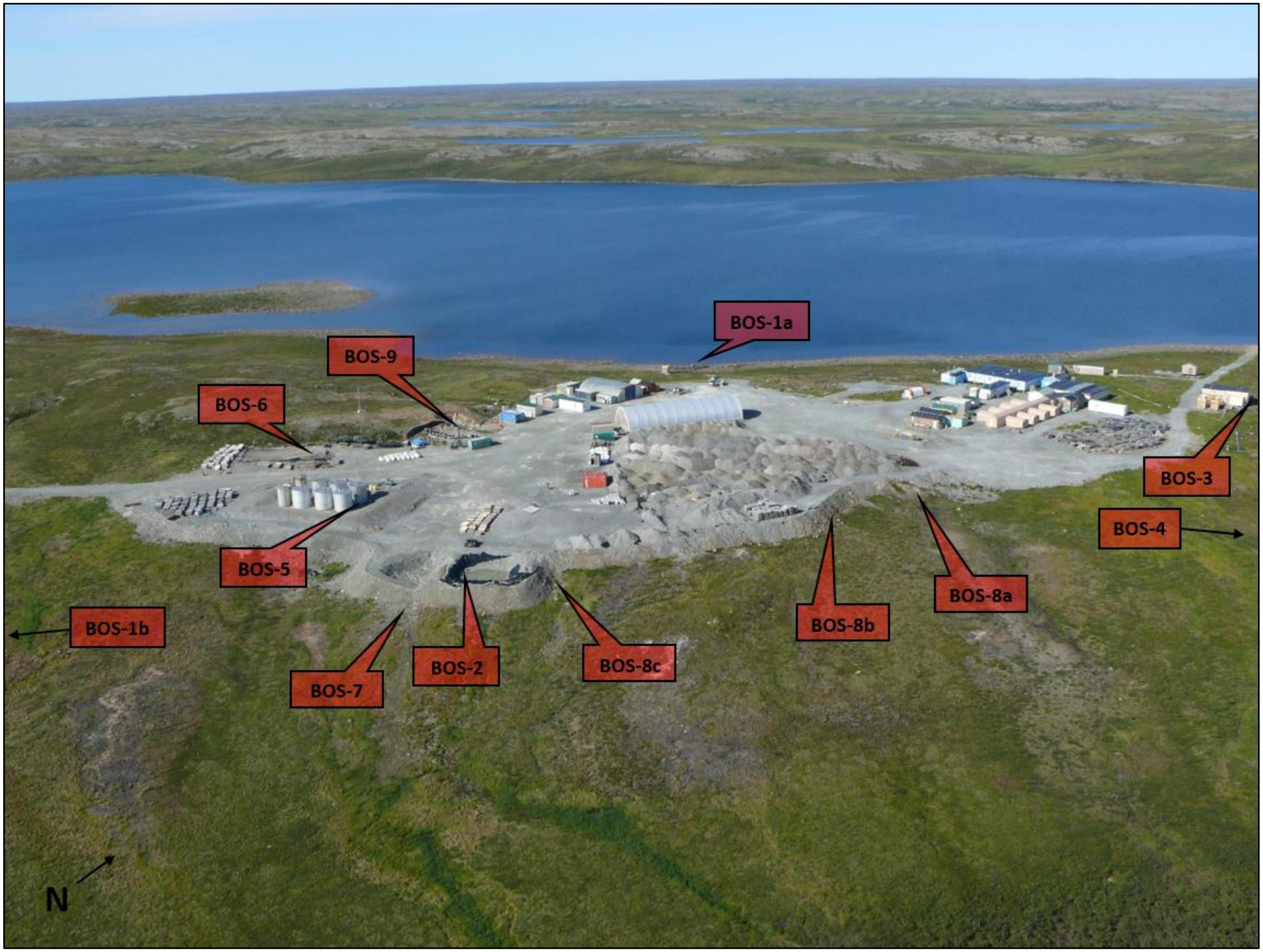
Table D4-1. 2BB-BOS1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
BOS-1a	Raw water supply intake at Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-1b	Raw water supply intake at Stickleback Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-2	Containment Pond discharge	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	Prior to discharge, weekly during periods of discharge
		D	Daily during periods of discharge
BOS-3	Sewage Disposal Facility final discharge	BOD_5, TSS, Oil and Grease, Fecal Coliforms, pH	Monthly
		D	Daily during periods of discharge
BOS-4	Treated sewage effluent point prior to entry into Aimaokatalok (Spyder) Lake	BOD5, TSS, Oil and Grease, Fecal Coliforms, pH	Once before any discharge, daily when discharging onto the tundra
		Acute Lethality	Annually
BOS-5	Effluent from the Bulk Fuel Storage Facility prior to release to a location approved by an Inspector	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se. TTPH	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
BOS-6	Effluent from the Landfarm Treatment Facility prior to release	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
BOS-7*	Runoff from the temporary storage of hydrocarbon contaminated soils prior to discharge onto the tundra	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	During periods of observed flow
		D	Daily during periods of discharge
BOS-8	Waste Rock and Ore Storage Pad	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Initially during spring thaw and monthly during periods of observed flow
BOS-9	Portal decline, surface water runoff discharged to onto the tundra	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Once before any discharge
		D	Daily during periods of discharge
BOS-10*	Underground Mine Water Sumps pumped from Underground	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Three times a year, during periods of water inflow
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	pH, TSS, Electrical Conductivity, Total Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Hg, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

** Station not in use at this time.*

Figure D4-1. 2BB-BOS1727 Sample Stations Locations



TABULAR SUMMARY OF MONITORING INFORMATION

The following tables summarize the results of sampling undertaken in 2019 as part of the monitoring program detailed in Part J of licence 2BB-BOS1727.

Boston Camp was reopened on June 21 to support a seasonal regional surface exploration program. This program was concluded November 27 and the camp was closed December 8.

In 2019, a total of 732 m^3 of water was used from Aimaokatalok (Spyder) Lake (BOS-1a) for domestic camp purposes. No other water sources were used under this licence in 2019. Daily water usage is presented in Table D4-2 below. Water usage for the regional surface exploration drilling activities was reported under water licence 2BB-HOP1222 for 2019. Table D2-5 in Appendix D.2 provides volumes of water used to support the regional surface exploration program. Water usage was metered at the source.

Water quality samples were collected at the raw water supply intake at Aimaokatalok (Spyder) Lake (BOS-1a) from June to November 2019. Due to an unanticipated power supply issue at Boston Camp in early December, no water quality sample was collected in December prior to closing the camp. Results of this monitoring are presented in Table D4-3.

No water was used from Stickleback Lake (BOS-1b) and no water quality samples were collected from this locations in 2019.

Pre-discharge water quality samples were collected from the Containment Pond (BOS-2) on June 23 and met the criteria outlined in Part D Item 6 of the licence. Dewatering of this facility occurred in July once compliant results were received. A total of 95m^3 was discharged to tundra at a location approved by the Inspector (13W 441332 7505378). Results of sampling conducted at the Containment Pond (BOS-2) are presented in Table D4-4 below.

The Sewage Treatment Facility (BOS-3) was reactivated in 2019. Pre-discharge samples were collected in July to confirm effluent quality results prior to discharge. Effluent discharge from the Sewage Treatment Facility began on July 13 upon receiving compliant results. Results of monitoring at BOS-3 are presented in Table D4-5 below. A total of 623 m^3 of compliant effluent was discharged from the Sewage Treatment Facility to the tundra at a location approved by the Inspector (13W 441191 7505560). Monthly and annual volumes of effluent discharge from BOS-3 are provided in Table D4-6 below. Sewage sludge produced in the Sewage Treatment Facility was removed and stored in plastic totes prior to closing of Boston Camp. A total of 9 m^3 of sewage sludge was removed in December and backhauled to Doris Camp via winter track for disposal in the Tailings Impoundment Area in 2019.

Monitoring was conducted monthly of the treated sewage effluent discharge at the point prior to entry into Aimaokatalok (Spyder) Lake (BOS-4) during periods of discharge. No observable flow was identified at this station in 2019 and no water quality samples were collected.

Table D4-2. Volume of Water Utilized for Domestic and Drilling Purposes, 2019

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
January			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
February			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
March			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
April			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
28	0	0	0
29	0	0	0
30	0	0	0
May			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0
June			
01	0	0	0
02	0	0	0
03	0	0	0
04	0	0	0
05	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	4	0	4
24	0	0	0
25	0	0	0
26	5	0	5
27	0	0	0
28	0	0	0
29	4	0	4
30	0	0	0
July			
01	0	0	0
02	4	0	4
03	0	0	0
04	0	0	0
05	8	0	8
06	0	0	0
07	0	0	0
08	0	0	0
09	5	0	5
10	0	0	0
11	2	0	2
12	0	0	0
13	6	0	6
14	0	0	0
15	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
16	5	0	5
17	0	0	0
18	0	0	0
19	5	0	5
20	0	0	0
21	5	0	5
22	8	0	8
23	0	0	0
24	5	0	5
25	0	0	0
26	9	0	9
27	2	0	2
28	8	0	8
29	0	0	0
30	10	0	10
31	7	0	7
August			
01	7	0	7
02	0	0	0
03	7	0	7
04	7	0	7
05	0	0	0
06	0	0	0
07	4	0	4
08	4	0	4
09	4	0	4
10	3	0	3
11	3	0	3
12	3	0	3
13	5	0	5
14	3	0	3
15	3	0	3
16	3	0	3
17	4	0	4
18	3	0	3
19	5	0	5
20	4	0	4
21	4	0	4
22	5	0	5
23	2	0	2
24	7	0	7

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
25	5	0	5
26	5	0	5
27	5	0	5
28	5	0	5
29	5	0	5
30	4	0	4
31	4	0	4
September			
01	6	0	6
02	6	0	6
03	5	0	5
04	6	0	6
05	6	0	6
06	5	0	5
07	7	0	7
08	6	0	6
09	7	0	7
10	6	0	6
11	13	0	13
12	7	0	7
13	6	0	6
14	6	0	6
15	13	0	13
16	7	0	7
17	6	0	6
18	6	0	6
19	2	0	2
20	8	0	8
21	2	0	2
22	7	0	7
23	6	0	6
24	7	0	7
25	6	0	6
26	5	0	5
27	5	0	5
28	6	0	6
29	5	0	5
30	6	0	6

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
October			
01	6	0	6
02	7	0	7
03	6	0	6
04	5	0	5
05	7	0	7
06	0	0	0
07	9	0	9
08	5	0	5
09	5	0	5
10	5	0	5
11	6	0	6
12	6	0	6
13	5	0	5
14	5	0	5
15	5	0	5
16	7	0	7
17	5	0	5
18	6	0	6
19	5	0	5
20	5	0	5
21	6	0	6
22	5	0	5
23	6	0	6
24	6	0	6
25	0	0	0
26	4	0	4
27	6	0	6
28	5	0	5
29	6	0	6
30	6	0	6
31	5	0	5
November			
01	7	0	7
02	3	0	3
03	6	0	6
04	6	0	6
05	7	0	7
06	6	0	6
07	0	0	0
08	5	0	5

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
09	5	0	5
10	4	0	4
11	5	0	5
12	5	0	5
13	5	0	5
14	6	0	6
15	5	0	5
16	4	0	4
17	12	0	12
18	5	0	5
19	5	0	5
20	5	0	5
21	6	0	6
22	5	0	5
23	5	0	5
24	4	0	4
25	4	0	4
26	5	0	5
27	5	0	5
28	5	0	5
29	5	0	5
30	4	0	4
December			
01	5	0	5
02	5	0	5
03	3	0	3
04	0	0	0
05	0	0	0
06	0	0	0
07	0	0	0
08	0	0	0
09	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0

Date	Domestic Water Usage Total (m^3)	Regional Drill Water Usage Total (m^3)	Total Daily Usage (m^3)
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	0	0	0
27	0	0	0
28	0	0	0
29	0	0	0
30	0	0	0
31	0	0	0

Note: Values rounded to nearest whole cubic metre.

Table D4-3. Results of 2019 Aimaokatalok (Spyder) Lake Water Supply Intake (BOS-1a) Water Quality Samples

	Sample ID	BOS1A	BOS1A ^	BOS1A	BOS1A	BOS1A	BOS1A	BOS1A	BOS1A
	ALS ID	L2293596-1	L2293596-2	L2298333-1	L2306654-1	L2325688-1	L2340702-1	L2361767-1	L2377022-4
	Date Sampled	2019-06-17 13:30	2019-06-17 13:30	2019-06-24 14:55	2019-07-08 16:55	2019-08-07 16:00	2019-09-02 15:00	2019-10-07 16:00	2019-11-04 11:45
Parameter	**Units**	**Results**							
pH		7.09	7.23	7.05	7.06	7.01	7.47	7.1	7.18
Total Suspended Solids	mg/L	3.7	<3.0	3.8	<3.0	<3.0	<3.0	5.2	<3.0
Chloride (Cl)	mg/L	9.1	10.6	6.31	5.73	7.16	9.04	12.3	9.65
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ammonia, Total (as N)	mg/L	0.0266	0.159	0.023	<0.0050	0.0072	0.0091	0.0119	0.0102
Nitrate (as N)	mg/L	0.0221	0.0676	0.0202	0.0237	0.0054	<0.0050	<0.0050	0.0093
Nitrite (as N)	mg/L	<0.0010	0.0094	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Aluminum (Al)-Total	mg/L	0.0413	0.041	0.157	0.0698	0.0373	0.0754	0.046	0.0307
Arsenic (As)-Total	mg/L	0.00245	0.00232	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cadmium (Cd)-Total	mg/L	0.0000412	0.000176	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	5.61	5.88	2.07	2.14	2.14	3.29	2.84	2.69
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Copper (Cu)-Total	mg/L	5.24	3.68	<0.0010	0.0954	0.0209	0.022	0.152	0.028
Iron (Fe)-Total	mg/L	0.749	0.539	0.587	0.372	0.182	0.189	0.154	0.196
Lead (Pb)-Total	mg/L	0.0197	0.163	<0.00050	0.00162	0.002	0.00062	0.00259	0.00083
Mercury (Hg)-Total	mg/L	0.0000171	0.0000089	<0.0000050	<0.0000050	<0.0000050	0.0000087	0.0000158	0.0000055
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	0.0403	0.106	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0142	0.0178	0.0156	0.0093	0.0073	0.0094	0.008	0.0085
Selenium (Se)-Total	mg/L	0.000095	0.000126	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silver (Ag)-Total	mg/L	0.000372	0.000254	<0.000020	<0.000020	<0.000020	<0.000020	0.000123	<0.000020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Sample ID		BOS1A	BOS1A ^	BOS1A	BOS1A	BOS1A	BOS1A	BOS1A	BOS1A
ALS ID		L2293596-1	L2293596-2	L2298333-1	L2306654-1	L2325688-1	L2340702-1	L2361767-1	L2377022-4
Date Sampled		2019-06-17 13:30	2019-06-17 13:30	2019-06-24 14:55	2019-07-08 16:55	2019-08-07 16:00	2019-09-02 15:00	2019-10-07 16:00	2019-11-04 11:45
Parameter	Units	Results							
Zinc (Zn)-Total	mg/L	0.287	2.07	<0.0050	0.0479	0.0104	0.0104	0.0152	0.0119
Biochemical Oxygen Demand (BOD5)	mg/L	<2.0	<2.0	5	3	<2.0	3	4	2
Fecal Coliforms	MPN/100mL	41		<1	<1	<1	<1	<1	<1
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	NO	NO

^ *Indicates duplicate sample.*

Table D4-4. Results of 2019 Containment Pond (BOS-2) Effluent Samples

Sample ID		BOS2	BOS2 ^	Part D Item 6	
ALS ID		L2298182-1	L2298182-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
Date Sampled		2019-06-23 15:10	2019-06-23 15:10		
Parameter	Units	Results			
Conductivity	µS/cm	182	182		
Hardness (as $CaCO_3$)	mg/L	74.1	72.8		
pH	pH	7.21	7.22	6.5-9.0	
Total Suspended Solids	mg/L	6.2	6.8	15	30
Alkalinity, Total (as $CaCO_3$)	mg/L	10.3	10.1		
Nitrate (as N)	mg/L	0.0077	0.0068	130	260
Nitrite (as N)	mg/L	0.0017	0.0013		
Sulfate (SO_4)	mg/L	57.8	57.7		
Aluminum (Al)-Total	mg/L	0.0398	0.0404		
Antimony (Sb)-Total	mg/L	0.00055	0.00059		
Arsenic (As)-Total	mg/L	0.0198	0.0201	0.050	0.10
Barium (Ba)-Total	mg/L	<0.020	<0.020		

	Sample ID	BOS2	BOS2 ^	Part D Item 6	
	ALS ID	L2298182-1	L2298182-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	2019-06-23 15:10	2019-06-23 15:10		
Parameter	Units	Results			
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10		
Cadmium (Cd)-Total	mg/L	0.000015	0.0000169		
Calcium (Ca)-Total	mg/L	18.1	18.1		
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010		
Cobalt (Co)-Total	mg/L	0.00607	0.00618		
Copper (Cu)-Total	mg/L	0.0083	0.0083	0.02	0.04
Iron (Fe)-Total	mg/L	0.13	0.131		
Lead (Pb)-Total	mg/L	0.00083	0.00092	0.01	0.02
Lithium (Li)-Total	mg/L	0.0021	0.0021		
Magnesium (Mg)-Total	mg/L	7	6.73		
Manganese (Mn)-Total	mg/L	0.035	0.0348		
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050		
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010		
Nickel (Ni)-Total	mg/L	0.0084	0.0085	0.25	0.5
Potassium (K)-Total	mg/L	<2.0	<2.0		
Selenium (Se)-Total	mg/L	0.000139	0.000154		
Silver (Ag)-Total	mg/L	<0.000020	<0.000020		
Sodium (Na)-Total	mg/L	2.9	2.8		
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050		
Titanium (Ti)-Total	mg/L	<0.010	<0.010		
Uranium (U)-Total	mg/L	<0.00020	<0.00020		
Vanadium (V)-Total	mg/L	<0.00050	<0.00050		
Zinc (Zn)-Total	mg/L	0.377	0.378	0.3	0.6
Oil and Grease	mg/L	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	No visible sheen	No visible sheen

	Sample ID	BOS2	BOS2 ^	Part D Item 6	
	ALS ID	L2298182-1	L2298182-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	2019-06-23 15:10	2019-06-23 15:10		
Parameter	Units	Results			
Phenols (4AAP)	mg/L	<0.0010	<0.0010		
Benzene	mg/L	<0.00050	<0.00050		
Ethylbenzene	mg/L	<0.00050	<0.00050		
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050		
Styrene	mg/L	<0.00050	<0.00050		
Toluene	mg/L	<0.00045	<0.00045		
ortho-Xylene	mg/L	<0.00050	<0.00050		
meta- & para-Xylene	mg/L	<0.00050	<0.00050		
Xylenes	mg/L	<0.00075	<0.00075		
4-Bromofluorobenzene (SS)	%	91.5	89.4		
1,4-Difluorobenzene (SS)	%	98.7	97.9		
TPH10-32	mg/L	<1.0	<1.0		
2-Bromobenzotrifluoride, EPH-sg	%	74.8	73.6		
Acenaphthene	mg/L	<0.000010	<0.000010		
Acenaphthylene	mg/L	<0.000010	<0.000010		
Acridine	mg/L	<0.000010	<0.000010		
Anthracene	mg/L	<0.000010	<0.000010		
Benz(a)anthracene	mg/L	<0.000010	<0.000010		
Benzo(a)pyrene	mg/L	<0.0000050	<0.0000050		
Benzo(b&j)fluoranthene	mg/L	<0.000010	<0.000010		
Benzo(b+j+k)fluoranthene	mg/L	<0.000015	<0.000015		
Benzo(g,h,i)perylene	mg/L	<0.000010	<0.000010		
Benzo(k)fluoranthene	mg/L	<0.000010	<0.000010		
Chrysene	mg/L	<0.000010	<0.000010		
Dibenz(a,h)anthracene	mg/L	<0.0000050	<0.0000050		
Fluoranthene	mg/L	<0.000010	<0.000010		
Fluorene	mg/L	<0.000010	<0.000010		

Sample ID		BOS2	BOS2 ^	Part D Item 6	
ALS ID		L2298182-1	L2298182-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
Date Sampled		2019-06-23 15:10	2019-06-23 15:10		
Parameter	Units	Results			
Indeno(1,2,3-c,d)pyrene	mg/L	<0.000010	<0.000010		
1-Methylnaphthalene	mg/L	<0.000050	<0.000050		
2-Methylnaphthalene	mg/L	<0.000050	<0.000050		
Naphthalene	mg/L	<0.000050	<0.000050		
Phenanthrene	mg/L	<0.000020	<0.000020		
Pyrene	mg/L	<0.000010	0.000012		
Quinoline	mg/L	0.000096	0.000097		

Bold/shading *indicates exceedance of criteria outlined in Part D Item 6 Maximum Concentration.*
^ Indicates duplicate sample.

Table D4-5. Results of 2019 Sewage Treatment Facility Treated Effluent Samples (BOS-3)

Sample ID		BOS3	BOS3	BOS3	BOS3	BOS3	BOS3	Part D Item 14
ALS ID		L2303744-1	L2306663-1	L2328791-1	L2346267-1	L2361742-1	L2376138-1	Maximum Allowable Concentration in Any Grab Sample
Date Sampled		2019-07-03 15:40	2019-07-08 16:35	2019-08-12 15:45	2019-09-11 16:00	2019-10-07 16:15	2019-11-01 11:30	
Parameter	Units	Results						
pH		6.94	6.35	6.67	6.68	6.73	6.58	6.0-9.5
Total Suspended Solids	mg/L	<3.0	3.8	39.4	11.6	11.6	4.9	100
Biochemical Oxygen Demand (BOD5)	mg/L	4	3	10	9	15	4	80
Fecal Coliforms	MPN/100mL	2420	435	2420	914	2420	483	10,000
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	NO	NO	No visible sheen

Bold/shading *indicates exceedance of criteria outlined in Part D Item 14 Maximum Concentration.*

Table D4-6. Treated Effluent Released from the Boston Sewage Treatment Plant (BOS-3), 2019

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	44	44
August	145	189
September	161	351
October	149	500
November	118	618
December	5	623
Total Volume of Treated Effluent Released 2019 (m^3)		**623**

** Values rounded to nearest whole cubic metre.*

Water quality sampling was conducted at the Bulk Fuel Storage Facility (BOS-5) on June 17 prior to water management activities. Results of this water quality sample exceeded the discharge criteria for total arsenic and total lead outlined in Part D Item 19 of the water licence. Water quality treatment was undertaken using an oil-water separator system containing activated carbon and Metsorb media. A second water quality sample was collected July 8 after this treatment and met the discharge criteria. Dewatering of this facility occurred in July once compliant results were received. A total of 90m^3 was discharged to tundra through the oil-water separator system at a location approved by the Inspector (13W 441321 7505322). An additional water quality sample was collected September 2 which exceeded the discharge criteria for total arsenic. Additional water quality treatment could not be conducted due to the onset of freezing conditions shortly after receiving results of this sample. No additional dewatering of this facility occurred in 2019. Results of sampling conducted at the Bulk Fuel Storage Facility (BOS-5) are presented in Table D4-7 below.

Dewatering of the Landfarm Treatment Area (LTA; BOS-6) was not required in 2019. In 2017, TMAC commenced reclamation of the LTA at Boston with the excavation and stockpiling of contaminated soils from the LTA into mega-bags for future treatment or shipment offsite to an approved facility. In March 2019, TMAC backhauled 130m^3 of contaminated soil from the LTA to Doris Camp via a winter track and disposed of this material underground in the Doris Mine as approved in the Hope Bay Project Hazardous Waste Management Plan. The Boston LTA was decommissioned in 2019 and no additional materials will be placed in this facility. Hydrocarbon contaminated materials generated from future activities conducted at Boston will be packaged for backhaul to Doris until a new LTA facility is constructed.

No landfill exists at Boston and the status of monitoring station BOS-7 is inactive.

During 2019, TMAC opportunistically sampled at locations where seepage was observed during periods of runoff near the waste rock and ore storage pad (BOS-8). Sampling in June was conducted concurrently with the annual seepage sampling program. No seepage was identified at BOS-8 locations after June. Table D4-8 shows the results of this sampling. These monitoring results were compared with previously reported kinetic testing results from the ARD Characterization Data base for the Boston Deposit. Further discussion regarding the waste rock and ore monitoring program at Boston Camp is presented in Appendix G.

Table D4-7. Results of 2019 Bulk Fuel Storage Area (BOS-5) Effluent Samples

Sample ID		BOS5	BOS5 ^	BOS5	BOS5	BOS5	Part D Item 19
ALS ID		L2293967-1	L2293967-2	L2307016-1	L2340655-1	L2344287-1	Maximum Concentration in Any Grab Sample
Date Sampled		2019-06-17 14:00	2019-06-17 14:00	2019-07-08 16:45	2019-09-02 15:15	2019-09-07 07:00	
Parameter	**Units**	**Results**					
Conductivity	µS/cm	524	527	720	1070		
Hardness (as $CaCO_3$)	mg/L	255	260	372	609		
pH	pH	7.57	7.58	7.69	8.06		6.5-9.0
Total Suspended Solids	mg/L	<3.0	3.7	<3.0	<3.0		15
Alkalinity, Total (as $CaCO_3$)	mg/L	32.4	32.2	45.3	69.4		
Nitrate (as N)	mg/L	0.0852	0.0903	<0.0050	<0.025		
Nitrite (as N)	mg/L	0.0077	0.0074	<0.0010	<0.0050		
Sulfate (SO_4)	mg/L	223	223	337	510		
Aluminum (Al)-Total	mg/L	0.0314	0.0439	0.0076	<0.0050		
Antimony (Sb)-Total	mg/L	0.00229	0.00226	<0.00050	<0.00050		
Arsenic (As)-Total	mg/L	**0.132**	**0.133**	0.0424	**0.0504**		0.05
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10		
Cadmium (Cd)-Total	mg/L	0.000113	0.0001	0.0000159	<0.0000050		
Calcium (Ca)-Total	mg/L	63.4	65.5	99.2	138		
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	0.001		
Cobalt (Co)-Total	mg/L	0.0294	0.0296	0.00116	0.00086		
Copper (Cu)-Total	mg/L	0.0044	0.0042	<0.0010	<0.0010		0.04
Iron (Fe)-Total	mg/L	0.284	0.285	0.261	0.246		
Lead (Pb)-Total	mg/L	**0.0222**	**0.0227**	0.00525	0.00273		0.01
Lithium (Li)-Total	mg/L	0.0025	0.0026	0.0051	0.0098		
Magnesium (Mg)-Total	mg/L	23.5	23.4	30.3	64.5		
Manganese (Mn)-Total	mg/L	0.129	0.128	0.00264	0.00084		
Mercury (Hg)-Total	mg/L	0.0000052	0.0000059	<0.0000050	<0.0000050		

Sample ID		BOS5	BOS5 ^	BOS5	BOS5	BOS5	Part D Item 19
ALS ID		L2293967-1	L2293967-2	L2307016-1	L2340655-1	L2344287-1	Maximum Concentration in Any Grab Sample
Date Sampled		2019-06-17 14:00	2019-06-17 14:00	2019-07-08 16:45	2019-09-02 15:15	2019-09-07 07:00	
Parameter	**Units**	**Results**					
Molybdenum (Mo)-Total	mg/L	0.001	0.001	<0.0010	<0.0010		
Nickel (Ni)-Total	mg/L	0.0853	0.0873	0.0057	0.0138		0.5
Potassium (K)-Total	mg/L	3.3	3.4	4.8	7.7		
Selenium (Se)-Total	mg/L	0.000196	0.000181	0.000092	0.000083		
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020		
Sodium (Na)-Total	mg/L	2.9	3	4.6	8.7		
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010		
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020		
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Zinc (Zn)-Total	mg/L	0.0331	0.0324	0.0192	0.0084		0.6
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0		15
Oil And Grease (Visible Sheen)		NO	NO	NO	NO		No visible sheen
Phenols (4AAP)	mg/L	0.0011	<0.0010	<0.0010	<0.0010		
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Styrene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Toluene	mg/L	<0.00045	<0.00045	0.00144	<0.00045		
ortho-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
meta- & para-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050		
Xylenes	mg/L	<0.00075	<0.00075	<0.00075	<0.00075		
TPH10-32	mg/L	<1.0	<1.0	<1.0	*		
EPH10-19	mg/L				*	<0.25 **	

Sample ID		BOS5	BOS5 ^	BOS5	BOS5	BOS5	Part D Item 19
ALS ID		L2293967-1	L2293967-2	L2307016-1	L2340655-1	L2344287-1	Maximum Concentration in Any Grab Sample
Date Sampled		2019-06-17 14:00	2019-06-17 14:00	2019-07-08 16:45	2019-09-02 15:15	2019-09-07 07:00	
Parameter	Units	Results					
EPH19-32	mg/L				*	<0.25 **	
Acenaphthene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Acenaphthylene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Acridine	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Anthracene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Benz(a)anthracene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Benzo(a)pyrene	mg/L	<0.0000050	<0.0000050	<0.0000050	*	<0.0000050	
Benzo(b&j)fluoranthene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Benzo(b+j+k)fluoranthene	mg/L	<0.000015	<0.000015	<0.000015	*	<0.000015	
Benzo(g,h,i)perylene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Benzo(k)fluoranthene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Chrysene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Dibenz(a,h)anthracene	mg/L	<0.0000050	<0.0000050	<0.0000050	*	<0.0000050	
Fluoranthene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Fluorene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Indeno(1,2,3-c,d)pyrene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
1-Methylnaphthalene	mg/L	<0.000050	<0.000050	<0.000050	*	<0.000050	
2-Methylnaphthalene	mg/L	<0.000050	<0.000050	<0.000050	*	<0.000050	
Naphthalene	mg/L	<0.000050	<0.000050	<0.000050	*	<0.000050	
Phenanthrene	mg/L	<0.000020	<0.000020	<0.000020	*	<0.000020	
Pyrene	mg/L	<0.000010	<0.000010	<0.000010	*	<0.000010	
Quinoline	mg/L	<0.000080	<0.000080	<0.000050	*	<0.000050	

Bold/shading *indicates exceedance of criteria outlined in Part D Item 19 Maximum Concentration.*
^ Indicates duplicate sample.
** Incorrect bottles submitted to laboratory for these parameters. Additional sample for these parameters collected September 7, 2019.*
*** Laboratory analyzed EPH instead of TPH.*

Table D4-8. Opportunistic Seepage Sampling at Waste Rock and Ore Storage Pad (BOS-8) 2019

	Sample ID	BOS8A	BOS8A ^
	ALS ID	L2301937-1	L2301937-2
	Date Sampled	2019-06-29 14:20	2019-06-29 14:20
Parameter	**Units**	**Results**	
Conductivity	µS/cm	1030	1040
Hardness (as $CaCO_3$)	mg/L	544	541
pH	pH	7.8	7.79
Total Suspended Solids	mg/L	<3.0	3.5
Ammonia, Total (as N)	mg/L	0.0062	0.0057
Sulfate (SO_4)	mg/L	395	397
Aluminum (Al)-Total	mg/L	0.009	0.0088
Antimony (Sb)-Total	mg/L	0.00401	0.00413
Arsenic (As)-Total	mg/L	0.0471	0.0503
Barium (Ba)-Total	mg/L	0.025	0.025
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010
Boron (B)-Total	mg/L	0.1	0.1
Cadmium (Cd)-Total	mg/L	0.0000222	0.0000245
Calcium (Ca)-Total	mg/L	136	133
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.0244	0.0286
Copper (Cu)-Total	mg/L	0.0032	0.0031
Iron (Fe)-Total	mg/L	0.089	0.092
Lead (Pb)-Total	mg/L	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0068	0.0066
Magnesium (Mg)-Total	mg/L	49.5	50.8
Manganese (Mn)-Total	mg/L	0.0286	0.0328
Molybdenum (Mo)-Total	mg/L	0.0012	0.0012
Nickel (Ni)-Total	mg/L	0.0979	0.112
Potassium (K)-Total	mg/L	6.4	6.5
Selenium (Se)-Total	mg/L	0.000411	0.000456
Silver (Ag)-Total	mg/L	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	21.1	21.7
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	0.00054	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050

^ *Indicates duplicate sample.*

The Portal Decline (BOS-9) was sampled on June 23 prior to discharge. Results of this sample were compliant with the discharge criteria for BOS-9 and are presented in Table D4-9. Upon receiving compliant results, 125 m^3 of water was discharged directly to the tundra at a location approved by the Inspector (13W 441219 7505378). An additional water quality sample was collected September 2 which exceeded the discharge criteria for total arsenic. Water quality treatment could not be conducted due to the onset of freezing conditions shortly after receiving results of this sample. No additional dewatering of this facility occurred in 2019.

Underground mining activities were not conducted in 2019. Mine water was not pumped from underground and no water quality monitoring was conducted of the underground mine water sumps (BOS-10).

On-ice exploration drilling did not occur in the licence area in 2019, therefore no samples were taken through lake ice (required by Part F Item 6 and Part J Item 15) to establish water quality prior to, and upon completion of, an on-ice drilling program.

Table D4-9. Results of 2019 Portal Station (BOS-9) Effluent Quality Sampling

	Sample ID	BOS9	BOS9 ^	BOS9	BOS9 ^	Part D Item 6	
	ALS ID	L2298208-1	L2298208-2	L2340684-1	L2340684-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	2019-06-23 16:00	2019-06-23 16:00	2019-09-02 15:00	2019-09-02 15:00		
Parameter	**Units**	**Results**					
Conductivity	µS/cm	44.6	45.2	1440	1450		
Hardness (as $CaCO_3$)	mg/L	14.6	14.4	573	575		
pH	pH	7.47	7.38	8.39	8.4	6.5-9.0	
Total Suspended Solids	mg/L	13.3	12.9	5.2	5	15	30
Ammonia, Total (as N)	mg/L	0.0379	0.0361	0.0613	0.0611		
Chloride (Cl)	mg/L	2.74	2.75	222	222		
Nitrate (as N)	mg/L	0.0391	0.0407	2.84	2.83	130	260
Sulfate (SO_4)	mg/L	7.29	7.23	252	251		
Aluminum (Al)-Total	mg/L	1.19	0.709	0.123	0.107		
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	0.00397	0.00401		
Arsenic (As)-Total	mg/L	0.0238	0.023	**0.408**	**0.412**	0.050	0.10
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10	0.12	0.12		
Cadmium (Cd)-Total	mg/L	0.0000163	0.0000145	0.0000708	0.0000735		
Calcium (Ca)-Total	mg/L	3.7	3.63	146	145		
Chromium (Cr)-Total	mg/L	0.0093	0.0361	0.0012	0.0011		
Cobalt (Co)-Total	mg/L	0.00474	0.00466	0.102	0.103		
Copper (Cu)-Total	mg/L	0.004	0.0039	0.0264	0.0265	0.02	0.04
Iron (Fe)-Total	mg/L	0.49	0.505	0.19	0.209		
Lead (Pb)-Total	mg/L	0.00115	0.00107	<0.00050	<0.00050	0.01	0.02
Lithium (Li)-Total	mg/L	0.0012	0.0011	0.0229	0.0227		
Magnesium (Mg)-Total	mg/L	1.3	1.28	50.7	51.8		
Manganese (Mn)-Total	mg/L	0.0178	0.0177	0.137	0.138		
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	0.000021	0.0000067		

	Sample ID	BOS9	BOS9 ^	BOS9	BOS9 ^	Part D Item 6	
	ALS ID	L2298208-1	L2298208-2	L2340684-1	L2340684-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	2019-06-23 16:00	2019-06-23 16:00	2019-09-02 15:00	2019-09-02 15:00		
Parameter	**Units**	**Results**					
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010		
Nickel (Ni)-Total	mg/L	0.0113	0.011	0.406	0.402	0.25	0.5
Potassium (K)-Total	mg/L	<2.0	<2.0	9.1	9.2		
Selenium (Se)-Total	mg/L	0.000063	<0.000050	0.00151	0.00142		
Silver (Ag)-Total	mg/L	0.000022	0.000025	<0.000020	<0.000020		
Sodium (Na)-Total	mg/L	2.4	2.2	72.9	73.4		
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	0.00088		
Titanium (Ti)-Total	mg/L	0.011	<0.010	<0.010	<0.010		
Uranium (U)-Total	mg/L	<0.00020	<0.00020	0.00427	0.00443		
Vanadium (V)-Total	mg/L	0.00466	0.0029	0.00087	0.00065		
Zinc (Zn)-Total	mg/L	0.0107	0.0113	0.0076	0.0063	0.3	0.6
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		NO	NO	NO	NO	No visible sheen	No visible sheen

Bold/shading *indicates exceedance of criteria outlined in Part D Item 6.*
^ Indicates duplicate sample.

Appendix D.5. 2AM-BOS1835

Appendix D.5. 2AM-BOS1835

Table D5-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2AM-BOS1835. Sample station locations have not yet been established at this time as work has not commenced under this licence. Sample points and discharge locations for SNP stations under this licence will be established in consultation with the Inspector.

Table D5-1. 2AM-BOS1835 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
BMS-1*	Contact Water Pond #1 and #2	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total metals by ICP-MS, D	Sampled twice annually; Weekly water levels
BMS-2*	Surge pond at intake to Contact Water Treatment Plant	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226, HC, D	Sampled monthly during discharge periods; Weekly water levels
BMS-3*	Discharge from Contact Water Treatment Plant	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226, D, AT	Sampled weekly during discharge periods and prior to discharge
BMS-4*	Reclaim line from TMA Contact Water Pond	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, D, Fecal coliform	Sampled monthly during reclaim periods; Weekly water levels
BMS-5*	Non-contact water pond	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total metals by ICP-MS, D	Sampled annually; Water levels after large inflow events
BMS-6*	Fresh Water intake at Aimaokatalok Lake	G, N1, N2, MT, and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods
BMS-7*	Landfill sump	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease, D	Annually. Once prior to every discharge onto the tundra
BMS-8*	Discharge of treated Sewage	G, B, and Total Oil and Grease, D	Sampled monthly during active pumping periods
BMS-9*	Landfarm sump	G, HC, Total Ammonium, Total Lead, D	Annually. Once prior to every discharge onto the tundra

SNP Station	Description	Monitoring Parameters	Frequency
BMS-10*	Site runoff from sediment controls during construction	TSS or Turbidity	Daily during periods of discharge
BMS-11*	Discharge from the Boston fuel storage and containment sumps	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra.
		D	Daily during periods of discharge

** Station not in use at this time.*

SUMMARY OF MONITORING INFORMATION

The following summarizes sampling undertaken as part of the monitoring program detailed in Part I of 2AM-BOS1835.

No activity occurred at the Boston site under this licence in 2019. Activities at Boston Camp conducted in 2019 to support a surface exploration drilling program are reported under water licence 2BB-BOS1727. Results of this monitoring are presented in Appendix D.4 of this report.

Monitoring was not undertaken at monitoring stations BMS-1 (Contact Water Pond #1 and #2) as these facilities have not yet been constructed. The Contact Water Treatment Plant and surge pond have not yet been constructed and no monitoring was conducted at BMS-2 or BMS-3. The Tailings Management Area (TMA) has not yet been constructed and monitoring of the reclaim line from the TMA contact water pond (BMS-4) was not conducted in 2019. The Non-contact water pond (BMS-5) has not yet been constructed and no monitoring of this facility occurred in 2019.

No samples were collected under monitoring station BMS-6. Monitoring of the fresh water intake at Aimaokatalok Lake was conducted under water licence 2BB-BOS1727. Results of this sampling are provided in Table D4-3 in Appendix D.4.

No landfill exists at Boston at this time and no samples were collected from the landfill sump (BMS-7).

Monitoring of the Sewage Treatment Plant at Boston Camp during the surface exploration drilling program was completed under licence 2BB-BOS1727. Results of this sampling are provided in Table D4-5 in Appendix D.4. No samples were collected under monitoring station BMS-8 (Discharge of treated sewage) in 2019.

The Landfarm at Boston has not yet been constructed (BMS-9). No construction was conducted at Boston in 2019 and no monitoring was conducted under monitoring station BMS-10.

Monitoring of the Bulk Fuel Storage Facility at Boston was conducted under water licence 2BB-BOS1727. Results of this monitoring are presented in Table D-7 in Appendix D.4 of this report. The Boston Fuel Storage Area and Containment sumps (BMS-11) listed under licence 2AM-BOS1835 has not been constructed at this time.

Appendix E

Doris Mine Annual Water and Load Balance Assessment – 2019 Calendar Year

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Memo

To:	Oliver Curran, TMAC	**Client:**	TMAC Resources Inc.
From:	Andrea Bowie, PEng	**Project No:**	1CT022.066
Reviewed By:	Lisa Barazzuol, PGeo John Kurylo, PEng	**Date:**	March 26, 2020
Subject:	Doris Mine Annual Water and Load Balance Assessment – 2019 Calendar Year		

1 Introduction

Monthly monitoring of the Doris Tailings Impoundment Area (TIA) is a requirement during operations under the Hope Bay Water Licence No: 2AM-DOH1335 – Amendment No. 2 (NWB 2018). The Doris TIA receives tailings slurry from the mine's process plant; mine water from the Doris Underground mine; runoff from the camp, ore and waste rock pads; natural runoff and direct precipitation.

Under Water Licence No: 2AM-DOH1335, Schedule B Item 4, a summary of the results for the monthly Doris TIA water balance and water quality model assessments, as well as any re-calibrations that have been carried out is required to be reported. Model assessments are conducted each year. A summary of the past assessments are presented in Table 1.

Table 1: Previous Model Calibrations (2017 and 2018)

Model Reference	Monitoring Year	Calibration Changes	Key Conclusions and Model Changes
SRK 2017	Final Environmental Impact Statement	Baseline Model	-
SRK 2018	2017	None	*Water Balance:* predictions trending with measured elevations *Load Balance:* Doris Process Plant not at steady state, no changes made for underpredicted parameters
SRK 2019	2018	Hydrology, processing rate, mine water flows, stage storage curves	*Water Balance:* after updates, predictions trending with measured elevations *Load Balance:* most parameters at detection limits, overpredicted or trending well with measured data. Update for underpredicted parameters as follows: *Doris process water:* ammonia, total cyanide, free cyanide, sulphate, and the following total metals: aluminum, copper, iron, manganese, nickel, phosphorous and sodium *Doris Mine water:* ammonia

Source: SRK 2018, 2019

The previous annual assessments (i.e., 2017, 2018) concluded the overall mechanisms behind the water balance adequately represented the system (SRK 2018, 2019). Therefore, a similar approach was taken for the 2019 calibration. Measured 2019 elevations and water quality data were compared to the predictions from calibrated SRK (2019) model adjusted for 2019 measured values (e.g. flows, precipitation, processing rate).

After the water balance (quantity or volume) adjustment, the model was assessed from a water quality perspective. Parameters were grouped based on the comparison of predicted and observed results for the Doris TIA. The following parameter groups were previously identified:

- Conservative predictions (measured values below the model predictions),
- Predictions trending well with measured data,
- Underpredicted, and,
- Detection limit greater than prediction.

The model was considered adequate for the parameters where predictions were conservative (overestimated in the model), trending well with measured data, and where detection limits were greater than prediction. Underpredicted values were assessed individually and adjusted based on measured observations in the process water, mine water and the Doris TIA.

2 Model Inputs and Measured Data Comparison

The model set-up and mechanisms represented are detailed in the Final Environmental Impact Statement (FEIS) Water and Load Balance report (SRK 2017). Changes to source terms, based on review of data from 2018, are documented in the memo Doris Mine Annual Water and Load Balance Assessment – 2018 Calendar Year (SRK 2019). This section will discuss the key differences between the SRK (2019) model assumptions and the measured inputs, or implemented infrastructure decisions, from 2019.

2.1 Review of Water Balance Inputs

The model calibration relies on a comparison of similar input assumptions. For example, if the model assumed an average hydrological year but the site measured a 1 in 50 wet year, it would be likely that the model would underpredict elevations in the Doris TIA. Therefore, only inputs that were measured onsite were updated in the model. Any input not discussed in this Section remained as per the original model assumptions, as documented in the FEIS model (SRK 2017).

2.1.1 Hydrology Update

The measured Doris meteorological data in the model was updated to include values from the 2019 calendar year for mean daily temperature, daily rainfall and daily total precipitation. There were some gaps in the 2019 Doris measured data for all three parameters (for average daily temperature: October 15 to 29 and November 15 to 24, for total precipitation and rainfall: October 15 to 30 and Nov 15 to 24). The model includes the functionality to use data measured from the Cambridge Bay Station whenever Doris data was missing. Therefore, measured data from four

Cambridge Bay Stations (Environment and Climate Change Canada IDs: 2400600, 2400601, 2400602 and, 2400603) were compiled and updated in the model until the end of 2019. Data from the Cambridge Bay Stations included mean daily temperature, daily rainfall, daily precipitation and monthly under catch values for snow and rain. It is expected that data would be missing from the annual dataset from time to time. Patching in Cambridge Bay data was previously found to be an acceptable method for filling in the gaps and continues to be implemented if / as needed.

2.1.2 Processing Rate

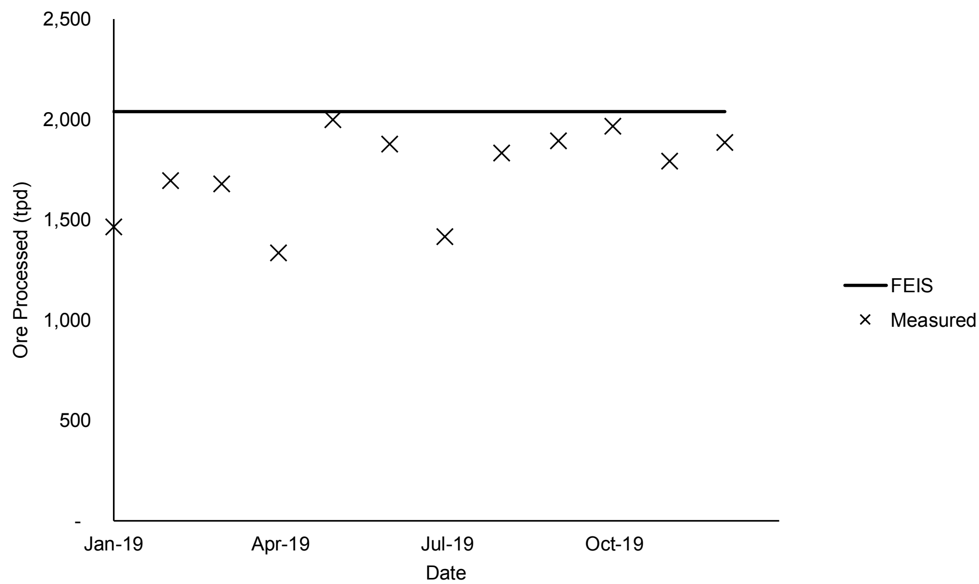
The processing rate in the model for 2019 was 1,973 tpd from the Doris Mine and 69 tpd from the Madrid North Mine in accordance with the FEIS mine plan. The modelled processing rates and measured processing rates for 2019 are presented in Table 2 and Figure 1. The processing rate has been consistently less than the modelled rate. Overall processing has been at an average of approximately 85% of the total amount (750,000 tonnes) projected in the FEIS.

Monthly processing rates were updated in the model to reflect the measured values for 2019. For 2020 to 2032, the forecasted processing rates in the model were left as the FEIS values, as presented in Attachment 1.

Table 2: Summary of FEIS Forecasted and Measured Processing Rates

Date	Ore Processed in the Doris Process Plant (tpd)					
	Doris Mine		Madrid Mine		Total Processed	
	FEIS	Measured	FEIS	Measured	FEIS	Measured
January	2,000	1,500	69	-	2,000	1,500
February	2,000	1,700	69	-	2,000	1,700
March	2,000	1,700	69	-	2,000	1,700
April	2,000	1,300	69	-	2,000	1,300
May	2,000	2,000	69	-	2,000	2,000
June	2,000	1,900	69	-	2,000	1,900
July	2,000	1,400	69	-	2,000	1,400
August	2,000	1,800	69	-	2,000	1,800
September	2,000	1,900	69	-	2,000	1,900
October	2,000	1,800	69	170	2,000	2,000
November	2,000	1,400	69	430	2,000	1,800
December	2,000	1,100	69	750	2,000	1,900
Total	720,000	590,000	25,000	41,000	750,000	630,000

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

Figure 1: FEIS Forecasted and Measured Processing Rates

2.1.3 Site Contact Water

Contact water at the Doris site from the ore, waste rock and camp pads are collected in two ponds: the pollution control pond and the sediment control pond. Contact water is also collected in Sump 3 and pumped back up to the pollution control pond. Contact water is transferred from the pollution control pond to the sediment control pond, which is pumped to the Doris TIA during the open water season.

Transfer rates from the sediment control pond to the Doris TIA were updated to include rates from 2017 to 2019, presented in Table 3.

Table 3: Monthly Measured Flows from the Sediment Control Pond to the Doris TIA

Month	Sediment Control Pond to Doris TIA (m^3/month)		
	2017	2018	2019
January	-	-	-
February	-	-	-
March	-	-	-
April	-	-	-
May	-	-	-
June	-	12,000	9,800
July	3,800	6,900	43,000
August	3,000	22,000	39,000
September	-	12,000	33,000
October	-	-	-
November	-	-	-
December	-	-	-
Total	6,800	53,000	120,000

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

2.1.4 Mine Water and Robert’s Bay Discharge Line

In 2019, mine water was directed to the Doris TIA for storage. Measured mine water encountered to date totaled 510,000 m^3, representing about 9% of the total volume of water held in the Doris TIA (assumes interpolation between the 1.2 and 1.8 M tonnes deposited bathymetry cures at an elevation of 31.99 masl as observed on January 1, 2020), and 40% of the FEIS predicted flow for 2019. A comparison of modelled and measured mine water flows are presented in Table 4 and Figure 2.

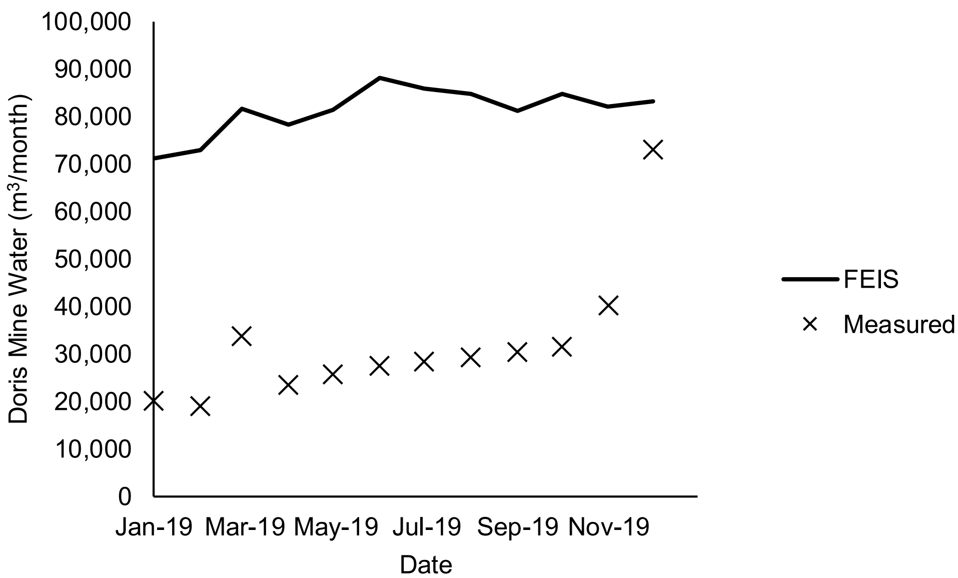
Flow rates for Doris Underground mine water were updated in the model to reflect measured values for 2019. No water was intercepted in the Madrid Mine and the values matched the FEIS predictions for 2019. For 2020 to 2032, the forecasted mine water flows for Doris, Madrid North and Madrid South were left as the FEIS values and are presented in Attachment 1.

The discharge line to Robert’s Bay was not commissioned in 2019; however, it was commissioned in February 2020. Therefore, the model discharge date has been changed to February 2020 when both mine water and Doris TIA water will be routinely discharged to Robert’s Bay. Realized discharge rates for 2020 will be tracked and provided as part of next years (2020 Calendar Year) Annual Water and Load Balance reporting.

Table 4: Summary of FEIS Forecasted and Measured Mine Water Flows

Month	Mine Water (m^3/month)			
	Doris Mine		Madrid North Mine	
	FEIS	Measured	FEIS	Measured
1	71,000	20,000	-	-
2	73,000	19,000	-	-
3	82,000	34,000	-	-
4	78,000	23,000	-	-
5	81,000	26,000	-	-
6	88,000	27,000	-	-
7	86,000	28,000	-	-
8	85,000	29,000	-	-
9	81,000	30,000	-	-
10	85,000	31,000	-	-
11	82,000	40,000	-	-
12	83,000	73,000	-	-
Total	980,000	380,000	-	-

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

Figure 2: FEIS Forecasted and Measured Mine Water Flows

2.2 Review of Water Quality Inputs

TMAC provided 2019 water quality data collected in the Doris TIA at the reclaim pump station (TL-1). This data was compared to the SRK (2019) model predictions (referred to as Predicted Concentration – 2018 in Attachment 2) and the SRK (2019) model was updated with the 2019 measured water balance inputs (referred to Predicted Elevation – WB in Attachment 2). Parameters were grouped into three categories identified through the previous reviews (as discussed in Section 1), and as presented in Table 5. For parameters that were conservative or trending well according to model predictions no further action was taken; however, parameters that were underpredicted are addressed in the sections below.

Table 5: Initial Screening Assessment of Water Load Balance Parameters

Classification Type	Parameters Included	Comparison to Model Prediction
Conservative	F, WAD cyanide (CN-WAD), nitrate (NO_3), thiocyanate (SCN) Dissolved metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Fe, Pb, Li, Hg, Mo, Ni, Se, Ag, Tl, U, V, Zn, P Total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Pb, Li, Mg, Hg, Mo, Se, Ag, Na, Tl, U, V, Zn,	Measured values are below the model prediction. The modeled values are reflective of conservative assumptions. Note: some values may be at or close to the method detection limit and slightly above the model prediction; these parameters were still considered to be conservative.
Trending Well	Total dissolved solids (TDS), Cl, ammonia (NH_4)	Measured values are tracking well with the model predictions.

Classification Type	Parameters Included	Comparison to Model Prediction
	Dissolved metals: B, Co, Cu, Mg, Na Total Metals: B, Co, Cu, Mg, Na	
Underpredicted	Total suspended solids (TSS), free cyanide (CN-F), total cyanide (CN-T), cyanate (CNO), nitrite (NO_2) Dissolved metals: Mn Total metals: Al, Cu, Fe, Mn	Model predictions are lower than measured values. Corrective actions discussed in subsequent sections.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

Notes:

TDS = Total Dissolved Solids

TSS = Total Suspended Solids

To re-calibrate the model, model TIA source terms were evaluated to determine how each would affect the results. TIA model mechanisms and source loadings likely affecting the underpredictions were identified as:

- Doris process plant source loadings (TL-5),
- Mine water source loading (TL-12), and
- Biological degradation rates in the Doris TIA (based on reductions in TL-1 chemistry).

The remainder of this section describes the source term refinement while Section 3 presents the step-wise methodology for how the calibration was carried out. Section 4 discusses why the calibration was carried out and the results of the calibration.

For underpredicted parameters, loading rates for Doris TIA inputs were assessed to identify increased source loadings for 2019. Sources were identified as either Doris mine water or process water from the process plant. This analysis used the mine water measured chemistry either at the inflow line to the pump box or the sediment control pond before mixing (TL-12) and the process water chemistry measured at the flotation tailings thickener underflow (TL-5). The parameters fell into two groups:

- Parameters with most of the loading from process water, including reagents or reagent by-products originating from the process plant and ore and waste rock bearing minerals: total cyanide, free cyanide, WAD cyanide, cyanate, nitrite, total aluminum, total copper, total iron, and total and dissolved manganese.
- Parameters with most of the loading from the mine water, which were primarily metals linked to high TSS or groundwater signature: total aluminum, total copper, total iron, and total and dissolved manganese.

2.2.1 Total Cyanide and Degradation Products

The total cyanide source term was changed as part of the calibration exercise. As a result, all cyanide derivatives involved were subsequently reviewed. This included:

- free cyanide,
- WAD cyanide,
- cyanate,
- ammonia,
- nitrate, and,
- nitrite.

Thiocyanate was not included in this list as it forms in the process plant and was found to be conservative in the initial screening comparison (Table 5).

The process source term for total cyanide was adjusted to 3.8 mg/L based on the average of the 2019 TL-5 data, with omission of the February 3, 2019 sample due to an elevated concentration nine times higher than the 2017 to 2019 observed range. The degradation rate for total cyanide was adjusted to 50 mg/m^2/day based on a mass balance calculation.

Photolysis of iron cyanide complexes to free cyanide or WAD cyanide (depending on dissolved metals in solution) followed by volatilization of free cyanide has been shown in certain settings to contribute up to 90% of cyanide attenuation (Simovic and Snodgrass 1995, Botz, Mudder and Akcil 2005). Based on this work, it was hypothesized that total cyanide was converted to free cyanide and WAD cyanide (WAD cyanide analytical method includes free cyanide fraction) instead of the modeled cyanate. Therefore, the degradation of total cyanide was changed in the model to convert to free and WAD cyanide. A new free and WAD cyanide removal rate was added to the model based on mass balance calculations at 29 mg/m^2/day.

Cyanate was found to be quite variable in the process effluent (<2.0 to 133 mg/L) and dependent on performance of the cyanide destruction circuit. Due to variability, the cyanate source term was changed to 40 mg/L based on an average of the 2018 and 2019 TL-5 data. Although ammonia was a parameter trending well, cyanate is converted to ammonia via biological oxidation and the ammonia degradation rates was reviewed and changed to 450 mg/m^2/day.

Nitrite was classified as an underpredicted parameter in the initial screening (Table 5). Nitrite is a short-lived intermediate in nitrification and denitrification, especially in oxygen rich environments. Concentrations were quite variable in the Doris TIA and did not follow a general trend throughout 2017 to 2019 that could be modeled. Since the order of magnitude matched well, no changes were made for this parameter.

Nitrate was classified as a conservative parameter in the initial screening (Table 5). Nitrate concentrations were reviewed after the model changes and were still found to be conservative (measured values below the model predictions).

2.2.2 Metals Assessment

The mine water and process water source terms for total aluminum, copper, iron, manganese and dissolved manganese were changed in both the process water and mine water source terms. Concentrations applied in the model are presented in Table 6 based on the following datasets:

- Process water (TL-5): average 2019 values were used from TL-5 (monitoring period of dissolved metals dataset) with the exclusion of the August 11, 2019 sample that had elevated concentrations above the historical range for all parameters.
- Mine water (TL-12): average values since mine water was intercepted (Feb 2018) were used from TL-12.

If the proposed source term for process water or mine water was lower than the source term in the model, the value was not revised.

Table 6: Updated Source Terms for Mine and Process Water

Parameter	Average Concentration (mg/L)			
	Mine Water (TL-12)		Process Water (TL-5)	
	Dissolved	Total	Dissolved	Total
Aluminum	-	59	-	0.27
Copper	-	0.79	-	0.50
Iron	-	230	-	4.1
Manganese	7.0	7.0	0.16	0.20

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

3 Stepwise Calibration Methodology

Changes to the model were applied one step at a time to assess the impact on the model results. A summary of the steps taken during the calibration were:

1. Water balance inputs updated.
   (a) Includes: hydrology update, Doris mine water flows, and Doris Process Plant processing rate updated to include the measured data for 2019.
   (b) Results were compared back to measured data. Water quality screening assessment results presented in Table 5.
2. Total cyanide degradation evaluation:
   (a) Total cyanide in the process water changed to 3.8 mg/L based on TL-5 data.
   (b) New total cyanide degradation rate applied to the Doris TIA degradation.
   (c) New free and WAD cyanide degradation rate applied to the Doris TIA degradation.
   (d) Results were compared back to measured data.
3. Cyanate degradation evaluation:

(a) Cyanate in the process water changed to 40 mg/L based on TL-5 data.

(b) Changed ammonia degradation rate based on increased production due to cyanate degradation.

(c) Results were compared back to measured data.

4. Metals evaluation:

(a) Aluminum, copper, iron and manganese values changed as per Table 6 based on TL-5 and TL-12 data.

(b) Results were compared back to measured data.

5. Final results generation:

(a) All adopted values were accepted. Source term changes for total cyanide and cyanate were applied to the Madrid and Boston process water.

4 Calibration Explanation and Evaluation

4.1 Doris TIA Elevation

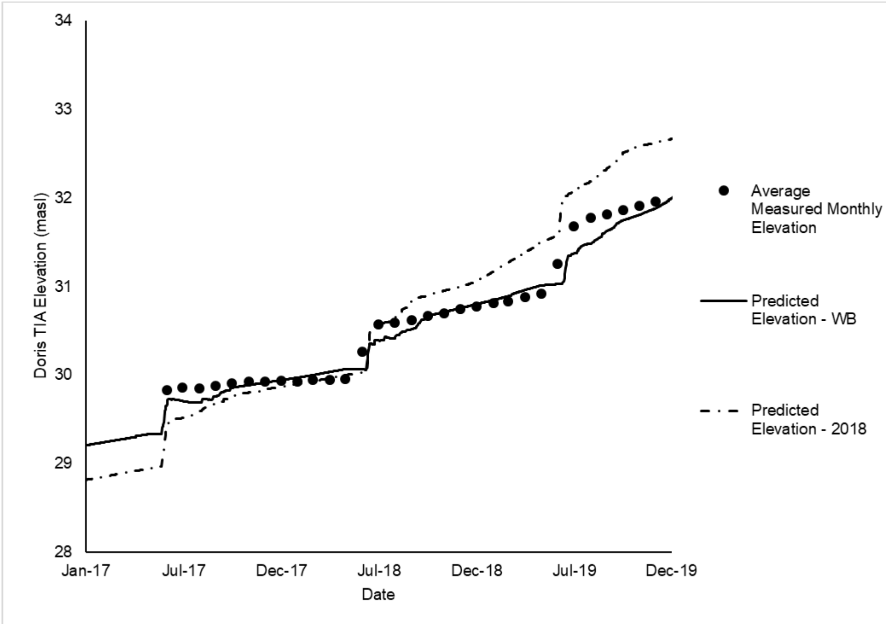
TMAC supplied measured water elevations for the Doris TIA for 2019. These were compared to the SRK (2019) model predictions (Predicted Elevation – 2018) as well as the updated predictions (Predicted Elevation – WB). The results of the measured elevations and the two predicted elevation cases are shown in Table 7 and Figure 3.

Although some months show an elevation difference, the general trend of the measured elevation data matches the updated predictions. It appears the mechanisms affecting model calibration are trending well with measured data and no further recalibration of the model is required at this time regarding water inventory.

Table 7: Doris TIA Elevation Comparison to Model Predictions

Month	Doris TIA Elevation (masl)		
	Average Measured Monthly Elevation	**Predicted Elevation - 2018**	**Predicted Elevation - WB**
1/1/2019	30.8	31.1	30.8
2/1/2019	30.8	31.2	30.9
3/1/2019	30.8	31.3	30.9
4/1/2019	30.9	31.4	31.0
5/1/2019	30.9	31.5	31.0
6/1/2019	31.3	31.9	31.2
7/1/2019	31.7	32.1	31.4
8/1/2019	31.8	32.3	31.5
9/1/2019	31.8	32.4	31.7
10/1/2019	31.9	32.6	31.8
11/1/2019	31.9	32.6	31.8
12/1/2019	32.0	32.6	31.9

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

Figure 3: Modeled and Predicted Elevations in the Doris TIA

4.2 Predicted TIA Water Quality

Attachment 2 presents a comparison between the measured data at TL-1 and the water quality predictions generated by the current model. The graphs show several model predictions, representing the model calibration evolution described in Section 3. A summary of the graphed results is presented in Table 8.

The graphs include predictions up until the Doris TIA is drained and maintained empty after the North Dam is breached. For parameters regulated under the Metal and Diamond Mining Effluent Regulations (MDMER), the maximum monthly mean limit was included on the plots (MDMER 2019).

Table 8: Description of the Predictive Cases Graphed in Attachment 2

Graphed Prediction	Description
Predicted - 2018	Results from the SRK (2019) model
Predicted - WB	Results after water balance changes (hydrology update, mine water, process rate, sedimentation flows)
Predicted - LB1	Results after total cyanide evaluation
Predicted - LB2	Results after cyanate evaluation
Predicted - LB3	Results after metals evaluation
Predicted - 2019	Results after the 2019 Assessment

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.066_2020 Site Wide Water Mgmt\1_2019_AnnualWLB\Inputs\HopeBay_2019Inputs_1CT022.045_R00_ajb.xlsx

After the screening assessment, parameters could be reclassified into three groups presented in Table 9.

Table 9: Screening Summary of Water Load Balance Parameters after Calibration

Classification Type	Parameters Included	Comparison to 2019 Model Prediction
Trending Well	CN-T, CN-F, CN_WAD, CNO, NH_4, Mn (total and dissolved)	Measured values are tracking well with the model predictions.
Slightly underpredicted - microbial community establishment	NO_2	Model predictions are tracking slightly under measured values. Nitrite trending is based on how a microbial community is established and is beyond the removal capabilities of the model; ongoing evaluation throughout the year.
Slightly underpredicted - TSS driven	TSS Total metals: Al, Cu, Fe	Model predictions are tracking slightly under measured values. Concentrations are likely reflective of high TSS water and the model does not account for settling of TSS (conservative, completely mixed reservoir). No increase to source terms; ongoing evaluation of parameters throughout the year to further examine trends.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

4.2.1 Total Cyanide Degradation Evaluation

The total cyanide removal rate in the FEIS model was 218 mg/m^2/day based on biological removal of total cyanide to cyanate at the Colomac Mine. For Hope Bay, the total cyanide removal rate was hypothesized to be linked to photolysis of complexed iron cyanide in the Doris TIA. Observed levels of free and WAD cyanide at TL-1 were low and at near parity, suggesting that most WAD cyanide was comprised of free cyanide. A short lived spike (two weeks in July 2018, and May and June 2019) in both free and WAD cyanide concentrations at TL-1 was observed as total cyanide concentrations were decreasing. The field pH measured at TL-1 was in between 7 and 8, but generally closer to 7. At these pH levels, free cyanide would be present in solution as hydrogen cyanide which would readily off-gas. Therefore, it was hypothesized that photolysis of iron cyanide complexes (as quantified by total cyanide measurements) resulted in a short lived spike in free cyanide prior to volatilization of hydrogen cyanide gas.

To test this hypothesis, the source term of total cyanide was changed to 3.8 mg/L and the total cyanide degradation rate was changed to 50 mg/m^2/day, based on a mass balance calculation. The degradation products were changed from cyanate to free and WAD cyanide. A degradation rate for both free and WAD cyanide was added to the model of 29 mg/m^2/day based on mass balance calculations. However, the removal rate was found to be too low and adjusted to 35 mg/m^2/day. Monthly samples in the Doris TIA might be too far apart to capture the actual peak values; therefore, this increase in rate was adopted.

The changes were reflective of the measured concentrations at TL-1 and were adopted. Adopted changes were applied to the Madrid and Boston process source terms for the 2019 predictions and presented in Table 10.

Table 10: Summary of Total Cyanide Degradation Changes

Model Input	Units	Updated Parameter	Updated Value
Doris process water source term	mg/L	Total cyanide	3.8
Madrid North process water source term	mg/L	Total cyanide	3.8
Madrid South process water source term	mg/L	Total cyanide	3.8
Boston process water source term	mg/L	Total cyanide	3.8
Total cyanide degradation rate	$mg/m^2/day$	Total cyanide to free and WAD cyanide (previously to cyanate)	50
Free and WAD cyanide degradation rate	$mg/m^2/day$	Free and WAD cyanide to hydrogen cyanide gas, which is volatilized and sent to a model sink	35

4.2.2 Cyanate Degradation Evaluation

The model was underpredicting concentrations of cyanate, which originates from the process water. The process source term was updated to 40 mg/L, although there was a lot of variability in the process source term. This variability was due to changing conditions in the cyanide detoxification circuit which is not a model mechanism that can be predicted. When compared back to the measured cyanate concentrations at TL-1, the results were considered acceptable with the variability partially linked to the performance of the cyanide destruction circuit.

Although ammonia was classified as parameter trending well in the initial screening, it was evaluated again as it was a by-product of total cyanide removal and of cyanate removal. The ammonia degradation rate was increased to 450 $mg/m^2/day$, which is within the range of the natural removal rate of 250 $mg/m^2/day$ (no phosphorous environment) and the enhanced removal rate of 1,100 $mg/m^2/day$ (excess phosphorous environment) observed at the Colomac Mine. Phosphorous is added to the flotation circuit in the form of a promoter and is present in the Doris TIA in small concentrations. It is hypothesized that the increased removal rate is linked to the presence of some phosphorous in solution that is available to support biological activity.

All changes in the model, presented in Table 11, produced results comparable to the measured concentrations at TL-1 and were adopted. Changes were applied to the Madrid and Boston process source terms for the 2019 predictions.

Table 11: Summary of Cyanate Degradation Changes

Model Input	Units	Updated Parameter	Updated Value
Doris process water source term	mg/L	Cyanate	40
Madrid North process water source term	mg/L	Cyanate	40
Madrid South process water source term	mg/L	Cyanate	40
Boston process water source term	mg/L	Cyanate	40
Ammonia degradation rate	$mg/m^2/day$	Ammonia degradation rate	450

4.2.3 Metals and TSS Evaluation

The model is set up as a conservative mass balance and is unable to accurately predict TSS in model reservoirs. For each timestep in the model, loading is added to the Doris TIA. The Doris TIA is then homogeneously mixed, and load is assigned to the reservoir and any outflows based on the homogeneously mixed concentration. The Doris TIA is a large facility that has previously demonstrated capacity to settle TSS from both the tailings slurry and the Doris mine water in 2018. For 2019, the total values for aluminum, copper, manganese and iron were adjusted, as well as dissolved manganese, to the concentrations presented in Table 6. The results were compared to measured concentrations at TL-1.

The graphs for total aluminum, copper and iron in Attachment 2 all show elevated total metals concentrations when compared to the measured TL-1 concentrations. The model does not predict total metals settling out of solution; therefore, the changes to these source terms were not adopted.

For manganese, the updated plots for both total and dissolved manganese showed an order of magnitude match for 2019 modelled results but did not trend well with 2017 and 2018 measured concentrations. For now, the increase to the source terms will be adopted, as presented in Table 12, but this parameter will be evaluated again as part of the 2020 calibration.

Table 12: Summary of Metals Evaluation Changes

Model Input	Units	Updated Parameter	Updated Value
Doris process water source term	mg/L	Total (and dissolved) manganese	0.2 (0.16)
Madrid North process water source term	mg/L	Total (and dissolved) manganese	0.2 (0.16)
Madrid South process water source term	mg/L	Total (and dissolved) manganese	0.2 (0.16)
Boston process water source term	mg/L	Total (and dissolved) manganese	0.2 (0.16)
Doris mine water	mg/L	Total (and dissolved) manganese	7 (7)
Madrid North mine water	mg/L	Total (and dissolved) manganese	7 (7)
Madrid South mine water	mg/L	Total (and dissolved) manganese	7 (7)

5 Comparison to MDMER

5.1 Measured Values

Updated water quality projections for the Doris TIA were compared to the MDMER limits (MDMER 2019) in Attachment 2, as Doris TIA water will be discharged to Robert's Bay. All measured data were compared to the MDMER maximum monthly mean concentrations and maximum authorized concentrations in a grab sample, presented in Table 13 and Table 14, respectively.

The only parameter that exceeded the MDMER limits in 2019 was TSS for the maximum monthly mean concentration, but not the maximum authorized concentration. However, no discharge from the TIA took place in 2019 during these elevated TSS periods. TMAC is actively taking steps to manage TSS in the Doris TIA. All other parameters remain below the discharge limits.

Unionized ammonia concentrations increased in August and September 2019 in the Doris TIA to just under three times the future MDMER limit. This coincided with an algae bloom that increased TSS and pH concentrations in the facility. Since unionized ammonia is dependent on temperature and pH, the combination of increased temperature during the open water season with the pH increase lead to an increase in the unionized fraction of ammonia at the peak of the algae bloom. Concentrations decreased again once the bloom was over and returned to levels 25 times below the future MDMER limit. Algae blooms are expected to occur again in the future. TMAC is actively working towards a TSS solution that would allow for a pH adjustment, if required, for any subsequent algae blooms during planned active discharge.

Table 13: Comparison of Maximum Monthly Mean Measured Concentrations in the Doris TIA to the Proposed MDMER

Parameter	Units	MDMER Maximum Authorized Monthly Mean Concentration	Maximum of 2019 Doris TIA Average Monthly Concentrations (TL-1)	Month of Maximum Concentration	Percent of MDMER Limit
TSS	mg/L	15	21	September	138%
Total Arsenic	mg/L	0.5	0.0014	December	0.3%
Total Copper	mg/L	0.3	0.092	December	31%
Cyanide – Total	mg/L	1	0.33	December	33%
Total Lead	mg/L	0.2	0.00027	January	0.1%
Total Nickel	mg/L	0.5	0.013	June	3%
Total Zinc	mg/L	0.5	0.012	December	2%
Unionized Ammonia (as N)	mg/L	-	0.18	August	-

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Table 14: Comparison of Maximum Grab Sample Concentration Measured in the Doris TIA Compared to the Proposed MDMER

Parameter	Units	MDMER Maximum Authorized Concentration in a Grab Sample	Maximum Concentration Measured in the Doris TIA in 2019 (TL-1)	Date of Maximum Concentration	Percent of MDMER Limit
TSS	mg/L	30	23.8	9/2/2019	79%
Total Arsenic	mg/L	1	0.00157	12/2/2019	0.2%
Total Copper	mg/L	0.6	0.0938	12/2/2019	16%
Cyanide – Total	mg/L	2	0.338	12/9/2019	17%
Total Lead	mg/L	0.4	0.00031	1/28/2019	0.1%
Total Nickel	mg/L	1	0.0137	6/17/2019	1.4%
Total Zinc	mg/L	1	0.017	11/18/2019	1.7%
Unionized Ammonia (as N)	mg/L	-	0.331	9/9/2019	-

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

5.2 Modeled Values

The updated water quality predictions were also screened against the MDMER limits. A summary of the findings is presented in Table 15 with a discussion included for each parameter. MDMER limits were also presented along side predictions in Attachment 2.

Arsenic was identified during the FEIS as a parameter requiring treatment once the Madrid ore is processed and this remains unchanged for the updated predictions. Processing of Madrid ore began in October 2019, and the average monthly concentration in the Doris TIA increased by a factor of 1.3 in December 2019 compared to January 2019. The arsenic concentrations observed in 2019 remain below the predictions for arsenic. The same four parameters identified in the 2018 review will still be monitored closely: TSS, total copper, total cyanide and unionized ammonia.

Table 15: Comparison of Updated Predictions to MDMER Limits

Parameter	Discussion of Results
TSS	The model is not able to accurately predict TSS. TMAC is actively taking steps to manage TSS and these will continue to be applied in the future.TSS will be revisited over the course of 2020 and discharge will continue to done within the set project limits.
Arsenic	Concentrations in the Doris TIA increased by a factor of 1.3 after commencing Madrid ore processing, however, remain under the model predictions. The need for arsenic treatment will be evaluated during 2020 as greater quantities of Madrid ore are processed.
Copper	Updated predictions increase above the proposed MDMER limit. Since the dissolved fraction of copper is predicted to be below the current MDMER limit, it is projected that operational treatment of TSS prior to discharge will sufficiently lower total copper concentrations in the near-term. The model predictions for dissolved copper are expected to eventually increase above the proposed limit. It is expected that a water treatment solution for arsenic will also target copper removal if necessary.
Total Cyanide	Updated predictions increase above the MDMER limit in 2023. Total cyanide concentrations in the Doris TIA originate from iron cyanide complexes which readily degrade by photolysis. Modelled peaks for total cyanide occur in the spring before

Parameter	Discussion of Results
	longer sunlight days commence photolysis. Measured cyanide concentrations have demonstrated that cyanide readily undergoes degradation in the Doris TIA during the open water season. TMAC will not discharge water that is above total cyanide limits.
Lead	Updated predictions remain below the MDMER limits and are not of concern.
Nickel	Updated predictions remain below the MDMER limits and are not of concern.
Zinc	Updated predictions remain below the MDMER limits and are not of concern.
Unionized Ammonia	Unionized Ammonia is both pH and temperature dependent and not included in the model. TMAC is aware that algae blooms may occur each year and are actively taking steps towards managing this issue.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

6 Final Remarks

Overall the mechanisms behind the FEIS water and load balance appear to be well calibrated to the measured data. A summary of the changes and conclusions of the calibration is presented in Table 16.

Four parameters (TSS, total copper, total cyanide and unionized ammonia) have been identified as parameters of concern regarding the MDMER limits applied to mine discharges, including the future discharge of Doris TIA water to Robert's Bay. TMAC is actively taking steps to manage TSS and unionized ammonia concentrations in the Doris TIA. TMAC will continue to monitor copper and arsenic concentrations throughout 2020.

Table 16: Summary of the SRK (2019) Model Calibration to the Measured 2019 Data

<table>
<tr><th>Evaluated Model Input</th><th>Summary of Changes Made to the Model Input</th><th>Conclusions of Calibration</th></tr>
<tr><td>Hydrology Data</td><td>Updated to reflect 2019 measured data</td><td rowspan="4">Predicted elevation trends comparable to measure elevations.</td></tr>
<tr><td>Doris Process Plant process rate</td><td>Updated to reflect 2019 measured data</td></tr>
<tr><td>Doris Mine water flows</td><td>Updated to reflect 2019 measured data</td></tr>
<tr><td>Sedimentation control pond flows</td><td>Updated to reflect 2017 to 2019 measured data</td></tr>
<tr><td>Total cyanide degradation update</td><td rowspan="3">Source term for total cyanide updated for 2019 measured data at TL-5
Source term for cyanate updated for 2018 and 2019 measured data at TL-5 due to variability.
Degradation rates for total cyanide and ammonia updated, rates for free and WAD cyanide added.</td><td rowspan="3">Modelled degradation for nitrogen-based parameters trending well with measured data.</td></tr>
<tr><td>Cyanate source term increased</td></tr>
<tr><td>Ammonia degradation update</td></tr>
<tr><td>Metals evaluation</td><td>For total and dissolved manganese:
Process water source term updated based on 2019 measured data at TL-5
Mine water source term updated based on 2018 to 2019 measured data at TL-12</td><td>The model does not predict TSS settling in the Doris TIA. Measured data suggests that adjusting source terms for high TSS parameters result in an overprediction that is not representative of the Doris TIA.</td></tr>
</table>

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

7 References

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Attachment 1: Annual WLB Assessment – 2019 – TABLES

Project: **Hope Bay**
Number: **1CT022.066**
Task: **Summary of the FEIS Model Inputs**
Source: *HopeBay_FEISWLBalance_TypeA_Rev28_AJB.gsm*

Table A1.1: Processing Rates for the Doris, Madrid and Boston Processing Plants

Model Date	Processing Rates (tonnes/day)						
	Total Doris Process Plant	Doris Ore to Doris Process Plant	Madrid North Ore to Doris Process Plant	Madrid North Ore to Madrid Process Plant	Madrid South to Doris Process Plant	Boston Ore to Doris Process Plant	Boston Ore to Boston Process Plant
1/1/1900	0	0	0	0	0	0	0
1/1/2011	0	0	0	0	0	0	0
1/1/2016	0	0	0	0	0	0	0
1/1/2017	0	0	0	0	0	0	0
2/1/2017	212	212	0	0	0	0	0
3/1/2017	351	351	0	0	0	0	0
4/1/2017	635	635	0	0	0	0	0
5/1/2017	659	659	0	0	0	0	0
6/1/2017	662	662	0	0	0	0	0
7/1/2017	569	569	0	0	0	0	0
8/1/2017	741	741	0	0	0	0	0
9/1/2017	555	555	0	0	0	0	0
10/1/2017	733	733	0	0	0	0	0
11/1/2017	634	634	0	0	0	0	0
12/1/2017	841	841	0	0	0	0	0
1/1/2018	814	814	0	0	0	0	0
2/1/2018	966	966	0	0	0	0	0
3/1/2018	1,012	1,012	0	0	0	0	0
4/1/2018	1,073	1,073	0	0	0	0	0
5/1/2018	893	893	0	0	0	0	0
6/1/2018	818	818	0	0	0	0	0
7/1/2018	1,027	1,027	0	0	0	0	0
8/1/2018	1,386	1,386	0	0	0	0	0
9/1/2018	1,614	1,614	0	0	0	0	0
10/1/2018	1,851	1,851	0	0	0	0	0
11/1/2018	1,842	1,842	0	0	0	0	0
12/1/2018	1,555	1,555	0	0	0	0	0
1/1/2019	1,464	1,464	0	0	0	0	0
2/1/2019	1,696	1,696	0	0	0	0	0
3/1/2019	1,680	1,680	0	0	0	0	0
4/1/2019	1,335	1,335	0	0	0	0	0
5/1/2019	1,999	1,999	0	0	0	0	0
6/1/2019	1,877	1,877	0	0	0	0	0
7/1/2019	1,416	1,416	0	0	0	0	0
8/1/2019	1,835	1,835	0	0	0	0	0
9/1/2019	1,893	1,893	0	0	0	0	0
10/1/2019	1,966	1,792	174	0	0	0	0
11/1/2019	1,794	1,369	425	0	0	0	0
12/1/2019	1,888	1,143	745	0	0	0	0
1/1/2020	2,000	1,863	137	1,000	0	0	0
1/1/2021	2,000	286	1,714	1,000	0	0	0
1/1/2022	2,000	0	1,800	1,200	0	200	200
1/1/2023	2,400	0	2,000	1,200	0	400	800
1/1/2024	2,400	0	2,000	1,200	0	400	2,200
1/1/2025	2,400	0	2,000	1,200	0	400	2,400
1/1/2026	2,400	0	2,000	1,200	0	400	2,400
1/1/2027	2,400	0	2,000	1,200	0	400	2,400
1/1/2028	2,400	0	2,000	1,200	0	400	2,400
1/1/2029	2,400	0	1,932	1,200	68	400	1,184
1/1/2030	2,400	0	1,452	1,200	548	400	0
1/1/2031	2,400	0	1,147	1,200	685	569	0
1/1/2032	2,400	0	0	0	1,414	184	0
1/1/2033	2,400	0	0	0	0	0	0
1/1/2300	2,400	0	0	0	0	0	0

Note; Model interprets the values as constant over the next time period

Project: **Hope Bay**
Number: **1CT022.066**
Task: **Summary of the FEIS Model Inputs**
Source: *HopeBay_FEISWLBalance_TypeA_Rev28_AJB.gsm*

Table A1.2: Mine Water Flows By Source

Model Date	Mine Water Flows (m^3/day)								
	Doris Mine		Madrid North Mine				Madrid South Mine		
	Flows from Bedrock	Flows from Doris Lake	Flows from Patch Lake	Flows from Imniagut Lake	Flows from Windy Lake	Flows from Bedrock	Flows from Wolverine Lake	Flows from Patch Lake	Flows from Bedrock
1/1/1900	0	0	0	0	0	0	0	0	0
10/1/2017	0	0	0	0	0	0	0	0	0
11/1/2017	0	0	0	0	0	0	0	0	0
12/1/2017	0	0	0	0	0	0	0	0	0
1/1/2018	0	0	0	0	0	0	0	0	0
2/1/2018	13	85	0	0	0	0	0	0	0
3/1/2018	95	204	0	0	0	0	0	0	0
4/1/2018	101	150	0	0	0	0	0	0	0
5/1/2018	119	109	0	0	0	0	0	0	0
6/1/2018	188	137	0	0	0	0	0	0	0
7/1/2018	191	170	0	0	0	0	0	0	0
8/1/2018	188	128	0	0	0	0	0	0	0
9/1/2018	142	83	0	0	0	0	0	0	0
10/1/2018	396	215	0	0	0	0	0	0	0
11/1/2018	467	268	0	0	0	0	0	0	0
12/1/2018	419	234	0	0	0	0	0	0	0
1/1/2019	402	247	0	0	0	0	0	0	0
2/1/2019	385	293	0	0	0	0	0	0	0
3/1/2019	645	446	0	0	0	0	0	0	0
4/1/2019	485	296	0	0	0	0	0	0	0
5/1/2019	522	306	0	0	0	0	0	0	0
6/1/2019	523	389	0	0	0	0	0	0	0
7/1/2019	569	345	0	0	0	0	0	0	0
8/1/2019	604	344	0	0	0	0	0	0	0
9/1/2019	653	361	0	0	0	0	0	0	0
10/1/2019	643	373	0	0	0	0	0	0	0
11/1/2019	831	507	0	0	0	0	0	0	0
12/1/2019	1,477	875	0	0	0	0	0	0	0
1/1/2020	1,682	973	0	0	0	0	0	0	0
2/1/2020	1,650	655	0	0	0	0	0	0	0
3/1/2020	1,591	822	0	0	0	0	0	0	0
4/1/2020	1,562	825	0	1	0	1	0	0	0
5/1/2020	1,548	834	0	3	0	9	0	0	0
6/1/2020	1,503	396	0	9	0	17	0	0	0
7/1/2020	1,429	657	0	17	0	20	0	0	0
8/1/2020	1,328	72	1	24	0	20	0	0	0
9/1/2020	1,185	500	2	28	0	21	0	0	0
10/1/2020	1,132	580	3	31	0	26	0	0	0
11/1/2020	1,117	597	3	34	0	44	0	0	0
12/1/2020	1,113	596	5	37	0	78	0	0	0
1/1/2021	1,112	595	7	39	0	80	0	0	0
2/1/2021	1,111	592	9	40	0	71	0	0	0
3/1/2021	1,111	589	11	42	0	66	0	0	0
4/1/2021	1,111	589	12	43	1	59	0	0	0
5/1/2021	1,111	587	70	43	1	146	0	0	0
6/1/2021	1,111	588	244	45	2	146	0	0	0
7/1/2021	1,104	585	329	46	2	114	0	0	0
8/1/2021	0	0	386	47	3	102	0	0	0
9/1/2021	0	0	428	48	3	90	0	0	0
10/1/2021	0	0	460	49	3	85	0	0	0
11/1/2021	0	0	488	50	4	84	0	0	0
12/1/2021	0	0	512	51	4	80	0	0	0
1/1/2022	0	0	531	52	5	77	0	0	0
2/1/2022	0	0	547	52	5	71	0	0	0
3/1/2022	0	0	559	53	5	70	0	0	0
4/1/2022	0	0	569	53	6	63	0	0	0
5/1/2022	0	0	576	54	6	59	0	0	0
6/1/2022	0	0	601	54	6	196	0	0	0
7/1/2022	0	0	701	54	7	163	0	0	0
8/1/2022	0	0	773	55	7	139	0	0	0
9/1/2022	0	0	826	55	7	129	0	0	0
10/1/2022	0	0	868	55	7	125	0	0	0
11/1/2022	0	0	905	55	7	118	0	0	0
12/1/2022	0	0	935	55	8	109	0	0	0
1/1/2023	0	0	959	55	8	104	0	0	0
2/1/2023	0	0	977	56	8	97	0	0	0
3/1/2023	0	0	990	56	8	92	0	0	0
4/1/2023	0	0	1,001	56	8	91	0	0	0
5/1/2023	0	0	1,010	56	9	87	0	0	0
6/1/2023	0	0	1,017	56	9	84	0	0	0
7/1/2023	0	0	1,023	56	9	80	0	0	0
8/1/2023	0	0	1,028	56	9	80	0	0	0
9/1/2023	0	0	1,032	56	9	77	0	0	0
10/1/2023	0	0	1,035	56	9	76	0	0	0
11/1/2023	0	0	1,038	56	9	74	0	0	0
12/1/2023	0	0	1,041	56	9	73	0	0	0
1/1/2024	0	0	1,042	56	10	69	0	0	0
2/1/2024	0	0	1,044	56	10	69	0	0	0
3/1/2024	0	0	1,045	56	10	67	0	0	0

Project: **Hope Bay**
Number: **1CT022.066**
Task: **Summary of the FEIS Model Inputs**
Source: *HopeBay_FEISWLBalance_TypeA_Rev28_AJB.gsm*

Table A1.2: Mine Water Flows By Source

Model Date	Mine Water Flows (m^3/day)								
	Doris Mine		Madrid North Mine				Madrid South Mine		
	Flows from Bedrock	Flows from Doris Lake	Flows from Patch Lake	Flows from Imniagut Lake	Flows from Windy Lake	Flows from Bedrock	Flows from Wolverine Lake	Flows from Patch Lake	Flows from Bedrock
4/1/2024	0	0	1,046	56	10	66	0	0	0
5/1/2024	0	0	1,047	56	10	65	0	0	0
6/1/2024	0	0	1,048	56	10	64	0	0	0
7/1/2024	0	0	1,049	56	10	63	0	0	0
8/1/2024	0	0	1,049	57	10	63	0	0	0
9/1/2024	0	0	1,050	57	10	62	0	0	0
10/1/2024	0	0	1,051	57	10	60	0	0	0
11/1/2024	0	0	1,051	57	10	59	0	0	0
12/1/2024	0	0	1,051	57	11	56	0	0	0
1/1/2025	0	0	1,052	57	11	55	0	0	0
2/1/2025	0	0	1,052	57	11	54	0	0	0
3/1/2025	0	0	1,052	57	11	53	0	0	0
4/1/2025	0	0	1,053	57	11	52	0	0	0
5/1/2025	0	0	1,053	57	11	51	0	0	0
6/1/2025	0	0	1,053	57	11	51	0	0	0
7/1/2025	0	0	1,053	57	11	51	0	0	0
8/1/2025	0	0	1,053	57	11	51	0	0	0
9/1/2025	0	0	1,053	57	11	48	0	0	0
10/1/2025	0	0	1,054	57	11	49	0	0	0
11/1/2025	0	0	1,054	57	11	49	0	0	0
12/1/2025	0	0	1,054	57	11	49	0	0	0
1/1/2026	0	0	1,054	57	11	48	0	0	0
2/1/2026	0	0	1,054	57	11	48	0	0	0
3/1/2026	0	0	1,054	57	11	48	0	0	0
4/1/2026	0	0	1,054	57	11	48	0	0	0
5/1/2026	0	0	1,054	57	11	48	0	0	0
6/1/2026	0	0	1,054	57	11	48	0	0	0
7/1/2026	0	0	1,054	57	11	48	0	0	0
8/1/2026	0	0	1,054	57	11	48	0	0	0
9/1/2026	0	0	1,055	57	12	45	0	0	0
10/1/2026	0	0	1,055	57	12	45	0	0	0
11/1/2026	0	0	1,055	57	12	45	0	0	0
12/1/2026	0	0	1,055	57	12	45	0	0	0
1/1/2027	0	0	1,055	57	12	45	0	0	0
2/1/2027	0	0	1,055	57	12	45	0	0	0
3/1/2027	0	0	1,055	57	12	45	0	0	0
4/1/2027	0	0	1,055	57	12	45	0	0	0
5/1/2027	0	0	1,055	57	12	45	0	0	0
6/1/2027	0	0	1,055	57	12	45	0	0	0
7/1/2027	0	0	1,055	57	12	45	0	0	0
8/1/2027	0	0	1,055	57	12	45	0	0	0
9/1/2027	0	0	1,055	57	12	45	0	0	0
10/1/2027	0	0	1,055	57	12	45	0	0	0
11/1/2027	0	0	1,055	57	12	45	0	0	0
12/1/2027	0	0	1,055	57	12	45	0	0	0
1/1/2028	0	0	1,055	57	12	45	0	0	0
2/1/2028	0	0	1,055	57	12	45	0	0	0
3/1/2028	0	0	1,055	57	12	45	0	0	0
4/1/2028	0	0	1,055	57	12	45	0	0	0
5/1/2028	0	0	1,055	57	12	45	0	0	0
6/1/2028	0	0	1,055	57	12	45	0	0	0
7/1/2028	0	0	1,055	57	12	45	0	0	0
8/1/2028	0	0	1,055	57	12	45	0	0	0
9/1/2028	0	0	1,056	57	12	41	0	0	0
10/1/2028	0	0	1,056	57	12	41	0	0	0
11/1/2028	0	0	1,056	57	12	41	0	0	0
12/1/2028	0	0	1,056	57	12	41	0	0	0
1/1/2029	0	0	1,056	57	12	41	0	2	2
2/1/2029	0	0	1,056	57	12	41	0	2	2
3/1/2029	0	0	1,056	57	12	41	0	2	2
4/1/2029	0	0	1,056	57	12	41	0	2	2
5/1/2029	0	0	1,056	57	12	41	0	2	2
6/1/2029	0	0	1,056	57	12	41	0	2	31
7/1/2029	0	0	1,056	57	12	41	18	111	151
8/1/2029	0	0	1,056	57	12	41	35	166	115
9/1/2029	0	0	1,056	57	12	41	49	198	97
10/1/2029	0	0	1,056	57	12	41	62	219	90
11/1/2029	0	0	1,056	57	12	41	72	234	86
12/1/2029	0	0	1,056	57	12	41	82	246	85
1/1/2030	0	0	1,056	57	12	41	91	257	85
2/1/2030	0	0	1,056	57	12	41	99	265	90
3/1/2030	0	0	1,056	57	12	41	109	272	106
4/1/2030	0	0	1,056	57	12	41	122	277	109
5/1/2030	0	0	1,056	57	12	41	135	283	105
6/1/2030	0	0	1,056	57	12	41	146	287	98
7/1/2030	0	0	1,056	57	12	41	153	291	93
8/1/2030	0	0	1,056	57	12	41	160	294	87
9/1/2030	0	0	1,056	57	12	41	164	297	84
10/1/2030	0	0	1,056	57	12	41	168	299	78

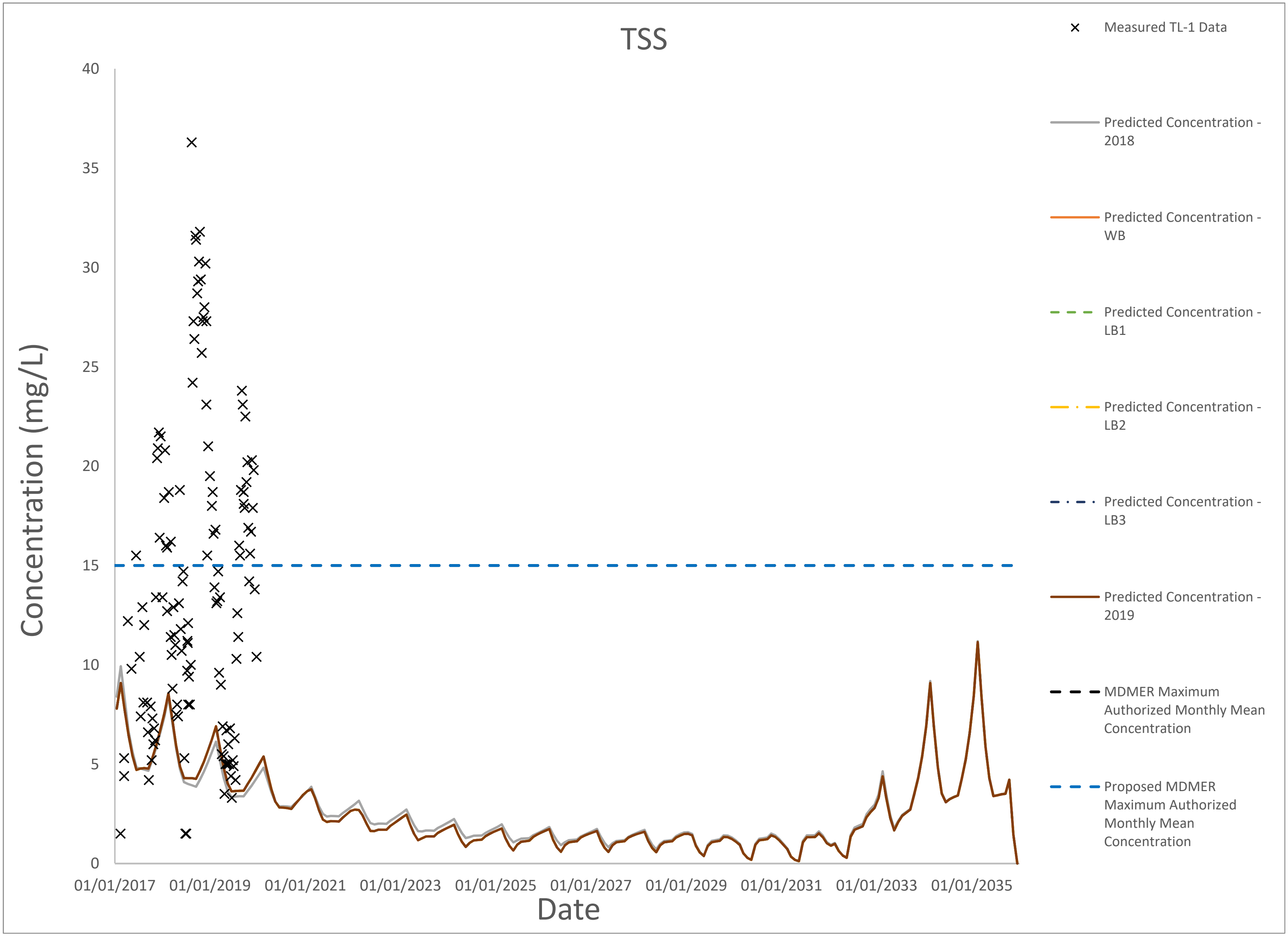
Project: **Hope Bay**
Number: **1CT022.066**
Task: **Summary of the FEIS Model Inputs**
Source: *HopeBay_FEISWLBalance_TypeA_Rev28_AJB.gsm*

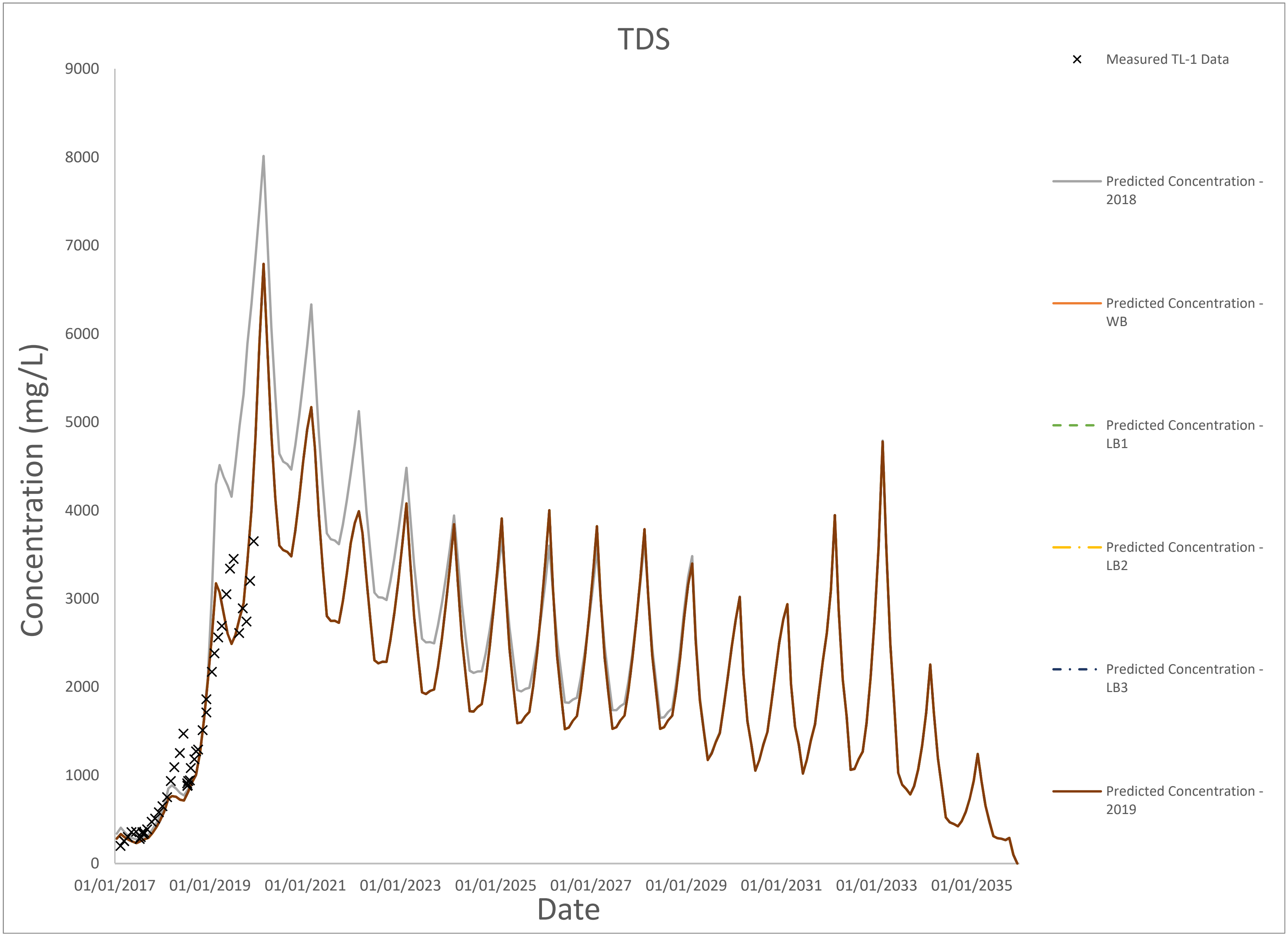
Table A1.2: Mine Water Flows By Source

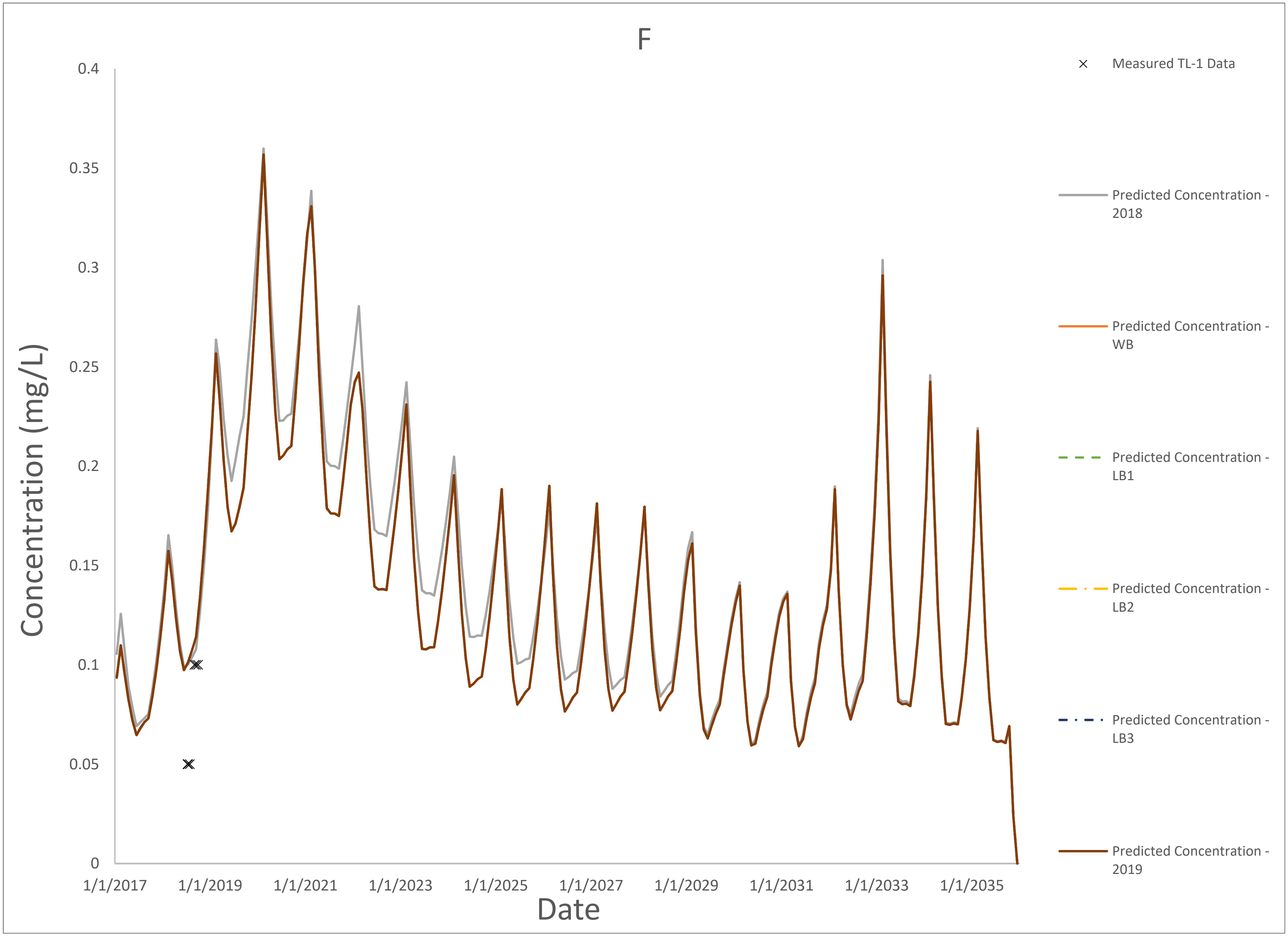
Model Date	Mine Water Flows (m^3/day)								
	Doris Mine		Madrid North Mine				Madrid South Mine		
	Flows from Bedrock	Flows from Doris Lake	Flows from Patch Lake	Flows from Imniagut Lake	Flows from Windy Lake	Flows from Bedrock	Flows from Wolverine Lake	Flows from Patch Lake	Flows from Bedrock
11/1/2030	0	0	1,056	57	12	41	171	300	75
12/1/2030	0	0	1,056	57	12	41	173	302	73
1/1/2031	0	0	1,056	57	12	41	175	303	70
2/1/2031	0	0	1,056	57	13	38	177	304	69
3/1/2031	0	0	1,056	57	13	38	178	305	65
4/1/2031	0	0	1,056	57	13	38	179	305	64
5/1/2031	0	0	1,056	57	13	38	179	306	60
6/1/2031	0	0	1,056	57	13	38	180	306	59
7/1/2031	0	0	1,056	57	13	38	180	307	58
8/1/2031	0	0	1,056	57	13	38	181	307	58
9/1/2031	0	0	1,056	57	13	38	181	308	57
10/1/2031	0	0	1,056	57	13	38	181	308	55
11/1/2031	0	0	1,056	57	13	38	182	308	55
12/1/2031	0	0	1,056	57	13	38	182	308	53
1/1/2032	0	0	0	0	0	0	182	308	53
2/1/2032	0	0	0	0	0	0	182	309	54
3/1/2032	0	0	0	0	0	0	182	309	52
4/1/2032	0	0	0	0	0	0	182	309	51
5/1/2032	0	0	0	0	0	0	182	309	50
6/1/2032	0	0	0	0	0	0	183	309	49
7/1/2032	0	0	0	0	0	0	183	309	48
8/1/2032	0	0	0	0	0	0	183	309	47
9/1/2032	0	0	0	0	0	0	183	309	47
10/1/2032	0	0	0	0	0	0	183	309	47
11/1/2032	0	0	0	0	0	0	183	309	47
12/1/2032	0	0	0	0	0	0	183	310	46
1/1/2033	0	0	0	0	0	0	0	0	0
1/1/2100	0	0	0	0	0	0	0	0	0

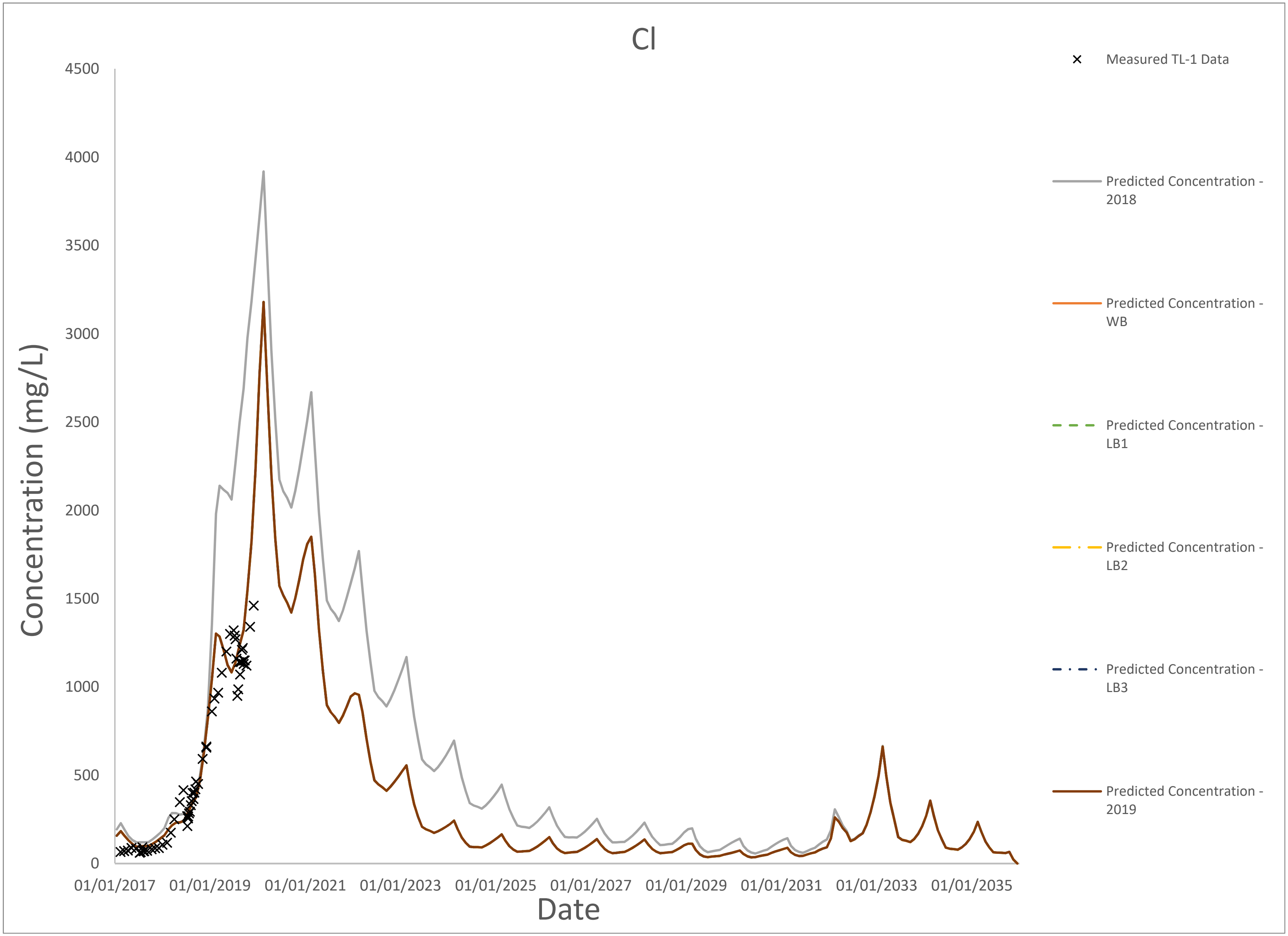
Note; Model interprets the values as constant over the next time period

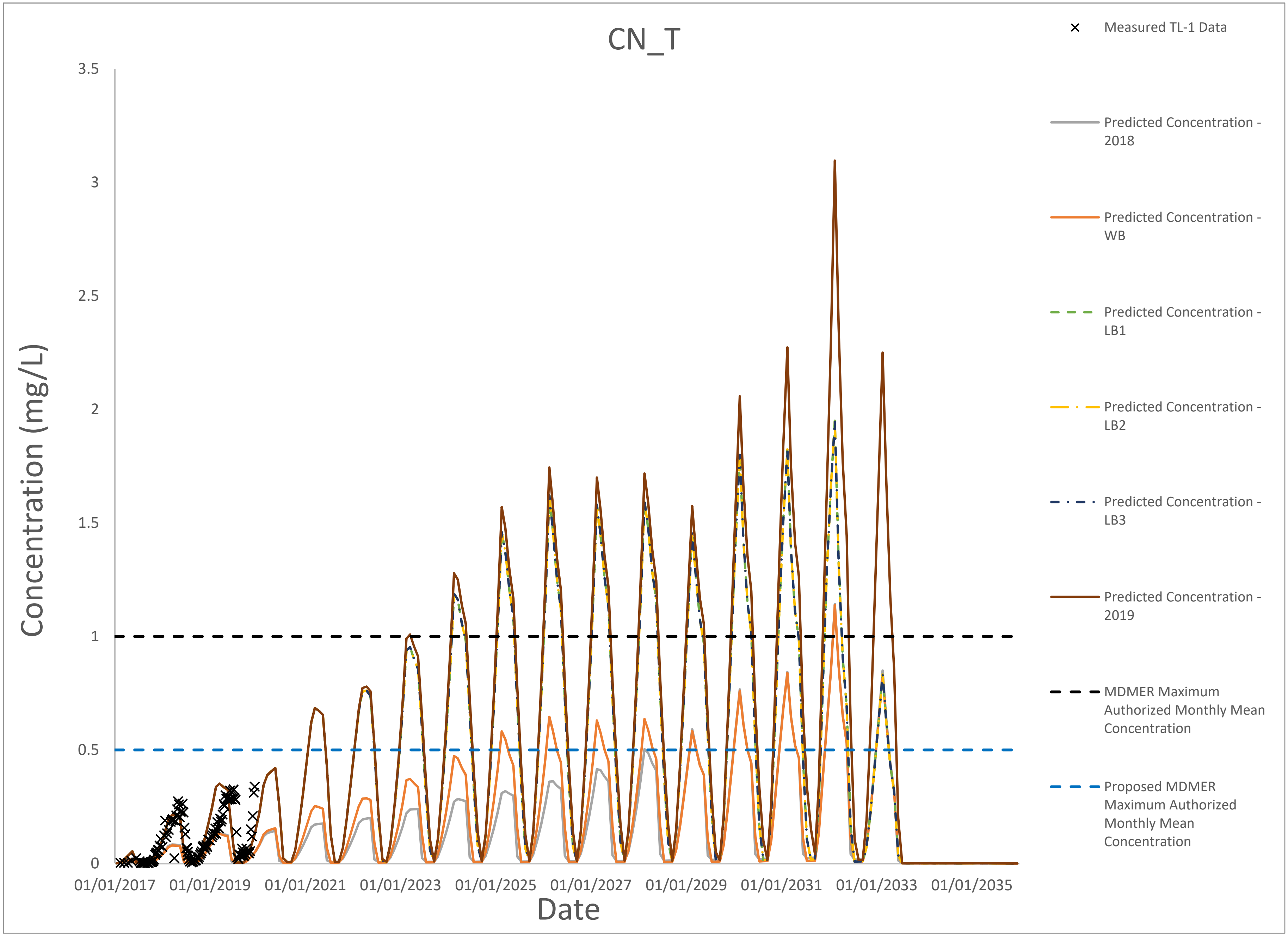
Attachment 2: Annual WLB Assessment – 2019 - PLOTS

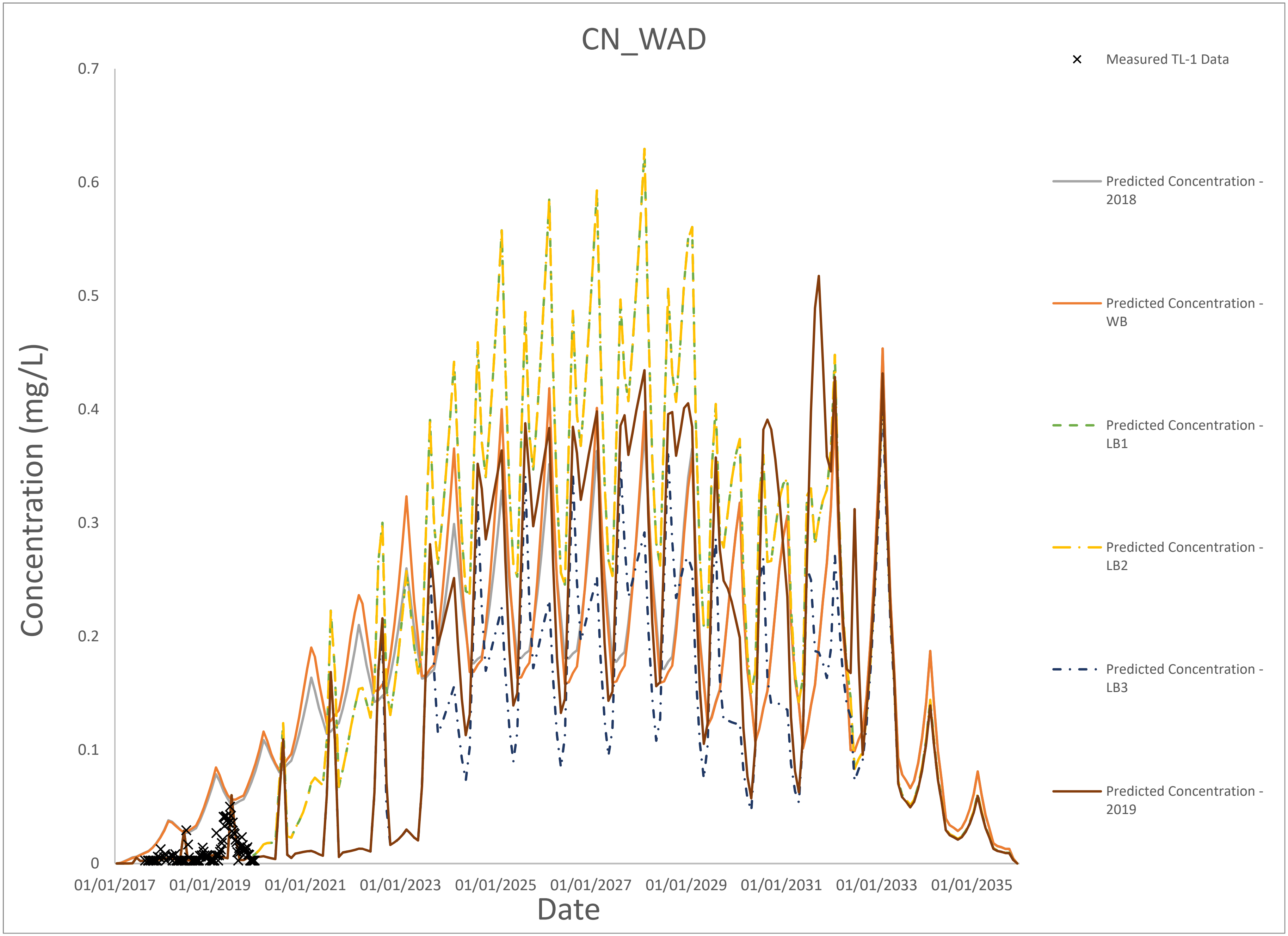

TSS
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration
Concentration (mg/L)
40
35
30
25
20
15
10
5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

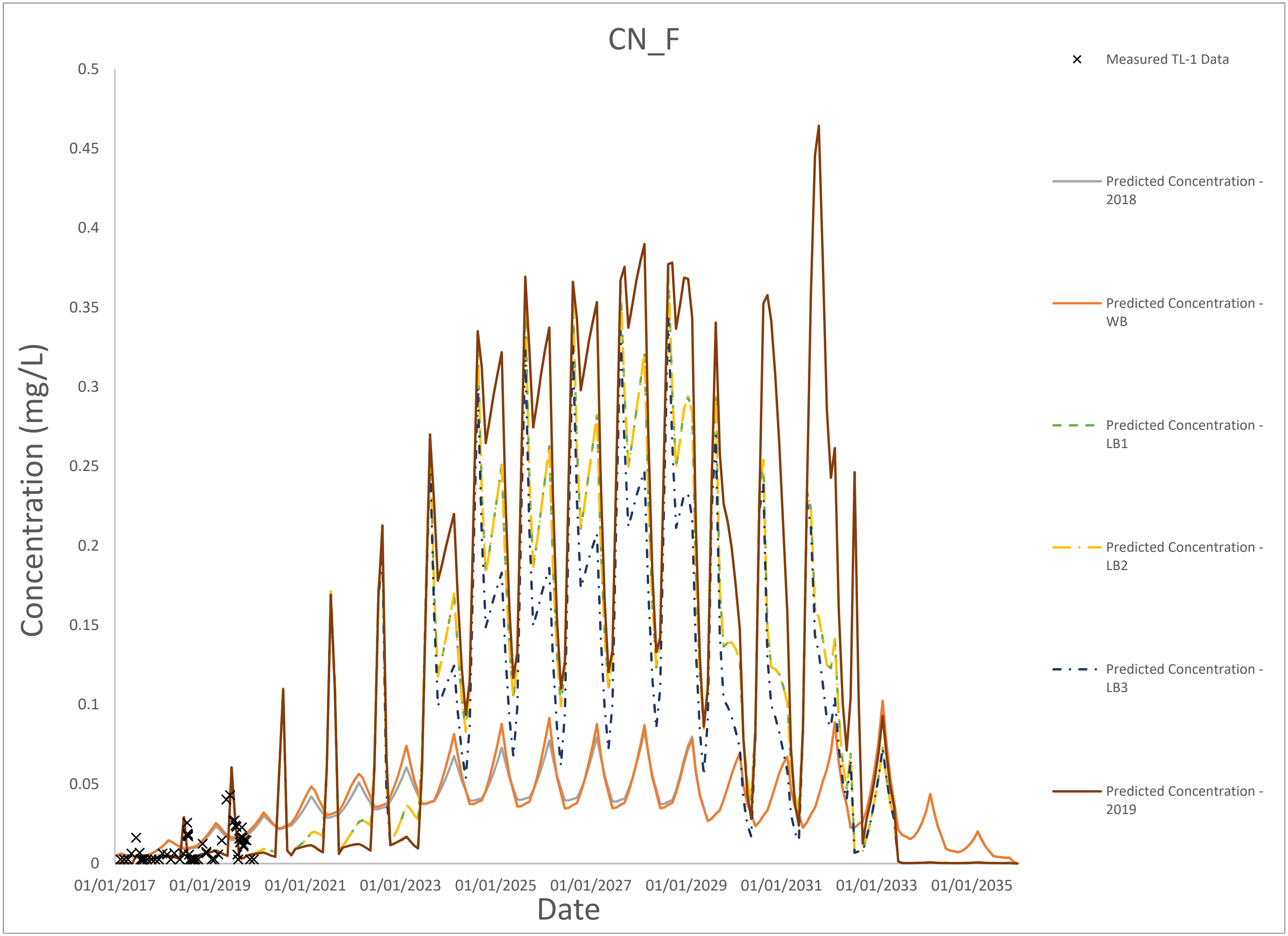

TDS
Concentration (mg/L)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

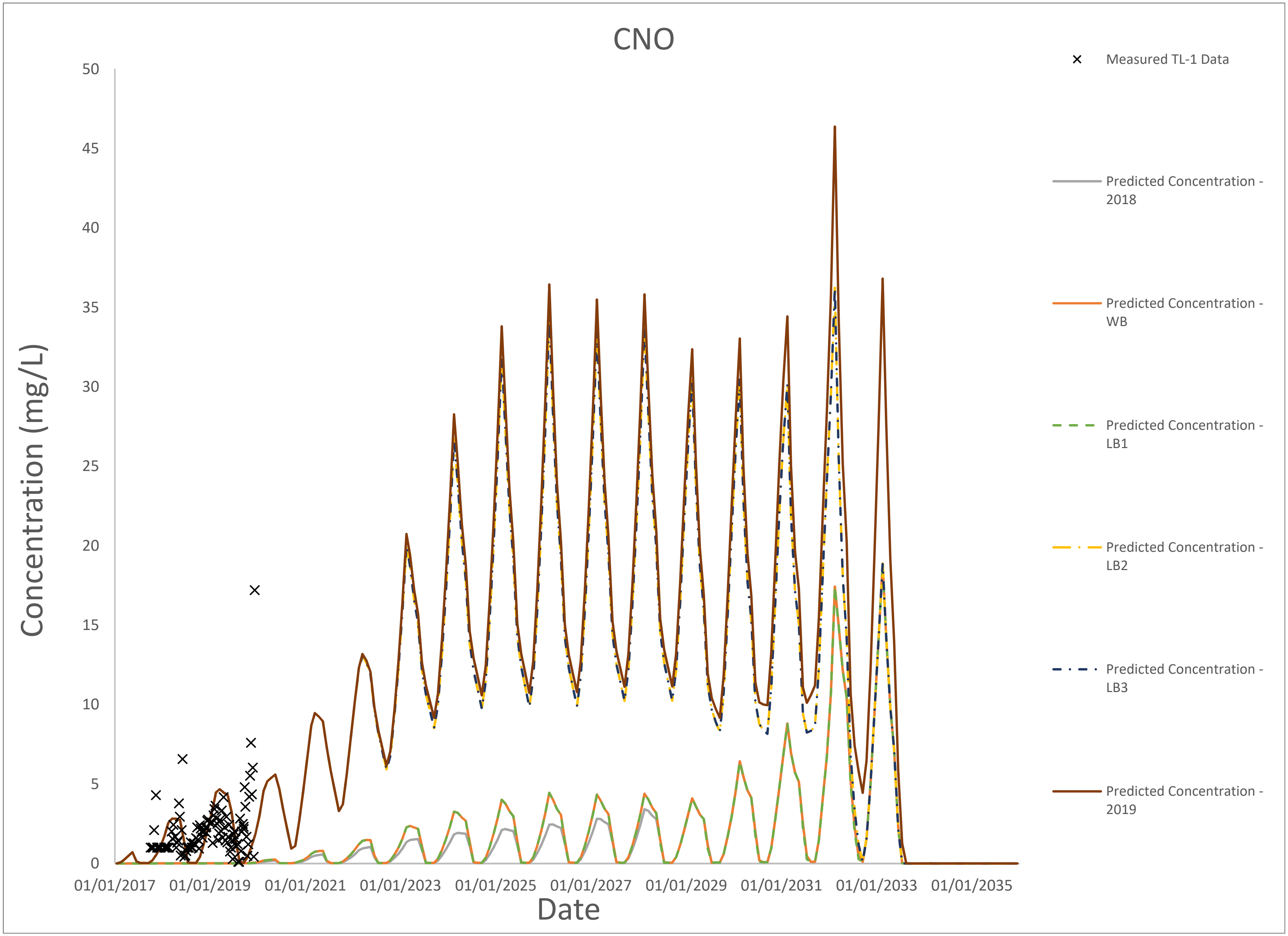

F
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Date
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035

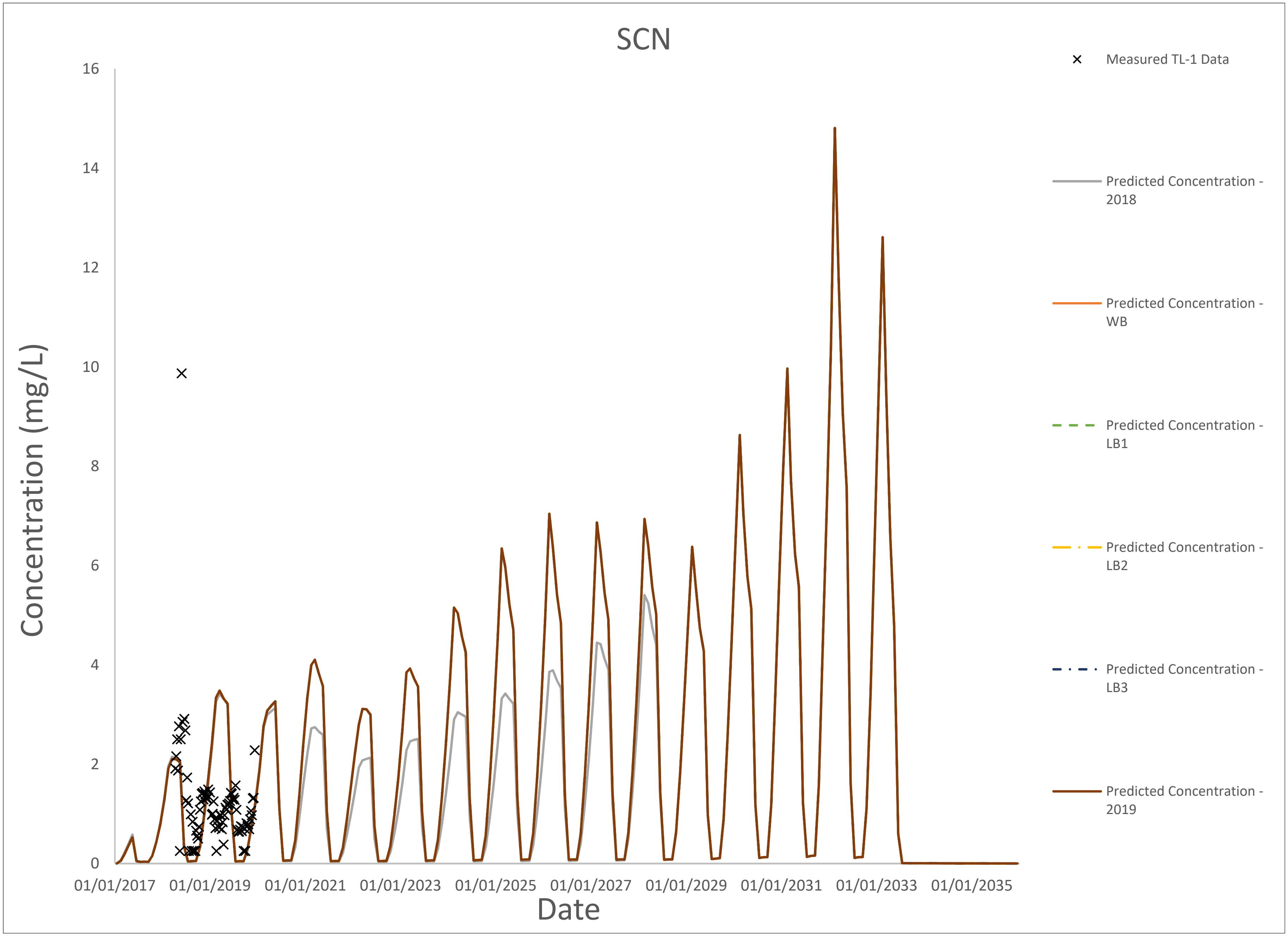

Cl
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

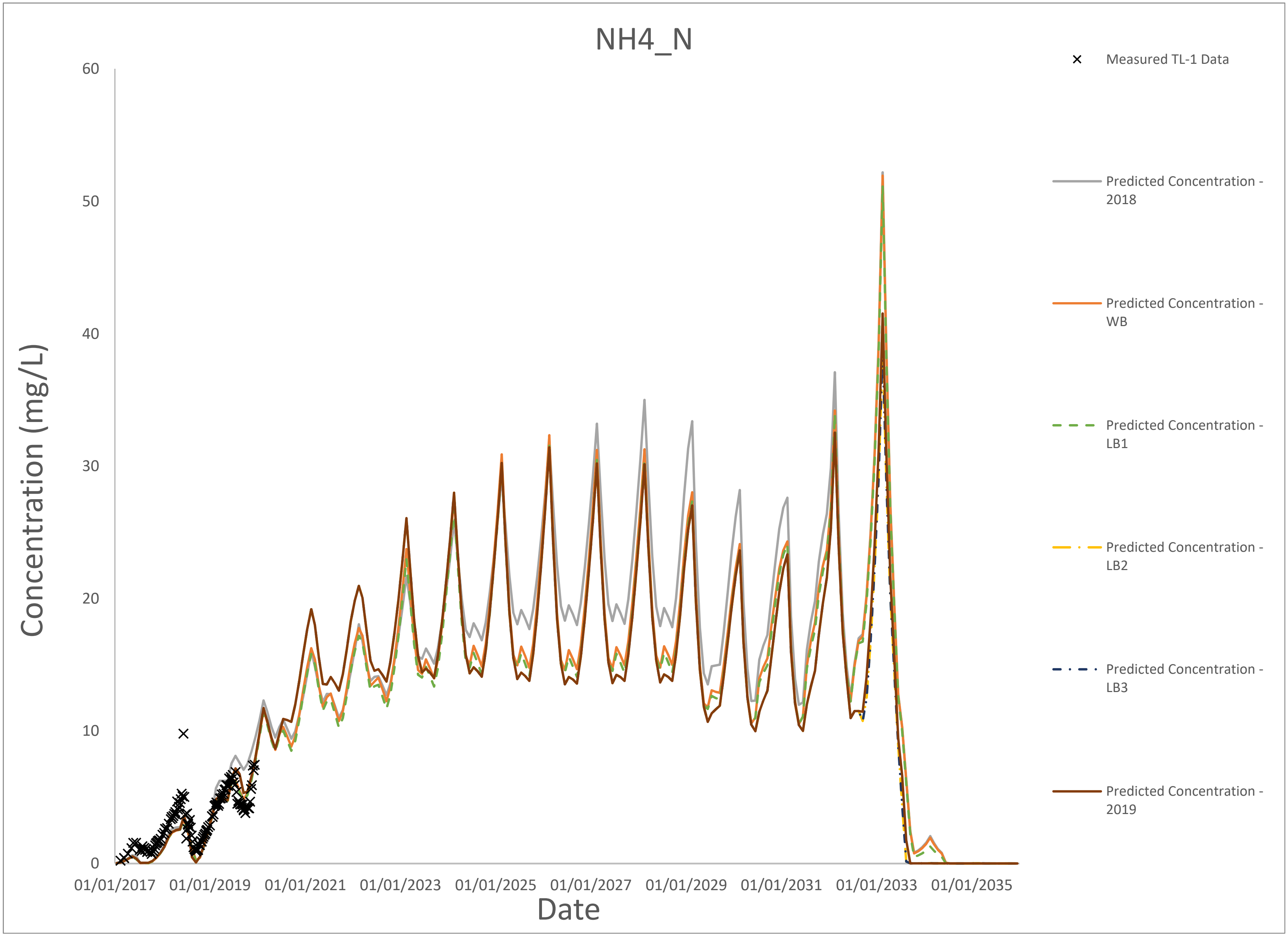

CN_T
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

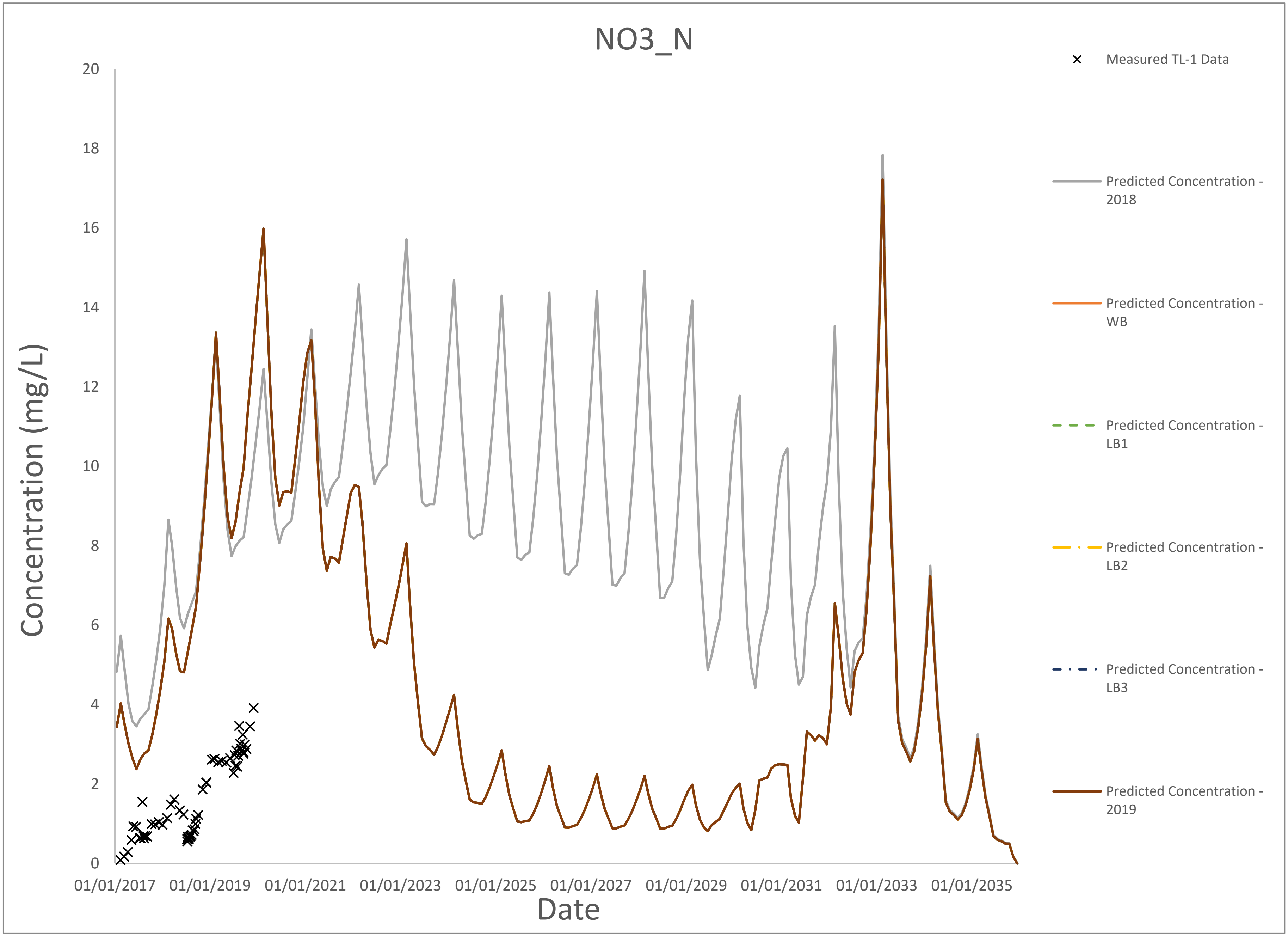

CN_WAD
Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

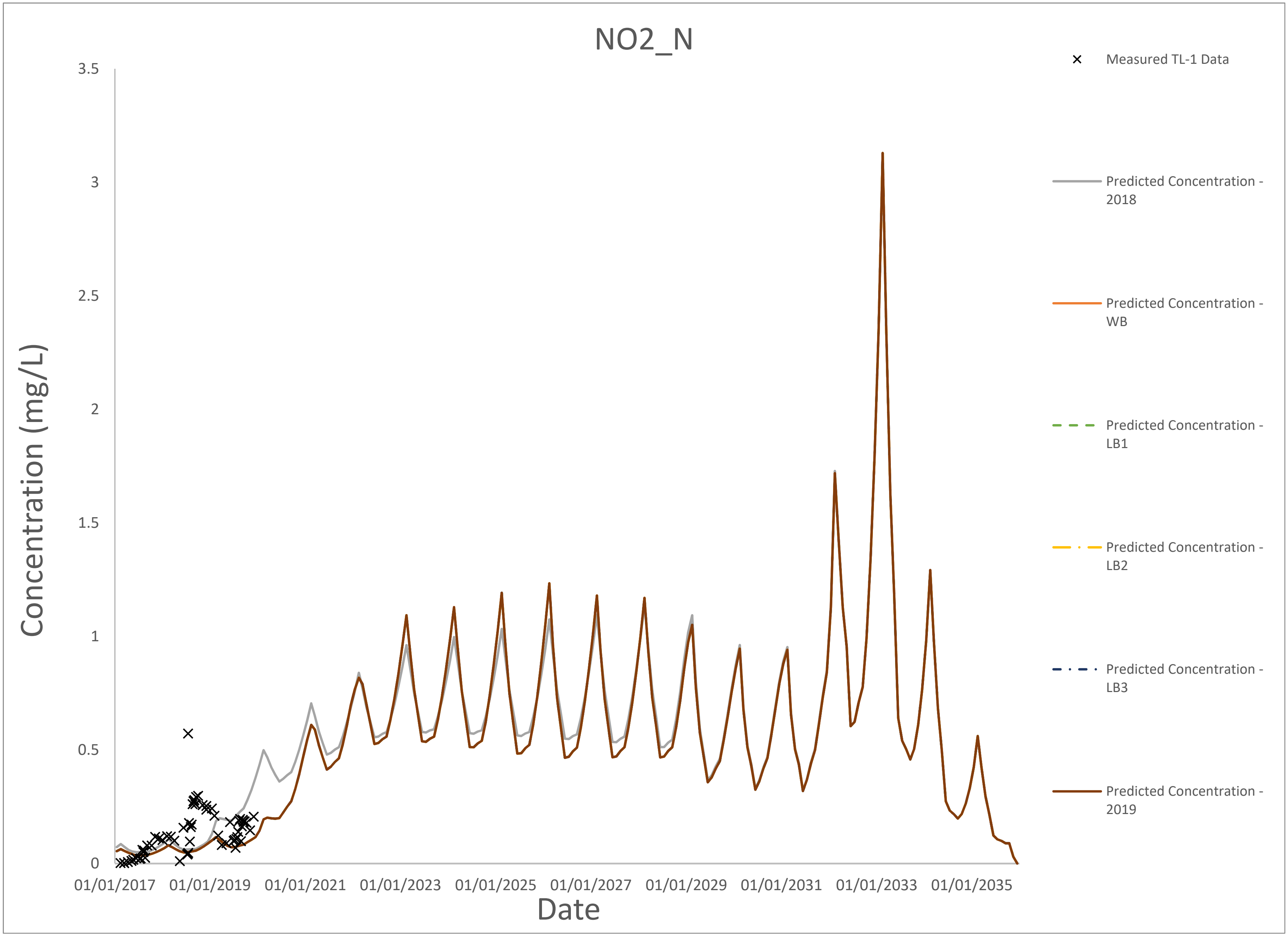

CN_F
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

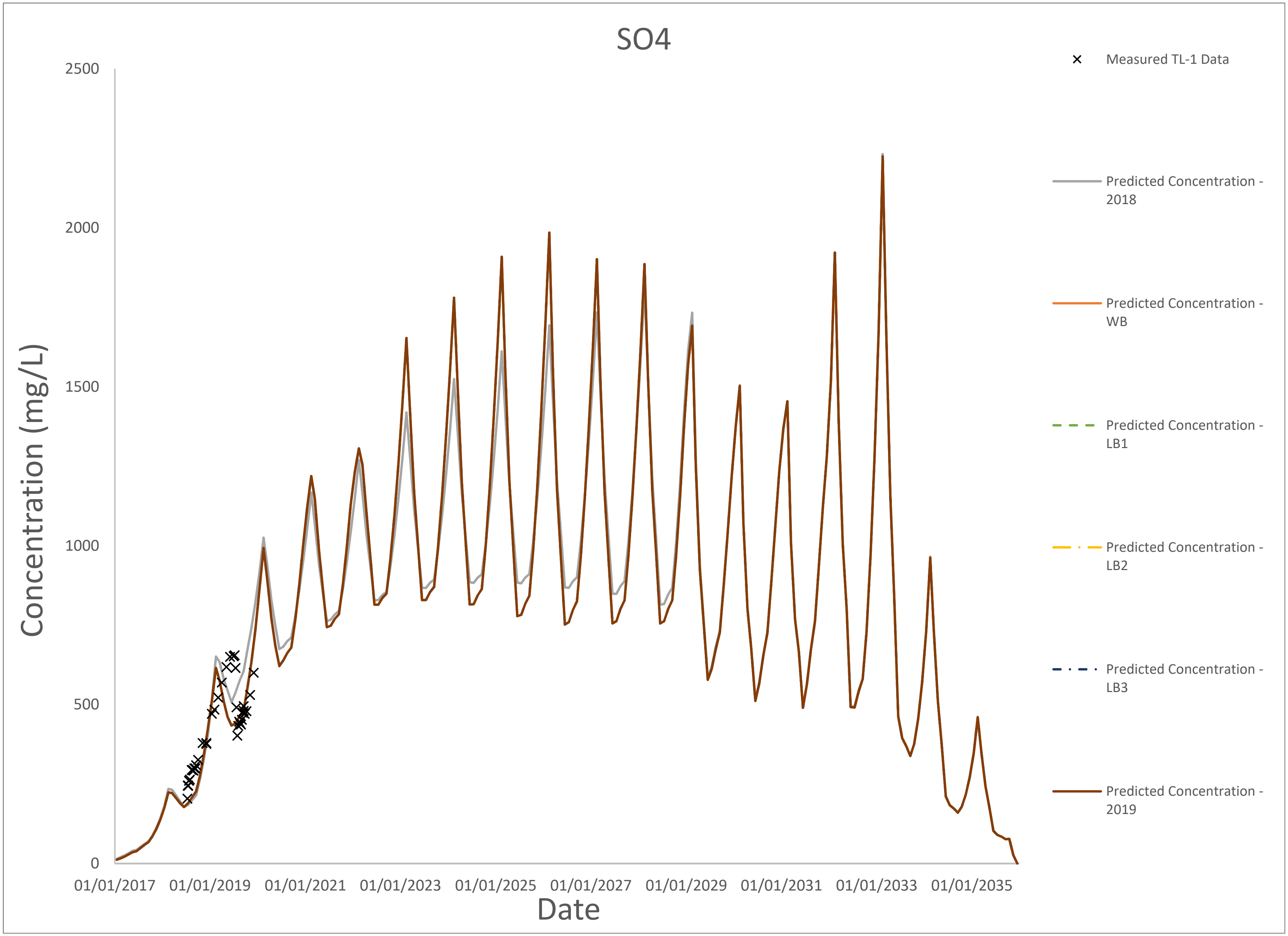

CNO
Concentration (mg/L)
50
45
40
35
30
25
20
15
10
5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

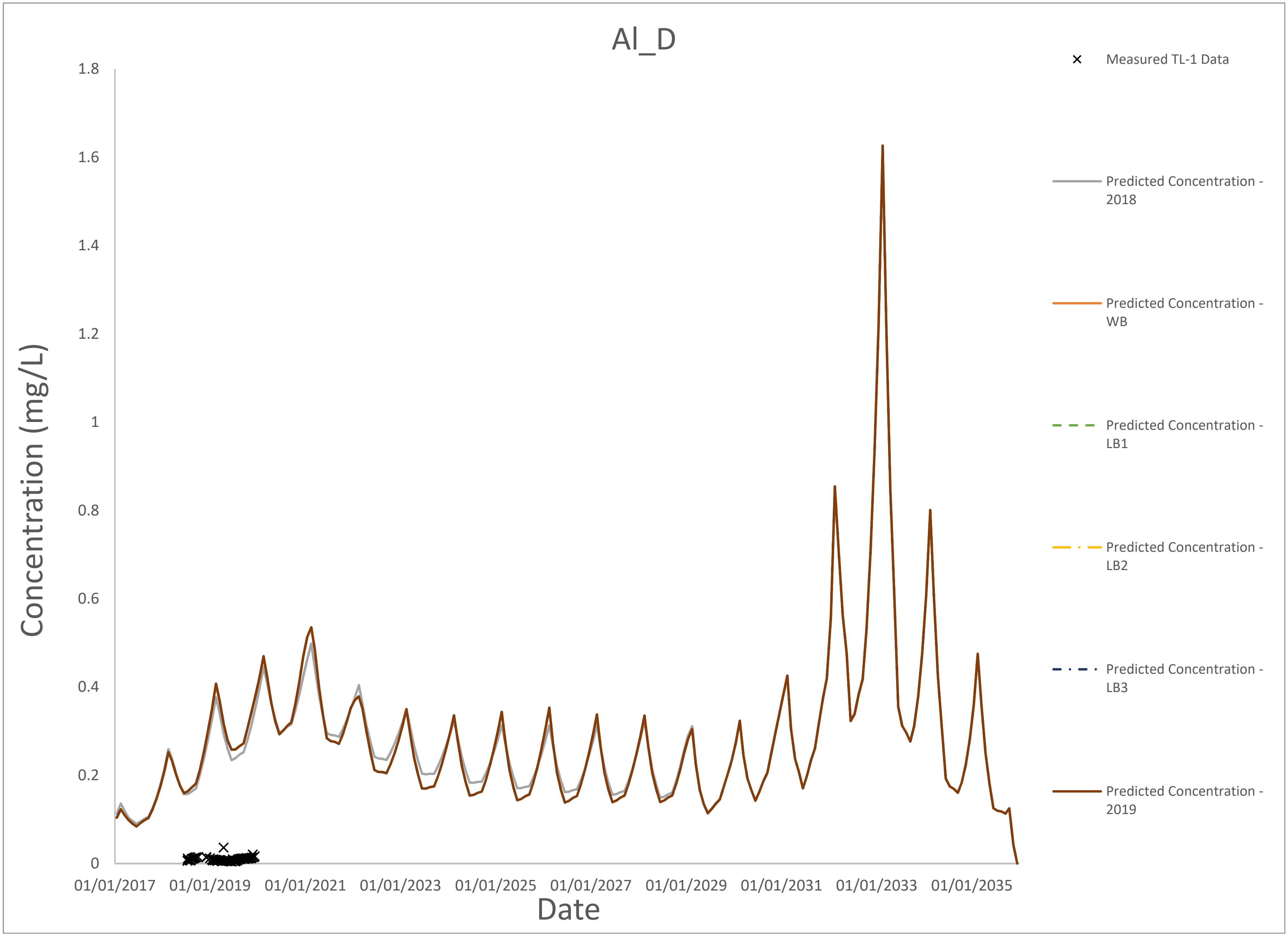

SCN
Concentration (mg/L)
0
2
4
6
8
10
12
14
16
Date
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

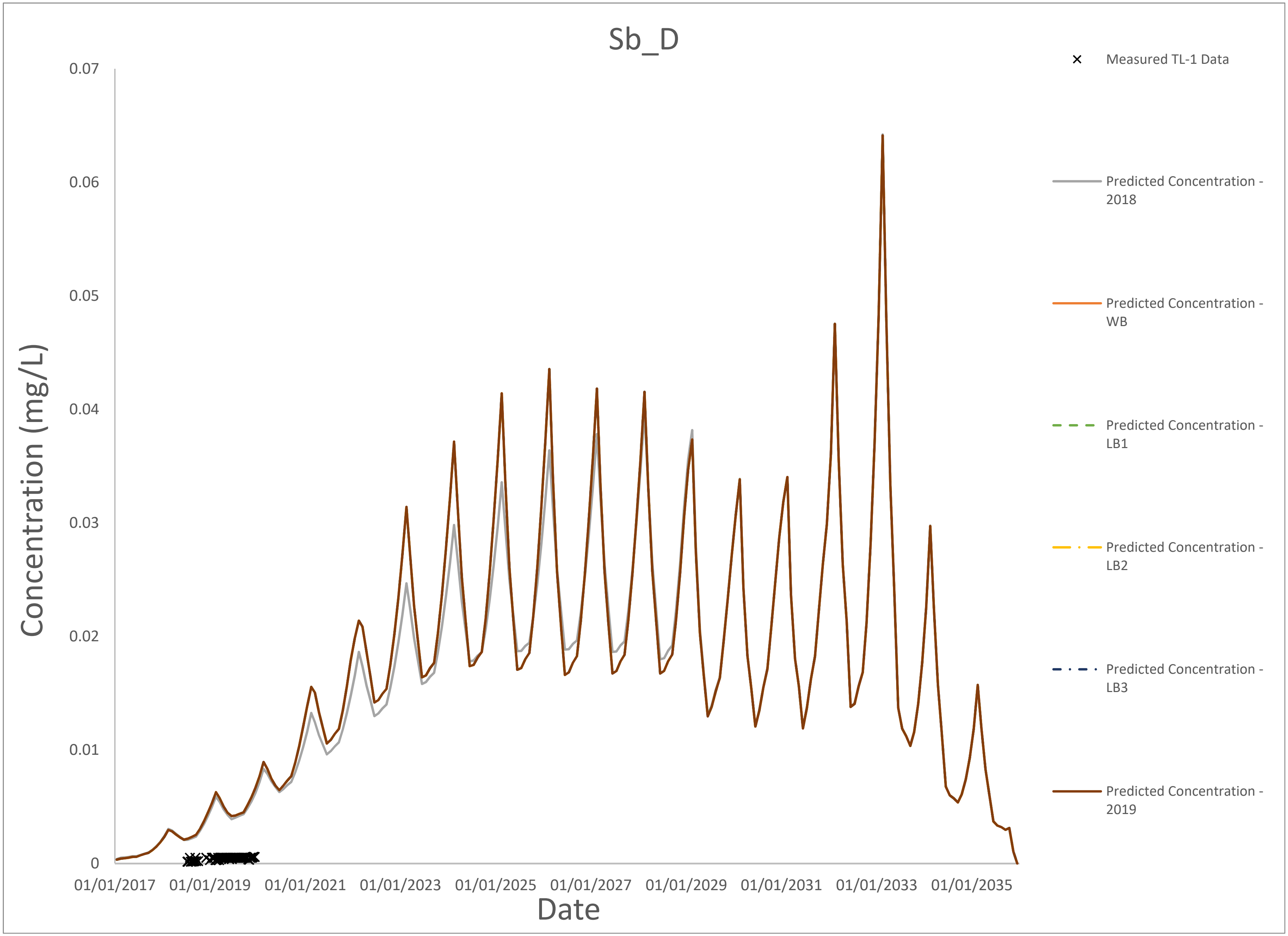

NH4_N
Concentration (mg/L)
60
50
40
30
20
10
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

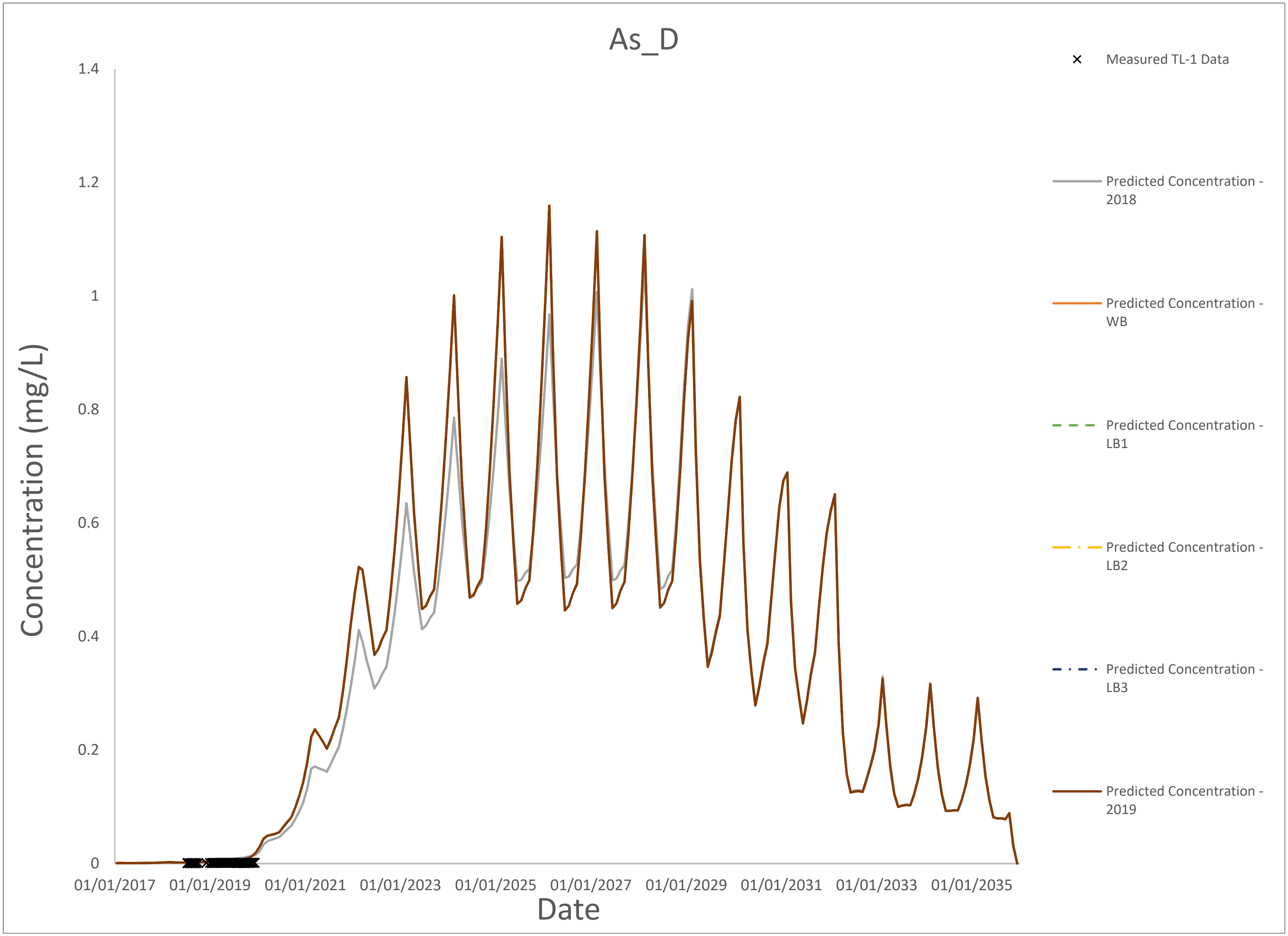

NO3_N
Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

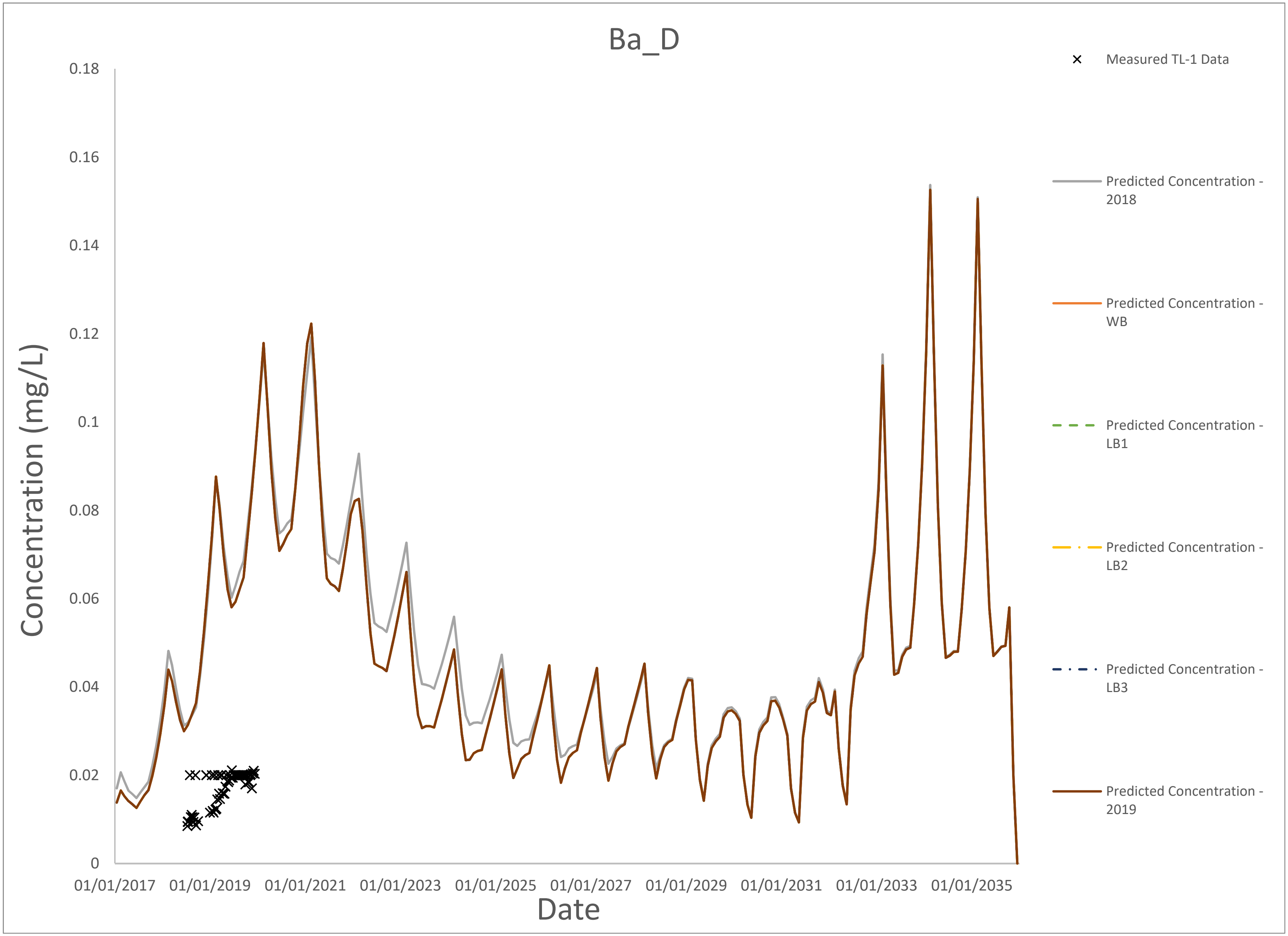

NO2_N
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

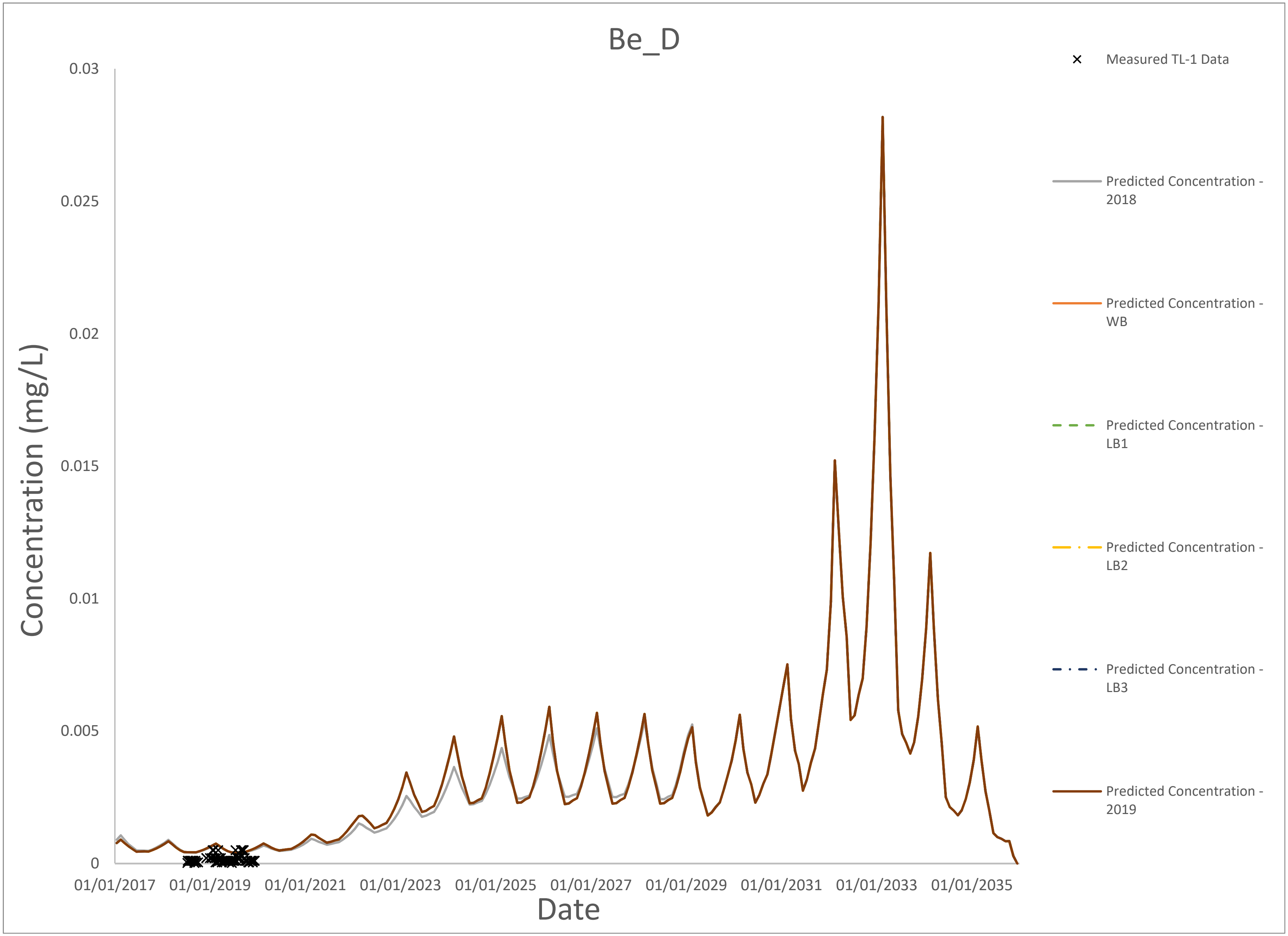

SO4
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

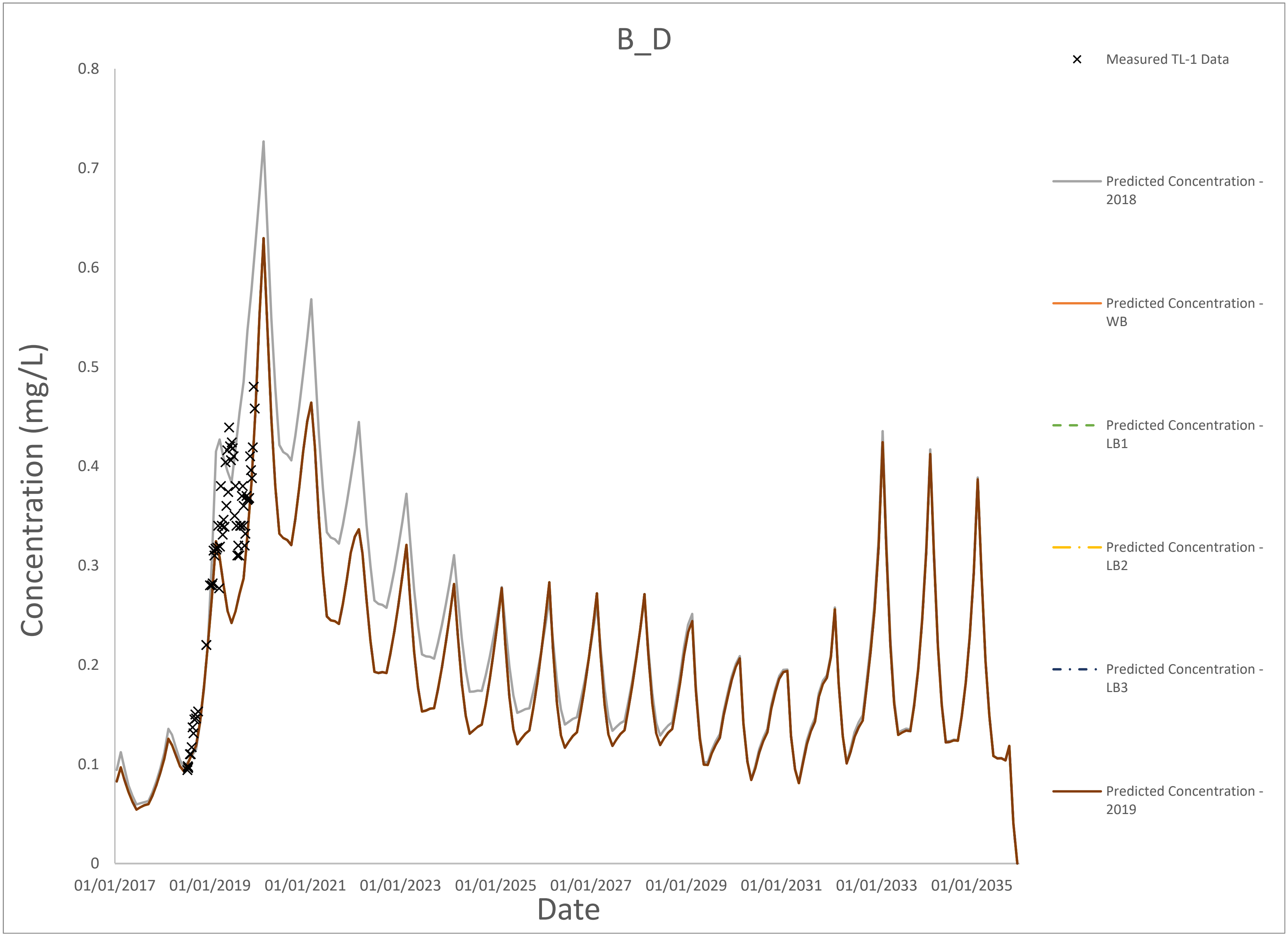

Al_D
Concentration (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

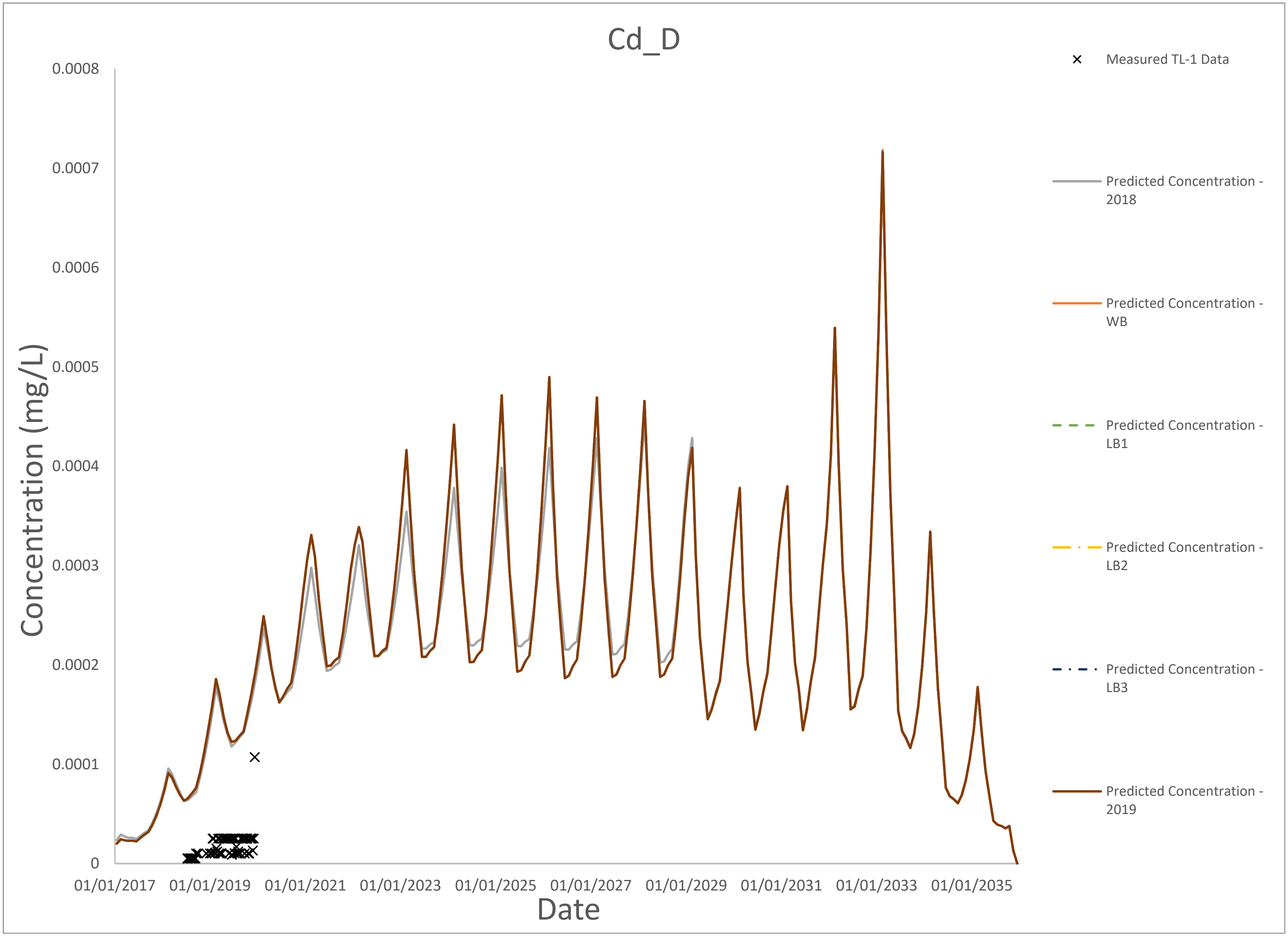

Sb_D
Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

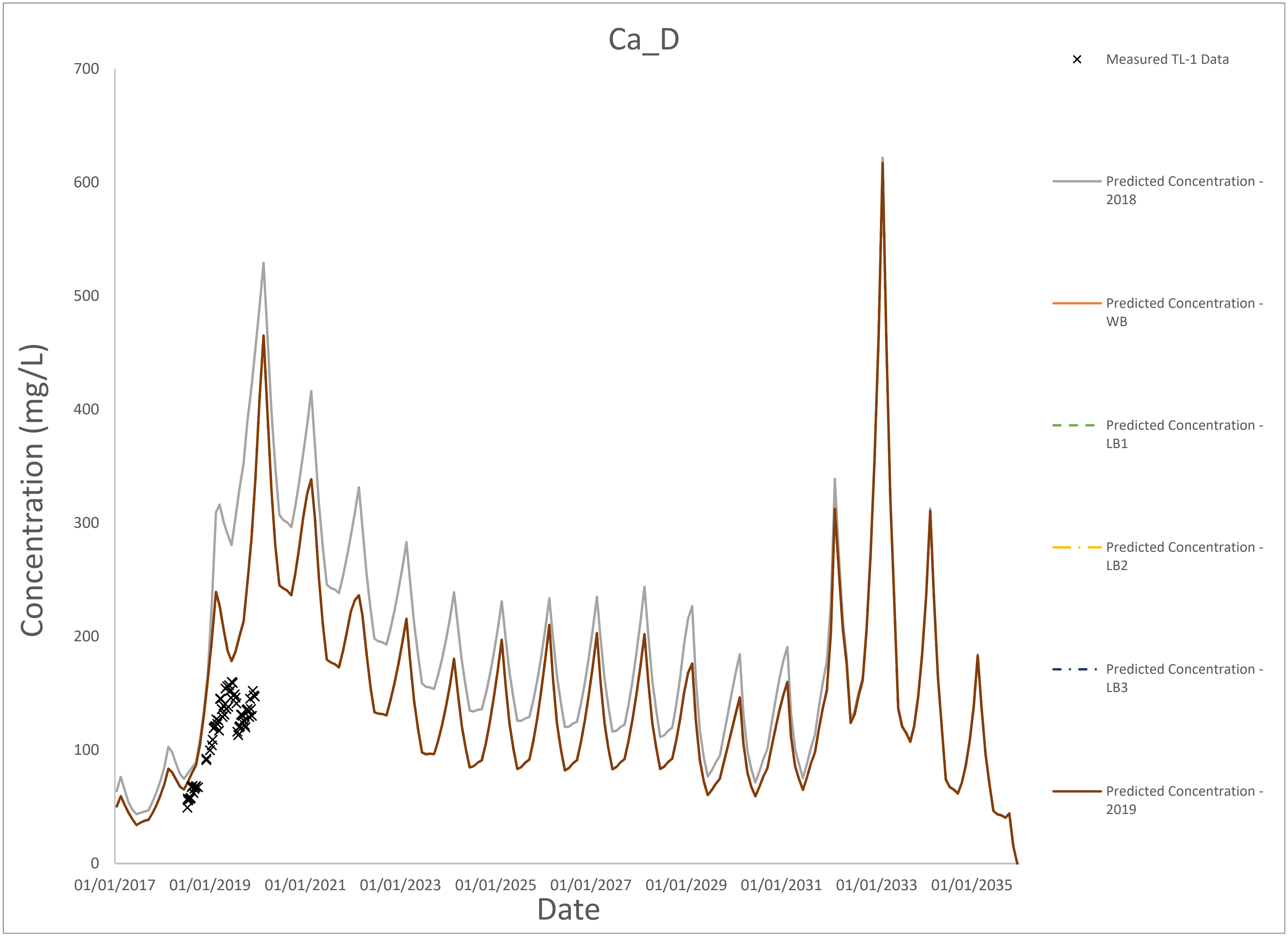

As_D
Concentration (mg/L)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

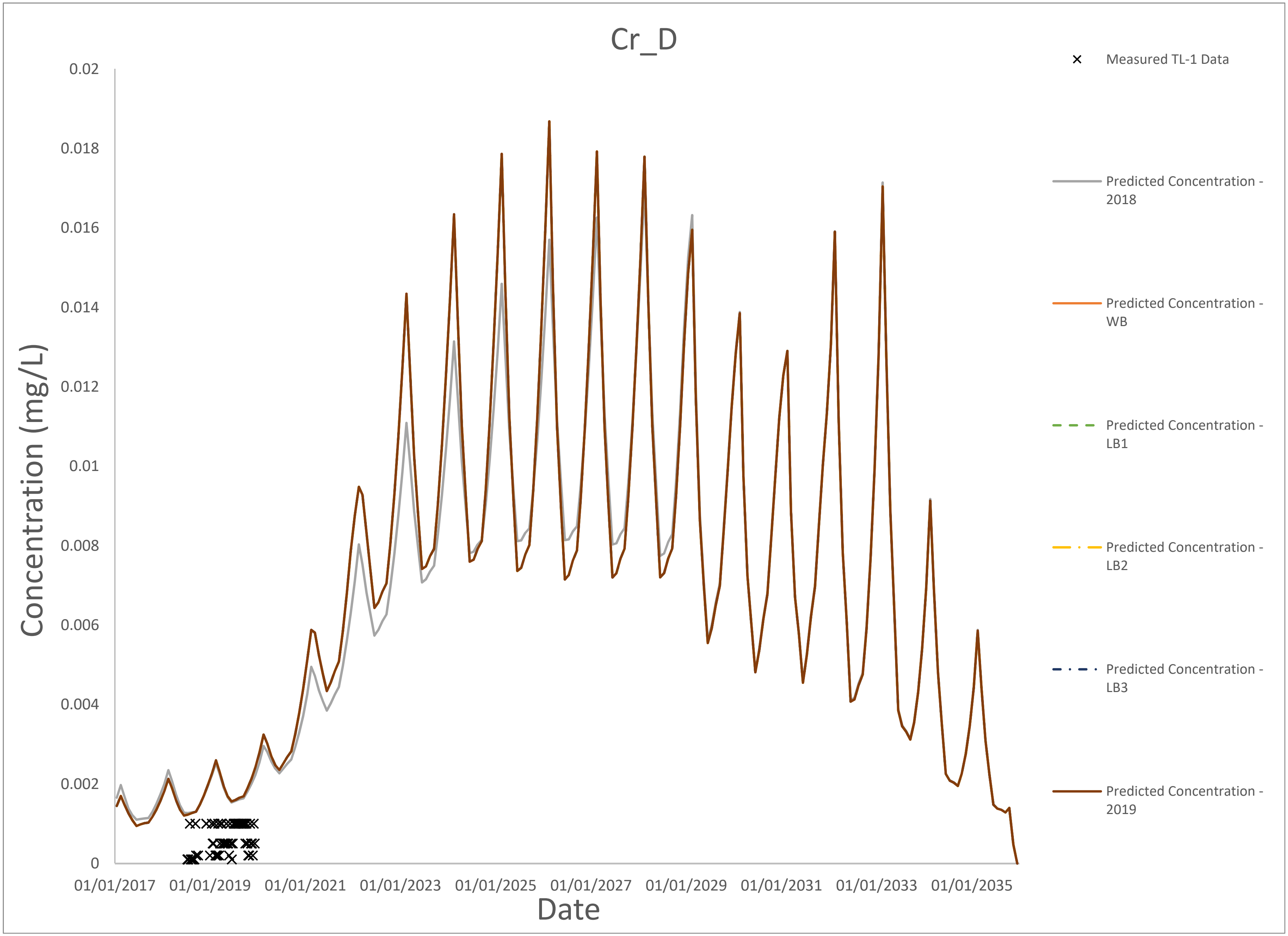

Ba_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

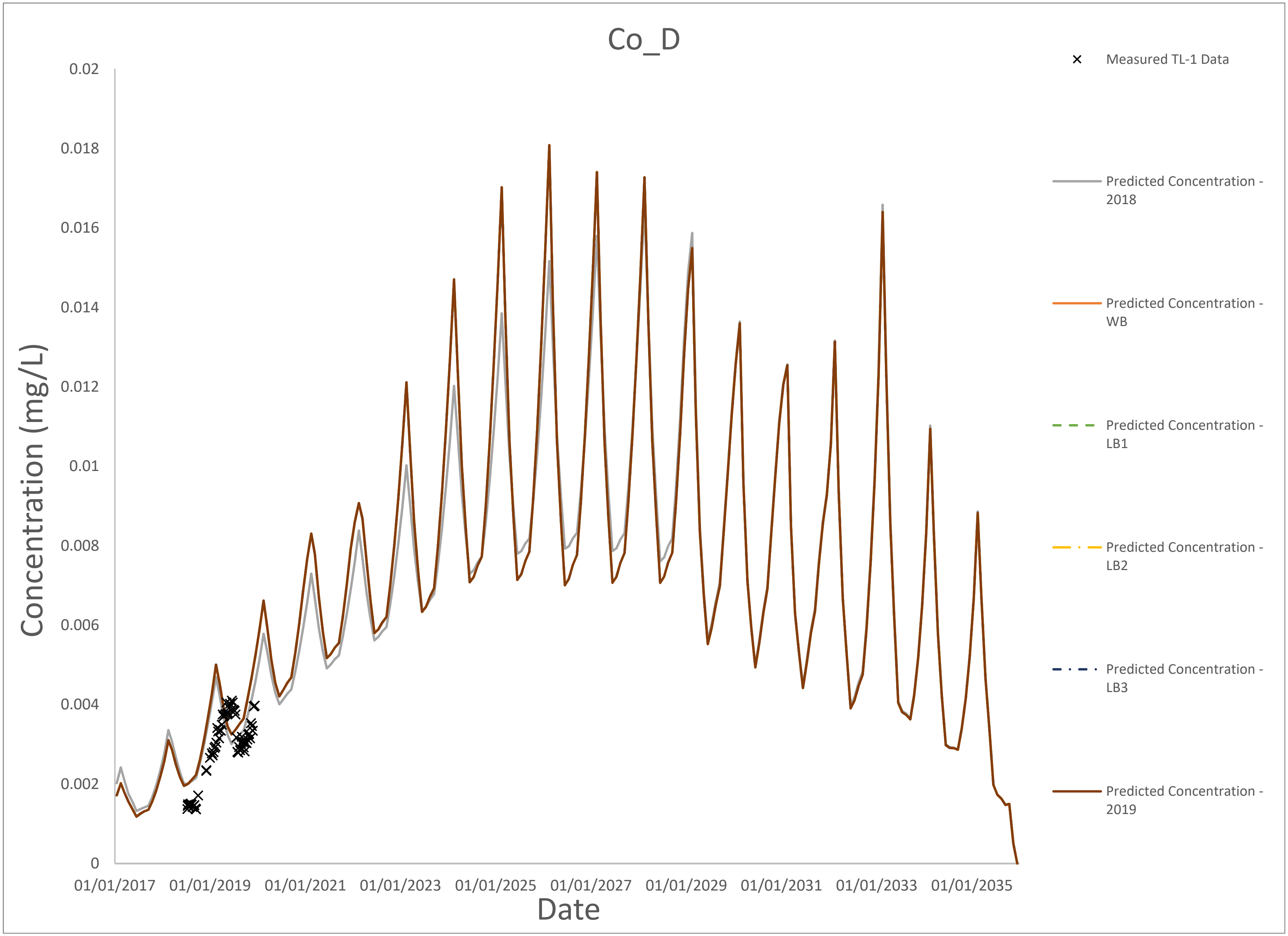

Be_D
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

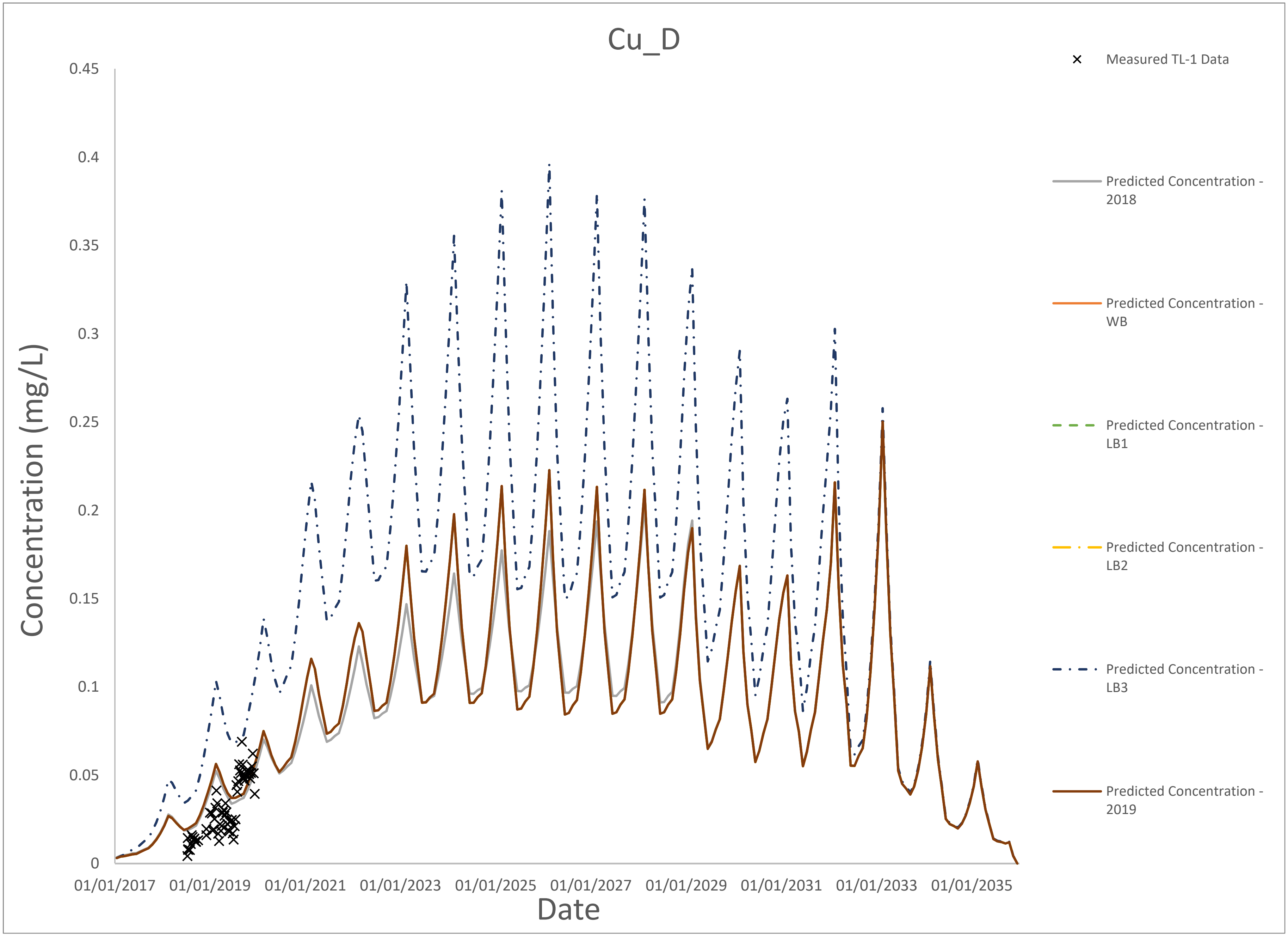

B_D
Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

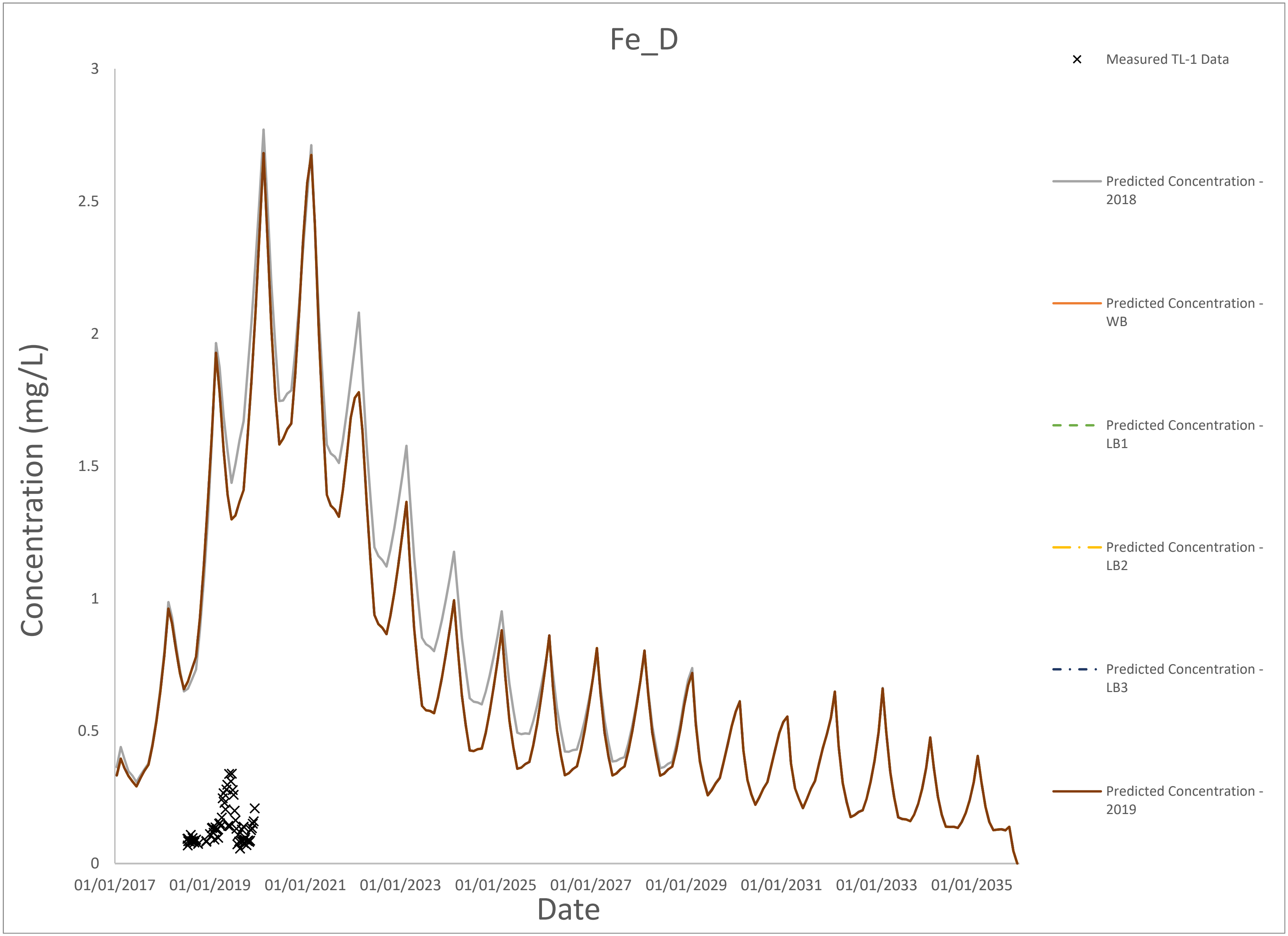

Cd_D
Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

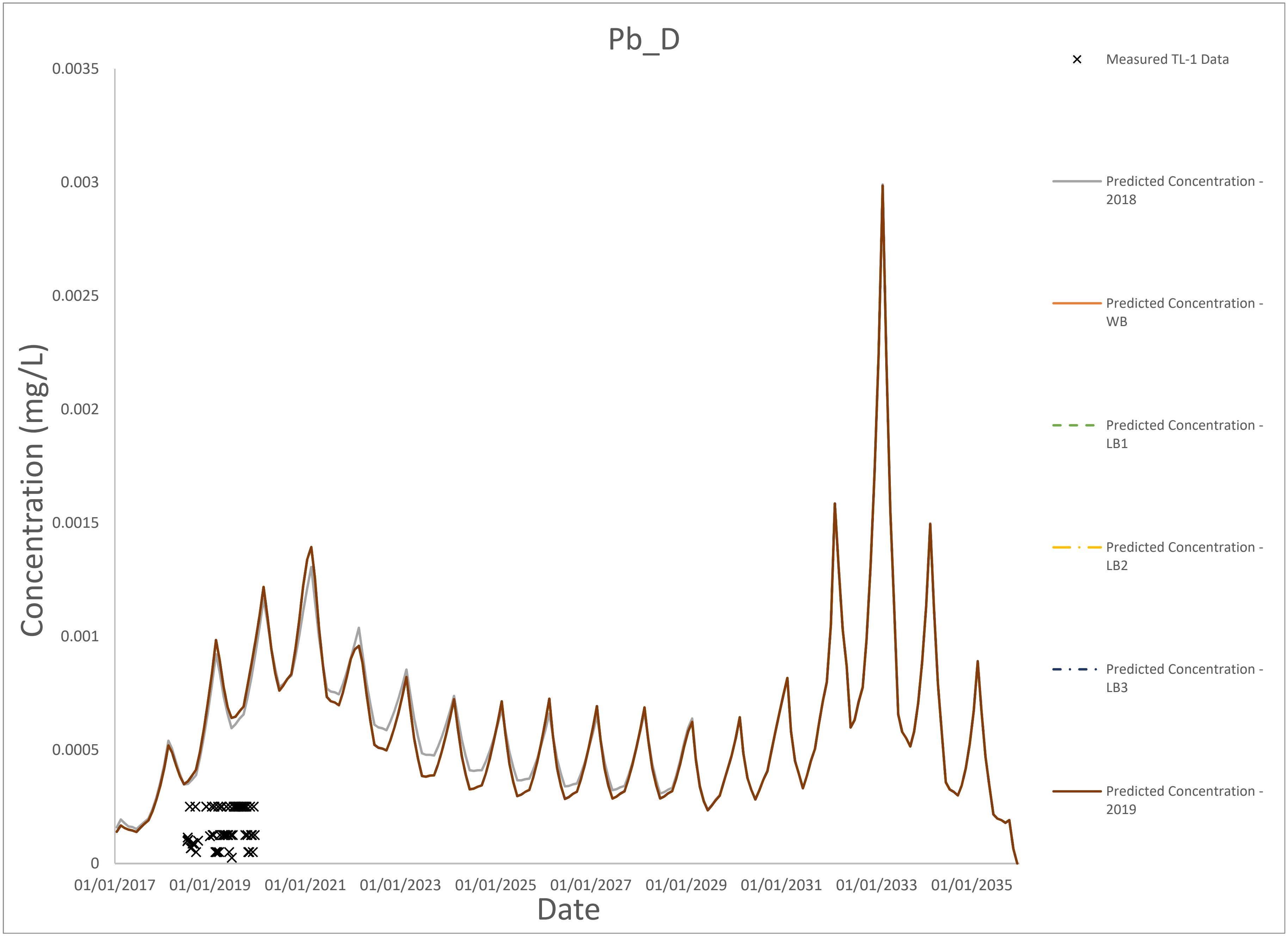

Ca_D
Concentration (mg/L)
700
600
500
400
300
200
100
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

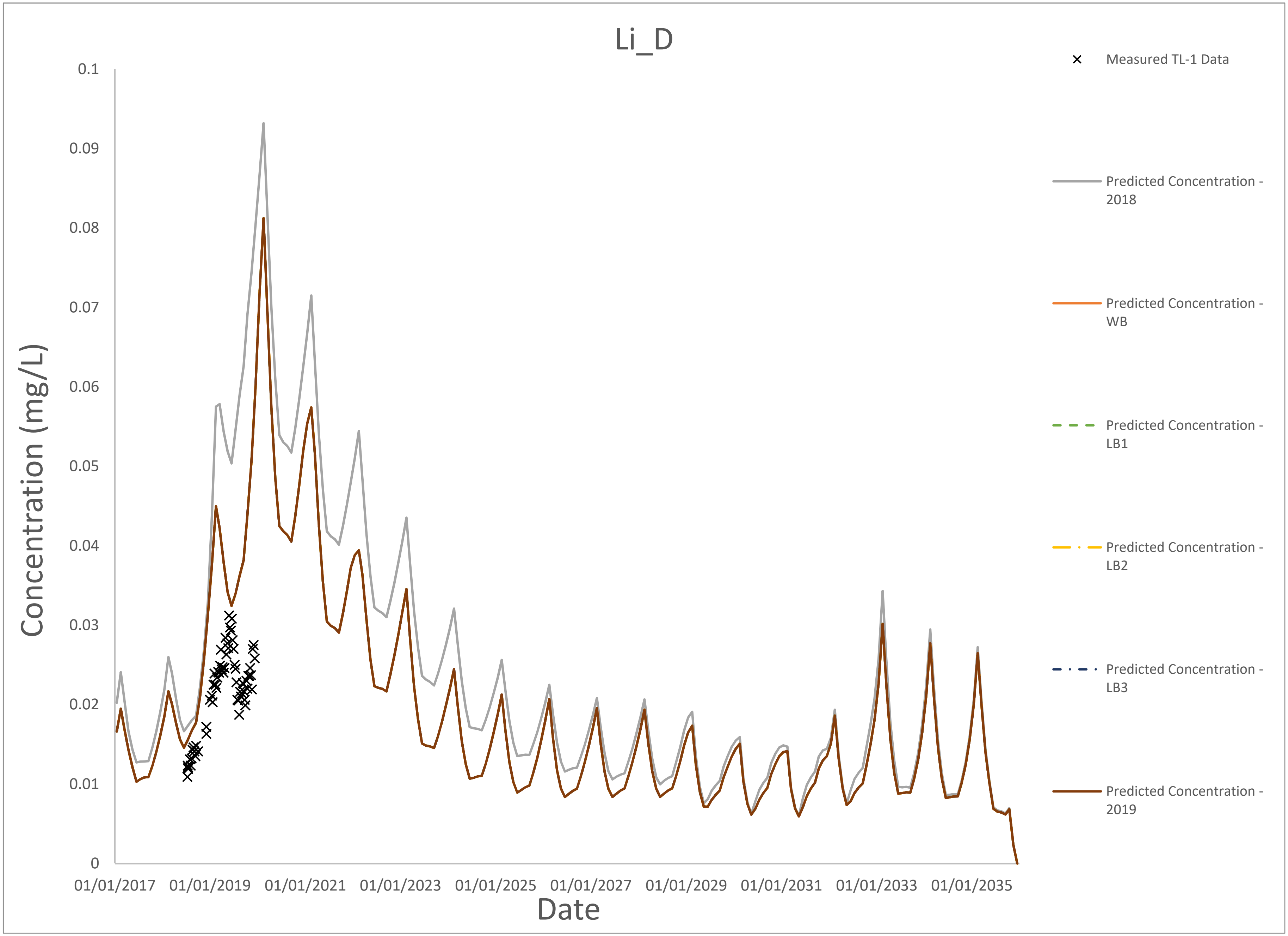

Cr_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

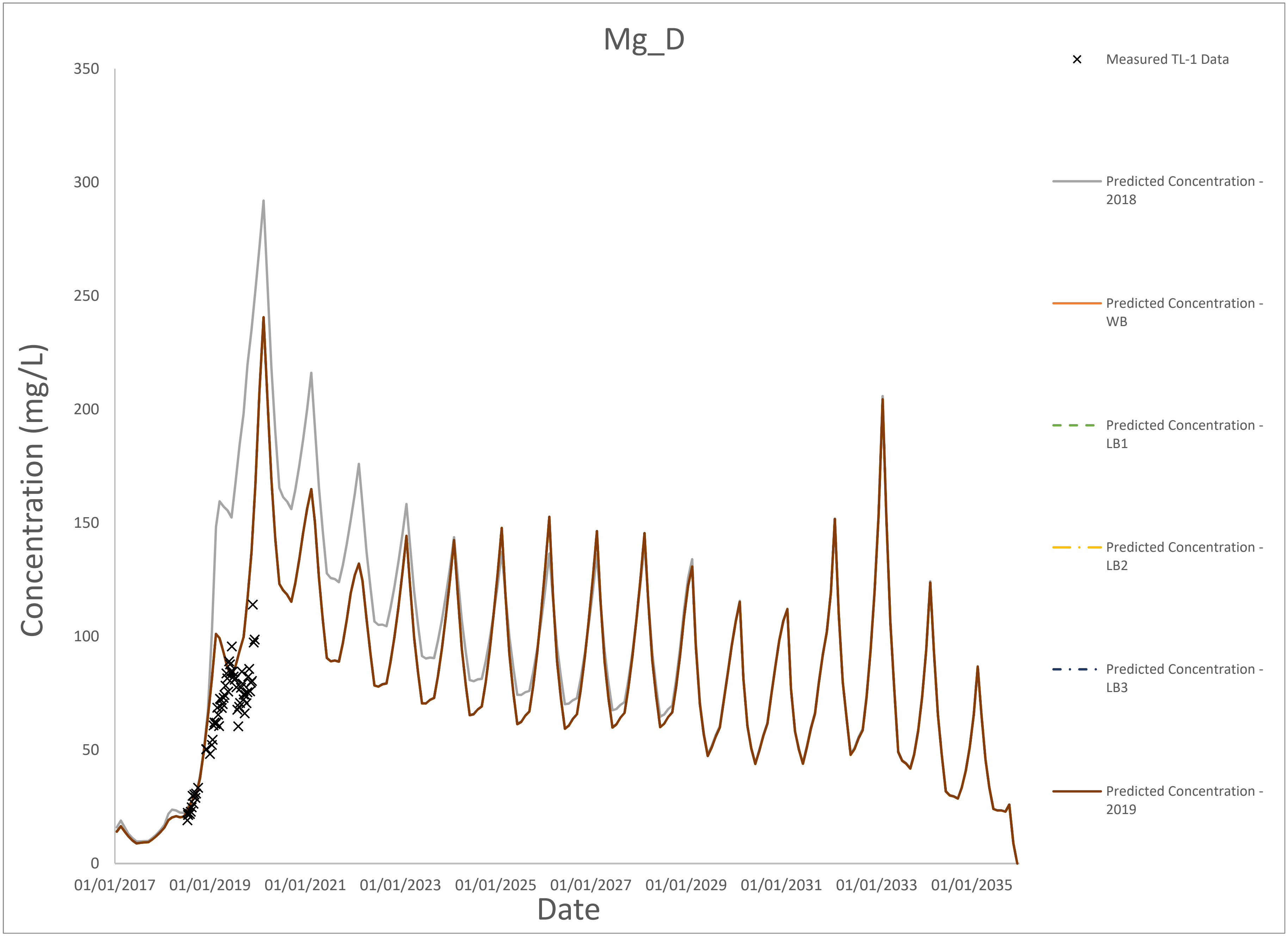

Co_D
Concentration (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
Date
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

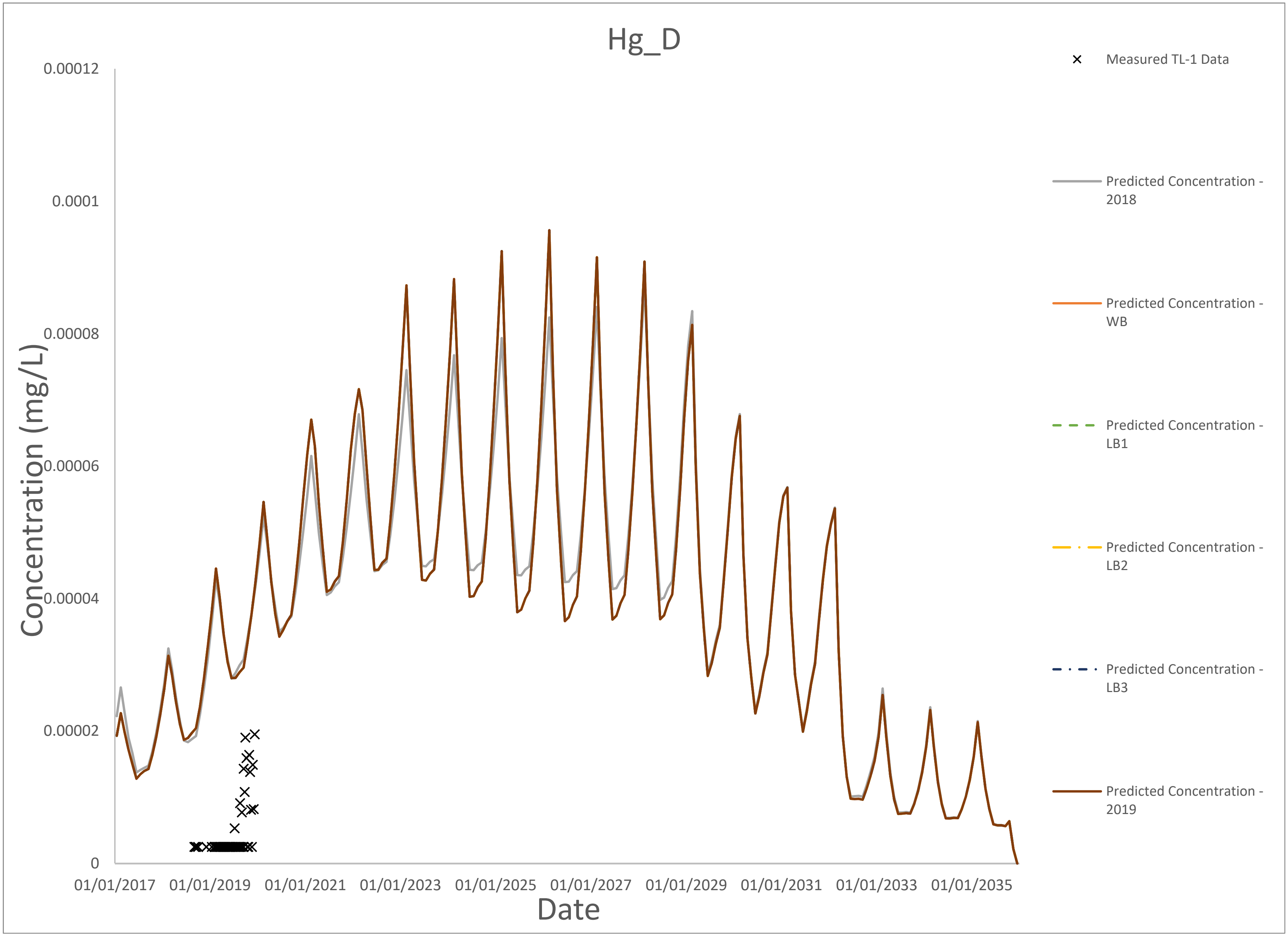

Cu_D
Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

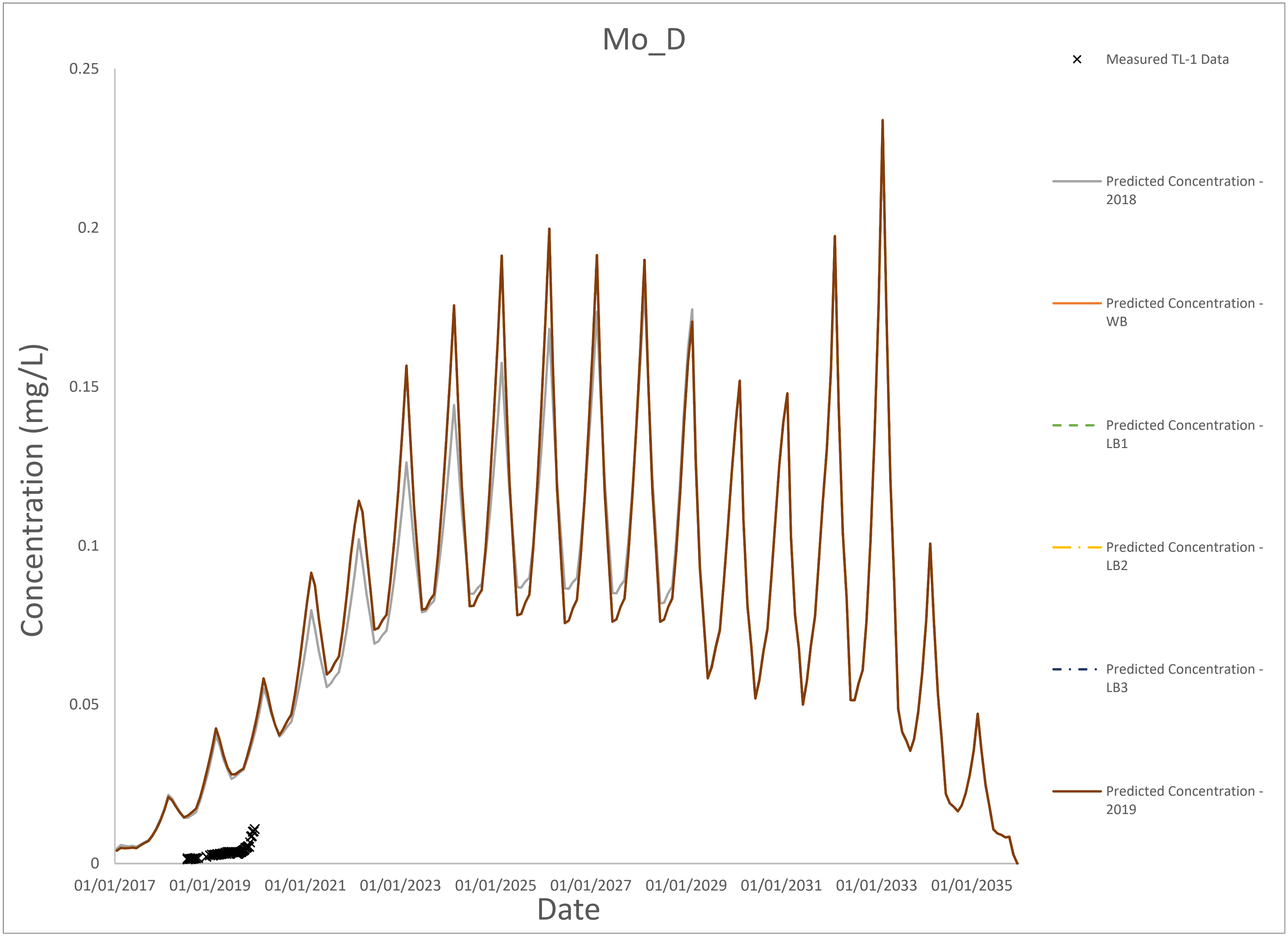

Fe_D
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

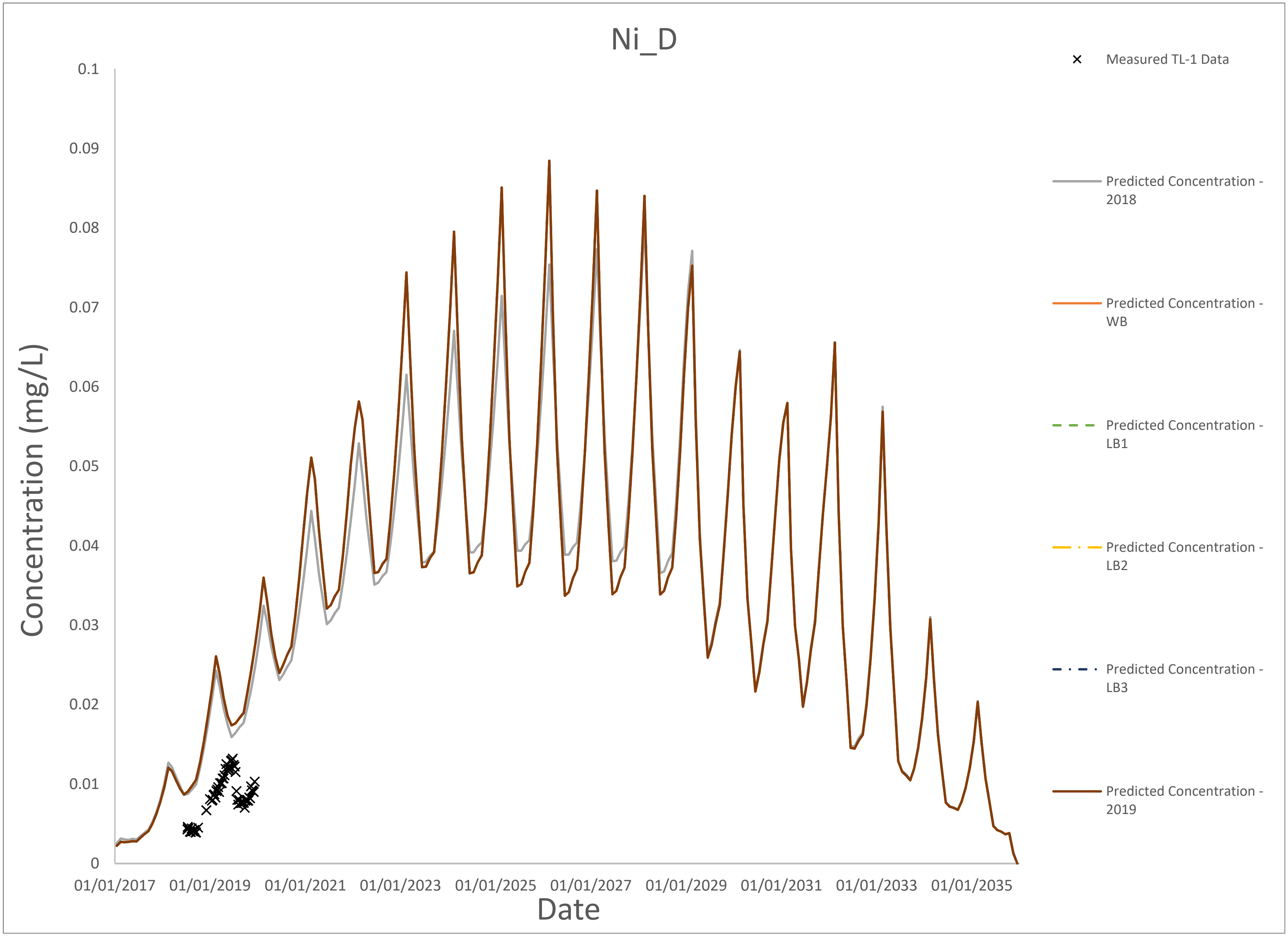

Pb_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date


Li_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date


Mg_D
Concentration (mg/L)
350
300
250
200
150
100
50
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


Hg_D
Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


Mo_D
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


Ni_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
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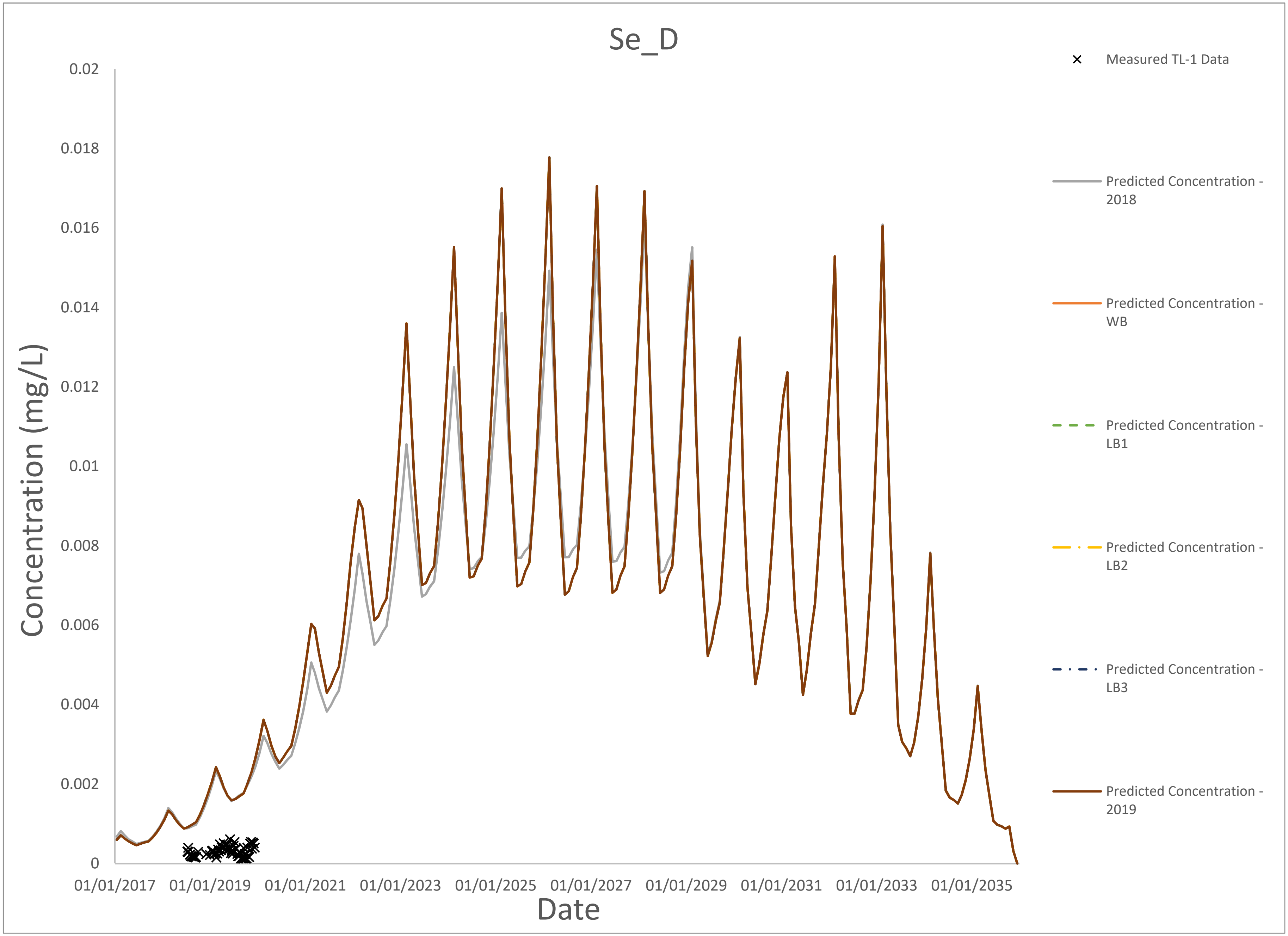
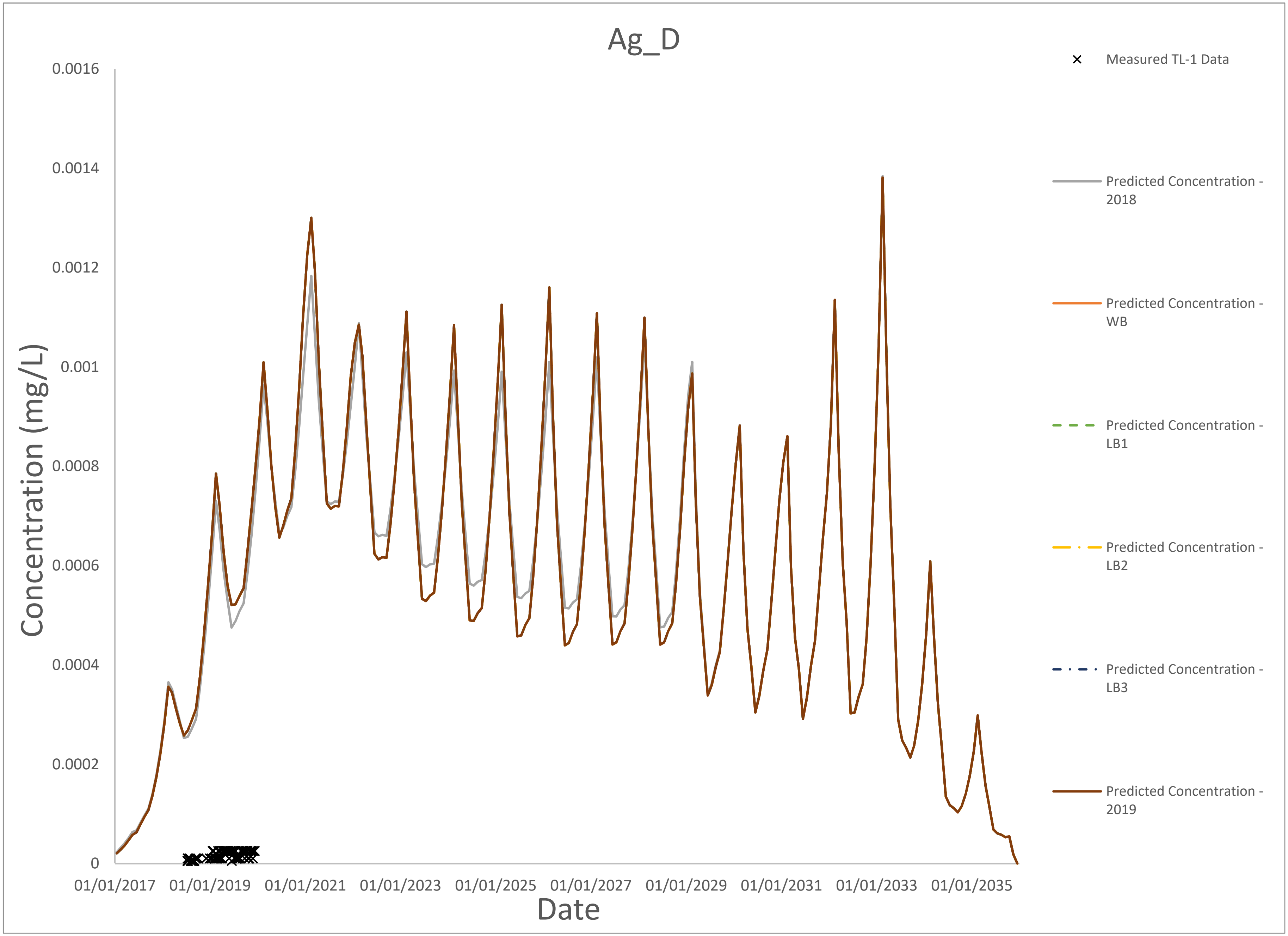
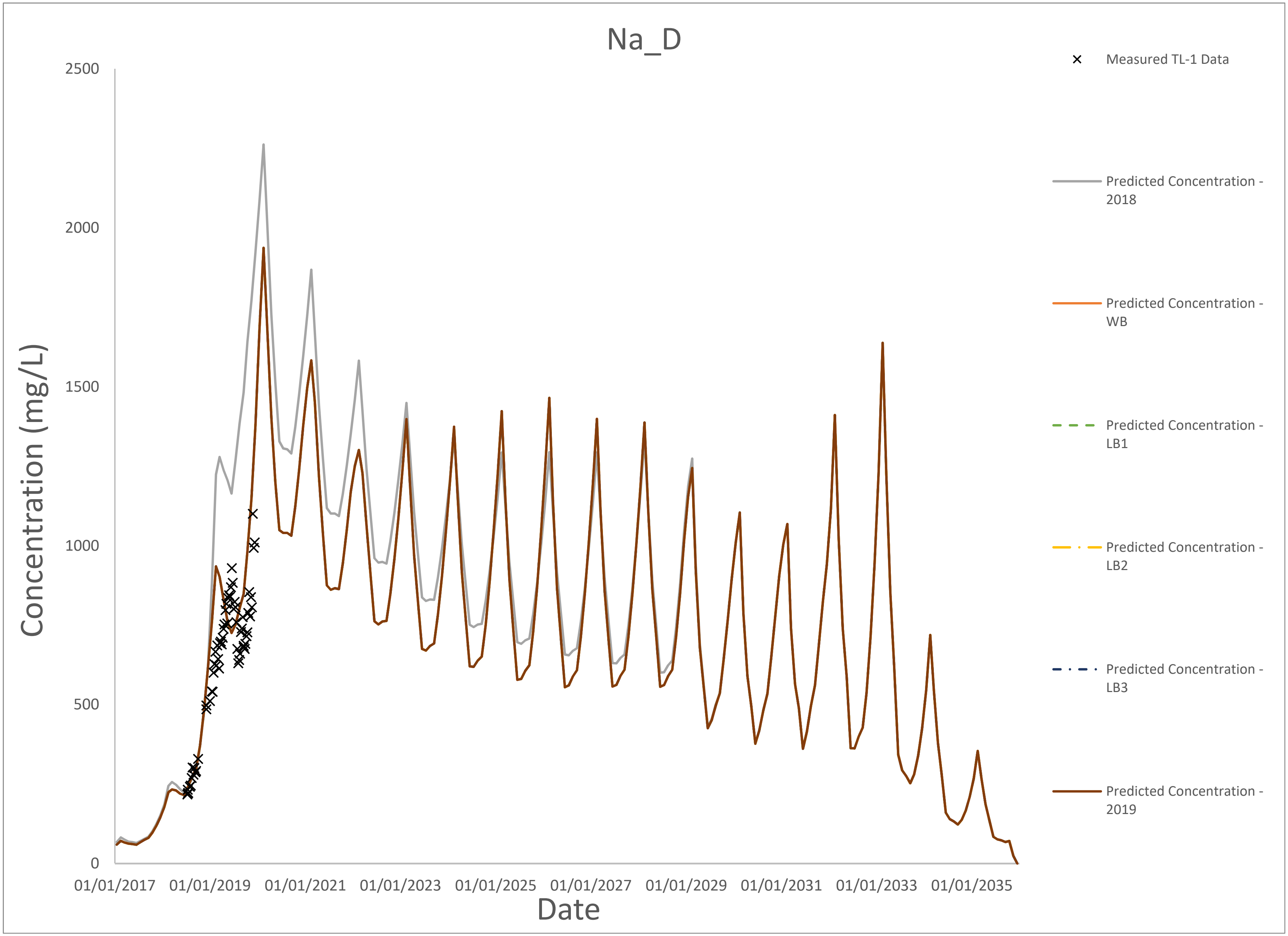
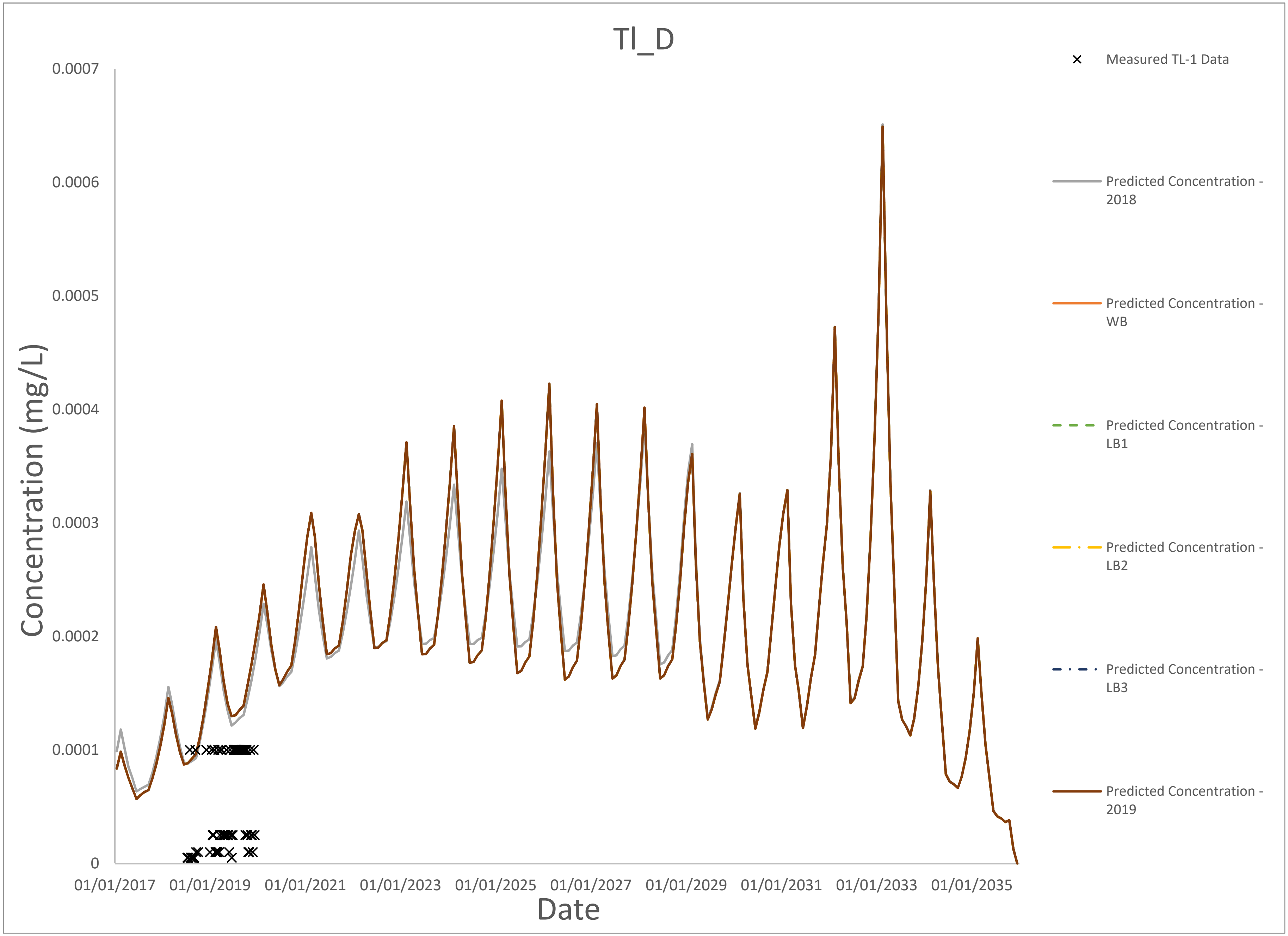
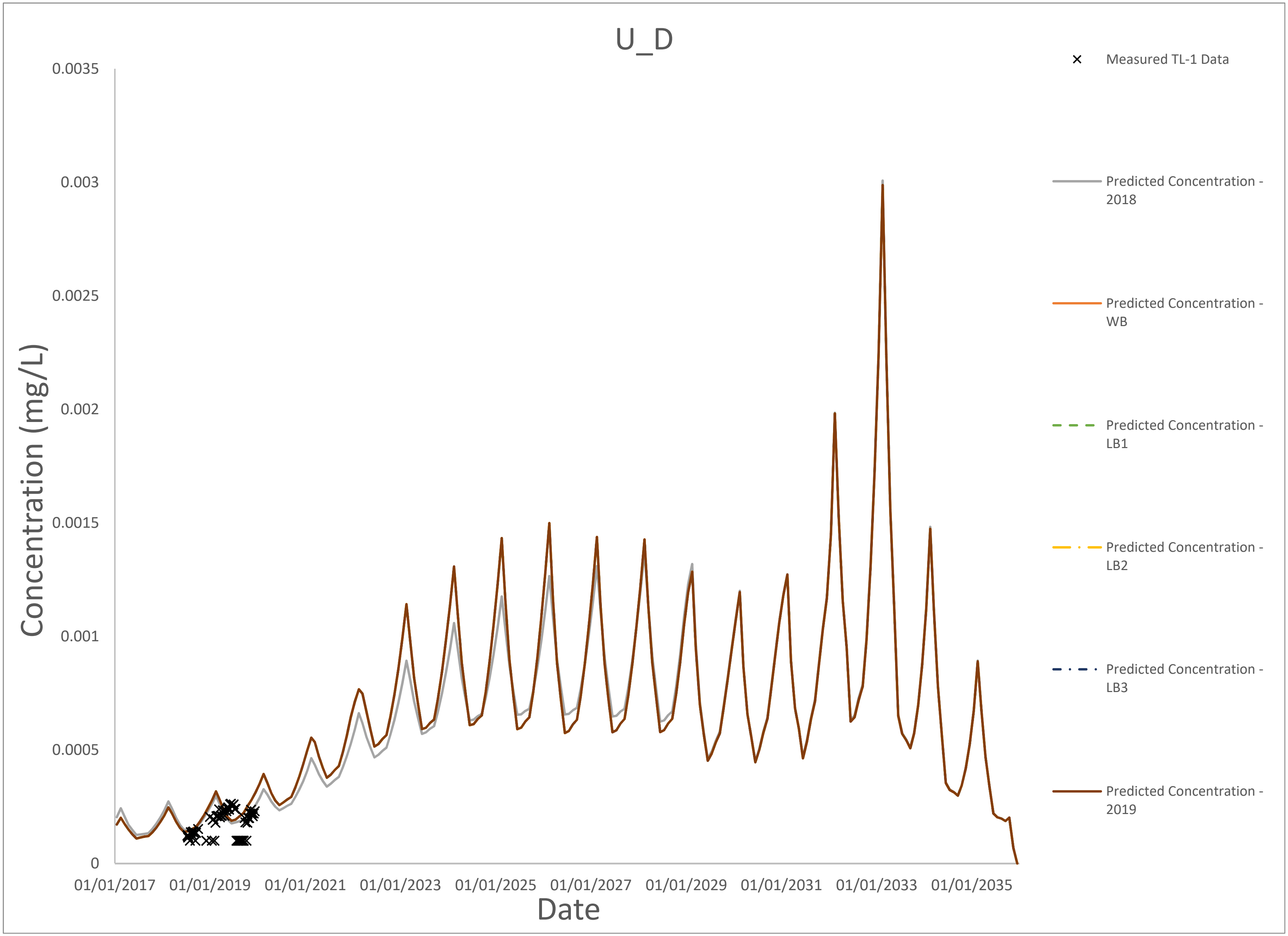
01/01/2033
01/01/2035
Date

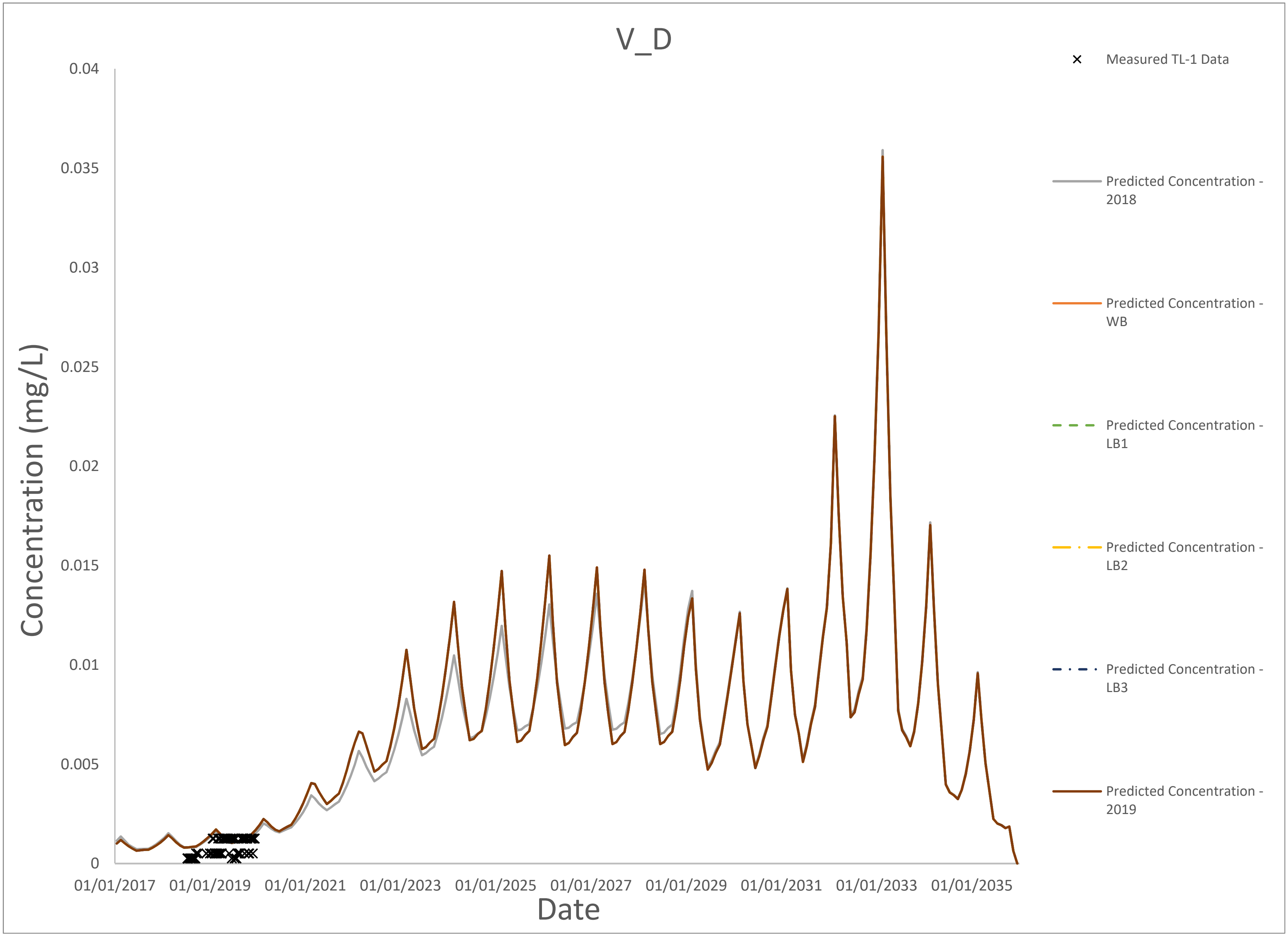

Se_D
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

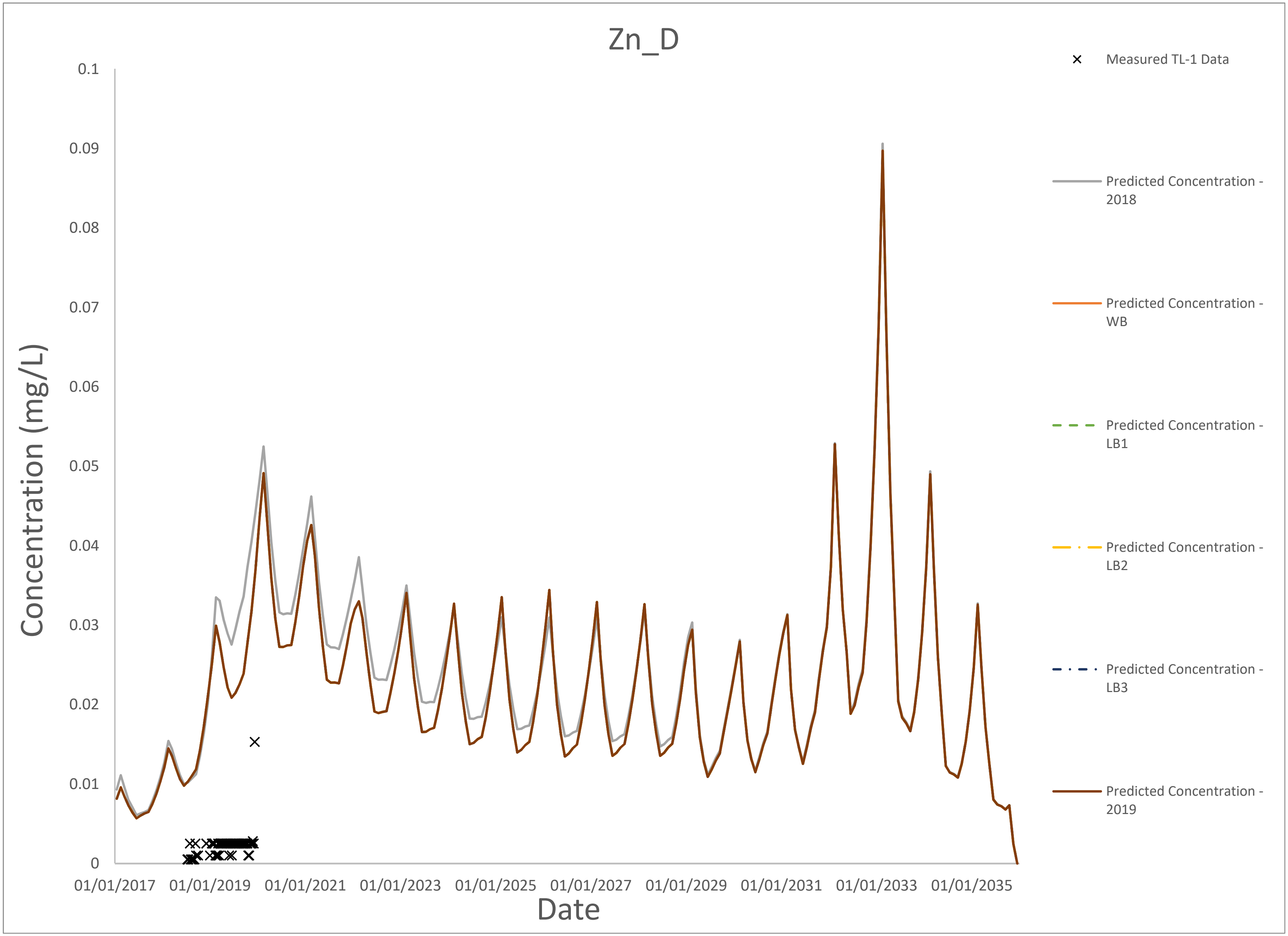

Ag_D
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

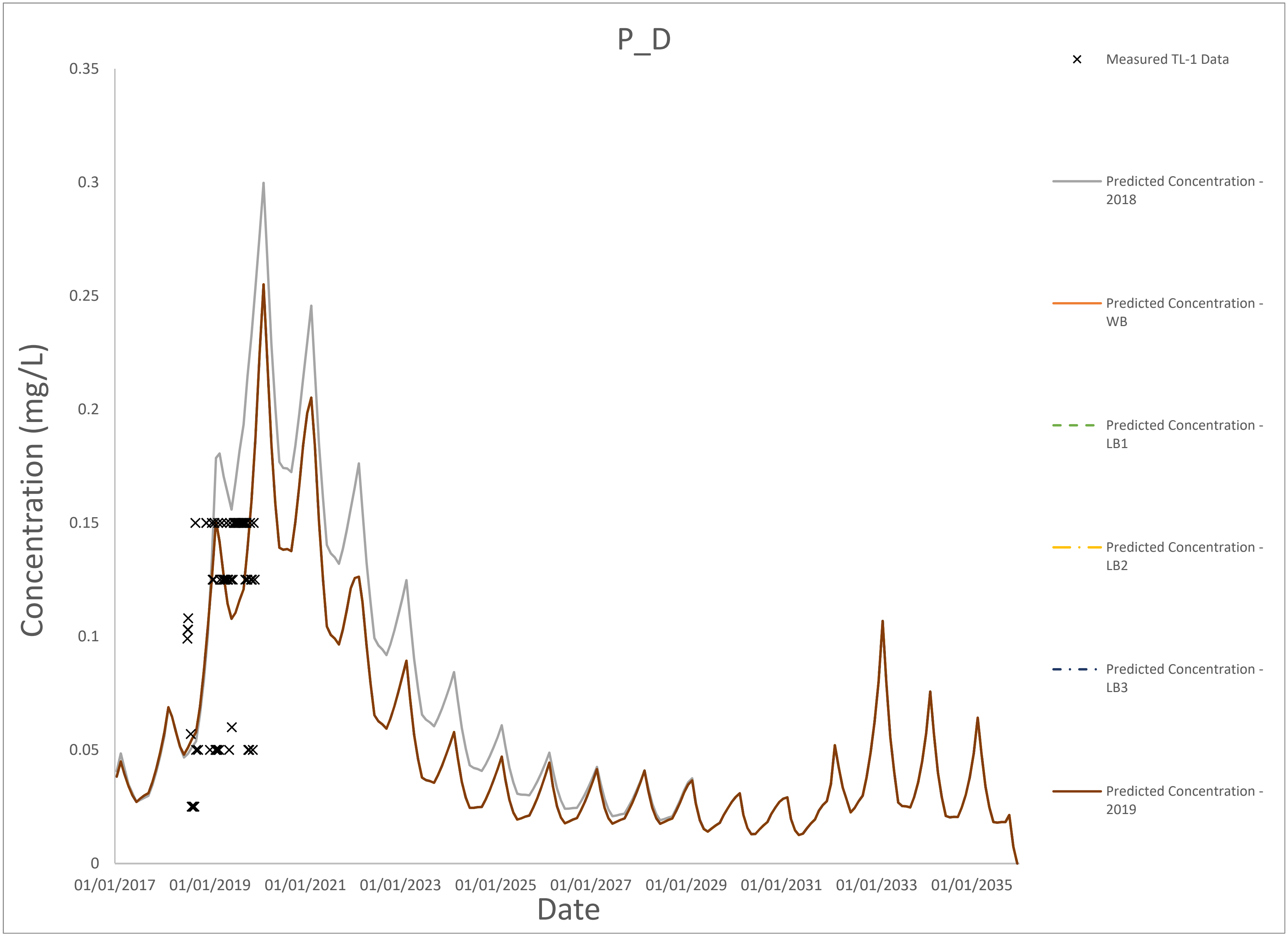

Na_D
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

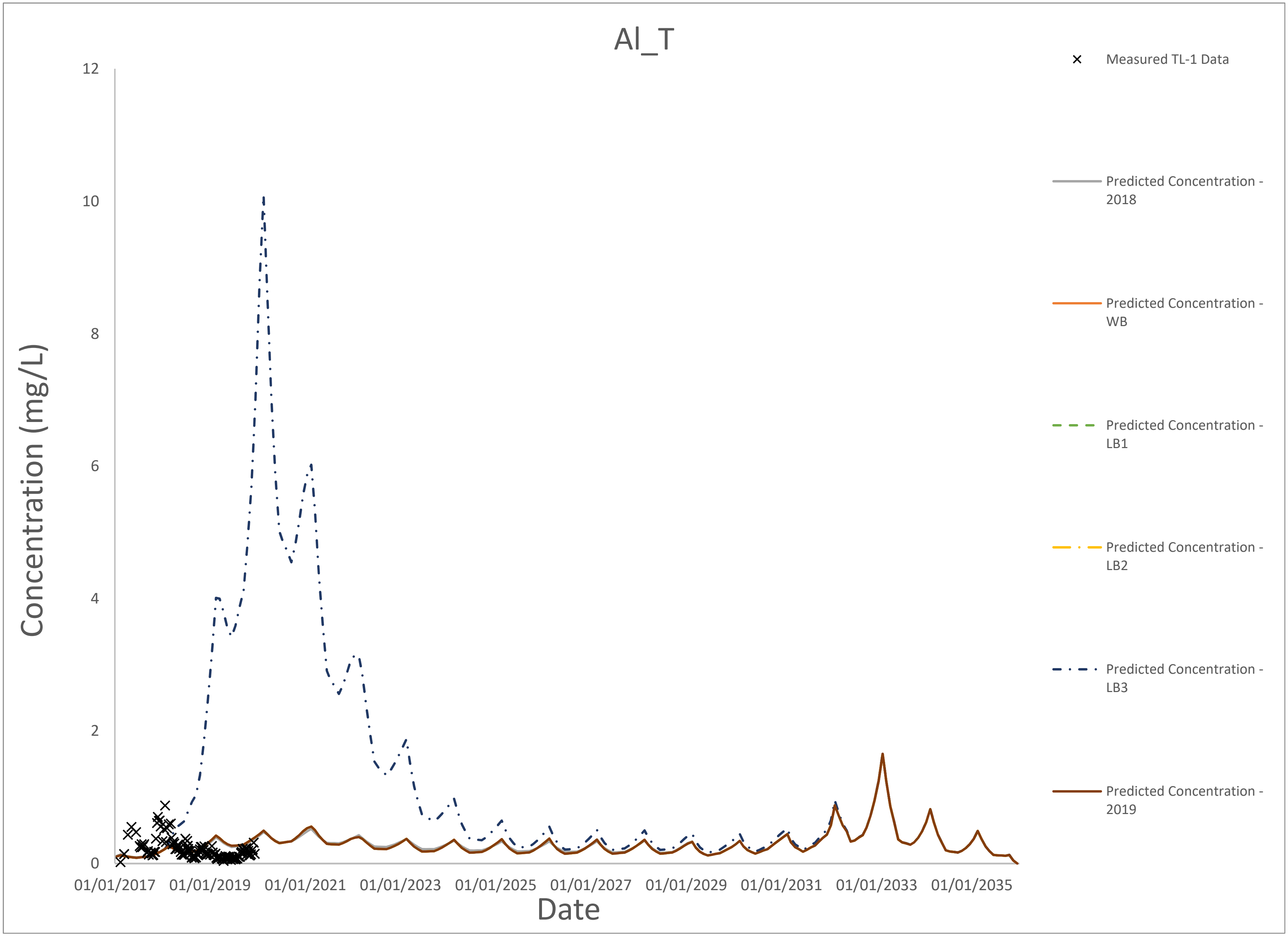

Tl_D
Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

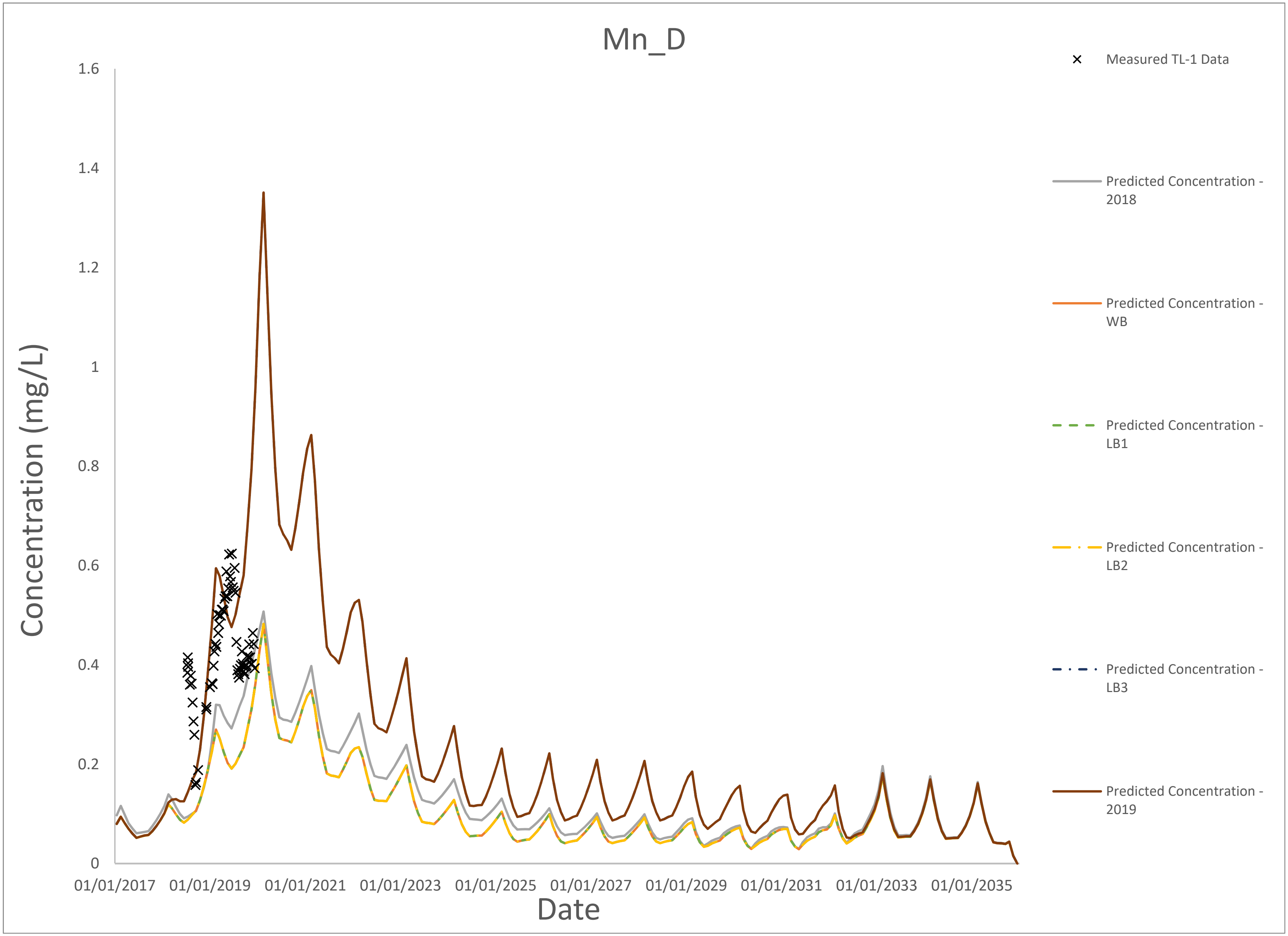

U_D
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

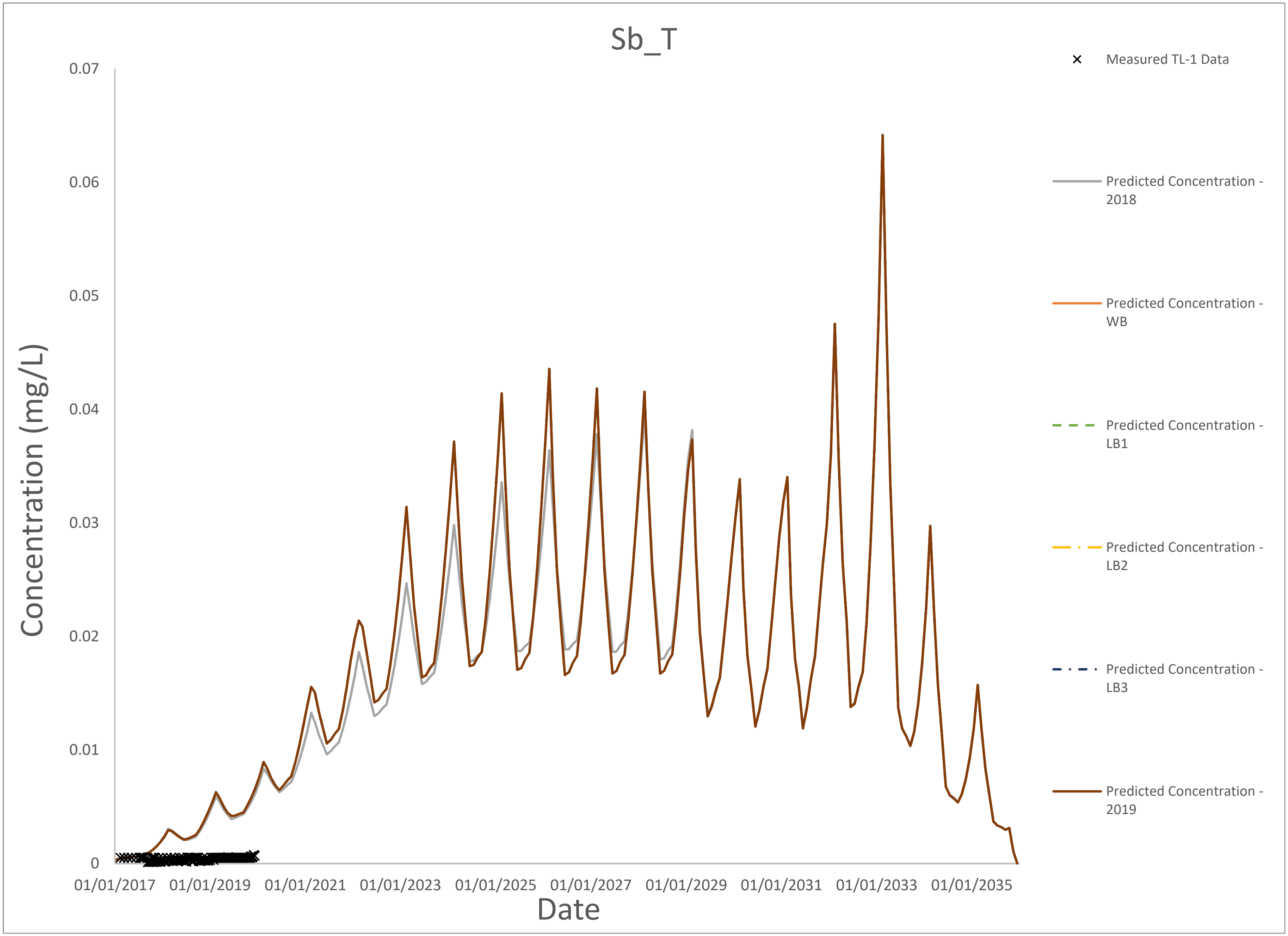

V_D
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

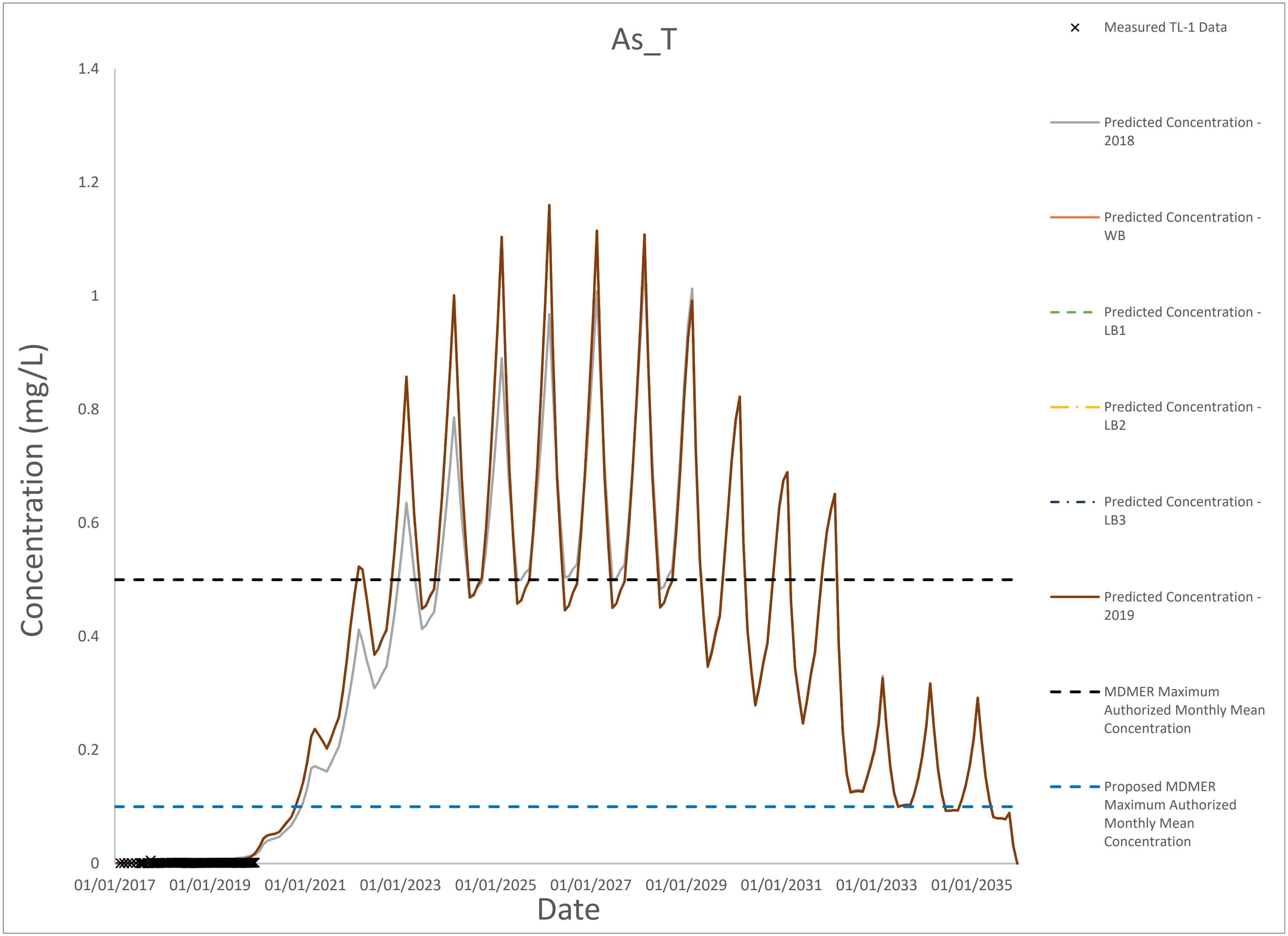

Zn_D
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

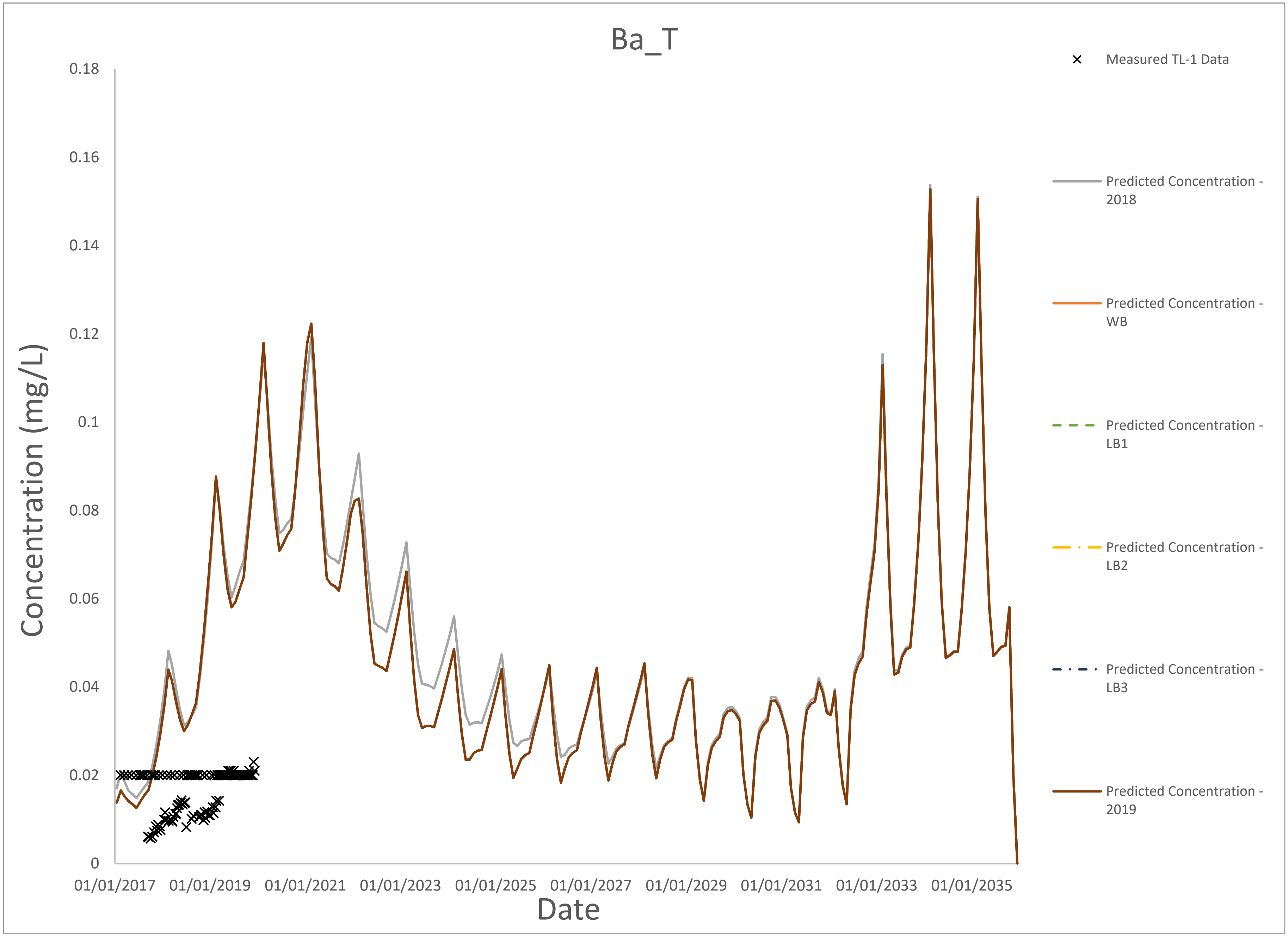

P_D
Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

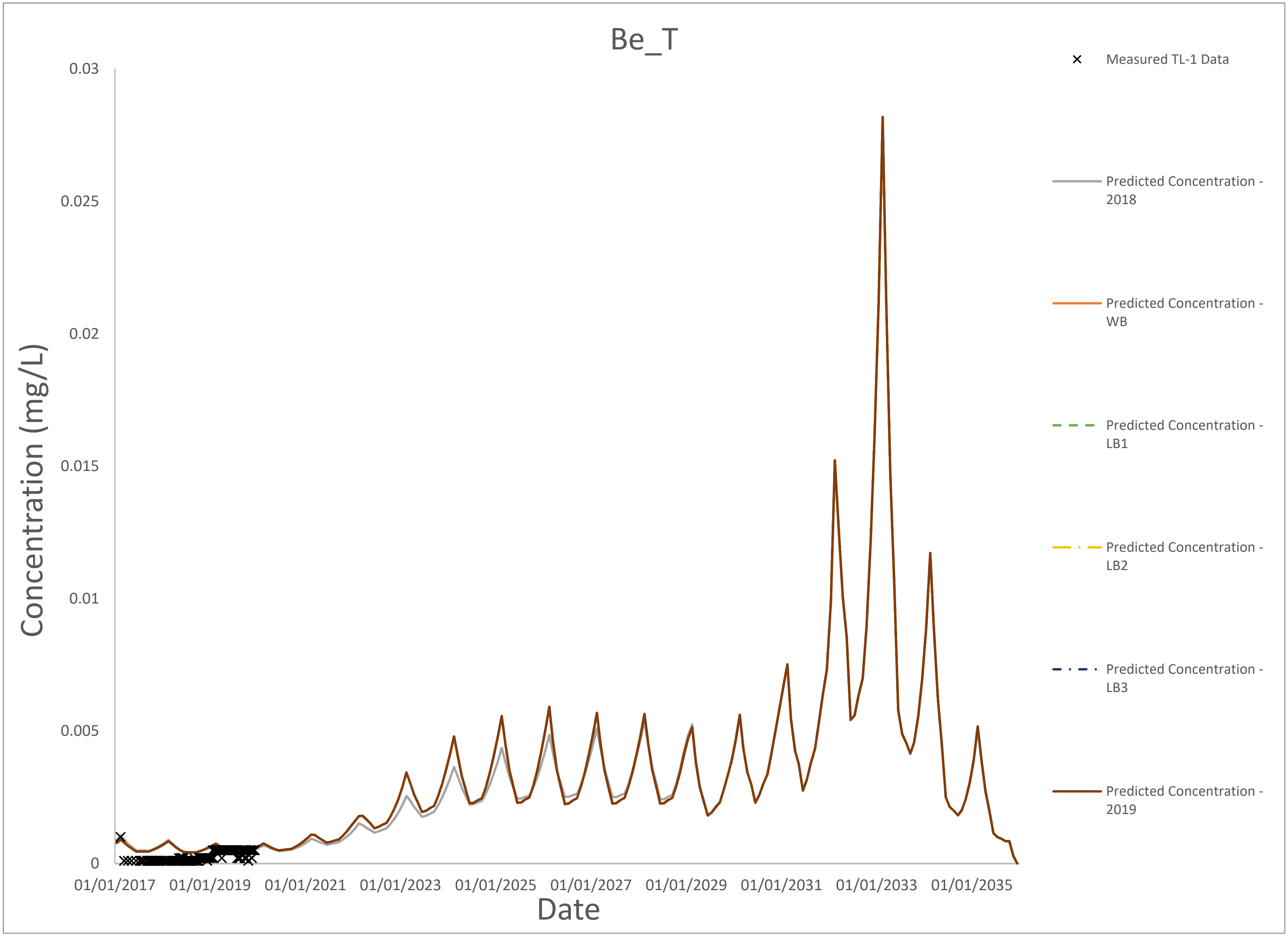

Al_T
Concentration (mg/L)
0
2
4
6
8
10
12
Date
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

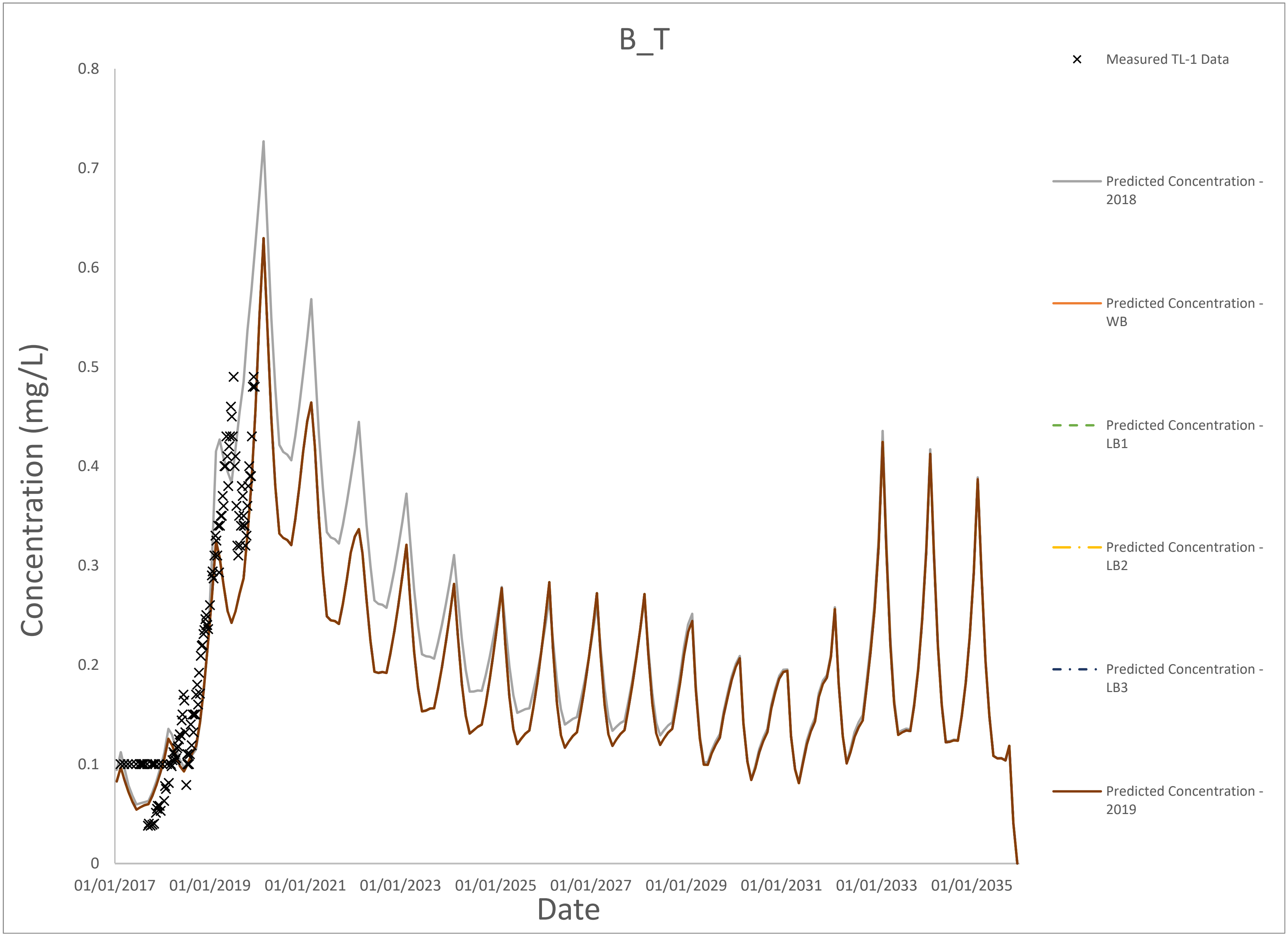

Mn_D
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

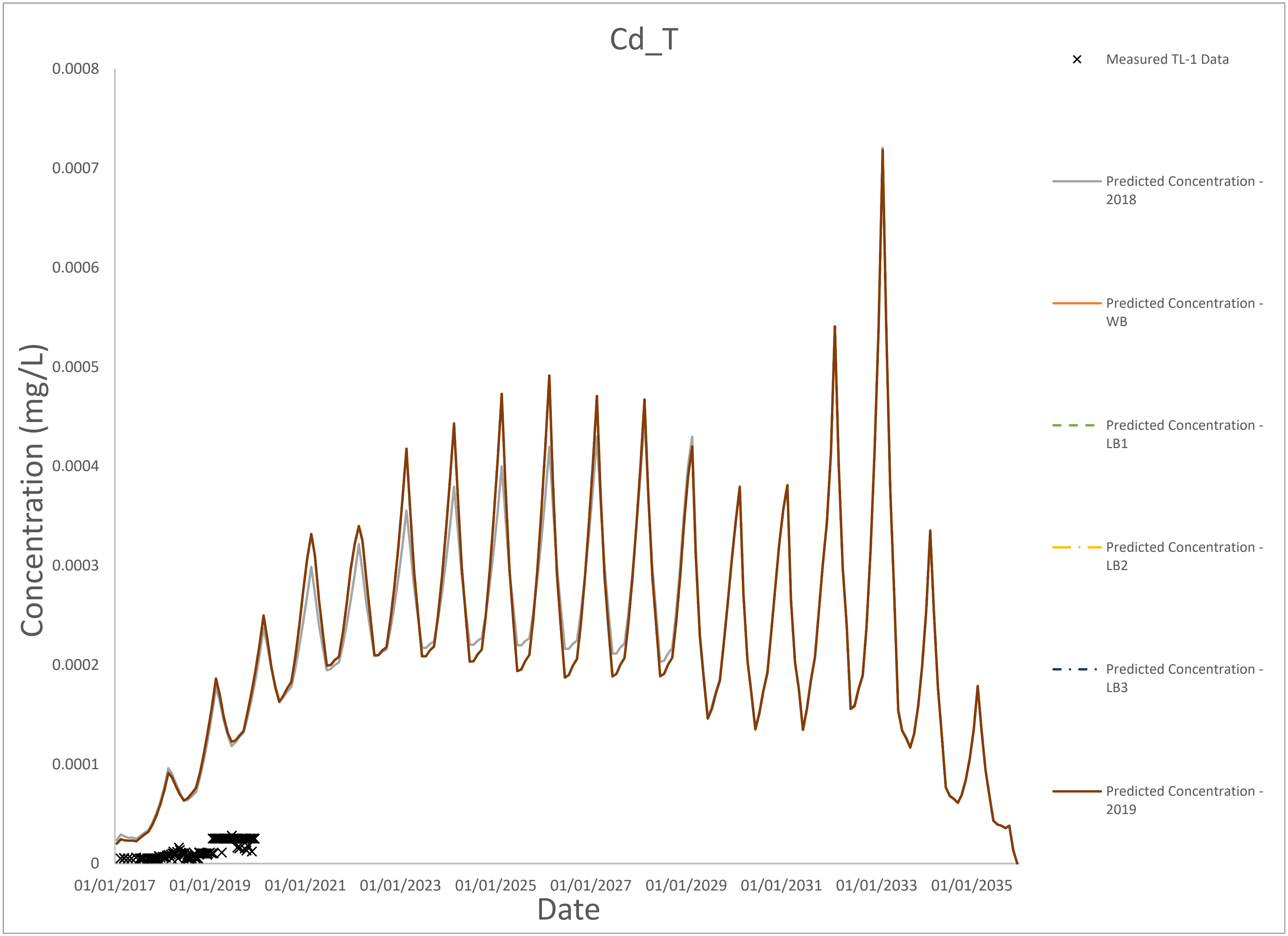

Sb_T
Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

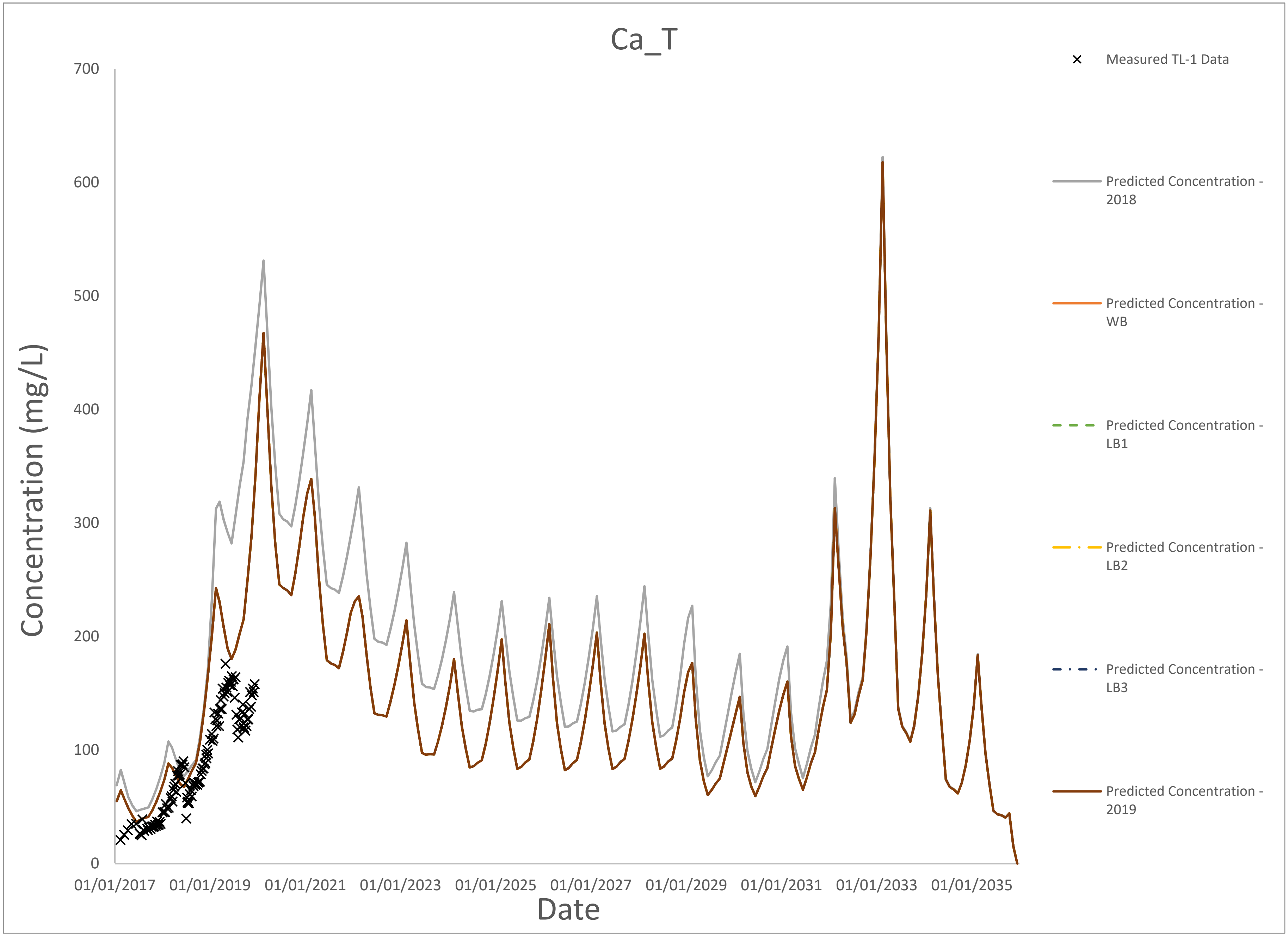

As_T
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

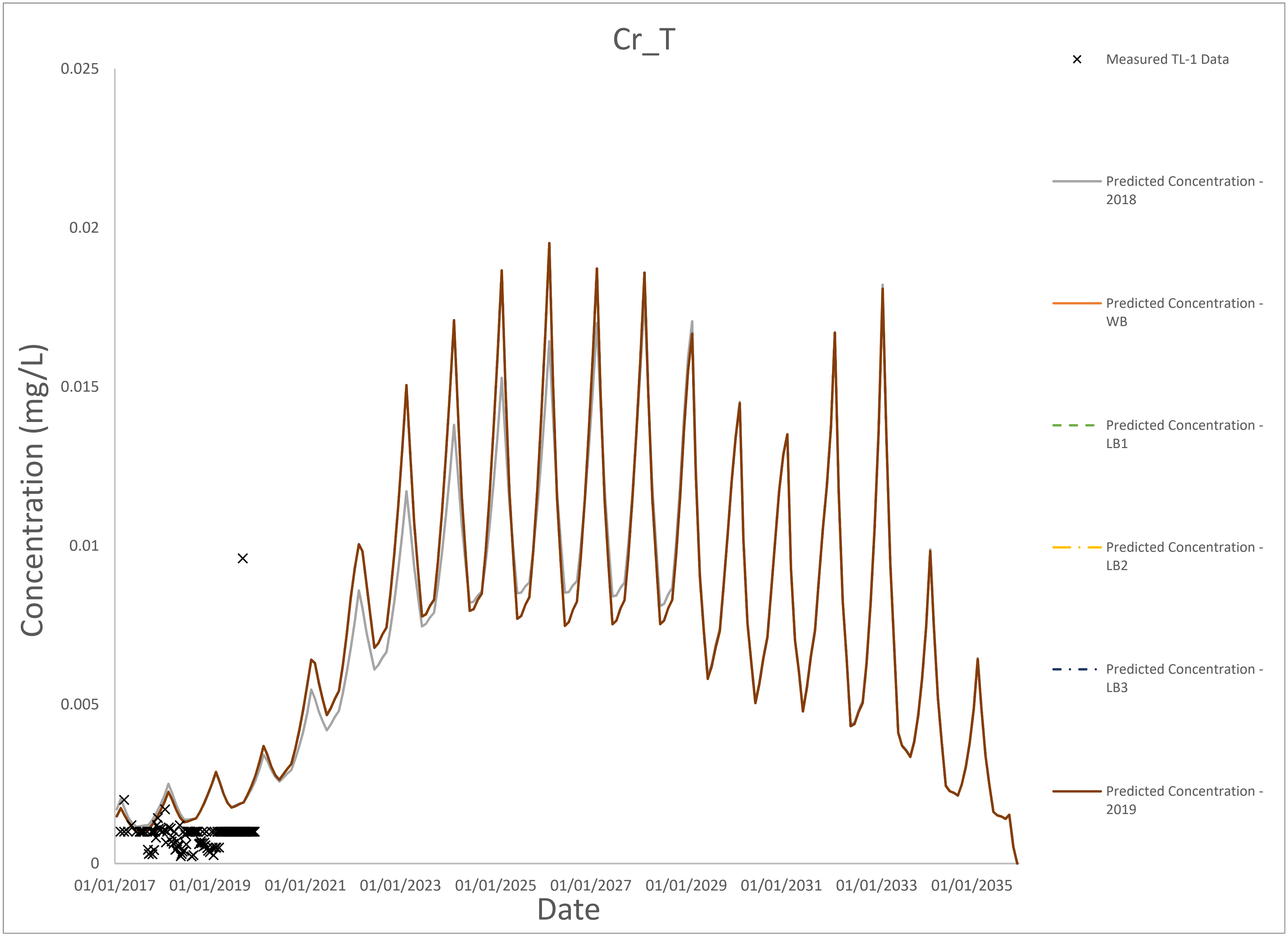

Ba_T
Concentration (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

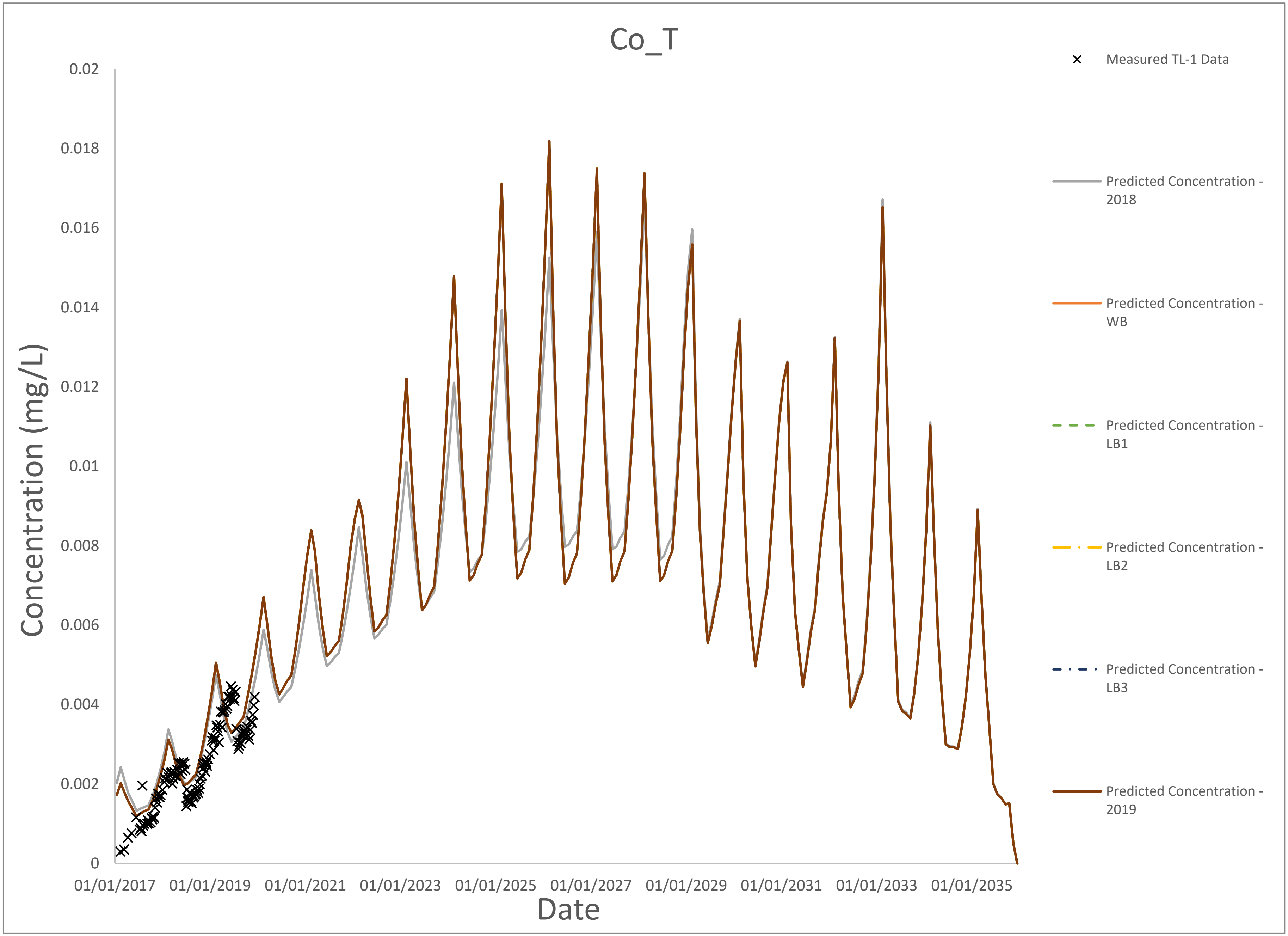

Be_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

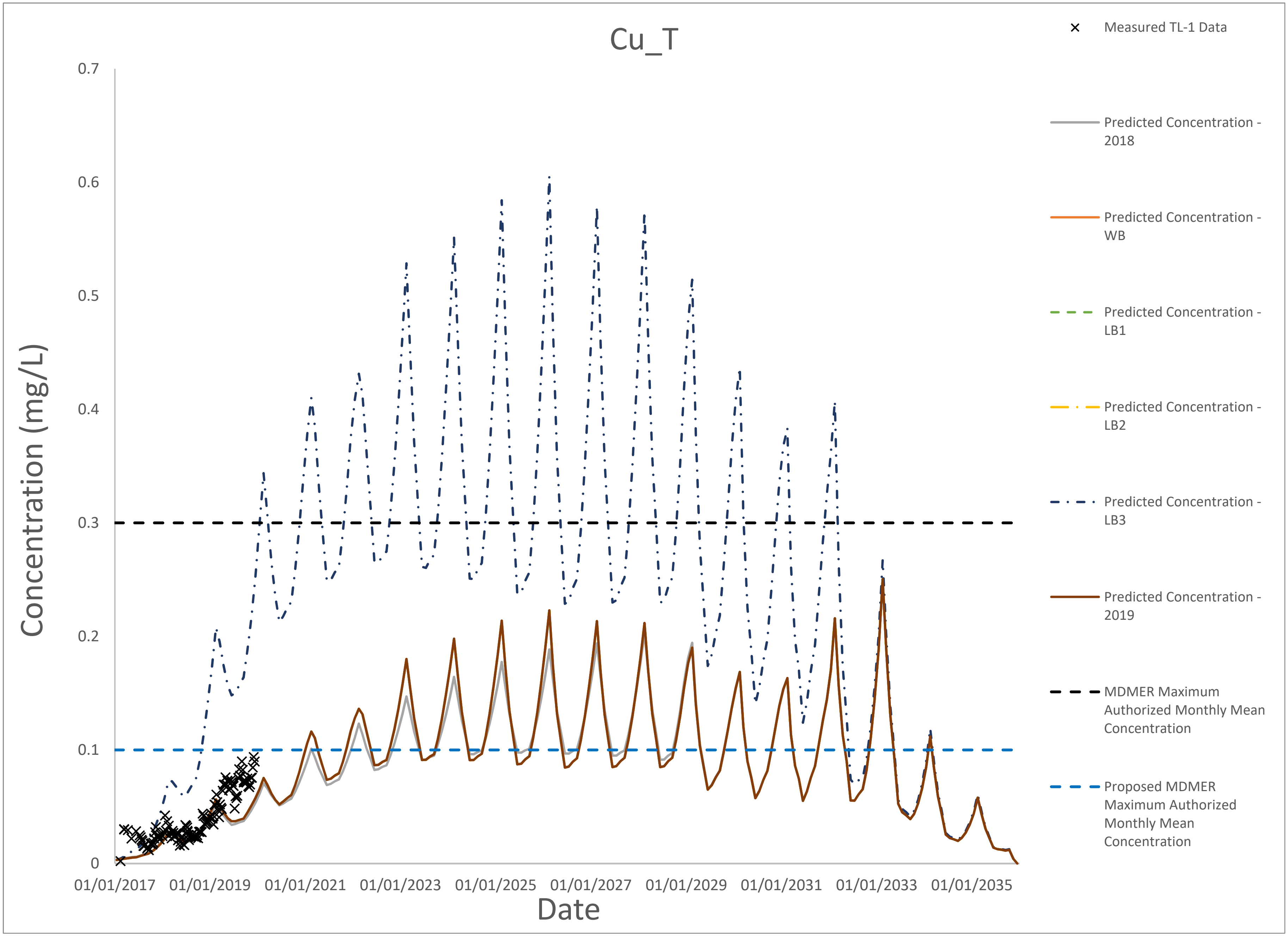

B_T
Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

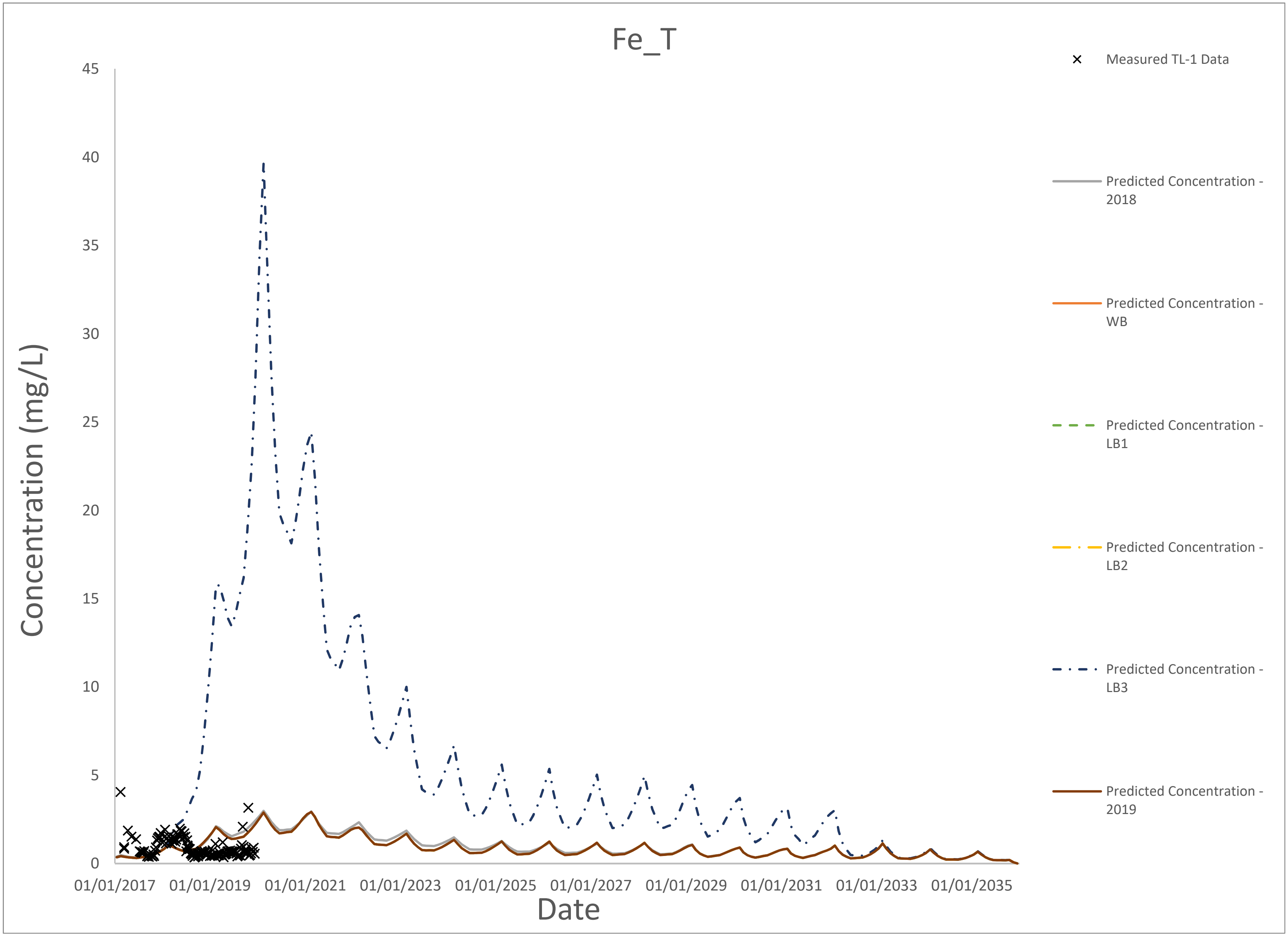

Cd_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

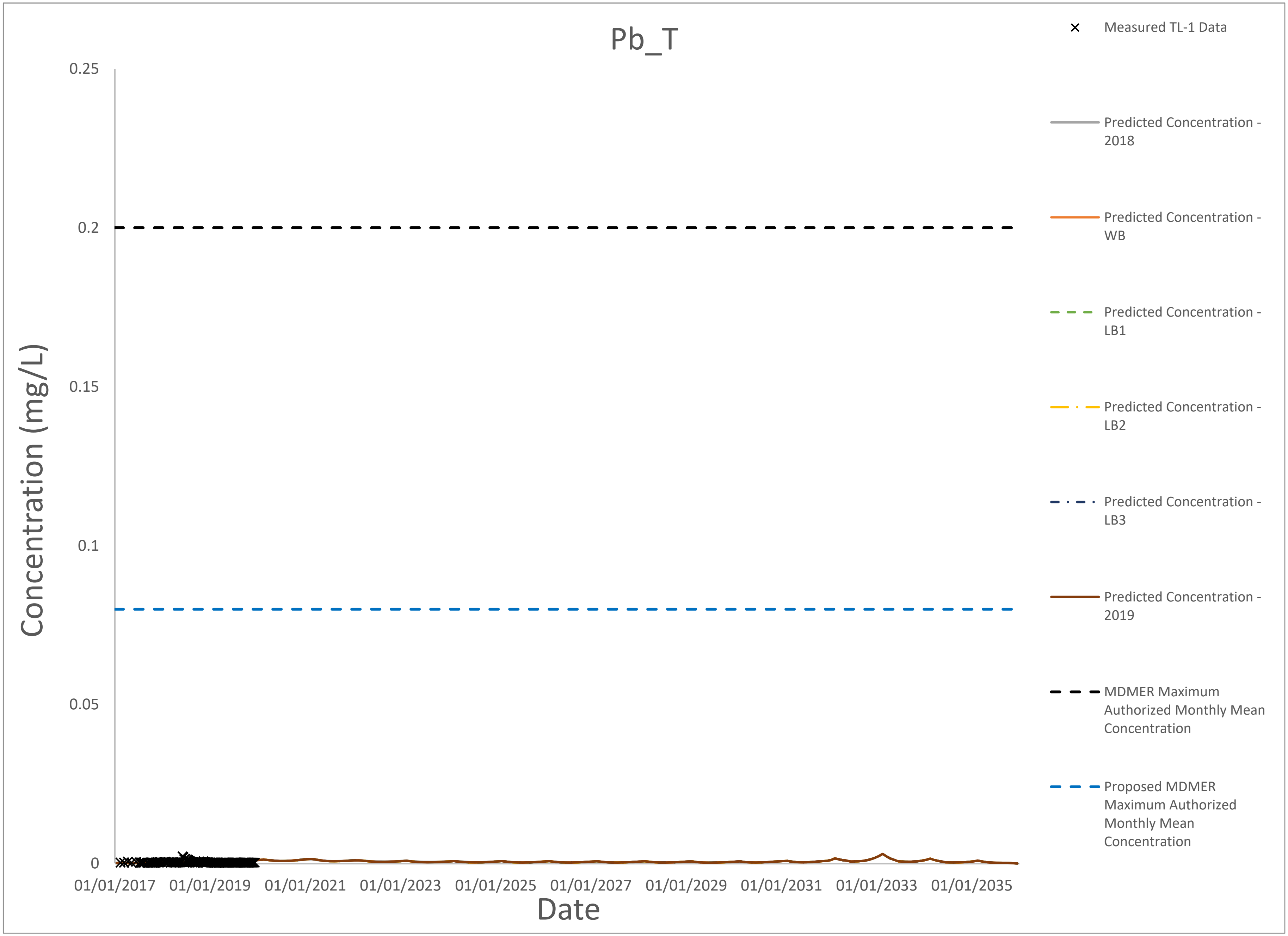

Ca_T
Concentration (mg/L)
0
100
200
300
400
500
600
700
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

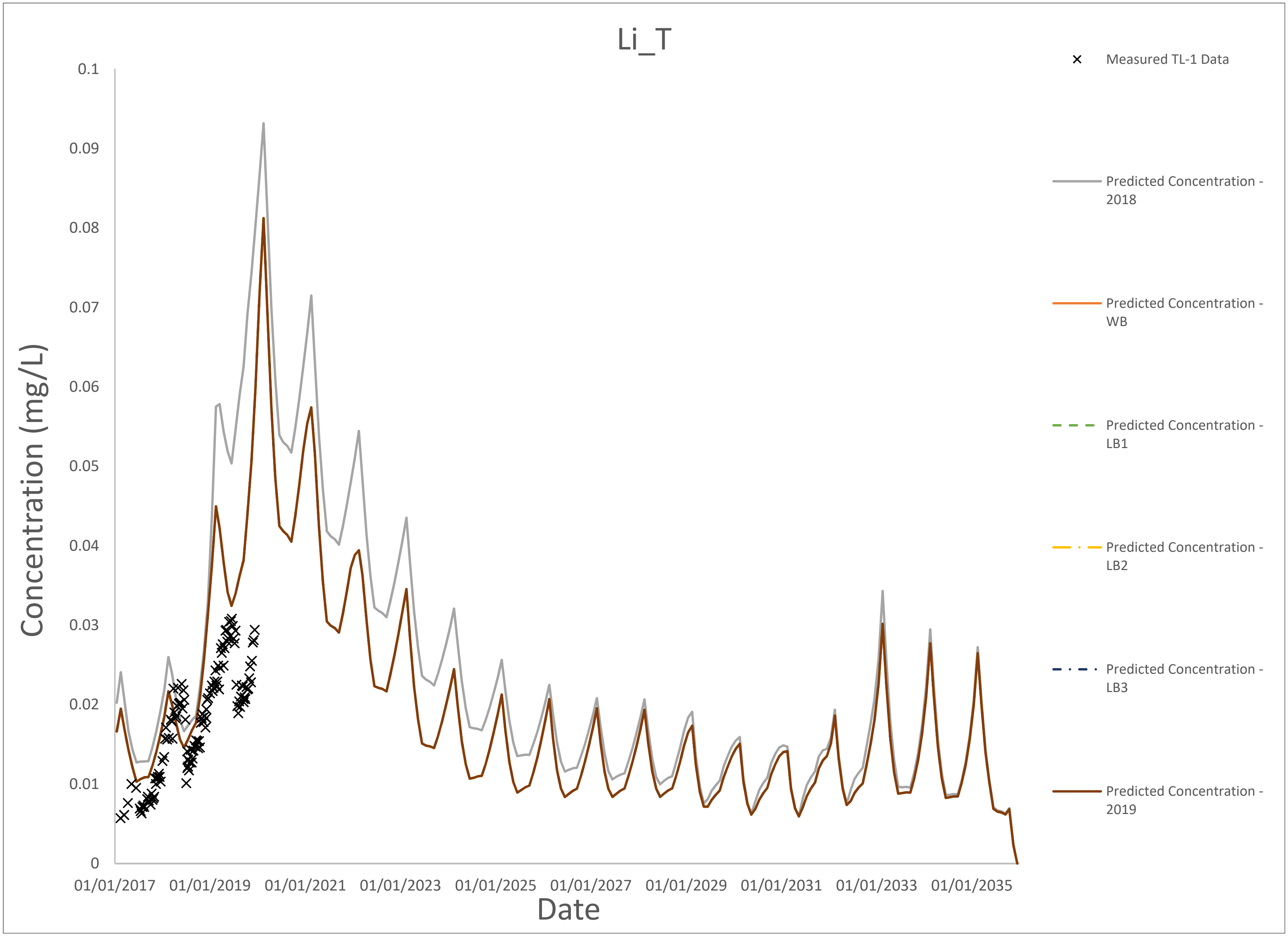

Cr_T
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

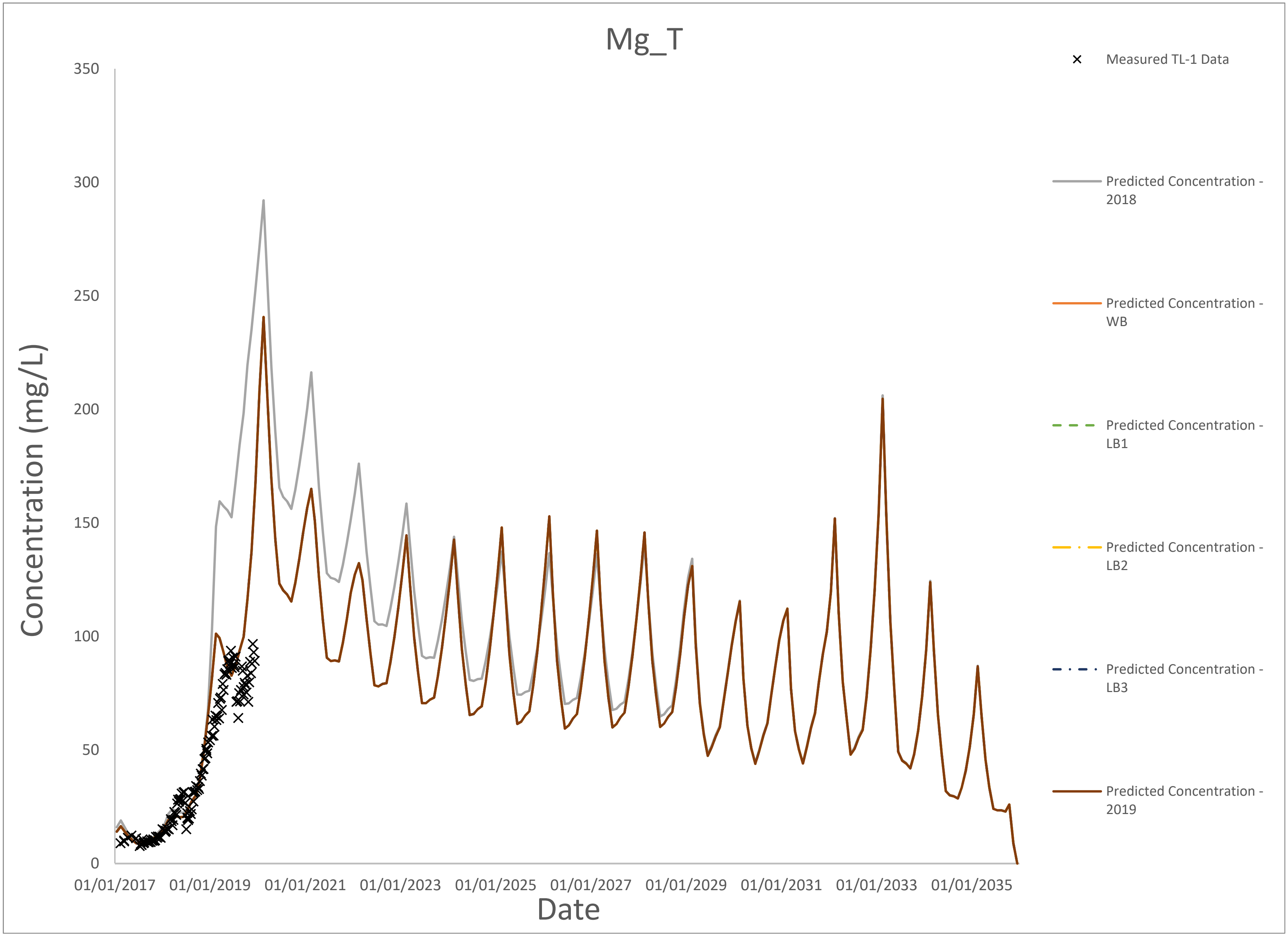

Co_T
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

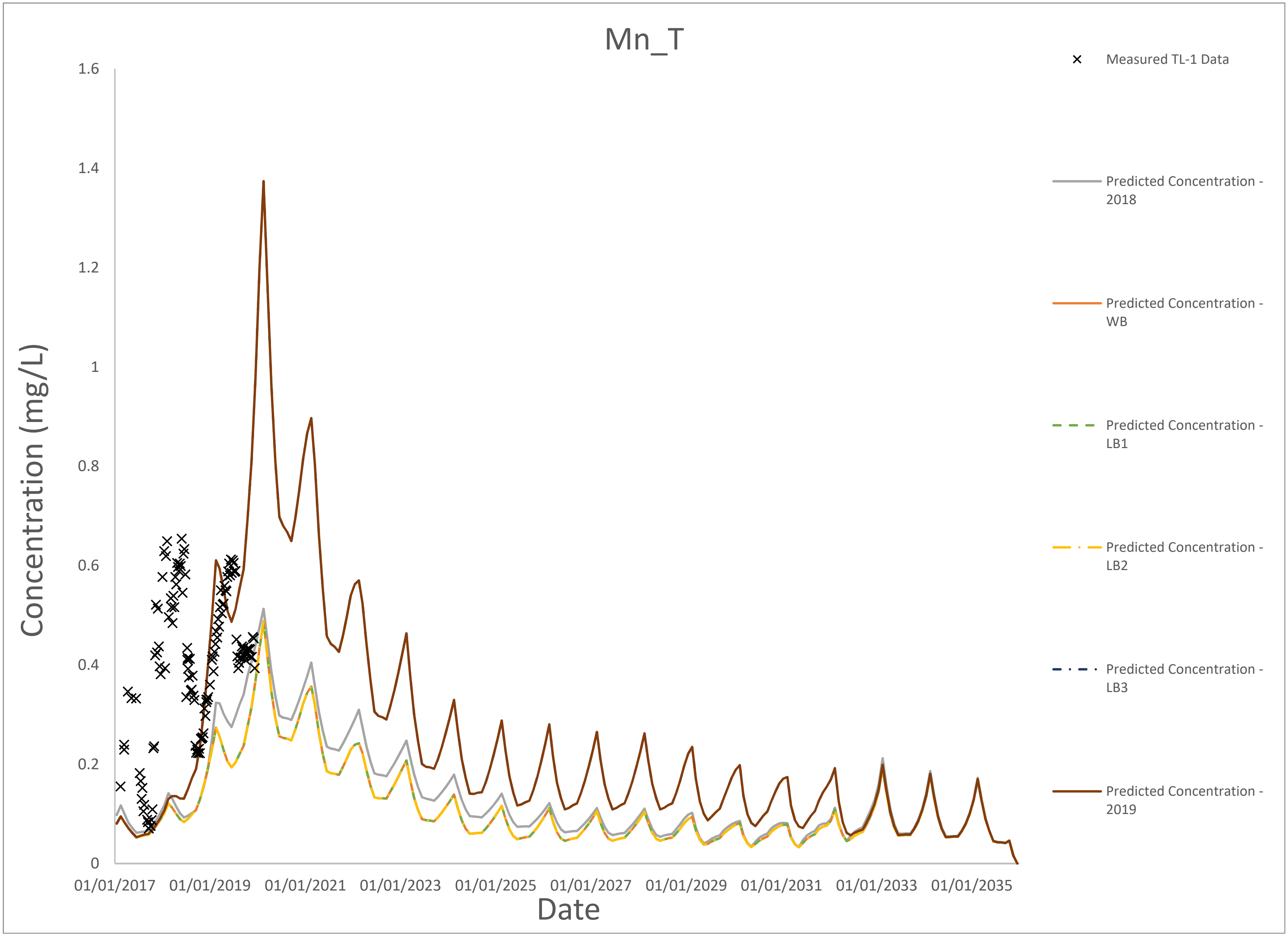

Cu_T
Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

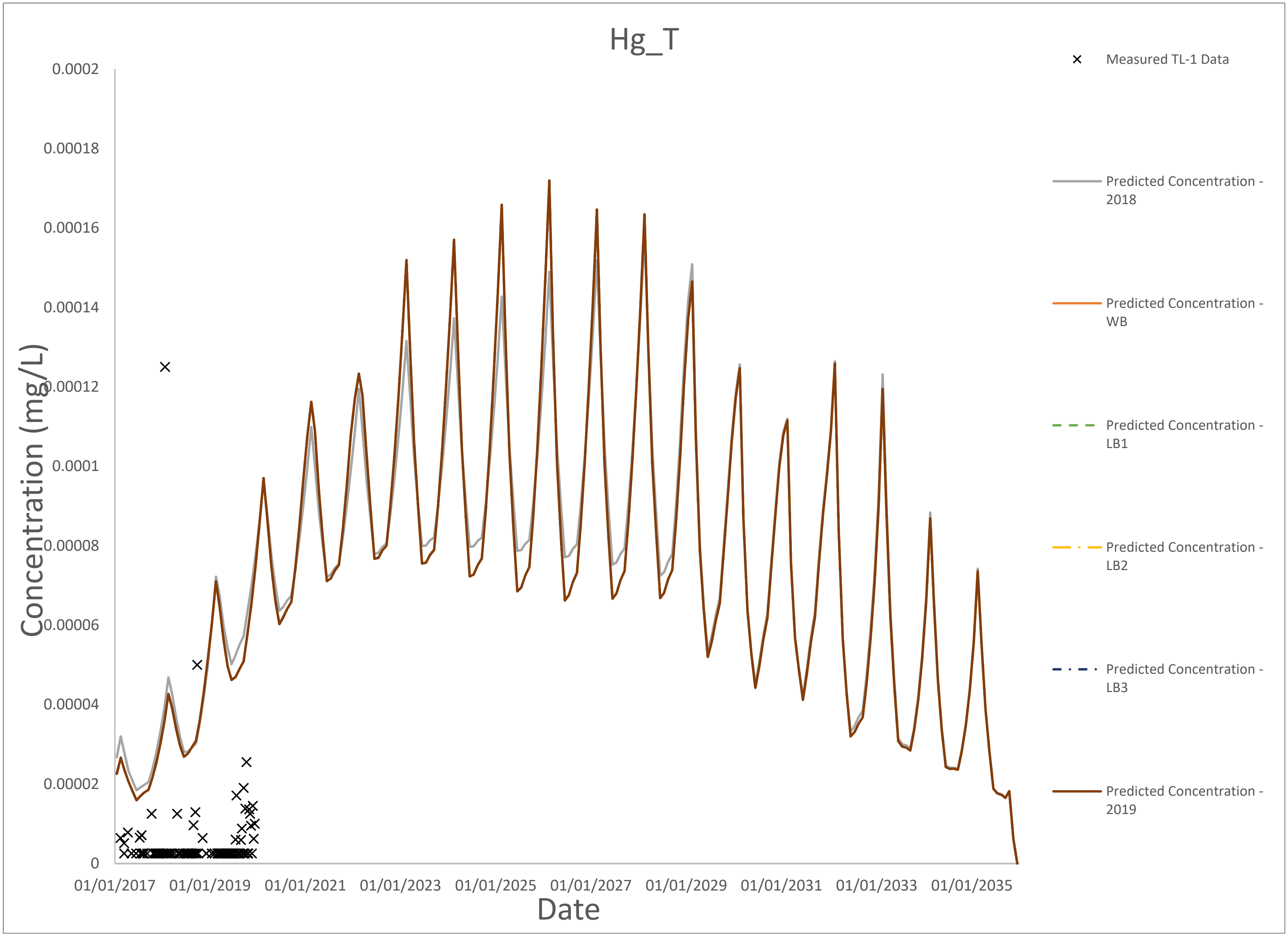

Fe_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
45
40
35
30
25
20
15
10
5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

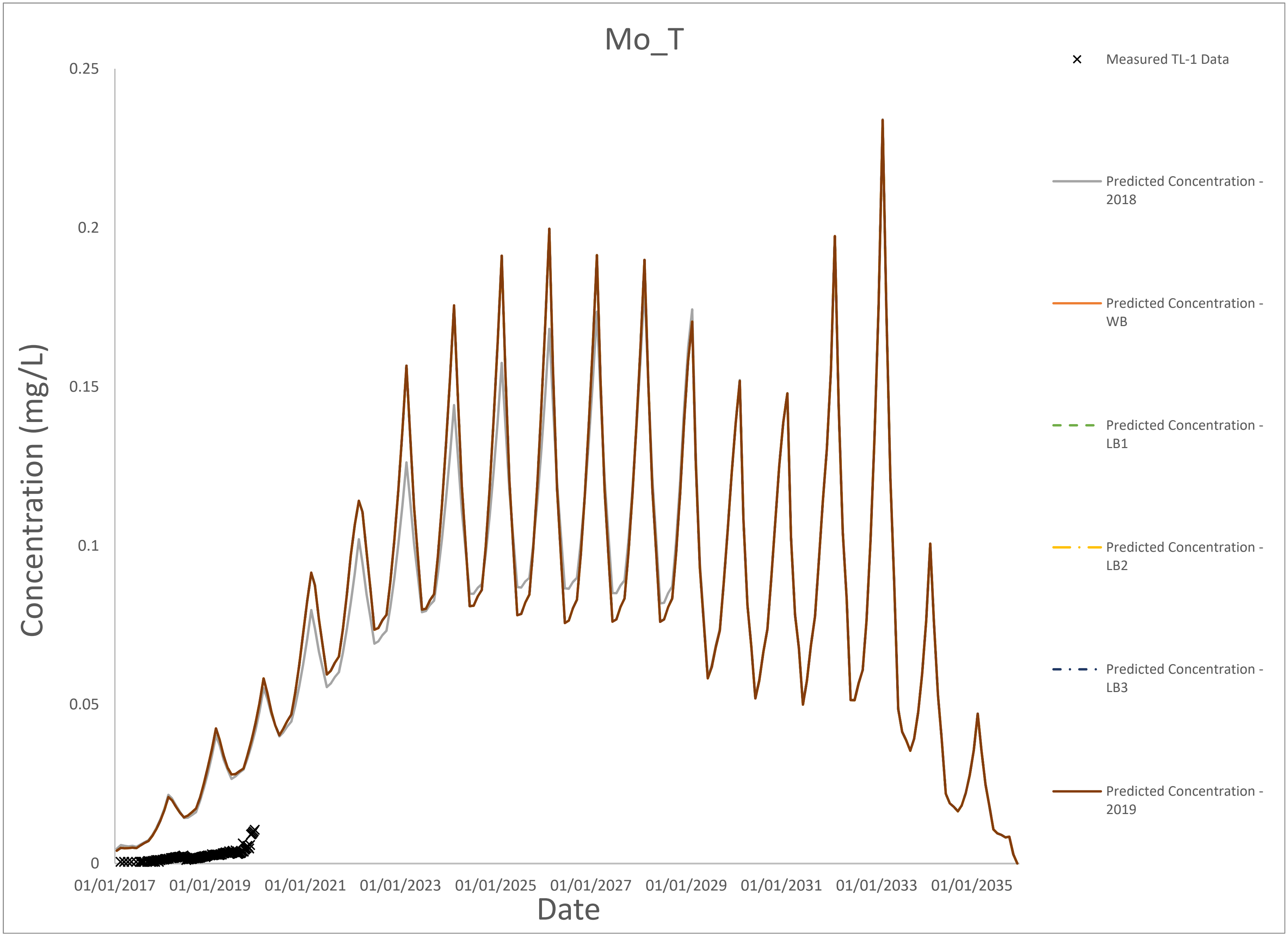

Pb_T
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

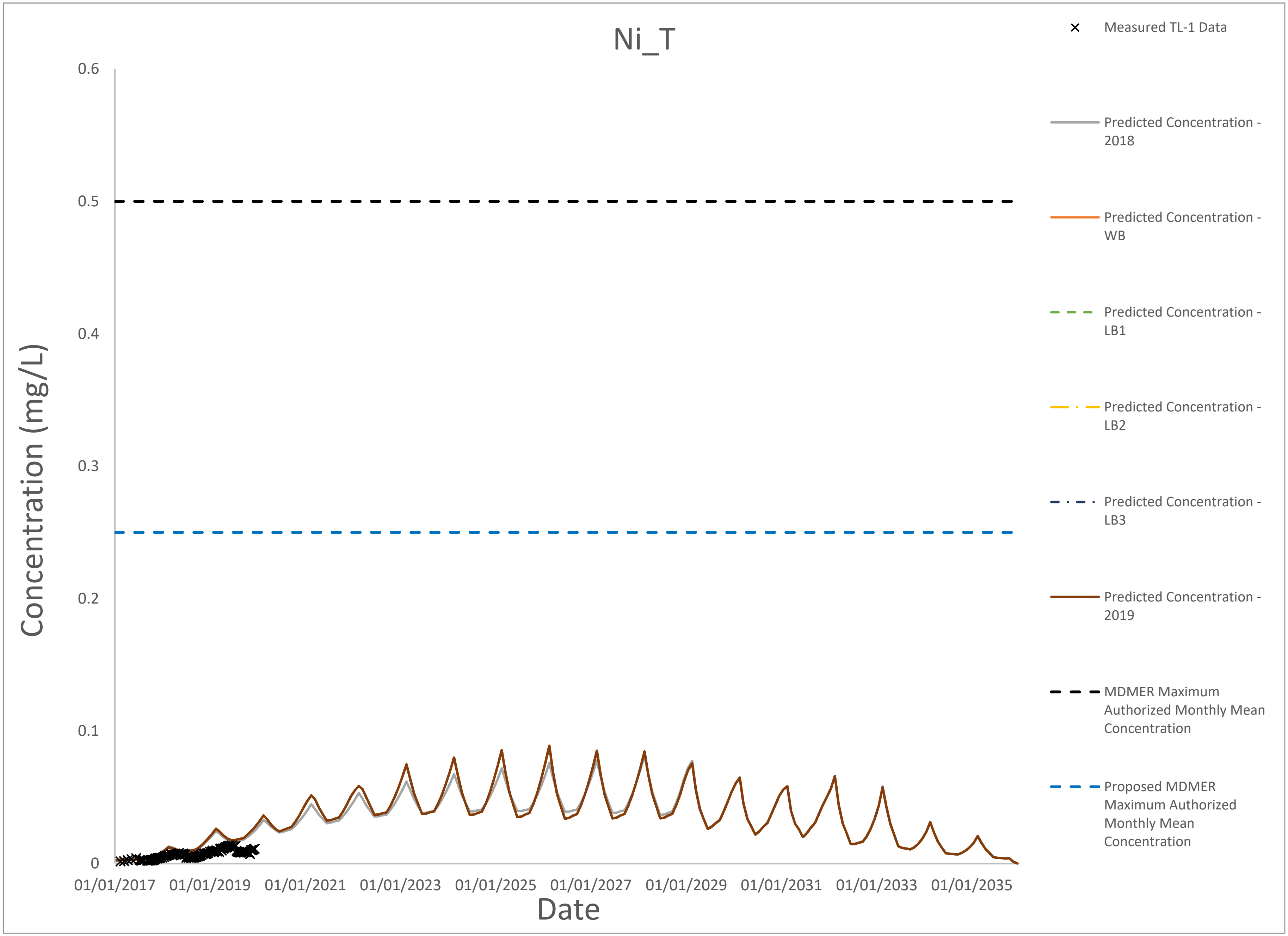

Li_T
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

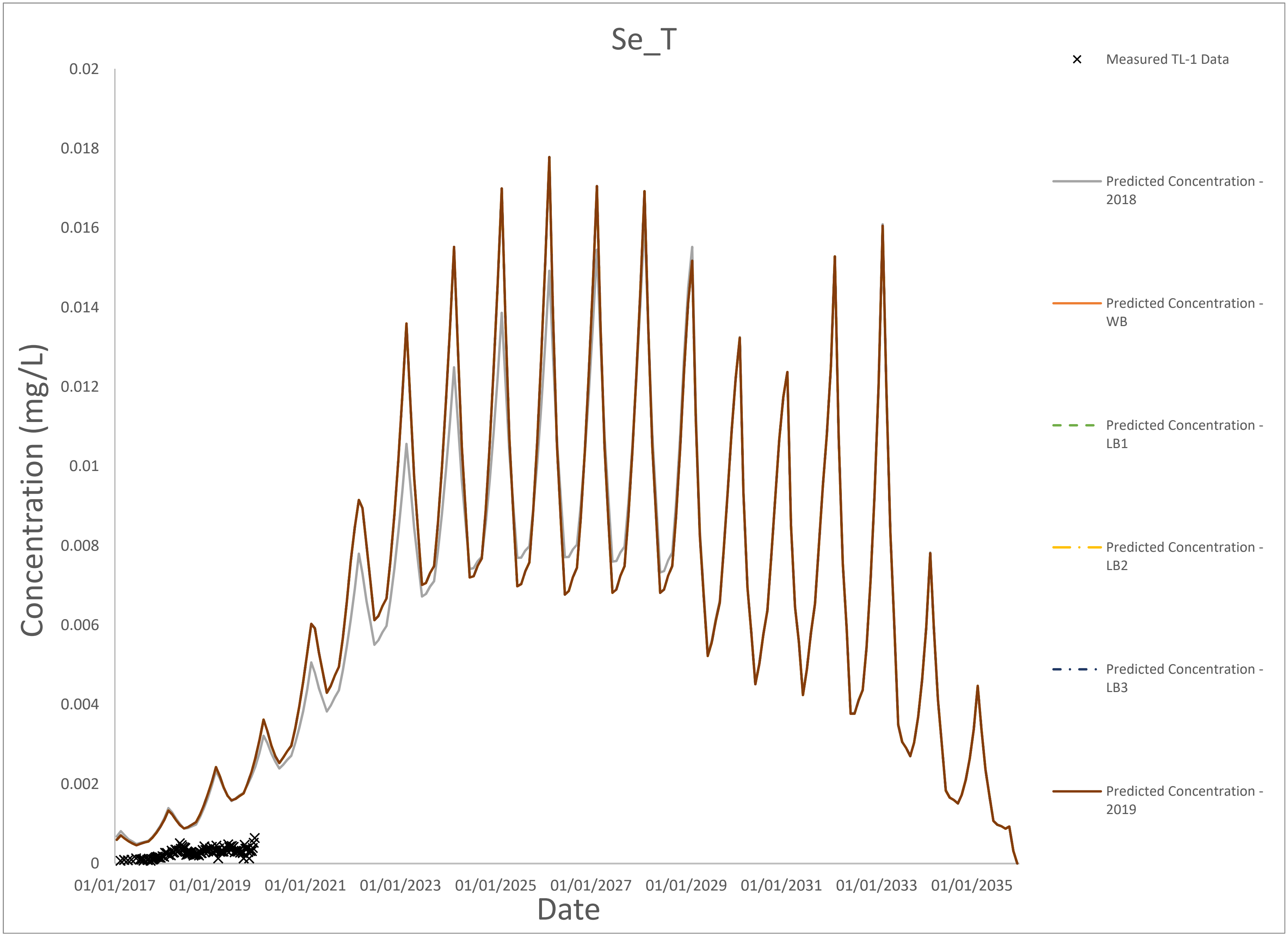

Mg_T
Concentration (mg/L)
350
300
250
200
150
100
50
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

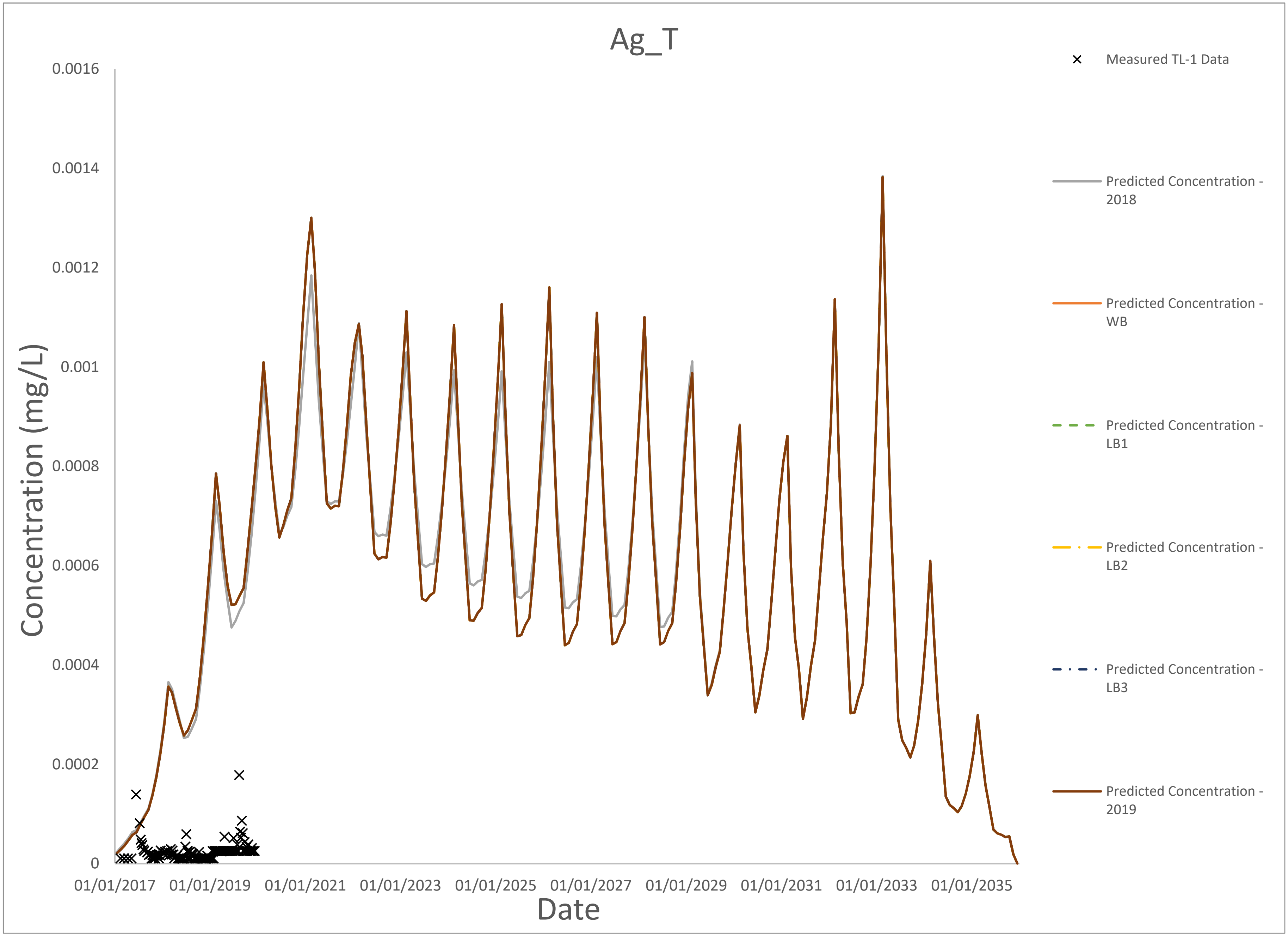

Mn_T
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

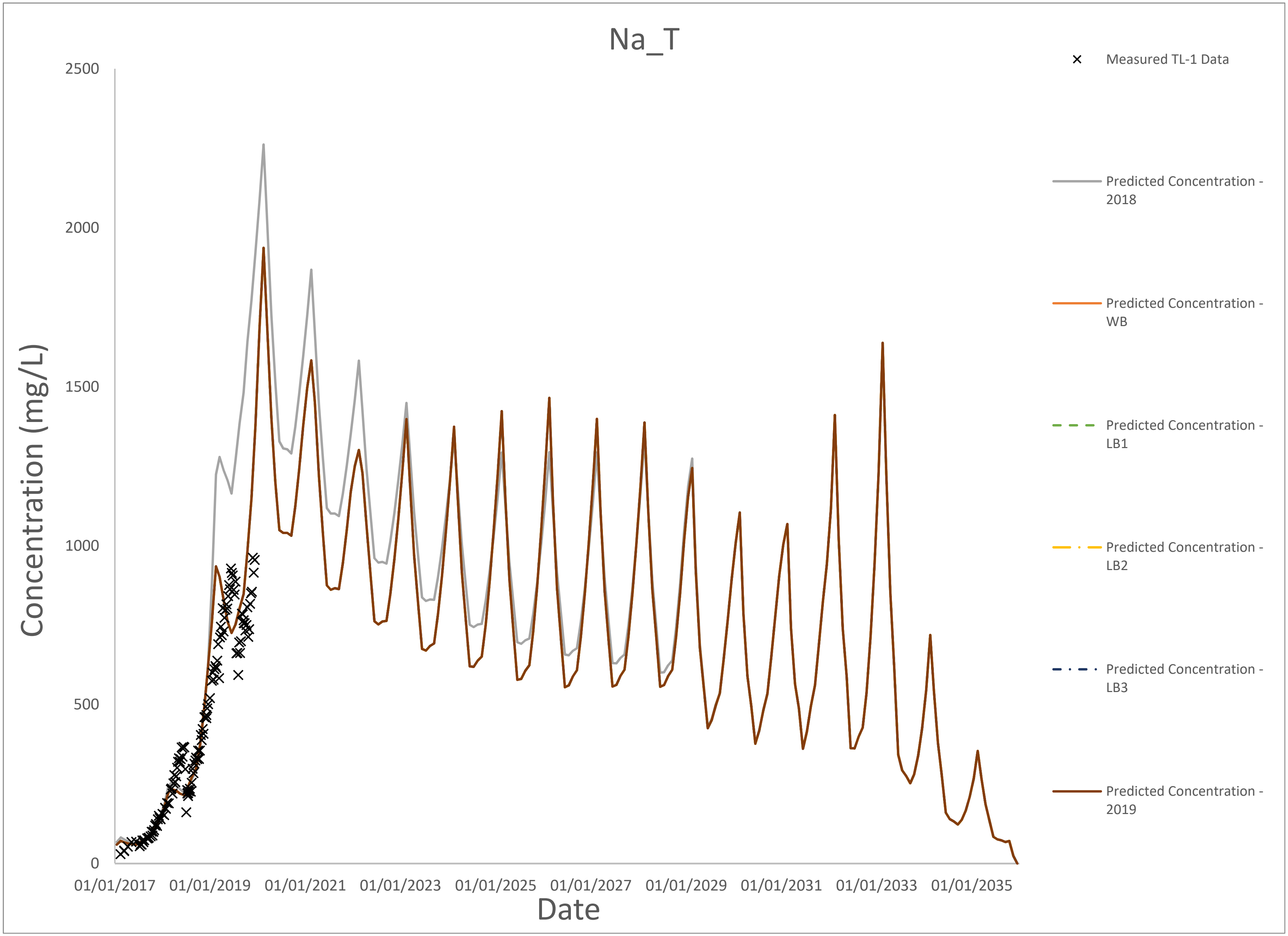

Hg_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

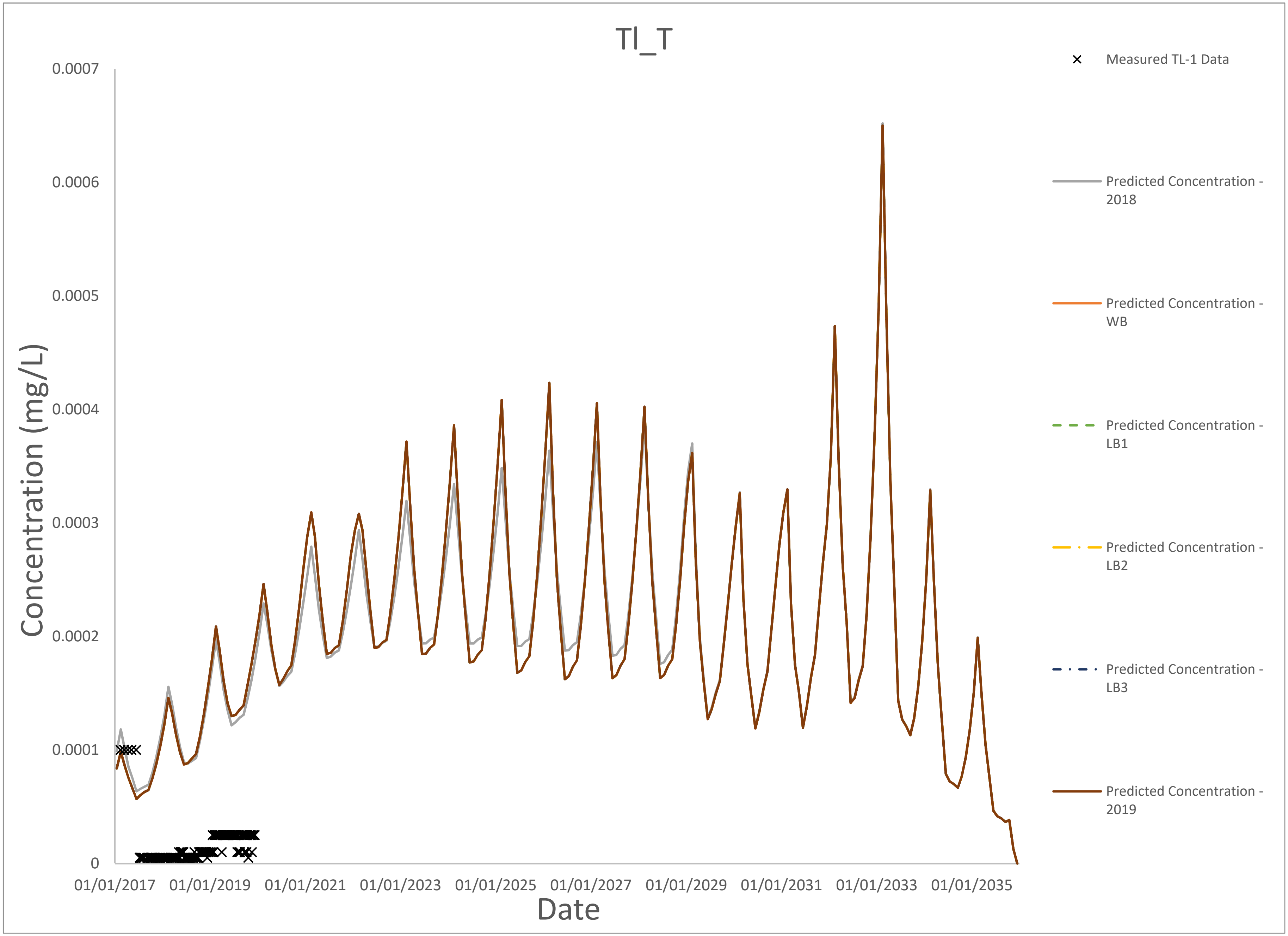

Mo_T
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

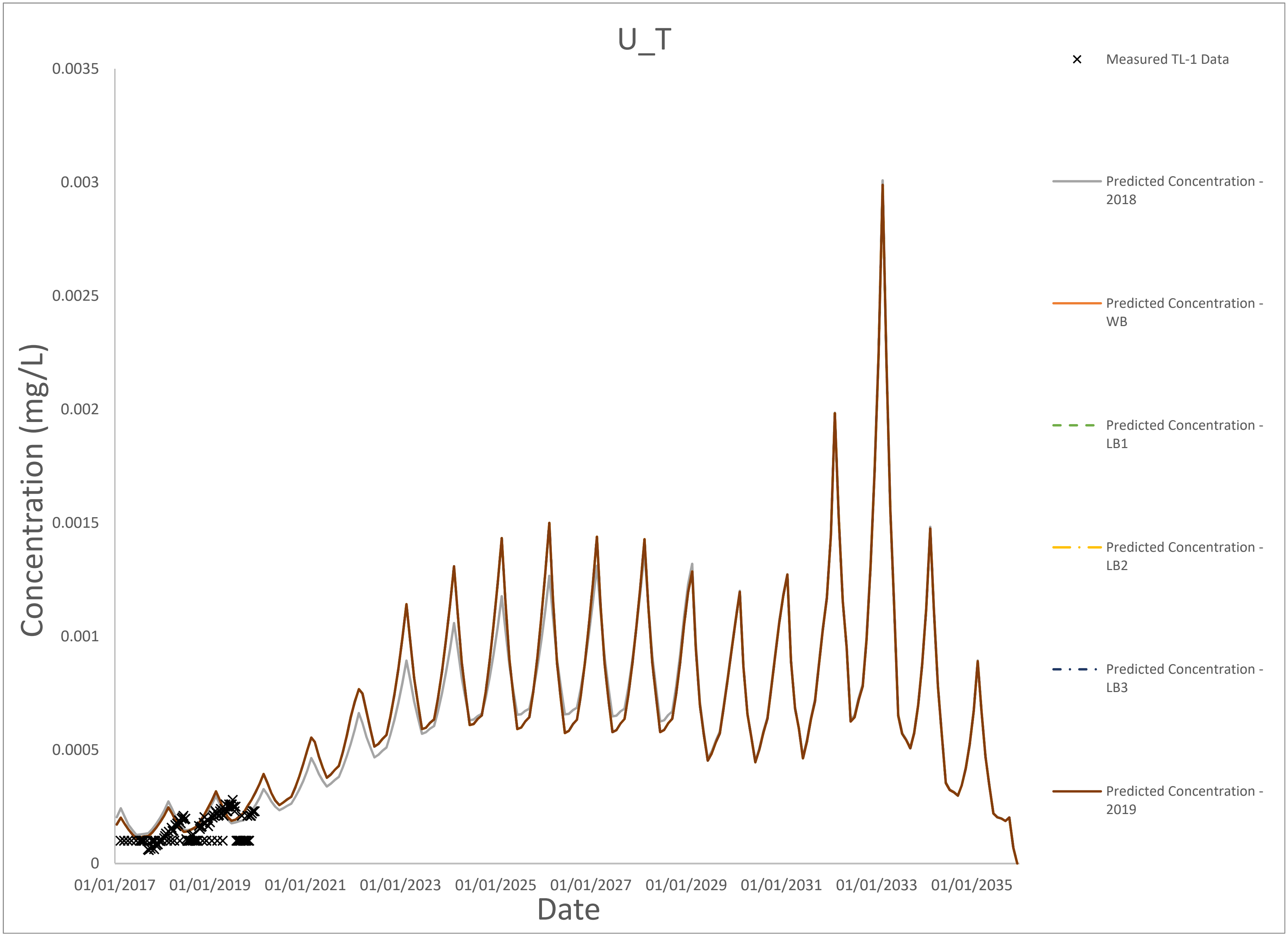

Ni_T
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

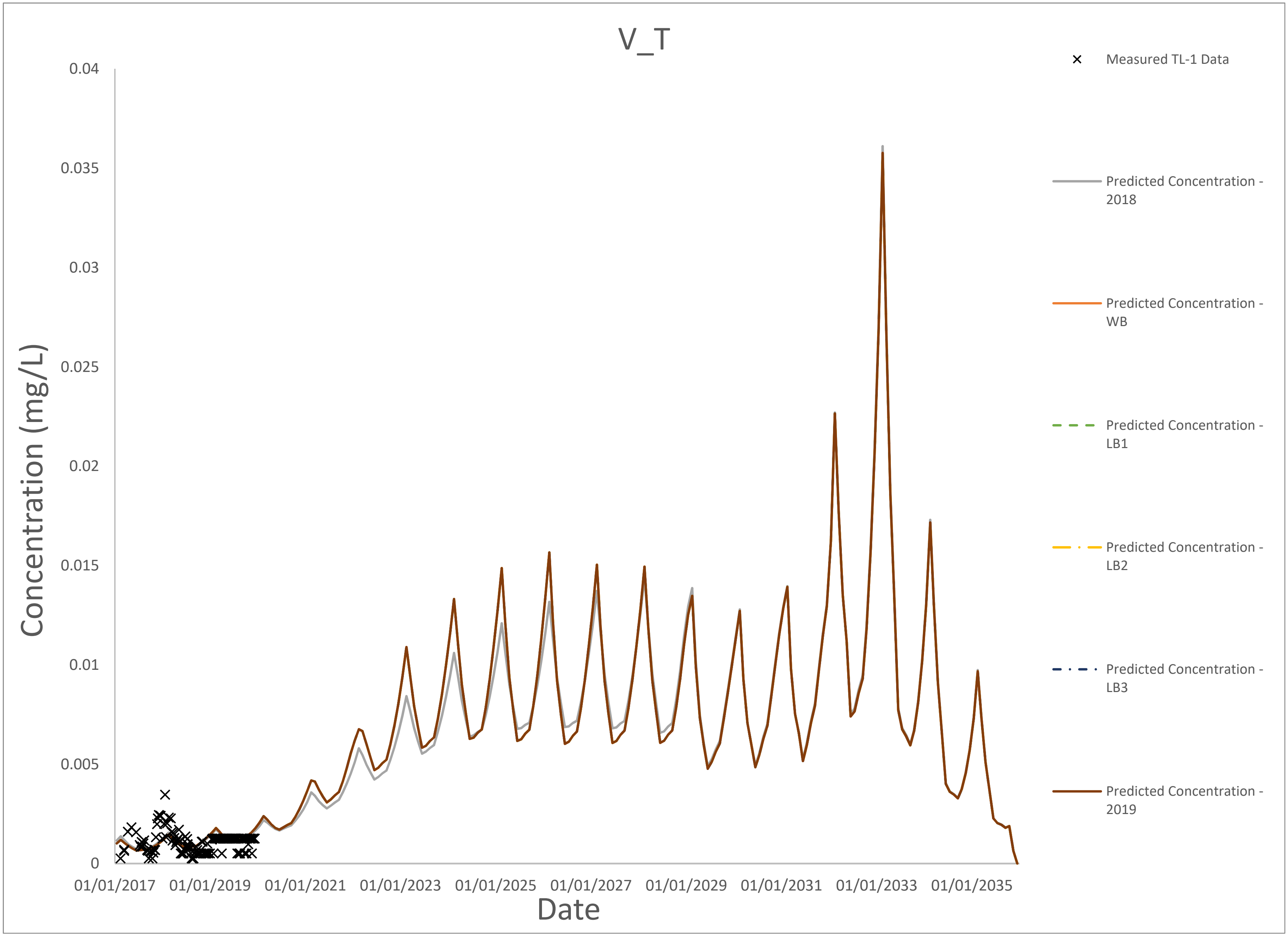

Se_T
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

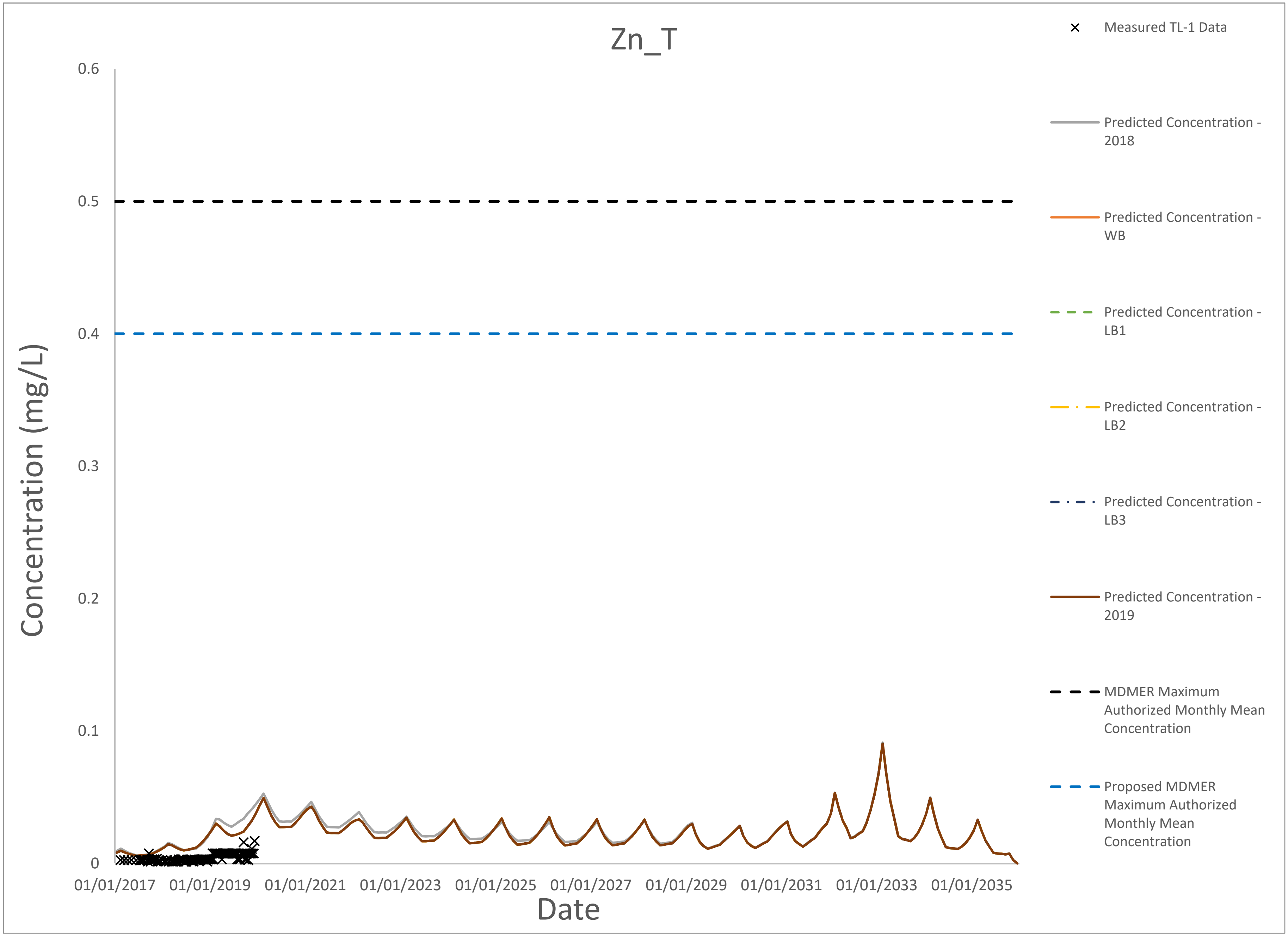

Ag_T
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

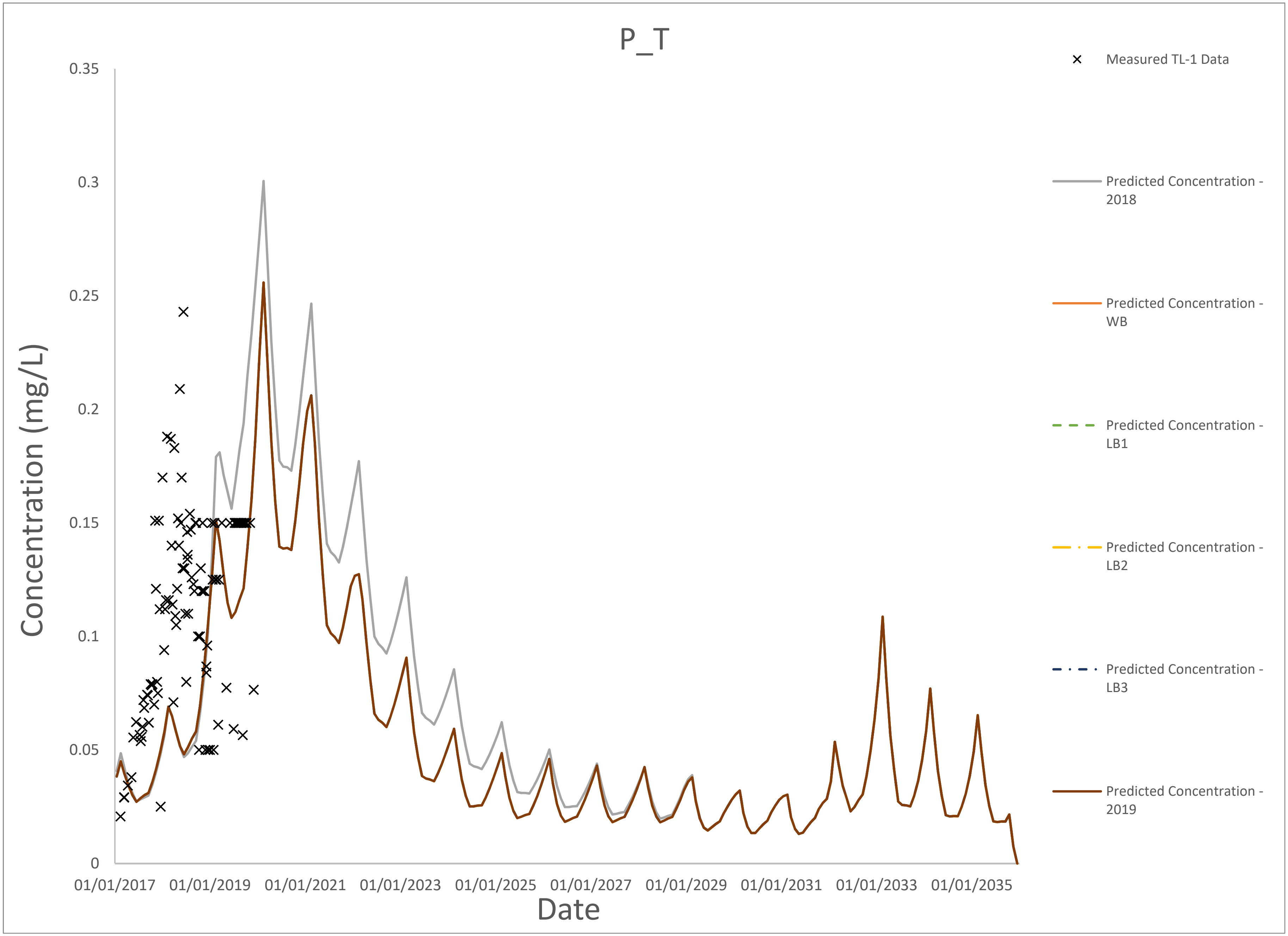

Na_T
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


Tl_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date


U_T
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


V_T
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019


Zn_T
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration


P_T
Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

Appendix F

2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid Mines, Hope Bay Project

2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid North Mines, Hope Bay Project

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.037
March 2020

2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid North Mines, Hope Bay Project

March 2020

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Appendices

1 Introduction

Development of the Doris and Madrid North mine has resulted in the development of quarries, use of quarry rock for construction of roads, pads and other infrastructure, production of waste rock from the underground mine and processing of ore resulting in flotation tailings slurry and detoxified tailings. Monitoring plans are in place to confirm metal leaching and acid rock drainage (ML/ARD) potential for quarry rock, waste rock and tailings (flotation and detoxified), consistent with geochemical characterization studies conducted at the environmental assessment and/or water licence applications for Doris and Madrid, and to monitor the chemistry of seepage and runoff associated with these materials.

This report presents results from the 2019 waste rock, quarry, construction rock and tailings geochemical monitoring programs for Doris and Madrid North. The report is organized as follows:

- A summary of the monitoring requirements is provided in Section 2.
- Results of the geological inspections and monitoring of Doris underground and CPR waste rock are summarized in Section 3.
- Results of the geological inspections and monitoring of Madrid North waste rock are summarized in Section 4.
- Results of the geochemical inspections and monitoring of quarry and construction rock are summarized in Section 5.
- Results of the seepage surveys around infrastructure areas and downgradient of the waste rock piles are provided in Section 6.
- Results of geochemical monitoring of flotation tailings slurry and detoxified tailings solids are summarized in Section 7.
- Detailed technical memorandum on each of these subjects are provided in Appendices A, B, C, D and E.

2 Monitoring Requirements and Conformity Assessment

2.1 Waste Rock

2.1.1 Doris Mine

Monitoring plans for Doris waste rock are provided in the "*Waste Rock, Ore and Mine Backfill Management Plan, Hope Bay Project, Nunavut [WROMP]"* (TMAC 2019). The program includes inspection and geochemical monitoring of the waste rock solids from the underground mine and Doris crown pillar recovery (CPR) and routine monitoring of the pollution control pond (PCP).

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in the WROMP (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). Geochemical monitoring of underground waste rock executed by TMAC between January and April 2019 was according to the requirements of the waste rock management plan outlined in TMAC (2016). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (SRK 2019a) to assess if the waste rock was geochemically suitable for use as construction rock.

A summary of the requirements of TMAC (2019) is summarized in Table 2.1.

Table 2.1: Doris Waste Rock Monitoring Requirements and 2019 Monitoring Summary

Document Reference[1]	Monitoring Item	2019 Monitoring Summary
TMAC (2016)	Inspection of the working face and muck pile by a field geologist to confirm rock types, mineralogical characteristics, and to classify the rock as mineralized or non-mineralized. All waste rock will be classified and managed as "mineralized" waste rock and be used as backfill.	Not a monitoring requirement in 2019. Refer to Section 3 and Appendix A for results.
TMAC (2016)	Sampling and testing of the underground waste rock, including acid base accounting (ABA) on a minimum of one sample per 10,000 tonnes of rock.	Not a monitoring requirement in 2019. Refer to Section 3 and Appendix A for results.
TMAC (2016)	Sampling and testing of the underground waste rock, including ABA.	Completed. Nineteen samples geochemically characterized. Refer to Section 3 and Appendix A.
TMAC (2019)	Conduct waste rock geological inspections: i) underground at the blast face by TMAC geologists, with internal record keeping and ii) surface waste rock stockpile (Pad T)	Completed. Refer to Section 3 and Appendix A.
TMAC (2019)	Geochemical sampling program for CPR waste rock to confirm that it is suitable for use as construction rock: sampling frequency of one sample for every 20,000 tonnes.	Completed. Collected one sample per 1,600 t from CPR waste rock stockpile on Pad T. Refer to Section 3 and Appendix A.
TMAC (2019), NWB (2018)	Monitoring and recording the volumes of waste rock mined, waste rock management designations (mineralized and non-mineralized and placement locations, including any waste rock that is approved and used for construction (pending confirmatory test work and approval from NWB);	Completed. Refer to Section 3 and Appendix A. All waste rock managed as mineralized except for waste rock approved as construction rock (as per previous item in table).

Document Reference[1]	Monitoring Item	2019 Monitoring Summary
NWB (2018)	Annual water quality monitoring will be carried out at a surveillance monitoring station ST-2 located in the pollution control pond;	Completed. Refer to Appendix D of the Hope Bay Belt Project 2019 Nunavut Water Board Annual Report.
TMAC (2019)	Annual inspections by a qualified geochemist of the designated non-mineralized areas of the waste rock pile to confirm that there are no areas with elevated amounts of sulphide mineralization, and inspections of the designated mineralized areas of the pile to look for signs of weathering and oxidation of the sulphides; representative sample set of waste rock to be collected;	Completed. Ten samples geochemically characterized from Pad T. Refer to Section 3 and Appendix A.
TMAC (2019)	Seep surveys along the down-gradient toe of the waste rock pile and below the pollution control ponds and access road throughout operations and for at least 2 years following mining and backfilling activities. The seep survey will be completed at the same time and will follow the same procedures as used for the seep survey around other infrastructure areas. However, given the increased importance of obtaining samples from this area, all distinct seeps in the immediate vicinity of the waste rock pile (i.e. any seeps spaced more than 50 metres apart) will be tested for a full suite of laboratory parameters; and	Completed. Refer to Section 6 and Appendix D.
NWB (2018)	An annual waste rock monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	Completed. Refer to Section 3 and Appendix A.

Note: [1]TMAC (2016) items not required in 2019 but monitoring presented for completeness. See text for details.

2.1.2 Madrid North Mine

Waste rock monitoring at Madrid North is outlined in in *Waste Rock, Ore and Mine Backfill Management Plan* (TMAC 2019), which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018) except for waste rock from the Naartok East CPR. Geochemical monitoring of waste rock from NE CPR is documented in *Classification of Waste Rock in Support of Segregating Construction Rock from Naartok East Crown Pillar Recovery, Madrid North, Hope Bay* (SRK 2019b). SRK (2019b) includes a field classification method and geochemical criteria to identify waste rock that is non-PAG and with low potential for neutral pH arsenic leaching and recommendations for operational implementation of the field-based geochemical characterization program that identifies waste rock that is suitable for use as construction rock.

A summary of the requirements for Madrid North waste rock monitoring as outlined in SRK (2019b) and TMAC (2019) is summarized in Table 2.2. Of note is that the program of geochemical sampling for Madrid North waste rock from the underground mine has been modified, with rationale outlined in Table 2.2.

Table 2.2: Madrid North Waste Rock Monitoring Requirements and 2019 Monitoring Summary

Monitoring Program	Monitoring Item	2019 Monitoring Summary
TMAC (2019)	Conduct waste rock geological inspection at underground blast face by TMAC geologists, with internal record keeping	Completed. Refer to Section 4 and Appendix B.
SRK (2019b)	Geological inspection and pXRF analysis of Naartok East Crown Pillar Recovery (NE CPR) drill cuttings for geochemical classification of waste rock to determine suitability of waste rock as construction rock.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	In pit NE CPR waste rock construction classification and segregation according to blast rounds.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019), NWB (2018)	Monitoring and recording the volumes of waste rock mined and placement locations, including waste rock that is approved for use in construction (pending confirmatory test work and approval from NWB);	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	Annual inspections by a qualified geochemist of the designated non-mineralized areas of the Madrid North WRP to confirm that there are no areas with elevated amounts of sulphide mineralization, and inspections of the designated mineralized areas of the pile to look for signs of weathering and oxidation of the sulphides; representative sample set of waste rock to be collected;	Not applicable. Waste rock not placed on the Madrid North WRP pad in summer 2019. Monitoring will be initiated in Summer 2020.
TMAC (2019)	Geochemical verification sampling program for underground waste rock approved for use as construction rock: sampling frequency of one sample for every 5,000 tonnes for underground development.	Not applicable. Underground waste rock not a source of construction rock in 2019.
TMAC (2019)	Geochemical verification sampling program for NE CPR waste rock approved for use as construction rock: sampling frequency of one sample for every 20,000 tonnes.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	Seep surveys along the down-gradient toe of the Madrid North Waste Rock Pad and below the CWP and access road throughout operations and for at least 2 years following mining and backfilling activities. The seep survey will be completed at the same time and will follow the same procedures as used for the seep survey around other infrastructure areas. However, given the increased importance of obtaining samples from this area, all distinct seeps in the immediate vicinity of the waste rock pile (i.e. any seeps spaced more than 50 metres apart) will be tested for a full suite of laboratory parameters;	Not applicable - Waste rock not present on the WRP pad in 2019 at time of seep survey. The seep survey will be initiated in Summer 2020.
NWB (2018)	Routine water quality monitoring (sampled twice annually, weekly water levels) will be carried out at a surveillance monitoring station MMS-1, located at the Madrid North CWP; and	Completed. Refer to Appendix D of the Hope Bay Belt Project 2019 Nunavut Water Board Annual Report.
NWB (2018)	An annual waste rock monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March	Completed. Refer to Section 4 and Appendix B.

Monitoring Program	Monitoring Item	2019 Monitoring Summary
	31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	

2.2 Quarry and Construction Rock

Details on the monitoring program for quarries and as-built construction rock for Doris and Madrid infrastructure are provided in "*Quarry Management and Monitoring Plan*" (TMAC 2017). A summary of the requirements is provided in Table 2.3.

Table 2.3: Quarry and Construction Rock Monitoring Requirements and 2019 Monitoring Summary

Monitoring Item	2019 Monitoring Summary
Visual inspections and sampling at the quarry face by site geologist when the quarries are in active use;	Completed. Refer to Section 5 and Appendix C.
Collection and testing of two samples per year from each active quarry for total sulphur analysis, and, if the sulphur content exceeds 0.1%, the samples would be subjected to full ABA tests. A subset of samples will be subjected to shake flask extraction tests. The ABA tests would be done on the whole sample and on the -2mm size fraction to determine whether there is any concentration of sulphides in the fine component of the rock;	Completed. Refer to Section 5 and Appendix C.
Quarry sumps will be monitored as described under the routine site water quality monitoring program;	Quarry sump monitoring was not required in 2019 because it was not necessary to discharge water from Quarry 2 or Quarry D.
After construction of roads and other infrastructure components that were constructed using the quarry or waste rock since the previous inspection will be inspected by a qualified geologist or geochemist to verify that the rock used in construction was suitable for that purpose. During the inspection, samples will be collected for total sulphur analysis. If the sulphur content exceeds 0.1%, the samples will be subjected to full ABA tests. A subset of samples will be subjected to shake flask extraction tests.;	Completed. Refer to Section 5 and Appendix C.
A seep survey will be conducted around all infrastructure components that have been constructed or modified within the previous year. Field pH, electrical conductivity (EC), Eh, and temperature readings will be collected. A minimum of 10% of the samples will be submitted for laboratory analyses, as detailed in Quarry Management and Monitoring Plan (TMAC 2017). Established reference stations will also be monitored to provide basis for comparing this to waters that are not influenced by the development activities; and,	Completed. Refer to Section 5 and Appendix C.
An annual quarry monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	Completed. Refer to Section 5 and Appendix C.

2.3 Tailings

The geochemical monitoring program for flotation tailings slurry and detoxified tailings are specified in Schedule I, Tables 1 to 3 of NWB Type A Water Licence 2AM-DOH1335 Amendment

No. 2 (the “Water Licence”, Nunavut Water Board 2018) and includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids[1] (TL-7A), detoxified tailings supernatant (TL-7B) and seepage from underground backfilled stopes (TL-11). Station TL-7B was added to the Water Licence (NWB 2018) and monitoring commenced in 2019. A summary of the monitoring requirements is summarized in Table 2.4.

Table 2.4: Tailings Monitoring Requirements and 2019 Monitoring Summary

Monitoring Item	2019 Monitoring Summary
Sampling of the supernatant from flotation tailings slurry discharge (TL-5) once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), and total metals. Cyanate and thiocyanate should be analysed quarterly;	Completed. Refer to Section 7 and Appendix E.
Maintain monthly records of tonnages and locations of disposal for flotation tailings (TL-6) discharged into the TIA and detoxified tailings (TL-7A) placed in the underground mine in stopes as backfill;	Completed. Refer to Section 7 and Appendix E.
Monthly geochemical monitoring of a homogenized monthly composite sample of flotation tailings solids (TL-6), from equal amounts of weekly samples, for analysis of total sulphur, sulphate sulphur, TIC and trace element content;	Completed. Refer to Section 7 and Appendix E.
Monthly sampling and analysis of detoxified tailings solids (TL-7A) for TIC, total metals (including sulphur) and moisture content;	Completed. Refer to Section 7 and Appendix E.
Monthly sampling and analysis of detoxified tailings filtrate (TL-7B) for total metals, WAD cyanide, cyanate and thiocyanate;	Completed. Refer to Section 7 and Appendix E.
Bi-annual seepage surveys of underground backfilled stopes with opportunistic sampling of seepage (TL-11) for the analysis of pH, electrical conductivity (EC), trace metals by ICP-MS, alkalinity, acidity, sulphate, total and WAD cyanide, total ammonia, nitrate and nitrite; and,	Completed. Refer to Section 7 and Appendix E.
Preparation of an annual tailings monitoring report to be submitted to the NWB by March 31 of the year following sample collection and including the results and interpretation of the geochemical data for tailings solids (TL-6, TL-7A, TL-7B), geochemical data and figures depicting time series of constituent concentration and loads for tailings supernatant (TL-5) and results and interpretation of seepage data from the bi-annual underground seepage survey of backfilled stopes (TL-11).	Completed. Refer to Section 7 and Appendix E.

3 Monitoring of Doris Waste Rock Geochemistry

Details of the 2019 waste rock monitoring program are presented in Appendix A.

[1] Detoxified tailings are referred to as cyanide leach residue in the Water License and prior to 2019 was monitored as station TL-7.

3.1 2019 Activities

In April 2015, TMAC re-initiated underground mining at Doris, with placement of waste rock on surface commencing in October 2015. Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T (Table 3-1), all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from surface waste rock stockpiles on Pad T was placed as backfill in the Doris Crown Pillar and in stopes of the Doris mine.

Table 3-1: Summary of 2019 Waste Rock Placement Locations and Volume

Doris Mine	Source Location	Placement Location	Volume (t)	Total (t)
Underground	Underground	Backfill in Stopes	265,000	430,000
		Pad T	165,000	
	Pad T	Backfill in Stopes	90,000	230,000
		Backfill in CPR	140,000	
CPR	Pad T	Backfill and cover* of CPR	38,000	51,000
		Underground waste rock stockpile	13,000	

Notes: *Deemed to be suitable for construction as per TMAC (2019)

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan* (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (Table 3-1) to assess if the waste rock was geochemically suitable for use as construction rock. CPR waste rock is considered potential construction material because the mining practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and/or ammonia (related to blasting residues).

3.2 Sampling and Testing Program

3.2.1 Underground Mine

Underground Sampling Program

TMAC geologists collected 19 underground waste rock samples as part of the waste rock geochemical monitoring program in 2019 from January to April. Of the 19 samples, all were analyzed for total sulphur and TIC and 5 samples for expanded ABA. Ore is considered to be mineralized by definition, and therefore geochemical testing was not required.

Geological inspections were conducted by site geologists when monitoring samples were collected. Where possible, both the working face and the muck pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs.

Waste Rock Stockpile (Pad T) Sampling Program

SRK completed an inspection of the underground waste rock placed in the stockpile on Pad T in August 2019. Waste rock was inspected by walking over the stockpiles and around the perimeter of the upper bench, examining rock types and the presence of sulphide content. The lower benches were not inspected as they either contained waste rock deposited prior to the last inspection or were not accessible. SRK collected 10 samples with sample distribution according to the rock types visually identified by SRK during the stockpile inspection and also the proportion of rock types that were intersected by mining, as provided by TMAC geologists.

3.2.2 Doris CPR

In 2018, waste rock from the Doris CPR was placed in a separate stockpile from waste rock sourced from the underground with the objective using CPR waste rock for construction, as required. In 2019, TMAC collected an additional 24 samples from the CPR waste rock stockpile to supplement the six samples collected in 2018 (SRK 2019a) with the objective of demonstrating the suitability of using CPR waste rock as construction rock. Geochemical analysis included ABA, elemental analyses and SFE tests.

The sampling and test work program design was according to the program requirements documented in TMAC (2019) to demonstrate the suitability of waste rock as construction rock. Sample locations were randomly distributed across the area of the stockpile and an excavator used to disturb frozen areas of the stockpile to allow sample collection.

3.3 Results

3.3.1 Underground Mine

Underground Sampling Program

In 2019, waste rock intersected by the Doris underground workings was primarily (95%) mafic metavolcanic flow (1a) with lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, and rare (1%) diabase or felsic dykes. Of the 19 underground waste rock samples, they were geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high (ranging

from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

Waste Rock Stockpile (Pad T) Sampling Program

As part of the TMAC (2019) waste rock monitoring program, SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- The one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP.

- Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

- SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

The Type A waste rock sample set represents the geochemical characteristics of all 2019 waste rock samples and rock types.

The geological and geochemical inventory of waste rock on Pad T precludes a long-term assessment of the anticipated geochemical behaviour of the waste rock on Pad T with respect to metal leaching and acid rock drainage (ML/ARD). The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP). The results of the seepage survey are reported in Appendix D, while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

3.3.2 Doris CPR

In 2018, CPR waste rock placed in a separate stockpile on Pad T for potential use as construction material. CPR waste rock is considered potential construction material because the drilling and blasting practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and lower loads of ammonia (related to blasting residues).

In 2019, TMAC collected 24 samples of CPR waste rock from the stockpile on the west end of Pad T to assess if this waste rock could be used for construction as per the requirements of the *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The results of the geochemical program for CPR waste rock are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment.

- SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock.

- All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%. Confirmatory samples taken from the CPR cover were classified as suitable for use as construction rock.

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure. The Type A waste rock sample set represents the geochemical characteristics of the CPR waste rock samples analyzed as part of the 2019 waste rock monitoring program.

4 Monitoring of Madrid North Waste Rock Geochemistry

Details of the 2019 quarry and construction rock monitoring program will be presented in Appendix B as an addendum to this report.

5 Monitoring of Quarry and Construction Rock Geochemistry

Details of the 2019 quarry and construction rock monitoring program are presented in Appendix C.

5.1 2019 Activities

In 2019, active blasting was conducted in Quarry 2 in May, June, October and December 2019. Active quarrying was conducted in Quarry D in May, June and September 2019. Between mid-2018 and mid-2019, TMAC constructed the following infrastructure at Doris and Madrid North:

- Doris: access road to the vent raise; access road to the Doris crown pillar recovery (CPR); cover for the Doris CPR; and access road and jetty at Roberts Bay to the effluent discharge point.
- Madrid North: access road to the Naartok East CPR; Madrid North contact water pond (CWP); access road to the Madrid North CWP; and Naartok East overburden pad berm.

Infrastructure at Doris and Madrid North were constructed using rock from Quarry 2 and Quarry D, respectively except for the Doris CPR cover, which was built using of a combination of Doris waste rock (underground and CPR) and rock from Quarry 2.

5.2 Sampling and Testing Program

5.2.1 Quarry Monitoring

In order to comply with the Quarry Management and Monitoring Plan (TMAC 2017), monitoring includes geological inspections of active quarry blast faces and collection of ROQ rock for geochemical characterization. A summary of monitoring activities at Quarry 2 and Quarry D is presented in Table 5-1. TMAC documented each blast face inspection including lithology, sulphide content and veining and presence/absence of fibrous actinolite. TMAC visually described the samples, including lithology, visible sulphide content, carbonate content and presence of veining.

TMAC collected samples of quarry rock samples from Quarry 2 in May, July and August, and from Quarry D in May, July and September 2019. Each sample set consisted of a sieved coarse fraction (screened to -1 cm) and a finer fraction (screened to -2 mm). In addition, SRK collected one composite sample of argillite from the quarry wall of Quarry 2 in August.

All -1 cm samples containing total sulphur concentrations >0.1% were submitted for analysis of acid-base accounting (ABA) and trace element content by aqua regia digestion followed by ICP-MS scan. The -2 mm samples also underwent a shake flask extraction (SFE) test on the as-received fraction using the MEND (2009) method.

Table 5-1: Summary of Quarry Inspections and Samples Collected

Inspection Month	Quarry 2		Quarry D	
	Inspections	Samples Collected	Inspections	Samples Collected
May	1	2	3	2
June	-	-	3	-
July	2	2	1	2
August	1*	1*	-	-
September	-	-	2	4

Notes: *Argillite in quarry wall.

5.2.2 Construction Monitoring

SRK inspected the Doris and Madrid infrastructure areas. The visual inspection entailed a geological inspection of infrastructure areas constructed between September 2018 and August 2019.

Twelve surface rock samples (6 samples each from Doris and Madrid North) and one field duplicate were collected from surface material in the areas inspected. Samples were collected from pre-determined locations with one sample taken from each infrastructure area inspected or at a minimum of every 500 m along roads. At each sampling site a bulk sample was screened to -1 cm and -2 mm to generate two separate samples. All 13 samples were analyzed for total sulphur, of which 12 had total sulphur content above the 0.1% criteria and were submitted for full ABA analysis and elemental content. In addition, 7 samples of as-received -2 mm fraction were submitted for SFE testing according to MEND (2009). One sample from each infrastructure area was selected for SFE. In areas where there were multiple samples, SRK selected samples on the basis of high rinse EC values and high total sulphur values. Field contact rinse tests on the -2 mm fraction were conducted on the SRK sample set.

5.3 Results

5.3.1 Quarry Monitoring

Quarry 2

In 2019, TMAC conducted geological inspections in Quarry 2 between May and August. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets except for the August inspection. In August, a 3 to 4 m thick band of argillite (5a) within mafic metavolcanics was observed in one active face in the western extent of the quarry. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated all samples of mafic metavolcanics (1a) were non-PAG according to values of NP/AP and TIC/AP. The argillite (5a) sample was classified as having an uncertain potential for ARD owing to higher levels of total sulphur (2.3% compared to 0.14 to 0.41% for mafic metavolcanics (1a)) and lower NP and TIC (70 and 75 $CaCO_3$/t, respectively for argillite compared to an overall range of 140 to 220 kg $CaCO_3$/t for mafic metavolcanics (1a)).

Compared to the screening criteria, sulphur and arsenic were enriched for argillite (5a) and in the fine fraction (-2 mm) of mafic metavolcanics (1a). The -1 cm fraction of mafic metavolcanics were not enriched in arsenic and sulphur compared to the screening criteria. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results for mafic metavolcanics (1a) indicated non-acidic pH and metal concentrations below the screening criteria indicating the risk of ML/ARD from Quarry 2 metavolcanics (1a) is low.

SFE test results for argillite (5a) indicated non-acidic pH with sulphate concentrations (780 mg/L) suggestive of sulphide oxidation. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

Quarry D

In 2019, TMAC conducted geological inspections in Quarry D in May, July and September. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG for all mafic metavolcanics (1a) according to values of NP/AP and TIC/AP. Total sulphur content ranged between 0.09 and 0.26% and Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively.

Elemental analyses indicated no appreciable enrichment compared to the screening criteria.

SFE test results indicated that all test leachates were non-acidic and that all parameters were below the screening criteria indicating the risk of ML/ARD from Quarry D ROQ rock is low.

5.3.2 Construction Monitoring

Doris

SRK conducted a geological inspection of as-built construction at Doris that confirmed that construction materials for the access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay were characteristic of Quarry 2: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). The geological inspection of the Doris

CPR and access road to Doris vent raise identified material that were not exclusively or typical of Quarry 2 and are described as follows:

- Doris CPR cover: TMAC constructed the cover primarily using waste rock with selected areas using ROQ rock from Quarry 2. Waste rock was geochemically characterized prior to use as construction material according to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The majority of construction material (both waste rock and ROQ rock) in the cover were both geologically classified as mafic metavolcanics (1) with varying textural and compositional differences.
- Access road to Doris vent raise: the geology of construction material used for the access road was characteristic of Quarry 2, except for a 120 m segment that contained a minor amount (~5-10%) of black intermixed fragments of argillite (5a) mixed with mafic metavolcanics (1a).

Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads, including two samples of waste rock from the CPR cover and one sample from the access road to the vent raise containing argillite (5a).

Total sulphur ranged between 0.18% and 0.45% with the highest sulphur value from the sample containing a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a). For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover material. TMAC notes that the cover design specified that underground waste rock be placed below the active layer and CPR waste rock to be placed as the cover. TMAC suspects some underground waste rock may have been mixed with the surface layer when the CPR was being backfilled in stages resulting in waste rock placement in the cover.

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, construction rock used to construct the access road to the vent raise, access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay was geochemically suitable for use as construction rock. This includes the ROQ rock from the access road to the vent raise that contained 5 to 10% argillite and also the waste rock samples collected from the cover of the CPR.

Waste rock and ROQ rock used to construct the CPR cover has a low risk of ML/ARD; however, shake flask testing indicated the potential for elevated chloride and nitrate. No seepage was observed from the CPR cover during TMAC's 2019 seepage survey. The Doris CPR cover will be included in subsequent seepage surveys to assess the potential for contaminant leaching from the Doris CPR.

Madrid North

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, the quarry rock used to construct the access road to the Naartok East CPR; Madrid North CWP; access road to the Madrid North CWP; and Naartok East overburden pad berm was geochemically suitable for use as construction rock.

SRK conducted a geological inspection of as-built construction at the Madrid North mine and confirmed that construction materials were characteristic of Quarry D: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads.

Total sulphur content ranged between 0.07% and 0.22%. Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t. Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

In terms of elemental content, concentrations of all parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that dissolved metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

6 Seepage Survey

Details of the 2019 seep survey are provided in Appendix D.

6.1 2019 Activities

In 2019, TMAC conducted a seepage survey of the waste rock influenced area (WRIA) at Doris in the following areas: toe of the waste rock stockpiles on Pad T and Pad I, including the slope of the pollution control pond (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I; and toe of the access roads located down-gradient of the Doris waste rock stockpiles. At the time of the survey, there was no waste rock on the Madrid North waste rock pile (WRP) pad.

The scope of the 2019 construction rock seepage monitoring survey included infrastructure constructed since the previous seepage survey and infrastructure surveyed for seepage in 2018 but where none was observed (SRK 2019a). In the latter case, these areas were monitored again in 2019. Construction material used at Madrid North was sourced from Quarry D whereas material used at Doris was from Quarry 2 or Doris waste rock that was geochemically monitored for use as construction material according to TMAC (2019) and deemed suitable for construction by TMAC. The 2019 seepage monitoring program included the surveying of the following areas at Doris and Madrid North (with waste rock used as construction rock noted in parentheses):

- Doris
  - South Dam;
  - Access Road to the Doris Crown Pillar Recovery (CPR);
  - Access Road to Doris vent raise;
  - Cover of the Doris CPR (constructed primarily of Doris waste rock and some quarry rock); and
  - Marine Outfall Berm (MOFB) Access Road.
- Madrid North
  - Access road to the Madrid North Contact Water Pond (CWP);
  - Access road to the Naartok East CPR;
  - Naartok East overburden pad berm; and
  - Madrid North CWP construction area.

6.2 Sampling and Testing Program

TMAC conducted the seepage survey between June 19 and 24, 2019. Seepage survey locations were established where seepage was observed or suspected by examining the toes of the waste rock stockpile, infrastructure, roadways, and berms. Samples were collected and field measurements were taken at locations where water was observed flowing into and out of construction rock material; this included seepage where precipitation runoff and snowmelt came into contact with rock along the roadways, building pads, and berms. Electrical conductivity (EC), pH, temperature, oxidation-reduction potential (ORP), and flow rates (where possible) were measured at each of these locations at the time of monitoring.

A total of thirty-three (33) seepage survey sites and three (3) reference survey sites were established where chemical and physical properties of seepage water were measured, and samples were taken for laboratory analysis. The three reference sites, located in the undisturbed tundra and not subject to mine influences, were sampled on July 3, 2019. These samples, used as baseline reference points, were collected at approximately the same locations as those of the 2010–2018 seepage surveys (in the vicinity of the Doris-Windy Road).

One duplicate sample and one field blank were collected and submitted for laboratory analysis, and one travel blank was included in sample shipments as part of SRK's recommended quality assurance/quality control (QA/QC) program.

TMAC submitted a total of 38 samples (including a duplicate and field blank) to ALS Environmental Labs in Vancouver, BC, where they were analyzed for pH, EC, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and dissolved metals (including mercury and selenium). All samples were filtered and preserved in the field, as required.

6.3 Results

A summary of the field measurements is presented in Table 6.1. The pH at all sites was neutral to slightly alkaline (7.5 to 8.1). The samples collected within the Waste Rock Influenced Area (WRIA) had the highest levels of conductivity (2,100 to 3,500 µS/cm).

Parameter concentrations for reference samples collected in 2019 were generally stable and consistent with the historical dataset, including sulphate, arsenic, cobalt, iron, selenium, ammonia, nitrate and nitrite.

For the Doris mine area, one seepage sample was collected at the South Dam, two from along the access road to the Doris CPR, and thirteen samples along the MOFB access road. There was no seepage observed downstream of the Doris CPR cover, which was constructed primarily of waste rock, and the access road to the vent raise, constructed by Quarry 2 ROQ material. Dissolved trace metals concentrations were typically within an order of magnitude of concentrations at the reference stations with the exception of manganese and molybdenum

For the Madrid North mine area, eleven seepage samples were collected along the access road to the Madrid North CWP. Seepage was not observed at the Madrid North CWP, the access road to the Naartok East CPR, or the overburden pad berms; therefore, samples were not collected from these areas. Dissolved metals concentrations were similar to the reference seeps with values differing by less than an order of magnitude with the exception of manganese and, for one sample, zinc.

Consistent with previous years, seepage from areas impacted by waste rock had increasing trends in ammonia, nitrate and chloride concentrations after the placement of ore on the stockpile due to the re-initiation of mining by TMAC in 2015, and have continuously decreased since 2016 due to the flushing of salts from drilling brines (chloride) and explosives residues (ammonia, nitrate, and nitrite) from the waste rock stockpile. Concentrations of these parameters are below the 2015 source term input values (SRK 2015a).

In terms of metal leaching, concentrations of sulphate, copper and iron were higher than screening criteria and have exhibited increasing trends since 2015 when TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, copper and iron may be attributed to the presence of ore, which has higher sulphide content than waste rock. Iron has exhibited increasing concentrations, but only for samples collected at the toe of the waste rock stockpile and within the berm of the PCP. High iron concentrations in these samples are likely due to iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996). For other waste rock samples, iron concentrations are typically below the source term input values. All waste rock seepage is collected in the PCP and downstream sumps after which it is managed onsite and pumped to the TIA. In 2019, water from the PCP accounted for ~5% of total inflow volumes entering the TIA and ~2% of the total volume stored in the TIA.

Table 6.1: Median Values for Field Conductivity and pH Measurements

Mine Area	Material Source	Site Area	No. of Samples	Conductivity (µS/cm)	pH
				Median	
Reference	-	Reference (Windy Road)	3	-	-
Doris	Waste Rock	WRIA	6	2300	8.1
	Quarry 2	South Dam	1	300	7.9
		Access Road to Doris CPR	2	270	8.0
		MOFB Access Road	13	190	7.7
Madrid	Quarry D	Access Road to Madrid North CWP	11	79	7.5

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 115 - Doris Seepage Monitoring\3. Working File\1CT022.037_2019_Doris-MadridSeep_rev01_jce.xlsx

7 Monitoring on Tailings

7.1 2019 Activities

The geochemical monitoring program for flotation tailings slurry and detoxified tailings includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids (TL-7A), detoxified tailings supernatant (TL-7B) and seepage from underground backfilled stopes (TL-11). Detoxified tailings are referred to as cyanide leach residue in the Water Licence and prior to 2019 TL-7A was monitored as station TL-7. Station TL-7B was added to Water Licence and monitoring commenced in 2019. Details of the 2019 tailings monitoring programs are provided in 9Appendix E.

7.2 Sampling and Testing Program

7.2.1 Process Plant Flotation Tailings Slurry Discharge: Solids (TL-6) and Supernatant (TL-5)

Schedule I of the Water Licence (NWB 2018) specifies weekly sampling of flotation tailings (TL-6) and monthly sampling of the process plant tailings supernatant (TL-5). Samples of the flotation tailings solids (TL-6) and the supernatant solution (TL-5) were collected from the flotation tailings thickener tank. The filtrate from the detox filter press (where detoxified tailings are dewatered) is pumped to the flotation tailings thickener tank prior to discharge to the TIA.

TMAC collects flotation tailings slurry from the tailings thickener tank in a clean 5-gallon bucket. The sample is left in the bucket to allow gravitational settling and separation of the tailings solids from the liquid. After settling, samples of supernatant solution (TL-5) and flotation tailings solids (TL-6) are collected at the frequency outlined above.

The tailings supernatant solution (TL-5) was sampled using a sterile 60 mL syringe and submitted to ALS Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, dissolved and total metals. In total, the 2019 monitoring program included geochemical characterization of 12 monthly samples of tailings process supernatant collected from January to December with a duplicate sample collected in March.

After sampling is completed for the tailings supernatant solution (TL-5), the remaining supernatant is discarded and a clean stainless-steel spoon is used to transfer the solid tailings into a clean plastic Ziploc bag supplied by the laboratory. The bag is then sealed and placed in a fridge until the last weekly sample for the month has been collected. At the end of each month, TMAC combines and homogenizes equal amounts of tailings from each weekly sample to create an approximately 500 g monthly composite sample of flotation tailings solids (TL-6).

In total, the 2019 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample collected in May. Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to Bureau Veritas Laboratory in Burnaby, BC for analysis of:

- Total sulphur – by Leco combustion;
- Sulphate sulphur – by hydrochloric acid leach;
- TIC – carbonate carbon by CO_2 hydrochloric acid leach; and
- Trace element content – by aqua regia digest (nitric and hydrochloric acid) with ICP-MS finish.

7.2.2 Detoxified Tailings Solids (TL-7A) and Filtrate (TL-7B)

In total, the 2019 monitoring program included geochemical characterization of 12 samples of detoxified tailings solids (TL-7A) collected from January to December. One duplicate sample was collected in May. 12 samples of filtrate (TL-7B) from the detoxified tailings were collected from January to December. One duplicate sample was collected in May.

At the end of a detoxification cycle, TMAC collects one discrete sample of detoxified tailings solids (TL-7A) from the discharge compartment of the detoxification circuit filter press. A clean stainless-steel spoon is used to transfer the solid detoxified tailings solids into 125 mL glass sample jars supplied by the laboratory. Samples of the filtrate liquid component are collected from the receiving tank of the detoxification filter press using a 10 foot sampling pole with an open top 1 L poly bottle and then poured into four 500 mL settling bottles to allow gravitational settling and separation of residual tailings solids from the liquid. After settling, the filtrate (TL-7B) is transferred into laboratory supplied sample bottles either using a clean syringe or decanting the supernatant into the sample bottles.

The solids samples are submitted to Bureau Veritas Laboratory for total sulphur by total Leco, sulphate sulphur, TIC and multi-element trace element content by aqua regia digestion followed by ICP-MS finish. ABA methods at Bureau Veritas Laboratory are the same as described for flotation tailings (TL-6).

The filtrate samples (TL-7B) are submitted to ALS Laboratory for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals.

7.2.3 Seepage Survey of Underground Backfilled Stopes (TL-11)

TMAC completed underground seepage inspections of backfilled stopes in May and December 2019. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey, i.e. not all backfill could be inspected. Fifteen locations were surveyed in May and sixteen locations were surveyed in December. Inspection of the backfill materials in the stopes showed that detoxified tailings were only visible on Level 4946 and Level 5002 (TL-11B-27MAY19 and TL-11D-27MAY19); detoxified tailings were not visible in the backfill on the other levels where samples were collected.

No flowing seeps were identified in the May survey; however, TMAC collected samples from pools of water (all stagnant unless otherwise noted) at the base of stopes in the following locations:

- Base of the backfill in the East limb on Level 4932, location E433902, N7559742 (TL-11A-27MAY19). There were no obvious signs of seepage flow from the stope at this location.
- Base of the East limb of the South stope on Level 4946, location E433837, N7559620 (TL-11B-27MAY19). There were no signs of flow from the backfill tailings at this location.
- Base of the West limb on the South stope on Level 4964, location E433786, N7559507 (TL-11C-27MAY19).
- Base of the West limb, North stope on Level 5002, location E433744, N7559239 (TL-11D-27MAY19). This pool was near the Doris Central surface vent raise and there were detoxified tailings visible in the backfill at this location.
- Base of a stope in the East limb on Level 4735, location E433903, N7559726 (TL-11E-27MAY19). At the time of sampling from the pool there was water flowing down into the area from the access ramp.

- Pooled water at base of a stope in the East limb on Level 4905, location E433792, N7559314 (TL-11F-27MAY19). There were no signs of flow from the stope at this location. The area had recently been used as a drill bay.

In December, TMAC collected two seepage samples during the underground survey. One sample from the seep flowing from the bottom of the West limb, North stope at Level 120, location E433718, N7558636 (TL-11A-15DEC19). A field blank and duplicate sample were also collected at this location in the December survey. Another sample was also collected from the seep flowing from the toe of the backfill in the West limb, South stope of Level 134, location E433725, N7558381 (TL-11B-15DEC19).

Seepage samples were collected using a syringe and field measurements of pH, EC, ORP and temperature recorded. Seepage flow rates ranged from 0.022 to 0.044 L/s for TL-11A and TL-11B respectively. TMAC submitted samples to ALS in Burnaby, BC for analysis of pH, EC, TSS, TDS, alkalinity, chloride, sulphate, total and WAD cyanide, and dissolved and total metals. The sample for dissolved metals was filtered and preserved at the time of sampling.

7.3 Results

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

The results of the 2019 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019.
- TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019a) and metallurgical tailings samples (SRK 2015b).
- Trace element content was compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. The following parameters showed enrichment, all other parameters were below the screening criteria indicating no appreciable enrichment:
  - April, June, November and December samples contained elevated arsenic (9 to 170 mg/kg) and was within the range of concentrations for historical samples (except April at 170 ppm).
  - Five samples were elevated in sulphur (3,100 to 5,300 mg/kg for enriched samples).
  - All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg (660 to 3,100 mg/kg).
  - Bismuth was elevated in the sample collected in April (9.4 mg/kg).

The results of the 2019 geochemical monitoring program of detoxified tailings solids (TL-7A) is summarized as follows:

- Sulphur concentrations ranged between 9.6 and 25% in 2019 and were highest between the months of July and December (21 to 25%).
- TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015b).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration in 2018, compared to 15 mg/kg in 2019). All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2019 geochemical monitoring program of detoxified tailings filtrate (TL-7B) is summarized as follows:

- pH conditions ranged from 8.5 to 8.8 s.u.
- Concentrations of sulphate (a by-product of milling of sulphide rich ore) ranged from 12,000 mg/L to 28,000 mg/L.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process.
- Milling of the sulphide rich ore results in high concentrations of total metals, including: arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cadmium (<0.00025 to 0.00059 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L), silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Trends in process plant tailings water discharge (TL-5) are summarized as follows:

- pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u.
- Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019.
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018. Exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited

increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

The results of the opportunistic seepage sampling from underground backfilled stopes (TL-11) is summarized as follows:

- Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill with the results summarized as follows:
  - pH is slightly alkaline with both seeps reporting a pH of 8.0.
  - Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).
  - Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
  - Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015b). The exception to this was zinc, which reported elevated concentrations (0.026 to 0.096 mg/L) in the survey but was not noted as a parameter of potential concern in the HCT program.
- No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

8 Conclusions

8.1 Doris Waste Rock

Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T, all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from the surface waste rock stockpile was placed as backfill in the Doris Crown Pillar and stopes of the Doris mine.

TMAC collected 19 underground waste rock samples with the samples geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high, ranging from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. The one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP. Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment. SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

Mining of the CPR between November and December 2018 resulted in the production of and placement of 263,500 t of waste rock on Pad T. Of this amount, 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T, of which 190,000 t will be placed as backfill in the CPR and 22,500 t will be placed as backfill in stopes of the underground mine. Another 51,000 t of material was placed in its own stockpile on the western expansion of Pad T; this material will be placed as capping material on the CPR. None of the CPR waste rock was placed as backfill in 2018.

Twenty-four CPR samples were collected representing CPR waste rock from the stockpile on west end of Pad T. For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment. SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock. All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%.

8.2 Madrid North Waste Rock

Data interpretation for the geochemical and geological monitoring of Madrid North waste rock is in progress and will be provided as a supplementary submission.

8.3 Quarry and Construction Rock

Geological inspections of active Quarry 2 and Quarry D faces indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Geochemical characterization of Quarry 2 and Quarry D run-of-quarry rock indicated that all of the samples were non-PAG with low risk for ML/ARD with the exception of the argillite seam sample from Quarry 2 which was classified as having uncertain potential for ARD. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

Geological inspection of as-built construction areas confirmed that construction materials were characteristic of Quarry 2 for the Doris mine area and Quarry D for Madrid North. All samples were classified as non-PAG on the basis of both TIC/AP and NP/AP. Four samples from Doris were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

The results indicate that the quarry rock used in the infrastructure areas was geochemically suitable for use as construction rock and the risk for ML/ARD is low.

8.4 Infrastructure and Waste Rock Seepage Monitoring

The scope of the 2019 Hope Bay seepage monitoring survey included infrastructure constructed between fall 2018 and spring 2019 at Doris and Madrid North, three reference stations and areas downstream of the Doris waste rock stockpiles. There were no stockpiles of waste rock from Madrid North (Naartok East CPR) at the time of the survey.

Concentrations for reference area seeps were consistent and stable with the historical data record.

Infrastructure surveyed at Doris included the TIA south dam, MOFB access road at Robert's Bay, access road to the Doris Central vent raise, access road to the Doris CPR and Doris CPR cover. Construction rock at Doris was sourced from Quarry 2 except for the Doris CPR cover, which was constructed primarily of Doris waste rock and some quarry rock. Infrastructure surveyed at Madrid North included the access road to Naartok East CPR, overburden pad berm, Madrid North CWP, and access road to the Madrid North CWP. Construction rock at Madrid was sourced from Quarry D. Seepage was observed and samples collected representing construction rock from all aforementioned areas except the Doris CPR cover. The results of the 2019 seepage sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay.

Seepage from areas impacted by waste rock had concentrations of sulphate, copper and cobalt that have exhibited increasing trends since TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile in 2015. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, cobalt, and copper may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of iron for the 2019 waste rock seepage samples were increasing for samples collected from the berm of the PCP; however, this was attributed to the presence of particulate material less than 0.45 µm that are not truly dissolved species. Chloride, nitrate and ammonia levels increased after ore was placed on the stockpile but have since continuously decreased in relation to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock. All waste rock seepage is intercepted, managed and pumped to the TIA.

The waste rock seepage monitoring was initiated in 2012. An assessment of the waste rock seepage monitoring record for sulphate, copper, iron, chloride, ammonia and nitrate indicated that overall, monitoring data approximates the Doris waste rock source term inputs for the 2015 water and load balance (SRK 2015a). Continued monitoring will establish trends in parameter concentrations.

SRK recommends that the 2020 seepage survey include infrastructure areas monitored in 2019, including sites where seepage was not observed at Doris (CPR cover, access road to vent raise) and Madrid North (Madrid North CWP, overburden pad berm, access road to Naartok East CPR).

8.5 Monitoring on Tailings

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

For process plant tailings water discharge (TL-5), pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u. Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019. Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018; exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

For flotation tailings solids (TL-6), sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019. TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019a) and metallurgical tailings samples (SRK 2015b). Trace element content was elevated compared to screening criteria for arsenic, sulphur and gold. Bismuth was also elevated in one sample. All other parameters were below the screening criteria indicating no appreciable enrichment.

For detoxified tailings solids (TL-7A), total sulphur concentrations ranged between 9.6 and 25% in 2019 and were highest between the months of July and December (21 to 25%). TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015b). All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration) in 2018 than 2019 (15 mg/kg median concentration). All other parameters were below the screening criteria indicating no appreciable enrichment.

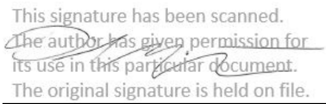
For detoxified tailings filtrate (TL-7B), pH ranged from 8.5 to 8.8 s.u. Concentrations of sulphate ranged from 12,000 mg/L to 28,000 mg/L. Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively. Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process. Milling of the sulphide rich ore results in high concentrations of total metals, including arsenic, antimony, cadmium, cobalt, copper, iron, manganese, molybdenum, nickel, selenium, and silver.

For underground backfilled stopes (TL-11), seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill. The pH is slightly alkaline with both seeps reporting a pH of 8.0. Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium). Levels of ammonia, nitrate and nitrite were lower than the 5th percentile concentrations from the historical sample set.

No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

This report, 2019 Waste Rock, Quarry and Tailings Monitoring Report, was prepared by

SRK Consulting (Canada) Inc.



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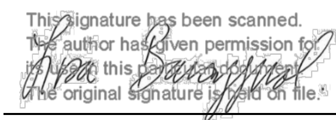

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Appendix A – 2019 Geochemical Monitoring of Waste Rock, Doris Mine

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter Lisa Barazzuol	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 17, 2020
Subject:	2019 Geochemical Monitoring of Waste Rock, Doris Mine		

1 Introduction

In April 2015, TMAC re-initiated underground mining at Doris, with placement of waste rock on surface commencing in October 2015. Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T (Table 1-1, Figure 1-1), all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from surface waste rock stockpiles on Pad T was placed as backfill in the Doris Crown Pillar and in stopes of the Doris mine.

Table 1-1: Summary of 2019 Waste Rock Placement Locations and Volume

Doris Mine	Source Location	Placement Location	Volume (t)	Total (t)
Underground	Underground	Backfill in Stopes	265,000	430,000
		Pad T	165,000	
	Pad T	Backfill in Stopes	90,000	230,000
		Backfill in CPR	140,000	
CPR	Pad T	Backfill and cover* of CPR	38,000	51,000
		Underground waste rock stockpile	13,000	

Notes:

*Deemed to be suitable for construction as per TMAC (2019)

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (SRK 2019) to assess if the waste rock was geochemically suitable for use as construction rock. CPR waste rock is considered potential construction material because the mining practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and/or ammonia (related to blasting residues).

This memo documents the geochemical monitoring of waste rock in 2019, which included the following programs (parenthesis indicates the relevant report section):

- Geochemical monitoring of underground waste rock executed by TMAC between January and April 2019 according to the requirements of the waste rock management plan outlined in TMAC (2016) (Section 3.1).
- Geochemical monitoring of underground waste rock executed by SRK according to the requirements of the waste rock management plan outlined in TMAC (2019) (Section 3.2).
- Geochemical monitoring of the CPR stockpile on Pad T to confirm the geochemical suitability of the waste rock as construction rock (Section 3.3). In 2019, waste rock from the CPR stockpile was placed as the cover for backfill in the CPR.

Other monitoring activities in the Doris mine area related to waste rock included an annual seep survey along the downgradient toe of the waste rock and ore stockpile area, routine monitoring of the Pollution Collection Pond (PCP) and as-built geochemical monitoring of waste rock used as construction rock, including a seepage survey. The results of the seepage surveys and monitoring of construction rock are reported in the accompanying memos (SRK 2020a and SRK 2020b), while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the NWB.

Figure 1-1: Waste Rock Stockpile on Pad T, Doris (looking south, July 31, 2019)

2 Methods

2.1 Geological Inspections

2.1.1 Underground Mine Inspections According to TMAC (2016)

Protocols for geological inspections are documented in TMAC (2016). To summarize, geological inspections were conducted by TMAC site geologists when monitoring samples were collected between January and April 2019. Where possible, both the working face and the blasted rock (muck) pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs (Attachment A).

2.1.2 Waste Rock Inspections According to TMAC (2019)

Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019) defines two types of waste rock inspections: underground at the blast face by TMAC geologists, with internal record keeping and of the surface stockpile. This report documents the latter inspection, as required by TMAC (2019).

In August 2019, SRK geochemist Derrick Midwinter, PGeo completed a geological inspection of waste rock placed on Pad T between August 2018 and July 2019. The objective of the inspection was to determine the geological composition of waste rock, to examine for signs of sulphide oxidation and weathering and to collect samples for geochemical characterization of waste rock for comparison with baseline geochemical characterization (Section 3.1.3, Table 3.1; TMAC 2019). TMAC identified the inspection area as the upper lift of waste rock. SRK's inspection was limited to the interior of the upper bench of the waste rock stockpile on Pad T due to safety and accessibility.

The inspection was carried out by walking over the stockpiles and along the perimeter of the upper bench, examining rock types and the presence of sulphide and carbonate content (Attachment A).

2.1.3 Waste Rock from Crown Pillar Recovery

TMAC completed mining of the Doris CPR in 2018; therefore, there was no waste rock to inspect in 2019.

2.2 Sample Collection and Geochemical Test Work Program

2.2.1 Program According to TMAC (2016)

TMAC site geologists collected a total of 19 run-of-mine (ROM) waste rock samples (blasted rock or muck) from the underground mine between January and April for geochemical characterization (Attachment A). Samples of muck were composited over an individual blast round, typically representing 70 to 95 m^3 of rock. In all cases, samples consisted of a representative mixture of fine and coarse rock fragments from the blasted rock pile. Samples were analyzed for total sulphur (S) and total inorganic carbon (TIC) with a subset also analyzed for paste pH, Modified

NP and trace elemental content (Table 2-1). Ore is considered to be mineralized by definition, and therefore geochemical testing was not required.

Samples collected by TMAC from January to April 2019 were shipped to Bureau Veritas Laboratories (BV) in Burnaby, BC. Analytical instructions were provided by TMAC with review of the analytical parameter selection by SRK.

Table 2-1: Underground Waste Rock Monitoring Samples Collected and Associated Test Program

Rock Type[1]	Sulphur & TIC	Full ABA & Elemental Analysis
1a	16	3
1as	3	2
Total Number of Tests	19	5

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Notes:

[1]1a = mafic metavolcanic, 1as = altered mafic metavolcanics

2.2.2 Waste Rock Collected from Stockpile on Pad T

In order to comply with the Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019), SRK collected samples of waste rock that was placed on the stockpile since the previous inspection (August 2018). SRK collected 10 samples (Table 2-2) with sample distribution according to the rock types visually identified by SRK during the stockpile inspection (Section 2.1.2) and also the proportion of rock types that were intersected by mining, as provided by TMAC geologists.

Each sample consisted of a sieved coarse fraction (screened to -1 cm) for ABA and total metals, and a finer fraction (screened to -2 mm) for rinse tests and shake flask extraction tests. SRK visually described the samples, including rock type, sulphide (quantity, type and habit) and carbonates (quantity, type and fizz test with 10% HCl). Rinse tests involved mixing a 1 to 1 ratio of distilled water and solids and measuring the resulting pH and electrical conductivity (EC).

SRK shipped samples to BV in Burnaby, BC for sample preparation and analysis of ABA (Section 2.3). Three samples were selected by SRK for shake flask extraction (SFE) testing based upon the high values of rinse EC. One field duplicate was collected for QAQC purposes (see Section 2.4 for more detail).

Table 2-2: Pad T Waste Rock Monitoring Samples Collected and Associated Test Program

Rock Type[1]	ABA & Elemental Analysis	SFE	Rinse Test (pH and EC)
1a	4	0	4
1as	5	3	5
12q	1	0	1
Total Number of Tests	10	3	10

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Note:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz veins

2.2.3 Waste Rock from Crown Pillar Recovery

In 2018, waste rock from the Doris CPR was placed in a separate stockpile from waste rock source from the underground with the objective of using CPR waste rock for construction, as required (Figure 2-1). In 2019, TMAC collected an additional 24 samples from the CPR waste rock stockpile to supplement the six samples collected in 2018 (SRK 2019) with the objective of demonstrating the suitability of using CPR waste rock as construction rock. Samples were collected from the stockpile in winter. Samples were selected based on spatial representation of the stockpile because snow cover on the stockpile precluded a geological inspection. Based on operational monitoring records of waste rock geology (SRK 2019) the sampling program included all waste rock types intersected during mining of the Doris CPR. Samples were sieved to -1 cm size fraction prior to being sent to the laboratory.

TMAC geologists collected and geologically described the 24 samples from the CPR waste rock stockpile representing a sampling density of one sample per 1,600 t of waste rock (Table 1-1). The sampling and test work program design was according to the program requirements documented in TMAC (2019) to demonstrate the suitability of waste rock as construction rock. Sample locations were randomly distributed across the area of the stockpile and an excavator used to disturb frozen areas of the stockpile to allow sample collection.

TMAC visually described the samples (Attachment A) including rock type, sulphide (quantity, type and habit) and carbonates (quantity, type and fizz test with 10% HCl) and sieved samples to -1 cm size fraction for ABA and trace metals and -2 mm for SFE tests and rinse tests. TMAC shipped 24 samples to BV for ABA, elemental analysis and SFE tests on a subset of samples (Table 2-3). Analytical instructions were provided by TMAC with review of sample preparation and analytical methods by SRK.

Table 2-3: Doris CPR Waste Rock Samples Collected to Demonstrate Suitability as Construction Rock

Source Area	Rock Type[1]	ABA & Elemental Analysis	SFE	Rinse
CPR Stockpile	1a	14	6	6
	1as	10	4	4
	Total Number of Tests	24	10	10

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Note:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

Figure 2-1: 2018 Map of CPR Waste Rock Stockpile

2.3 Analytical Methods

The geochemical analytical methods for waste rock samples are summarized as follows:

- Total sulphur by Leco;
- Sulphate by HCl leach;
- TIC by Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample;
- Modified Sobek NP (MEND 1991);
- Elemental analysis was determined by aqua regia digestion followed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analyses. This included determination of 9 major elements (e.g., aluminium, calcium, magnesium, sodium, potassium, iron, sulphur) and 26 trace elements (e.g., arsenic, zinc, copper, cadmium, lead).

- SFE tests, on the -2 mm size fraction, using a 3:1 solution to solid ratio and a 24 hour shaking period (MEND 2009). SFE leachates were analyzed for pH, EC, total dissolved solids (TDS), SO_4, alkalinity, acidity, chloride, ammonia, NO_3, NO_2 and element analysis by ICP-MS (including Hg).

2.4 Quality Assurance and Quality Control

All results, including BV's internal QA/QC program, were reviewed by SRK for quality assurance. Table 2-4 presents a summary of the QA/QC checks for the waste rock samples collected from the underground mine and CPR by TMAC and from Pad T by SRK, including the assessment of duplicate and blank samples and standard reference materials. SRK determined all data to be acceptable.

Table 2-4: Summary of QA/QC Results

QC Test	SRK QC Criteria	Results	
paste pH			
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=6)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2)	All Passed
Total C and TIC			
Method Blank	<2X detection limit (DL)	(n=3) for TIC	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4) for TIC	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for TIC	All Passed
Total S & Total Sulphate			
Method Blank	<2X detection limit (DL)	(n=3) for Total S and (n=3) for SO_4	All Passed
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within +/-20%	(n=40)	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1) for total S and (n=1) for SO_4	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for Total S and (n=6) for SO_4	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for Total S and (n=2) for SO_4	All Passed
Modified NP			
Method Blank (n=0)	<2X detection limit (DL)	(n=3) for NP	All Passed
NP consistent with paste pH	Negative NP has paste pH <= 5	(n=40)	All Passed
Field Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=1) for NP and (n=1) for Fizz Rating	All Passed
Pulp Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=6) for NP and (n=6) for Fizz Rating	All Passed
Fizz test rating with NP	Max NP does not exceed fizz test rating	(n=40)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=3) for NP	All Passed
Modified NP and TIC			
Comparison between Modified NP and TIC	Check for trends/co-relation	(n=40)	TIC generally higher than NP

QC Test	SRK QC Criteria	Results	
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n=40)	R828409 failed. Both S-Leco and S-ICP re-run and results confirmed. Data accepted.
Trace Elements (Aqua Regia Digestion with ICP Finish)			
Method Blank	<2X Detection Limit	(n=3)	All Passed
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=1)	All Passed
Pulp Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=3)	All Passed
Standard Reference Material	Within +/-15 % Difference	(n=6)	All Passed
MEND SFE			
Method Blank	<5x Detection Limit	(n=2)	All Passed
Pulp Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, ok 10% of metal scan failing.	(n=4)	All Passed
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=13)	SRK19-WR-01 failed due to low cations. Sample was rerun and results confirmed. Data accepted.
Standard Reference Material	Within specified tolerance ranges.	(n=2) for SO_4 and Total Alkalinity, (n=1) for the rest of the parameters	All Passed
Rinse pH			
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=4)	All Passed
Rinse pH vs. SFE pH	For any samples, +/- 0.5 difference pH unit	(n=3)	All Passed
Rinse EC			
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4)	All Passed
Rinse EC vs. SFE EC	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=3)	Rinse EC higher than SFE EC due to differences in solid to solution ratios.

QC Test	SRK QC Criteria	Results	
Rinse Test for Cl and Total Ammonia			
Method Blank	<5x Detection Limit	(n=1) for Cl	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=0)	#N/A
Standard Reference Material	Within specified tolerance ranges.	(n=1) for Cl	All Passed
Chloride			
Method Blank	<5X Detection Limit	(n=3)	All Passed
Matrix Spike	Within specified tolerance ranges.	(n=3)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2)	All Passed
Total Ammonia			
Method Blank	<5X Detection Limit	(n=3)	All Passed
Matrix Spike	Within specified tolerance ranges.	(n=3)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2)	All Passed

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2.5 Data Interpretation Methods

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample. On the basis of sulphide (calculated as the difference between total sulphur and sulphate) and total sulphur content being at near parity, total sulphur was used to calculate AP. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when TIC/AP ratios are less than 1 and as having an uncertain potential for ARD when TIC/AP ratios are between 1 and 3. For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

3 Results and Discussion

3.1 Waste Rock from the Underground Mine

3.1.1 Geological Inspection

A summary of the samples collected are provided in Table 3-1 and include primarily mafic volcanics (1a) with fewer altered mafic volcanics (1as). Visual sulphide content typically ranged from none to <1%, with 1 to 2% observed in altered basalt. All waste rock from the underground mine placed on Pad T was classified as mineralized.

Based on routine underground geological mapping by TMAC, waste rock intersected by the Doris underground workings between January and December 2019, waste rock was primarily (95%) mafic metavolcanic flow (1a); and lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, with rare (1%) diabase or felsic dykes.

3.1.2 ABA

ABA data are presented in Table 3-1 with complete results presented in Attachment B.

Mafic Metavolcanics (1a)

The paste pH of mafic metavolcanics (1a) ranged from 8.4 to 8.9.

Sulphur concentrations were uniformly low with a median value of 0.12% and a range of 0.02 and 0.33%, respectively. Sulphate content was below or near the limit of detection (0.01%).

TIC content ranged from 110 to 350 kg $CaCO_3$ eq/tonne with median levels of 230 kg $CaCO_3$ eq/tonne. Modified NP ranged from 140 to 170 kg $CaCO_3$ eq/tonne. For the three samples with full ABA, Modified NP was less than TIC (Figure 3-1), which results in TIC values that overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-2 and Figure 3-3).

Altered Mafic Volcanics (1as)

The paste pH of altered mafic metavolcanics (1as) ranged from 9.2 to 9.3.

Sulphur concentrations ranged from 0.12 to 1.1%. Sulphate was near the level of analytical detection (0.01%).

TIC and Modified NP content ranged from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. Modified NP was less than TIC (Figure 3-1), which results in TIC values that overestimate the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-2 and Figure 3-3).

Table 3-1: Statistical Summary of ABA Analyses for Underground Waste Rock Samples

Rock Type[1]	Statistic	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t		
1a	P000	8.4	110	0.02	0.01	0.6	140	25	24
	P025	8.4	190	0.10	0.01	3.0	150	42	26
	P050	8.4	230	0.12	0.02	3.8	160	54	28
	P075	8.7	310	0.17	0.02	5.4	160	71	30
	P100	8.9	350	0.33	0.02	10	170	500	32
	Count	3	16	16	4	16	3	16	3
1as	P000	9.2	190	0.12	0.01	3.8	140	9.2	4.2
	P025	9.2	250	0.17	0.01	5.2	140	29	8.9
	P050	9.2	310	0.21	0.01	6.6	150	49	13
	P075	9.2	310	0.64	0.01	20	150	49	18
	P100	9.3	320	1.1	0.01	33	150	50	23
	Count	2	3	3	1	3	2	3	2

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Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

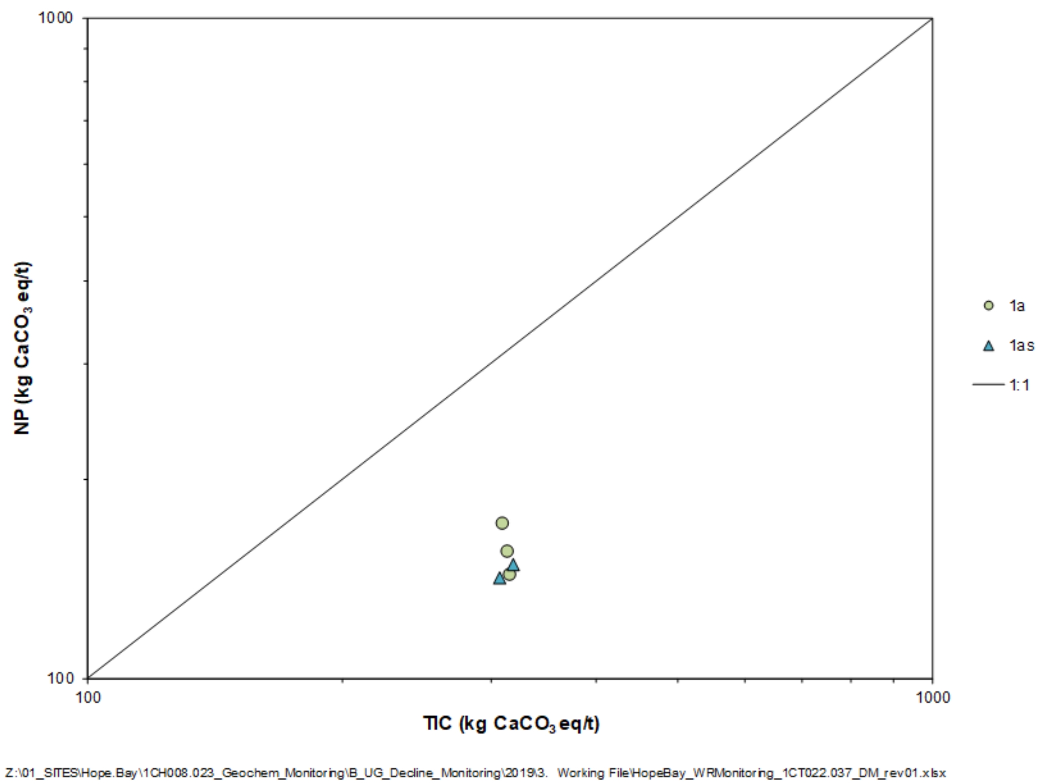

Figure 3-1: Modified NP versus TIC, Underground Waste Rock Samples

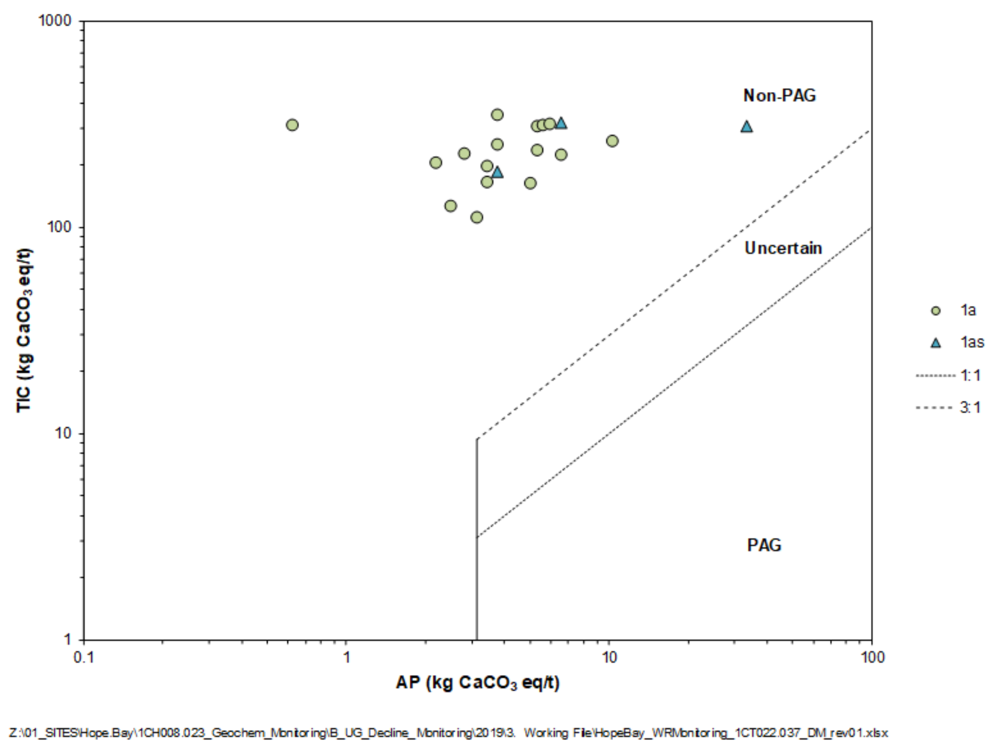

Figure 3-2: ARD Classifications based on TIC versus AP, Underground Waste Rock Samples

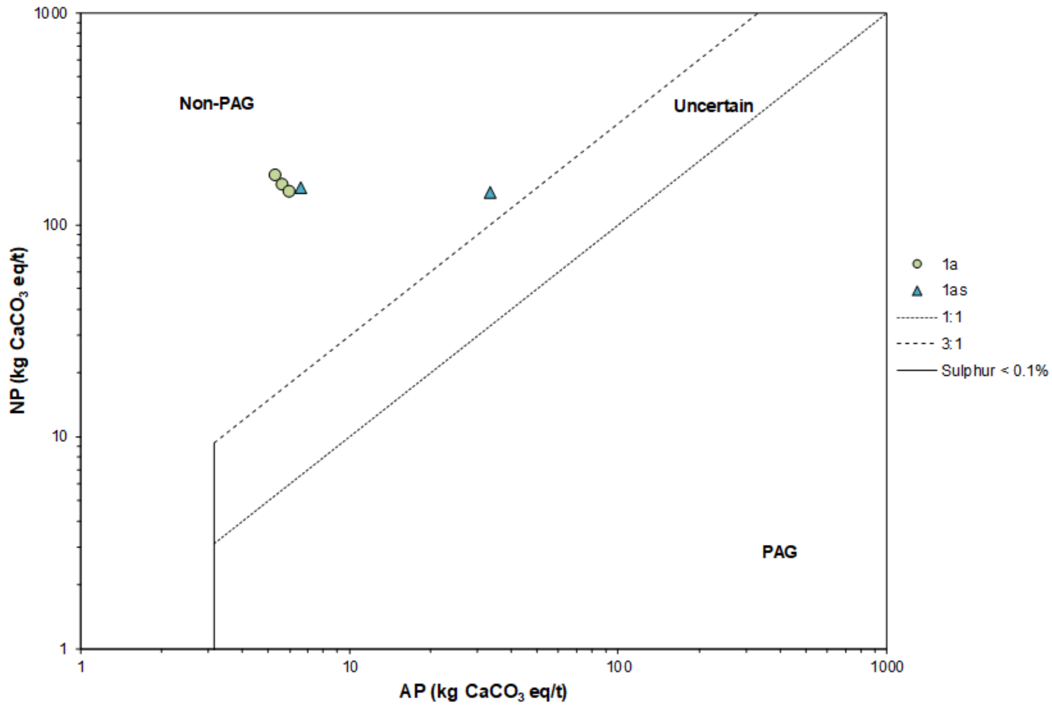

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Figure 3-3: ARD Classifications based on NP versus AP, Underground Waste Rock Samples

3.1.3 Trace Elemental Analyses

Trace element data for metavolcanics (1a) and mafic metavolcanics (1as) samples are summarized in Table 3-2 with complete results presented in Attachment C. Results were compared to ten times the average crustal abundance (CA) for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

One sample of altered mafic metavolcanics (1as; Y041493) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% visual sulphides. Concentrations for all other samples and parameters were less than ten times the average CA for basalt indicating no appreciable enrichment. This includes samples Y041497 (mafic metavolcanics) and W573598 (altered mafic metavolcanics), which were described as mineralized with 1% visual sulphides (Attachment A).

Table 3-2: Statistical Summary of Elemental Analyses for Underground Waste Rock Samples

Parameter	Detection Limit	Unit	Mafic metavolcanics (1a)			Altered Mafic metavolcanics (1as)		10x Average Crustal Abundance* for Basalt
			Y041490	W573599	Y041497	W573598	Y041493	
Ag	0.1	ppm	0.1	0.1	0.1	0.1	0.1	1.1
As	0.1	ppm	12	2.5	3.1	17	**<u>59</u>**	20
Ba	0.5	ppm	12	7	10	11	10	3300
Ca	0.01	%	6.0	7.6	5.3	5.8	5.9	76
Cd	0.1	ppm	0.1	0.2	0.1	0.1	0.1	2.2
Co	0.1	ppm	24	26	26	26	28	480
Cr	0.5	ppm	14	11	11	12	10	1700
Cu	0.1	ppm	24	26	37	28	24	870
Fe	0.01	%	9.9	9.4	9.8	9.7	10	87
Hg	0.01	ppm	0.01	0.01	0.01	0.01	0.01	0.09
Mg	0.01	%	1.5	1.6	1.5	1.5	1.4	46
Mn	1	ppm	2300	2300	2000	2200	2230	15000
Mo	0.01	ppm	0.1	0.2	0.4	0.2	0.1	15
Ni	0.1	ppm	1.3	1.8	1.1	2.9	1.1	1300
P	0.001	%	0.080	0.080	0.088	0.089	0.084	1
Pb	0.01	ppm	1	1.1	1.3	0.9	1.4	60
S	0.05	%	0.19	0.15	0.16	0.17	**<u>0.97</u>**	0.3
Sb	0.1	ppm	0.1	0.1	0.1	0.1	0.1	2
Sr	1	ppm	68	41	44	40	44	4650
U	0.1	ppm	0.1	0.1	0.1	0.1	0.1	10
V	2	ppm	18	27	12	12	10	2500
W	0.1	ppm	0.1	0.1	0.1	0.1	0.1	7
Zn	0.1	ppm	100	110	110	88	87	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

* Numbers bolded and underlined exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

3.2 Waste Rock from Pad T Stockpile

3.2.1 Geological Inspection

Based on routine underground geological mapping by TMAC, waste rock intersected by the Doris underground workings between January and June 2019 was geologically described as 97% mafic volcanics, 2% quartz veins and 1% diabase.

SRK inspected waste rock located on the upper bench of Pad T (Figure 1-1). The upper lift of the waste rock stockpile of Pad T was a mixture of approximately 40% dark green mafic metavolcanics (1a, Figure 3-4), 50% light brown foliated altered mafic metavolcanics (1as, Figure 3-5) and 10% massive blocky quartz veins (12q, Figure 3-6). Diabase was not observed. This could be because it was not visible, or diabase was placed directly as backfill in the underground and not brought to surface.

Both rock types, mafic metavolcanics (1a) and altered mafic metavolcanics (1as), had quartz and calcite veinlets (up to several cm thick) with rare occurrences of very-fine grained disseminated cubic pyrite (≤1%), and variable hematite staining. The altered mafic metavolcanics were less competent than the dark green mafic metavolcanics which occurred as boulders of variable size. Fizz test was strong for mafic metavolcanics (1a) and moderate to strong for altered mafic metavolcanics (1as). The quartz veins (12q) were associated with greater very-fine grained disseminated cubic pyrite content (5%) than the mafic metavolcanics. The fizz test was moderate for quartz (12q).

Figure 3-4: Dark Green Mafic Metavolcanics (1a) with Quartz Veining (SRK19-WR03)

Figure 3-5: Light Brown Altered Mafic Metavolcanics (1as), Note Calcite Vein on Fresh Face Near Hammer (SRK19-WR04)

Figure 3-6: Quartz Vein (12q) Waste Rock Pile (SRK19-WR06)

3.2.2 Rinse Tests

Rinse tests on the sieved -2 mm fraction indicated pH and EC values ranging from 7.9 to 8.4 s.u. and 2,700 to 7,300 µS/cm, respectively (Table 3-3).

Table 3-3: Rinse Test Results, Pad T Waste Rock

Rock Type	Sample ID	Rinse pH	Rinse EC
		s.u.	µS/cm
1a	SRK19-WR-03	8.4	2800
	SRK19-WR-05	7.9	6000
	SRK19-WR-07	8.3	5500
	SRK19-WR-10	8.4	2700
1as	SRK19-WR-01	7.8	6100
	SRK19-WR-02	8.2	5300
	SRK19-WR-04	7.9	6400
	SRK19-WR-08	8.1	3700
	SRK19-WR-09	8.0	7300
12q	SRK19-WR-06	8.3	5600

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Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz vein

3.2.3 ABA

A summary of ABA data are presented in Table 3-4 and Figure 3-7 to Figure 3-10. Full results are presented in Attachment D.

Values of paste pH for all rock types ranged from 7.8 to 8.4.

Overall, total sulphur content for all samples was less than 1%, with highest concentration measured in the quartz (12q; 0.98%) which was higher than altered mafic metavolcanics (1as; median of 0.24%) followed by mafic metavolcanics (1a; median of 0.16%). Sulphate content was below or near the level of analytical detection (0.01%). Sulphide sulphur, calculated as the difference between total sulphur and sulphate, was at near parity with total sulphur (Figure 3-7).

Modified NP and TIC did not vary between rock types with values ranging from 150 to 190 kg $CaCO_3$ eq/tonne and 180 to 300 kg $CaCO_3$ eq/tonne, respectively. TIC content was greater than NP for all rock types (Figure 3-8), suggesting that TIC values overestimate the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-9 and Figure 3-10).

Table 3-4: Statistical Summary of ABA Analyses for Pad T Waste Rock Samples

Rock Type	Statistic	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-
1a	P000	7.9	200	0.12	0.01	3.8	150	30	20
	P025	8.1	230	0.12	0.03	3.8	160	39	26
	P050	8.2	250	0.16	0.04	5.0	160	48	34
	P075	8.3	270	0.21	0.05	6.6	170	60	41
	P100	8.4	290	0.25	0.06	7.8	170	78	43
	Count	4	4	4	4	4	4	4	4
1as	P000	7.8	180	0.19	0.01	0.01	150	10	5.7
	P025	7.9	270	0.20	0.01	0.01	150	19	12
	P050	8.1	270	0.24	0.01	0.01	170	28	24
	P075	8.1	290	0.51	0.01	0.01	180	35	25
	P100	8.3	300	0.83	0.07	0.07	190	49	27
	Count	5	5	5	5	5	5	5	5
12q (n=1)	-	8.2	220	0.98	0.04	0.01	160	7.2	5.3

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

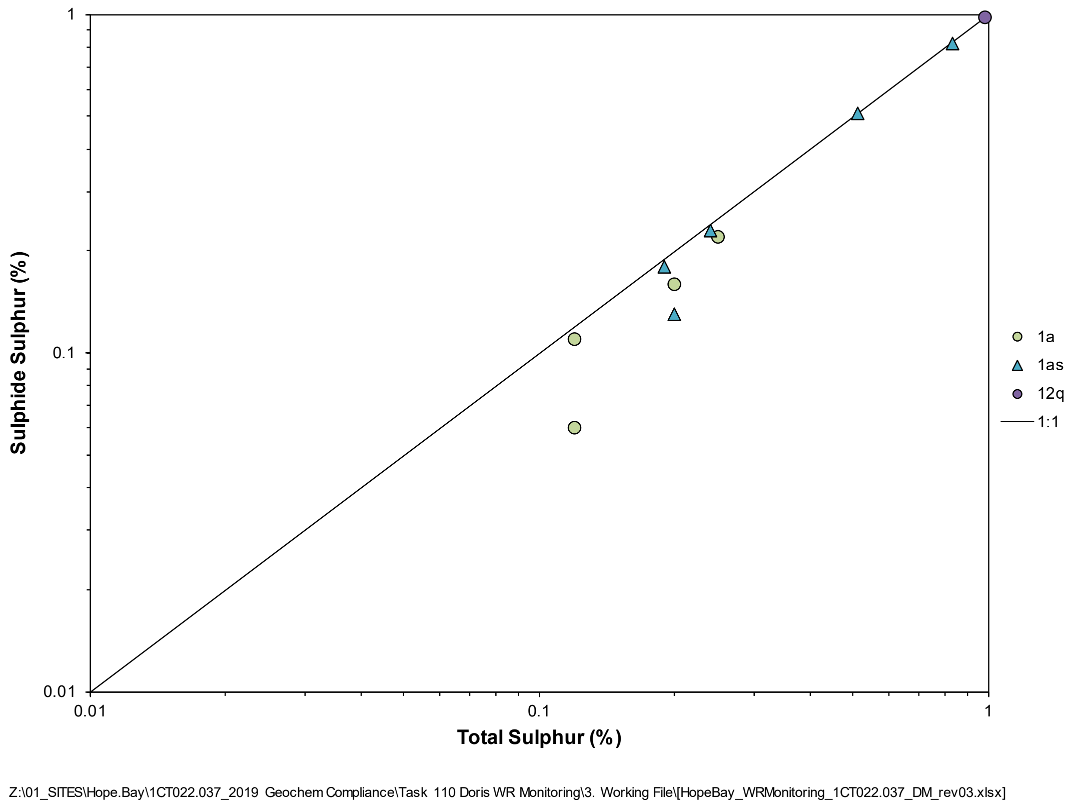

Figure 3-7: Comparison of Total Sulphur versus Sulphide, Pad T Waste Rock

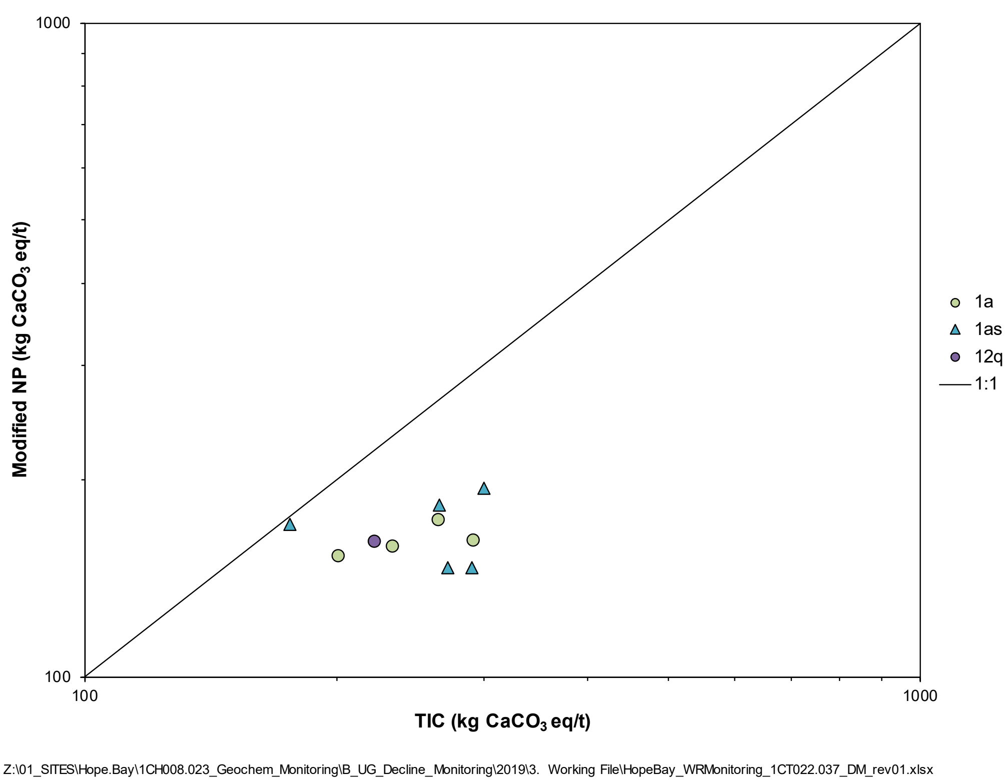

Figure 3-8: Comparison of Modified NP versus TIC, Pad T Waste Rock

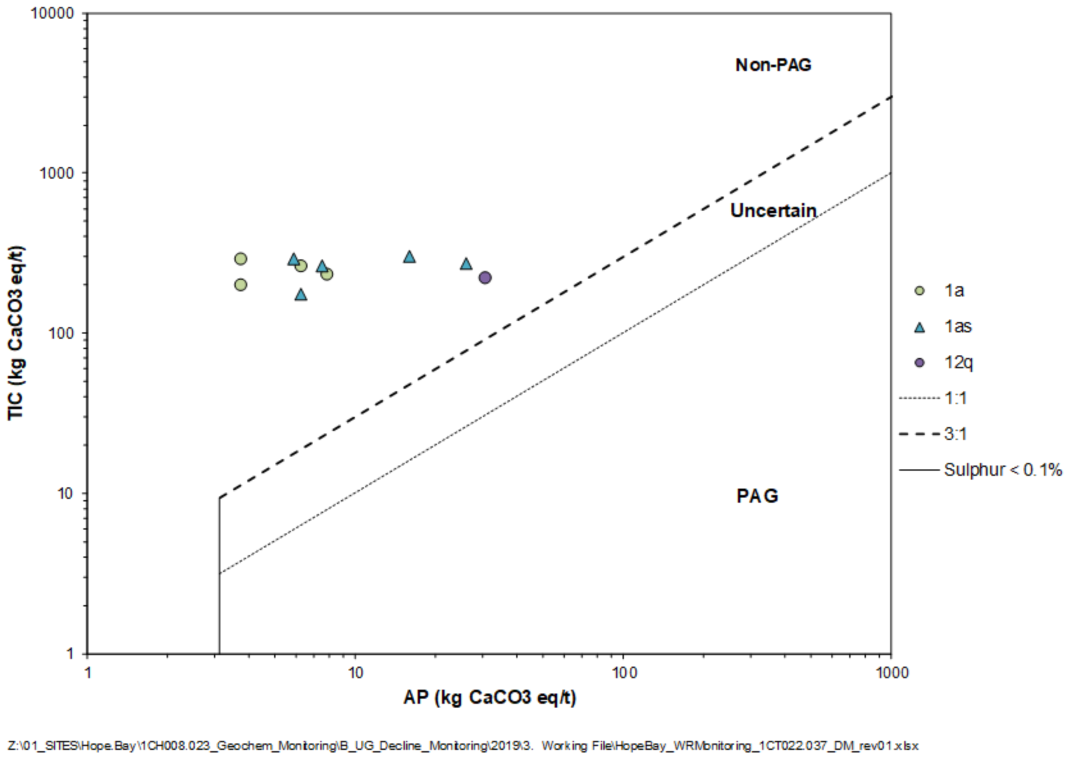

Figure 3-9: ARD Classifications by TIC/AP, Pad T Waste Rock

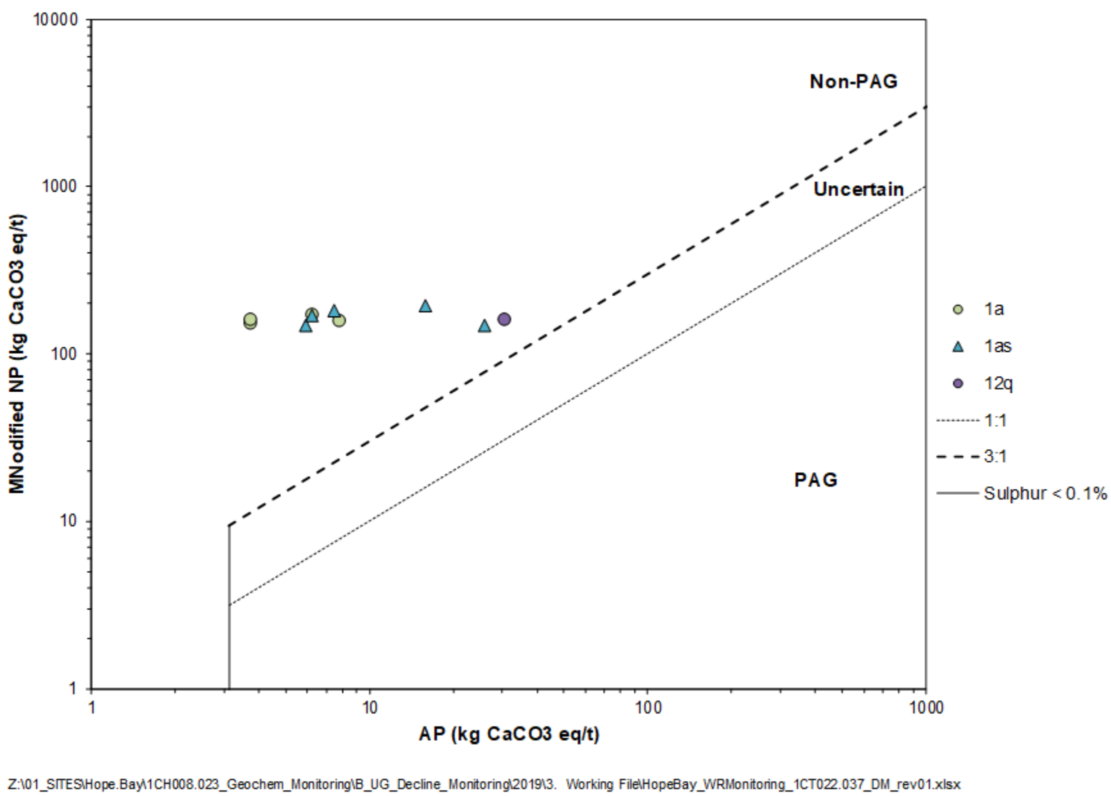

Figure 3-10: ARD Classifications by NP/AP, Pad T Waste Rock

3.2.4 Trace Elemental Analyses

A statistical summary of trace element content is presented in Table 3-5 with complete laboratory results presented in Attachment E. Table 3-5 presents the data as the median and maximum values by rock type. Results were compared to ten times average CA for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

Arsenic and sulphur were enriched compared to the average CA of basalt. Five samples were enriched in arsenic: one sample each of mafic metavolcanics (1a) and quartz (12q) and three samples of altered mafic metavolcanics (1as). Sulphur was enriched in three samples, two of which were altered mafic metavolcanics (1as) and one of quartz (12q).

Table 3-5: Summary of Elemental Analyses for Pad T Waste Rock

Parameter	Unit	Detection Limit	1a (n=5)[1]		1as (n=4)[1]		12q (n=1)[1]	10x Average Crustal Abundance* for Basalt
			P50	P100	P50	P100	-	
Ag	ppm	0.1	0.1	0.2	0.1	0.5	0.5	1.1
As	ppm	0.1	7.4	**<u>20</u>**	**<u>24</u>**	**<u>48</u>**	**<u>85</u>**	20
Ba	ppm	0.5	9.0	11	11	13	5.0	3300
Ca	%	0.01	6.1	6.5	6.1	7.6	5.0	76
Cd	ppm	0.1	0.1	0.2	0.2	0.3	0.2	2.2
Co	ppm	0.1	28	42	31	40	23	480
Cr	ppm	0.5	19	38	22	31	49	1700
Cu	ppm	0.1	45	229	70	84	45	870
Fe	%	0.01	8.4	9.3	7.9	9.8	3.6	87
Hg	ppm	0.01	0.01	0.01	0.01	0.01	0.01	900
Mg	%	0.01	1.4	2.3	1.5	2.1	1.6	46
Mn	ppm	1	1900	2100	1800	2000	850	15000
Mo	ppm	0.01	0.4	0.5	0.4	0.7	0.3	15
Ni	ppm	0.1	7.6	40	20	45	57	1300
P	%	0.001	0.076	0.11	0.069	0.085	0.054	1
Pb	ppm	0.01	4.3	5.7	4.2	8.4	5.4	60
S	%	0.05	0.14	0.24	0.21	**<u>0.72</u>**	**<u>0.98</u>**	0.3
Sb	ppm	0.1	0.1	0.2	0.1	0.2	0.2	2
Sr	ppm	1	34	41	37	44	34	4650
U	ppm	0.1	0.1	0.1	0.1	0.1	0.1	10
V	ppm	2	39	150	39	220	10	2500
W	ppm	0.1	0.1	0.1	0.1	1.4	0.2	7
Zn	ppm	0.1	110	110	95	130	28	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Note:

* Numbers bolded and underlined exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

3.2.5 SFE Tests

A summary of results for key SFE parameters is presented in Table 3-6 and complete results are included in Attachment F.

All SFE tests had alkaline pH ranging from 8.1 to 8.3. s.u. Values of EC ranged from 2,300 to 2,400 µS/cm.

Major cation chemistry was dominated by sodium (110 to 250 mg/L) and calcium (71 to 140 mg/L), while major anion chemistry was dominated by alkalinity (30 to 73 mg/L as $CaCO_3$), chloride (180 to 490 mg/L), nitrate (140 to 170 mg/L), and sulphate (40 to 48 mg/L). The source of nitrate and ammonia are explosives residues and the source of chloride is drilling brines.

The results indicate that the potential for metal leaching from these samples is low. Increased arsenic levels were not correlated to an increase in total sulphur values (Attachment D) for the 1as samples as SRK19-WR-01 had a total sulphur value of 0.83% but had the lowest dissolved arsenic.

Table 3-6: Shake Flask Extraction Results, 2019 Pad T Waste Rock Samples

Sample ID	Unit	Detection Limit	Altered Mafic Metavolcanics (1as)		
			SRK19-WR-01	SRK19-WR-04	SRK19-WR-09
pH	pH Units	5.73	8.1	8.3	8.2
EC	uS/cm	1	2300	2400	2400
Total Alkalinity	mg/L	0.5	73	33	30
SO_4	mg/L	0.5	48	40	43
Cl	mg/L	0.5	180	490	420
Ca	mg/L	0.05	71	130	140
Mg	mg/L	0.05	29	39	48
K	mg/L	0.05	22	20	36
Na	mg/L	0.05	110	250	220
Nitrate	mg/L as N	0.2	170	140	160
Nitrite	mg/L as N	0.05	1.8	1.1	1.4
Al	mg/L	0.0005	0.038	0.076	0.069
Sb	mg/L	0.00002	0.00045	0.00034	0.00038
As	mg/L	0.00002	0.00025	0.0022	0.0042
Ba	mg/L	0.000063	0.029	0.020	0.019
B	mg/L	0.05	0.12	0.10	0.086
Cs	mg/L	0.00005	0.0042	0.0053	0.0059
Cd	mg/L	0.000005	0.000012	*<0.000005*	*<0.000005*
Cr	mg/L	0.0001	0.00073	0.00015	0.0002
Co	mg/L	0.000005	0.0023	0.0018	0.0043
Cu	mg/L	0.00005	0.0035	0.00098	0.00081
Fe	mg/L	0.001	*<0.001*	0.003	*<0.001*
La	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*
Pb	mg/L	0.000005	0.000018	0.000093	0.0000094
Li	mg/L	0.0005	0.0072	0.0076	0.0065
Mn	mg/L	0.00005	0.25	0.15	0.22
Hg	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*
Mo	mg/L	0.00005	0.00090	0.0013	0.0022
Ni	mg/L	0.00002	0.000053	0.0012	0.0052
Se	mg/L	0.00004	0.00072	0.00064	0.0017
Sr	mg/L	0.00005	0.26	0.66	0.60
S	mg/L	10	17	16	16
Tl	mg/L	0.000002	0.000061	0.000066	0.00011
U	mg/L	0.000002	0.0000049	0.000011	0.0000051
V	mg/L	0.0002	*<0.0002*	*<0.0002*	*<0.0002*
Zn	mg/L	0.0001	0.00012	0.0018	0.00078

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes: All element concentrations are given as dissolved; SFE tests do not represent natural waters.

Values in italics represent values below the detection limit.

3.3 Assessment of CPR Waste Rock as Construction Rock

This section presents the geochemical results of the CPR waste rock stockpile samples collected in 2019 and presents the results in the context of suitability of waste rock for use as construction rock, as compared to the criteria in TMAC (2019).

3.3.1 Geological Inspection

CPR waste rock samples collected in the stockpile were described as primarily unaltered (1a) grey or green mafic metavolcanics (basalt) with minor sericitic alteration and altered mafic metavolcanics (1as) with moderate sericitic alteration. Trace disseminated to fine-grained pyrite (≤1%) was observed in the majority of samples with trace quartz and carbonate veins.

3.3.2 Rinse Tests

Rinse tests were conducted on a subset of samples. Rinse pH and EC values ranged from 8.7 to 9.2 and 320 to 480 µS/cm, respectively (Table 3-7).

Table 3-7: Rinse Test Results for 2019 CPR Samples (-2 mm Fraction)

Source	Rock Type[1]		Rinse pH	Rinse EC
			s.u.	µS/cm
Stockpile Material	1a (n=6)	Min	8.9	320
		Max	9.2	480
	1as (n=4)	Min	8.7	430
		Max	8.9	570

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

3.3.3 ABA

A summary of ABA data are presented in Table 3-8 and Figure 3-11 to Figure 3-14 with complete results presented in Attachment G.

Values of paste pH ranged from 8.5 to 9.4.

Total sulphur ranged from 0.05 to 0.78%. Sulphate values were typically at or below detection limit (0.01%). Sulphide, calculated as the difference between total sulphur and sulphate, was at near parity with sulphide sulphur (Figure 3-11).

TIC and Modified NP content ranged from 220 to 370 kg $CaCO_3$ eq/tonne and 150 to 190 kg $CaCO_3$ eq/tonne, respectively. There were no appreciable differences in TIC or NP content between rock types. TIC content was greater than NP (Figure 3-12), suggesting that TIC values overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-13 and Figure 3-14).

Table 3-8: ABA Data for CPR Samples

Rock Type[1]	Sample ID	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-
1a	R828418	8.8	260	0.21	0.03	6.6	160	40	25
	R828419	8.9	270	0.25	0.01	7.8	150	35	19
	R828420	9	250	0.78	0.01	24	180	10	7.2
	R828421	8.5	250	0.32	0.01	10	160	25	16
	R828422	9.4	370	0.14	0.01	4.4	190	84	43
	R828423	9	230	0.22	0.01	6.9	170	34	25
	R828424	8.6	320	0.1	0.01	3.1	180	100	56
	R828425	9.2	300	0.1	0.01	3.1	180	97	57
	R828426	9	300	0.17	0.01	5.3	180	56	33
	R828427	9	330	0.14	0.01	4.4	170	75	38
	R828428	8.8	310	0.32	0.01	10	180	31	18
	R828429	9	360	0.2	0.01	6.3	180	58	29
	R828430	9.1	280	0.49	0.01	15	170	18	11
	R828431	9.1	280	0.05	0.01	1.6	180	180	110
1as	R828406	9.1	290	0.23	0.01	7.2	180	40	25
	R828407	8.9	230	0.19	0.01	5.9	170	39	28
	R828408	9	270	0.28	0.01	8.8	170	31	19
	R828409	8.9	240	0.27	0.01	8.4	180	29	21
	R828410	8.8	240	0.32	0.01	10	160	24	16
	R828411	9	220	0.55	0.02	17	150	13	9
	R828412	9	300	0.59	0.01	18	190	16	11
	R828413	9.1	300	0.19	0.01	5.9	180	51	30
	R828414	8.8	260	0.36	0.01	11	160	23	14
	R828415	8.6	260	0.23	0.01	7.2	170	37	23

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

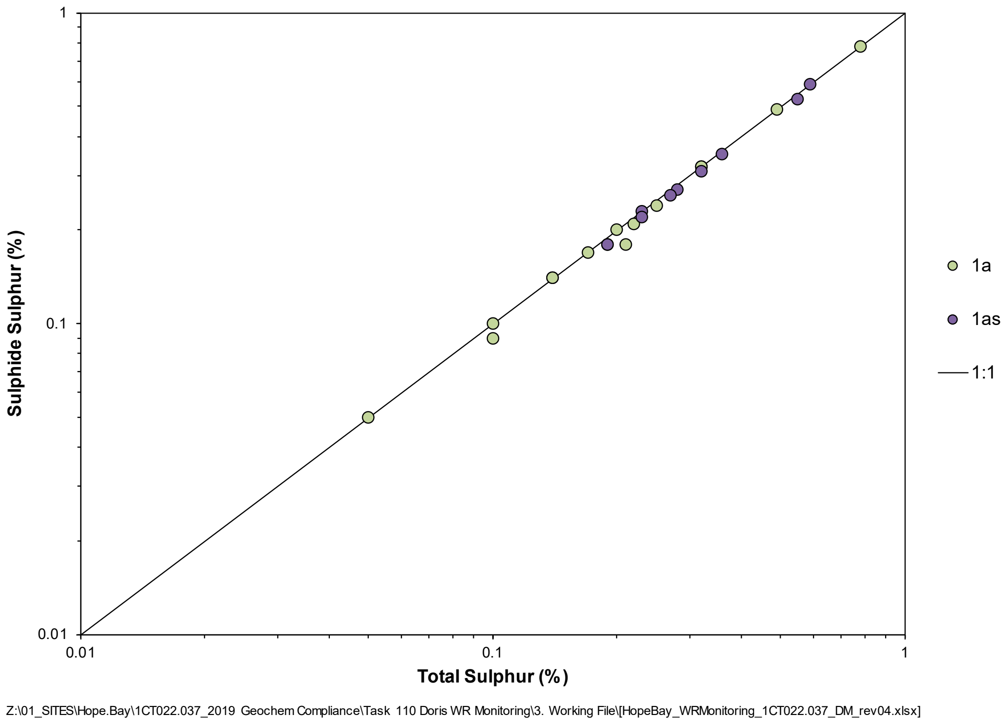

Figure 3-11: Comparison of Total Sulphur vs Sulphide in CPR Samples

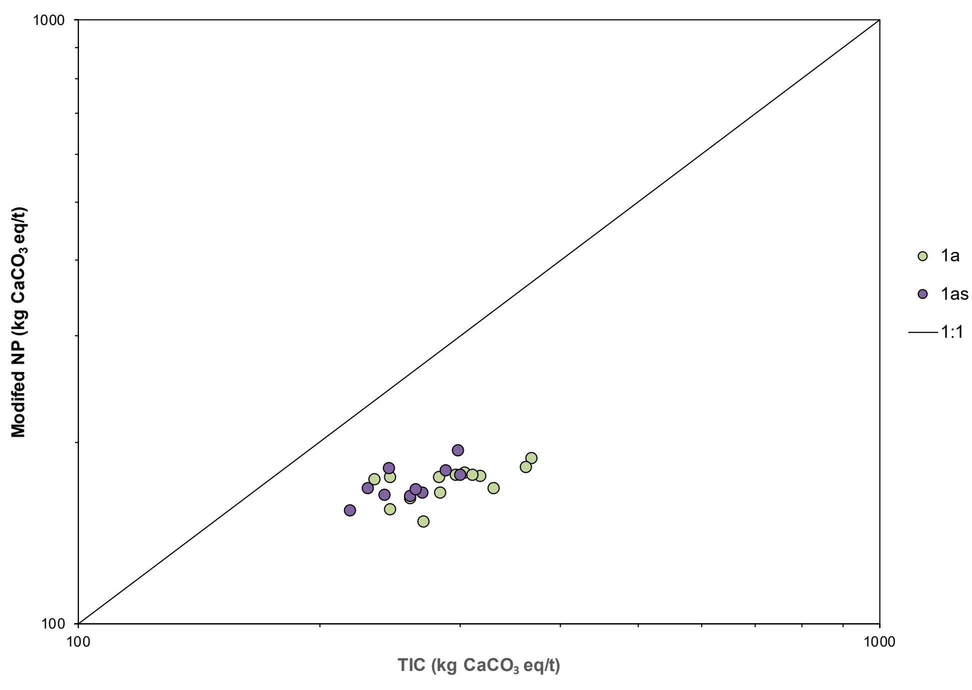

Figure 3-12: Comparison of Modified NP versus TIC, CPR Samples

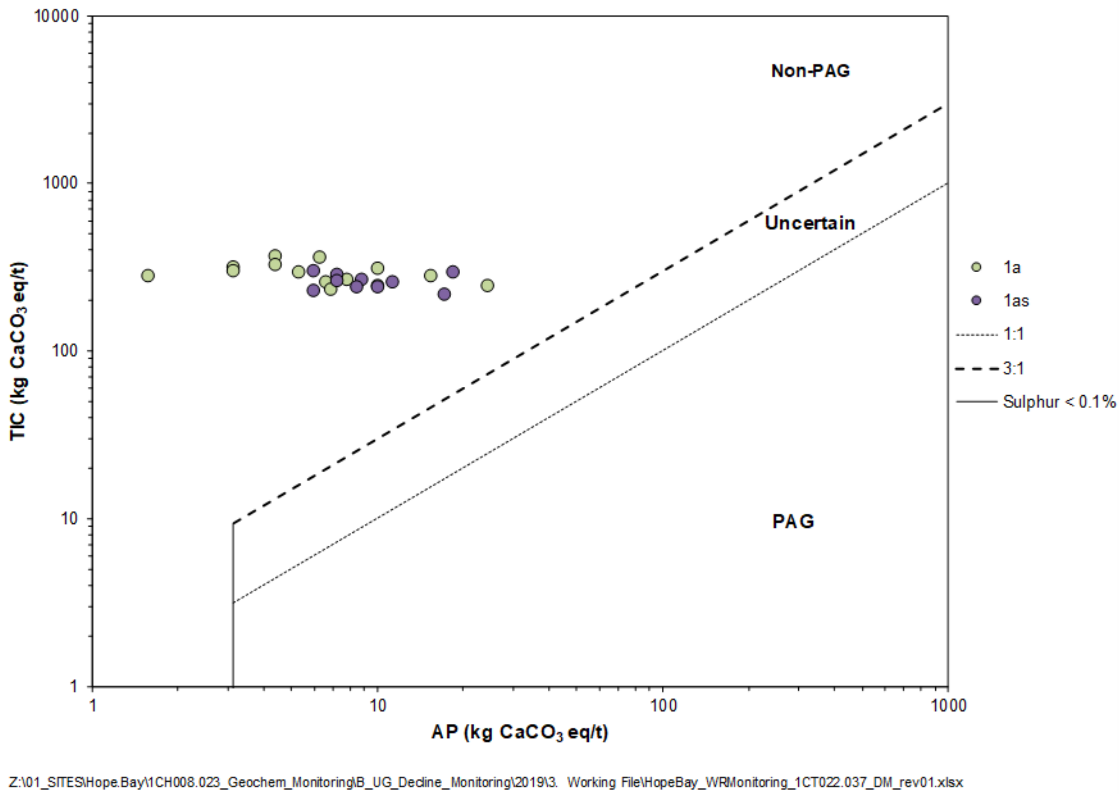

Figure 3-13: ARD Classifications by TIC/AP, CPR Samples

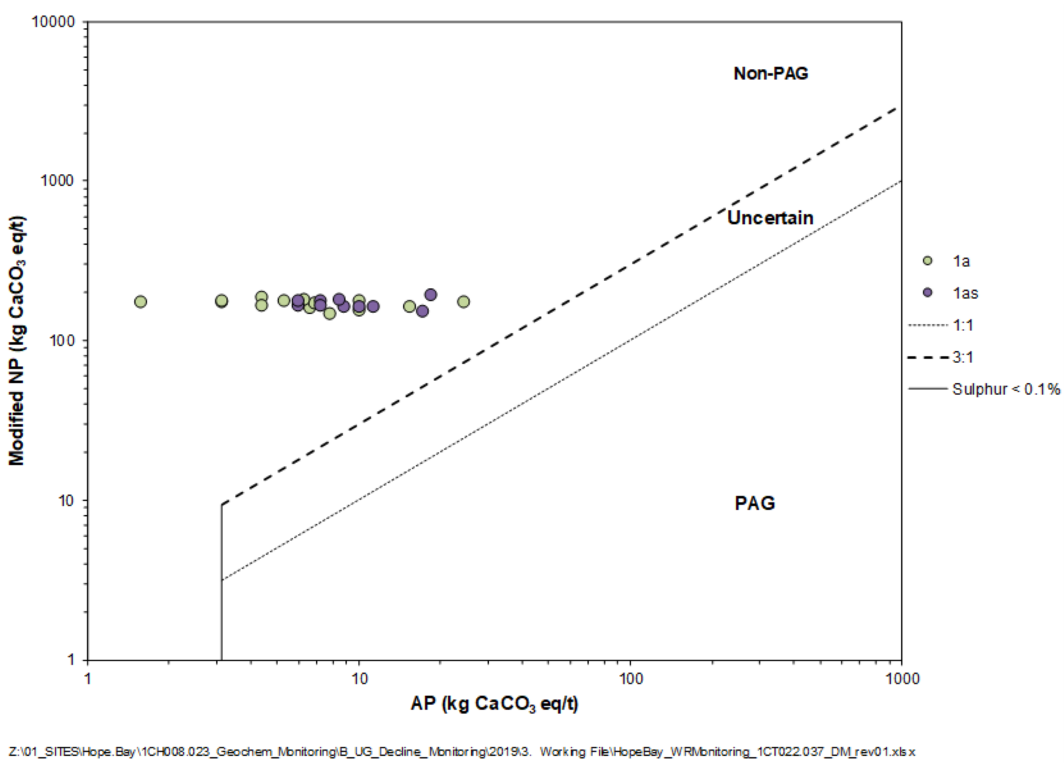

Figure 3-14: ARD Classifications by NP/AP, CPR Samples

3.3.4 Trace Elemental Analyses

A summary of trace element content is presented in Table 3-9 with complete laboratory results presented in Attachment H. Results were compared to ten times average the crustal abundance for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

For both rock types, median values for arsenic content were higher than the screening criterion (Table 3-9). Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver compared to the screening criterion. All other parameters were below the screening criteria suggesting no appreciable enrichment.

Table 3-9: Summary of Elemental Analyses for CPR Waste Rock

Parameter	Unit	Detection Limit	Stockpile Material				10x Average Crustal Abundance* for Basalt
			1a (n=14)[1]		1as (n=10)[1]		
			P50	P100	P50	P100	
Ag	ppm	0.1	0.1	**1.9**	0.1	0.3	1.1
As	ppm	0.1	**24**	**74**	**23**	**35**	20
Ba	ppm	0.5	5.5	14	7	14	3300
Ca	%	0.01	5.9	7.2	5.4	7.1	76
Cd	ppm	0.1	0.1	1.2	0.1	0.2	2.2
Co	ppm	0.1	36	58	34	39	480
Cr	ppm	0.5	33	43	36	56	1700
Cu	ppm	0.1	62	100	63	71	870
Fe	%	0.01	8.0	9.4	8.1	9.1	87
Hg	ppm	0.01	0.01	0.01	0.01	0.01	900
Mg	%	0.01	2.0	2.5	1.9	2.5	46
Mn	ppm	1	1700	2300	1770	2000	15000
Mo	ppm	0.01	0.25	0.5	0.4	0.5	15
Ni	ppm	0.1	54	86	32	70	1300
P	ppm	0.001	0.1	0.1	0.064	0.07	1.1
Pb	ppm	0.01	1.2	2.0	3.0	9.0	60
S	%	0.05	0.2	**0.81**	0.26	**0.56**	0.3
Sb	ppm	0.1	0.1	0.1	0.1	0.2	2
Sr	ppm	1	32	42	31	47	4650
U	ppm	0.1	0.1	0.1	0.1	0.1	10
V	ppm	2	36	50	39	54	2500
W	ppm	0.1	0.1	1.2	0.1	0.6	7
Zn	ppm	0.1	86	340	88	120	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

* Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997

3.3.5 SFE Tests

A summary of results for key SFE parameters is presented in Table 3-10 with complete results included in Attachment I.

Median values of pH were 9.3 s.u. Values of EC ranged from 120 to 200 µS/cm.

Major cation chemistry was dominated by calcium (ranging from 6.9 to 9.2 mg/L) and sodium (12 to 23 mg/L), while major anion chemistry was dominated by alkalinity (38 to 43 mg/L), chloride (9.6 to 27 mg/L) and sulphate (1.6 to 13 mg/L). Nitrite were all below the detection limit (0.005 mg/L) and nitrate concentrations ranged from 0.2 to 1.1 mg/L. Results indicate that the potential for metal leaching from these samples is low.

Table 3-10: Shake Flask Extraction Results for 2019 CPR Samples (-2 mm Fraction)

Sample ID	Unit	Detection Limit	CPR Waste Rock Stockpile			
			1a (n=6)		1as (n=4)	
			P50	P100	P50	P100
pH	pH Units	5.87	9.3	9.4	9.3	9.4
EC	uS/cm	1.3	140	170	190	200
TDS	mg/L	10	78	92	92	110
Hardness (as $CaCO_3$)	mg/L	0.5	33	34	31	32
Total Alkalinity	mg/L	0.5	42	48	37	39
SO_4	mg/L	0.5	3.3	7.3	9.7	13
Cl	mg/L	0.5	13	24	22	27
Ca	mg/L	0.05	8.6	9.2	8.5	9.0
Mg	mg/L	0.05	2.7	2.9	2.4	2.5
K	mg/L	0.05	3.0	3.0	4.0	4.7
Na	mg/L	0.05	14	19	20	23
Nitrate	mg/L as N	0.2	0.3	0.4	0.95	1.1
Nitrite	mg/L as N	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Total Ammonia	mg/L as N	0.047	0.072	0.11	0.19	0.30
Al	mg/L	0.0005	0.50	0.66	0.53	0.70
Sb	mg/L	0.00002	0.00047	0.00080	0.00038	0.00055
As	mg/L	0.00002	0.0029	0.0098	0.0046	0.0079
Ba	mg/L	0.00002	0.00052	0.00087	0.00070	0.00084
B	mg/L	0.05	0.051	0.060	0.061	0.096
Cs	mg/L	0.00005	*< 0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Cd	mg/L	0.000005	*< 0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Cr	mg/L	0.0001	*< 0.0001*	0.00014	*<0.0001*	0.00022
Co	mg/L	0.000005	0.00016	0.00054	0.00035	0.00041
Cu	mg/L	0.00005	0.00016	0.00071	0.00041	0.00054
La	mg/L	0.00005	0.0001	*<0.00005*	*<0.00005*	*<0.00005*
Fe	mg/L	0.001	0.045	0.31	0.079	0.34
Pb	mg/L	0.000005	0.00004	0.000075	0.00015	0.00022
Li	mg/L	0.0005	0.0010	0.0011	0.001015	0.0012
Mn	mg/L	0.00005	0.0050	0.0098	0.0036	0.0081
Mo	mg/L	0.00005	0.0003	0.00056	0.0013	0.0018
Ni	mg/L	0.00002	0.0001	0.00043	0.00016	0.00038
Se	mg/L	0.00004	0.0003	0.00063	0.00044	0.00053
Sr	mg/L	0.00005	0.010	0.0134	0.0118	0.013
S	mg/L	10	*< 10*	*<10*	*<10*	*<10*
Tl	mg/L	0.000002	0.000003	0.0000042	0.0000044	0.0000057
U	mg/L	0.000002	0.00002	0.00015	0.000040	0.000041
V	mg/L	0.0002	0.00073	0.0013	0.00066	0.0012
Zn	mg/L	0.0001	0.000105	0.00062	0.00064	0.00092
Hg	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

All element concentrations are given as dissolved; SFE tests do not represent natural waters; Values in italics indicates values below the detection limit

3.3.6 Assessment of Suitability to Use as Construction Material

The *Waste Rock, Ore and Mine Backfill Management Plan* outlines the process to determine the suitability of waste rock as construction material (Section 3.2, TMAC 2019). Rock is considered suitable for construction if:

- TIC/AP and NP/AP ratios are greater than 2 with total sulphur content less than 0.1%, or
- TIC/AP and NP/AP ratios are greater than 3 with total sulphur content less than 0.5%.

The results indicate that all 24 of the 2019 samples collected from the CPR waste rock stockpile had values of TIC/AP and NP/AP > 3 and 21 out of 24 samples fulfilled the accompanying sulphur criterion (<0.5%) (Table 3-8). The results indicate that on balance waste rock from the CPR meets the criteria. Confirmatory samples collected from the as-built cover meet the criteria TIC/AP, NP/AP and sulphur criteria (SRK 2020b).

Notably, chloride and ammonia values for the CPR stockpile material are lower than underground water rock samples because drilling brines are not used for CPR rock and blasting practices are different than underground waste rock resulting in a lower load of blast residues on the rock.

3.4 Comparison to Previous Waste Rock Geochemical Characterization Results

This section compares the 2019 waste rock monitoring samples to previous sample sets. Specifically, waste rock samples are presented according to rock type and the following samples sets:

1. Waste rock characterized as part of the Type A water licence amendment application (SRK 2015);
2. Underground mine operational waste rock monitoring samples collected prior to 2019;
3. CPR operational waste rock monitoring samples collected prior to 2019;
4. Underground mine operational waste rock monitoring samples collected in 2019; and
5. CPR operational waste rock monitoring samples collected in 2019.

Table 3-11 summarizes the differences in geological logging codes and sample types for the sample sets. The mafic metavolcanic waste rock samples that were geochemically characterized as part of the Type A Doris water licence amendment application (SRK 2015) were geologically logged as part of the exploration drilling program, at which time the lithology code 1as (altered mafic metavolcanics) was not used. Based on the geochemistry and spatial coverage of the ABA sample set, SRK assumes that altered mafic metavolcanics (1as) is represented in SRK (2015).

Figure 3-15 to Figure 3-17 compares by rock type the geochemical results from the 2019 waste rock monitoring programs to the other sample sets presented in Table 3-11. The results are discussed in subsequent sections.

Table 3-11: Overview of Waste Rock Geochemical Sample Sets

Rock Type	Sample Set and Source[1]		Geology Code[2]	Geology Codes for Samples[3]	Comment
Mafic Metavolcanics	2019 Operational Monitoring	ROM from Underground	1a,1as	1a, 1as	
		ROM from CPR	1a, 1as	1a, 1as	
	Pre-2019 Operational Monitoring	ROM from Underground	1a, 1as	1a, 1as	
		ROM from CPR	1a	1a	
	Type A	Drill core	1	1, 1a, 1ay, 1p and 1u	Logging code 1as (altered basalt) is not documented in SRK (2015) because this code was not used during the exploration logging program. Based on the geochemistry and spatial coverage of the ABA sample set, SRK assumes that rock type 1as is represented in the sample set.
Quartz Vein	2019 Operational Monitoring	Pad T	12q	12q	
	Pre-2019 Operational Monitoring	Underground ROM	12q	12q	
	Type A	Drill core	12q	12q, 12 (mixed)	

Notes:

[1]All operational monitoring samples are run-of-mine (ROM) waste rock samples; in 2019 waste rock from 2019 was sampled from the blasted pile underground and the Pad T stockpile

[2]For data interpretation and figures. For the Type A sample set, the sample set is as presented in SRK (2015).

[3] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz vein

3.4.1 Mafic Metavolcanics (1a)

For mafic metavolcanics (1a), 25th to 75th percentile sulphur content was roughly equivalent for 2019 operational samples collected from the underground mine (0.11 to 0.18%, n=20), the Type A sample set (0.11 to 0.31%, n=401) and operational samples from the underground mine collected prior to 2019 (0.09 to 0.20%, n=162). The 25th to 75th percentile sulphur content was equivalent for 2019 and 2018 CPR samples (0.14 to 0.30% and 0.23 to 0.31%, respectively) with 25th percentile values for CPR samples higher than the Type A sample set.

NP and TIC values for the 2019 operational samples collected from the underground mine and also the 2019 and 2018 CPR waste rock samples were within the range of the 25th to 75th percentile levels of the Type A sample set (140 and 220 kg $CaCO_3$ eq/tonne and 170 and 340 kg $CaCO_3$ eq/tonne, respectively).

All samples of mafic metavolcanic (1a) collected from the underground mine and CPR in 2019 were classified as non-PAG on the basis of TIC/AP and NP/AP. This was consistent with the majority of the Type A and operational monitoring mafic metavolcanic (1a) samples (Figure 3-16 and Figure 3-17).

Solid-phase arsenic content can be elevated in waste rock (e.g. Section 3.2.2) and is mobile at neutral pH, though seepage monitoring of Doris waste rock does not indicate neutral pH arsenic leaching. The 25th to 75th percentile levels of arsenic (3.5 to 15 ppm) for the 2019 mafic metavolcanic (1a) underground monitoring samples were within the range of previous operational monitoring samples (25th and 75th percentile levels of 0.78 and 9.5 ppm, respectively) and also the Type A samples (25th and 75th percentile levels of 0.70 and 74 ppm, respectively). Consistent with 2018 CPR samples, the 2019 CPR samples had higher 25th to 75th percentile levels of arsenic (20 to 28 ppm) compared to the Type A and underground mine sample sets (Figure 3-15). The geochemical characteristics of the CPR samples are likely representative of the alteration envelope related to ore genesis. Arsenic content in the CPR samples was within the range of arsenic content for waste rock humidity cell test (HCT) samples for mafic metavolcanics, which indicated low rates of arsenic leaching (SRK 2015).

In summary, ABA characteristics and arsenic content for the 2019 samples of mafic metavolcanics (1a) from the underground mine and CPR were represented by the Type A waste rock sample set.

3.4.2 Altered Mafic Metavolcanics (1as)

For 2019 altered mafic metavolcanics (1as) collected from the underground mine, 25th to 75th percentile levels of sulphur content (0.20 to 0.59%, n=8) were higher than the Type A sample set (0.11 to 0.31%, n=401) and previous operational of altered mafic metavolcanic (1as) samples collected prior to 2019 (0.07 to 0.35%, n=29). Of note is that the range of sulphur content for the 2019 underground samples is captured within the overall range of the Type A sample set. For the 2019 CPR samples of altered mafic metavolcanics, (n=10) 25th to 75th percentile levels (0.23 to 0.35%) were lower than the 2019 underground samples and within the 25th to 75th percentile range of the Type A sample set.

For 2019 samples of altered mafic metavolcanic (1as) collected from the underground mine, 25th to 75th percentile levels of TIC (250 to 300 kg $CaCO_3$ eq/tonne) and NP (150 to 180 kg $CaCO_3$ eq/tonne) were similar than other of altered mafic metavolcanic (1as) monitoring samples collected from the underground mine (25th and 75th percentile values of 200 and 330 kg $CaCO_3$ eq/tonne, respectively for TIC and 150 and 230 kg $CaCO_3$ eq/tonne, respectively for NP) and were slightly lower than the Type A sample set (25th and 75th percentile values of 170 and 335 kg $CaCO_3$ eq/tonne, respectively for TIC and 140 and 220 kg $CaCO_3$ eq/tonne, respectively for NP). For the 2019 CPR of altered mafic metavolcanic (1as) samples, 25th to 75th percentile levels of TIC (240 to 290 kg $CaCO_3$ eq/tonne) and NP (170 to 180 kg $CaCO_3$ eq/tonne) were comparable to the Type A and of altered mafic metavolcanic (1as) operational monitoring sample sets.

All samples of altered mafic metavolcanic (1as) collected from the underground mine (including Pad T) and CPR in 2019 were classified as non-PAG on the basis of TIC/AP and NP/AP. This is consistent with the majority of the Type A and operational monitoring of altered mafic metavolcanic (1as) samples (Figure 3-16 and Figure 3-17).

For 2019 of altered mafic metavolcanic (1as) underground monitoring samples, 25^{th} to 75^{th} percentile levels of arsenic (13 to 46 ppm) were higher than previous of altered mafic metavolcanic (1as) operational monitoring samples (25^{th} and 75^{th} percentile levels of 5.5 and 28 ppm, respectively) and within the Type A range (25^{th} and 75^{th} percentile levels of 0.70 and 74 ppm, respectively). For 2019 CPR of altered mafic metavolcanic (1as) samples had a similar relationship to other sample sets with 25^{th} and 75^{th} percentile levels of 19 and 29 ppm, respectively.

In summary, ABA characteristics and arsenic content for the 2019 samples of altered mafic metavolcanics (1as) from the underground mine and CPR were represented by the Type A waste rock sample set.

3.4.3 Quartz Veins (12q)

Total sulphur content for the 2019 quartz vein sample (0.98%) was roughly equivalent to the 75^{th} percentile values for the Type A samples (1.2%) and maximum levels for previous operational waste rock samples (1%). TIC and NP content for the 2019 quartz vein sample (222 and 161 kg $CaCO_3$ eq/tonne, respectively) were higher than 75^{th} percentile values for the Type A samples (44 and 36 kg $CaCO_3$ eq/tonne, respectively) and maximum value from the operational waste rock sample set (114 and 55 kg $CaCO_3$ eq/tonne, respectively, Figure 3-15).

The non-PAG classification of the quartz vein (12q) was consistent with the majority of quartz vein samples from the Type A and pre-2019 operational monitoring sample sets (Figure 3-16 and Figure 3-17).

The one 2019 quartz vein sample (12q) reported an arsenic concentration (85 ppm) that was greater than the 75^{th} percentile levels for Type A sample set (17 to 38 ppm) but less than the maximum value (229 ppm).

The ABA characteristics and arsenic content for the 2019 quartz vein sample (12q) were represented by the Type A waste rock sample set.

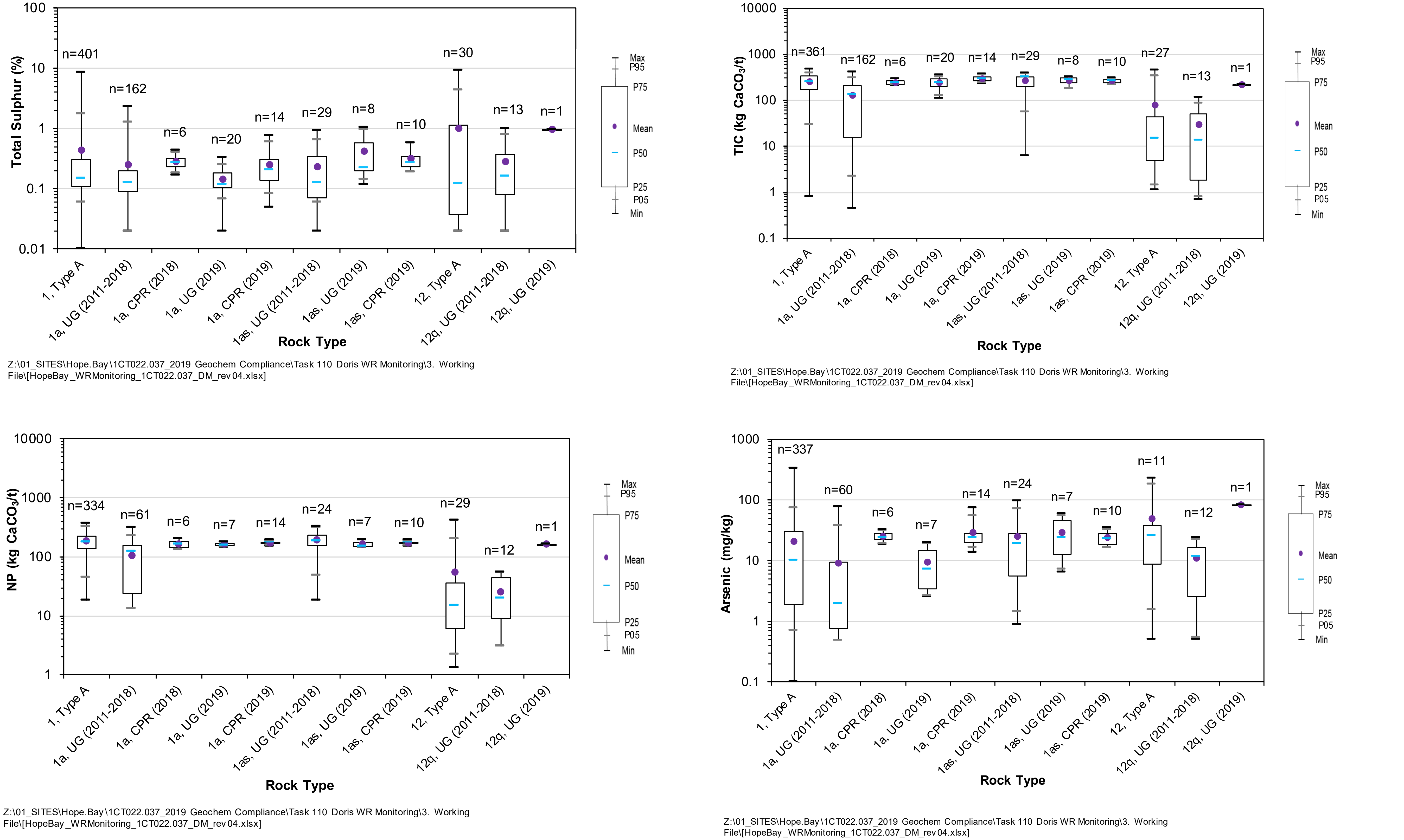

Figure 3-15: Box and Whisker Plots of S, TIC, NP and Arsenic – Comparison of 2019 Doris Waste Rock Monitoring Samples to Other Waste Rock Sample Sets

(These plots are conventional box and whisker graphs, with the upper and lower extremes showing the minimum and maximum values, tick marks outside of the box showing the 5th and 95th percentiles, outer margins of the box showing the 25th and 75th percentiles and central division in the box showing the median value)

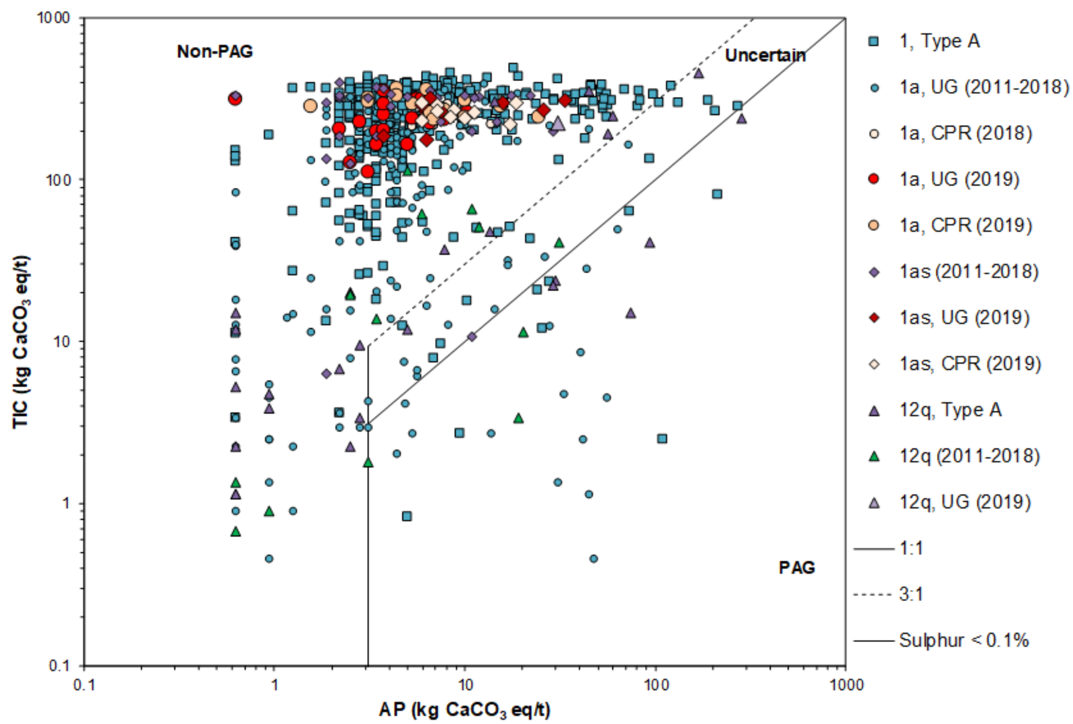

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Figure 3-16: ARD Classifications by TIC/AP, Doris Waste Rock Samples

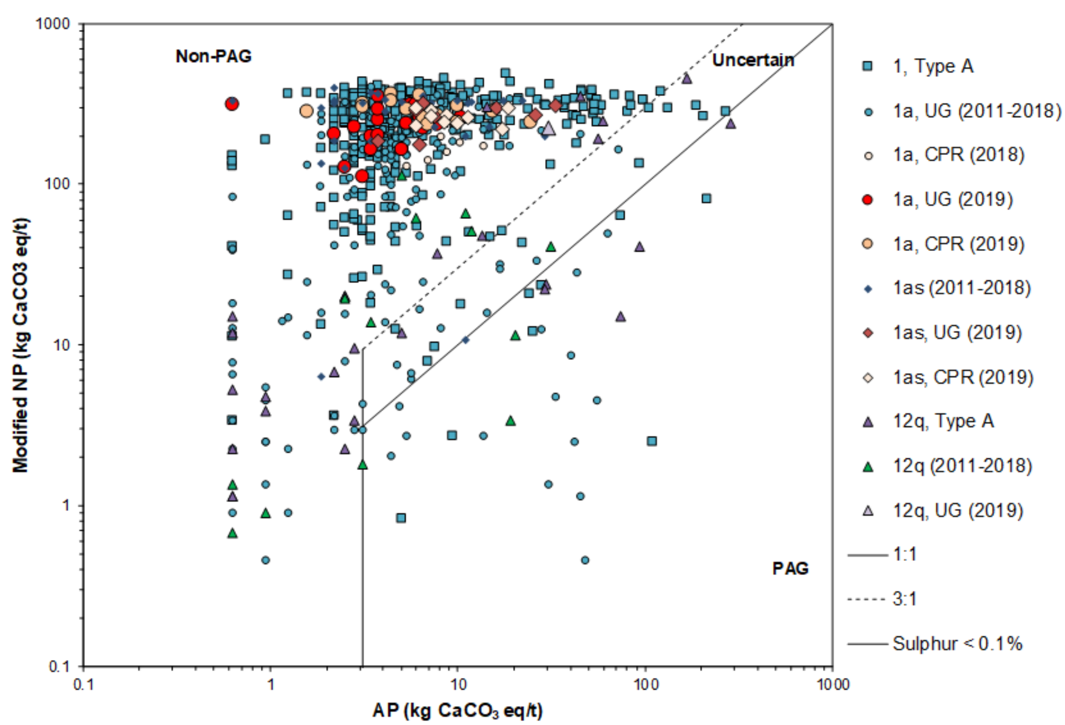

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Figure 3-17: ARD Classifications by NP/AP, Doris Waste Rock Samples

4 Summary and Conclusions

4.1 Waste Rock Monitoring Program

Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T, all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from the surface waste rock stockpile was placed as backfill in the Doris Crown Pillar and stopes of the Doris mine. In 2019, waste rock intersected by the Doris underground workings was primarily (95%) mafic metavolcanic flow (1a) with lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, and rare (1%) diabase or felsic dykes.

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019), the latter which is current plan. The major difference between the two waste rock management programs is that samples are collected from the underground in TMAC (2016) whereas for the TMAC (2019) program, samples are collected from the surface waste rock stockpile on Pad T.

As part of the TMAC (2016) monitoring program conducted from January to April, TMAC collected 19 underground waste rock samples with the samples geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high (ranging from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

As part of the TMAC (2019) waste rock monitoring program, SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25^{th} to

75th percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For the one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP.
- Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.
- SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

The Type A waste rock sample set represents the geochemical characteristics of all 2019 waste rock samples and rock types.

The geological and geochemical inventory of waste rock on Pad T precludes a long-term assessment of the anticipated geochemical behaviour of the waste rock on Pad T with respect to metal leaching and acid rock drainage (ML/ARD). The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP). The results of the seepage survey are reported in the accompanying memo (SRK 2020a), while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

4.2 Geochemical Assessment of CPR Waste Rock as Construction Rock

In 2018, CPR waste rock placed in a separate stockpile on Pad T for potential use as construction material. CPR waste rock is considered potential construction material because the drilling and blasting practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and lower loads of ammonia (related to blasting residues).

In 2019, TMAC collected 24 samples of CPR waste rock from the stockpile on the west end of Pad T to assess if this waste rock could be used for construction as per the requirements of the *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The results of the geochemical program for CPR waste rock are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment.

- SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock.

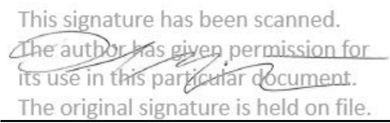
- All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%. Confirmatory samples taken from the CPR cover were classified as suitable for use as construction rock (SRK 2020b).

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure. The results of the seepage surveys and monitoring of construction rock are reported in the accompanying memos (SRK 2020a and SRK 2020b)

The Type A waste rock sample set represents the geochemical characteristics of the CPR waste rock samples analyzed as part of the 2019 waste rock monitoring program.

Prepared by

SRK Consulting (Canada) Ltd.



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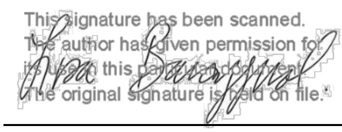
Staff Consultant (Geochemistry)

Reviewed by

SRK Consulting (Canada) Ltd.



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant (Geochemistry)

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Attachment A – Geological Description (Underground Waste Rock)

TMAC RESOURCES

WASTE ROCK SAMPLES

			SAMPLE LOCATION								GEOLOGIC DESCRIPTION			
SAMPLE #	GEOLOGIST	DATE SAMPLED	LEVEL	STN/GP#	X	Y	Z	MINING ZONE	ANALYSIS	MINERALIZED/NOT MINERALIZED	ROCK TYPE	SULPHIDE %	CARBONATE %	DESCRIPTION
W571495	CA	02-Jan-19	4700 Decline	Face as 01-Jan-19	433788	7559982	-306	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, TR Cb Strs
W571496	AP	05-Jan-19	West vally Vent access	Muck pile of lead in slash blasted Jan 4, 2019	433690	7558216	-110	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	-	-
W571497	AP	05-Jan-19	DCO Decline	Muckpile from Blast Jan 4, 2019 NS	433672	7558361	-130	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	1	~1% Carbonate Veinlets thought
W571498	AP	05-Jan-19	DCN RAMP	Left corner of face.	433649	7558111	-180	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	2	~-1-2% Quartz/Carbonate Stringers throughout.
W571499	GL	23-Jan-19	4700 Ramp	Safety Bay, left side	433794	7559982	-309	Basalt and buffer zone	Full ABA+Rinse	Not Mineralized	1a	<1	2	Foliated w/ wk chloric alt'n, 1-2% qtz/Carb stringers
W571500	GL	23-Jan-19	West Valley	Left corner of access to WV Elec. Sub	433701	7558164	-110	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	-	1	Barren, <1% Carb vnlts
W573597	GL	23-Jan-19	DCN Ramp	Right corner of face	433651	7558069	-188	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	2	<1% qtz/carb stringers
Y041487	C.A.	10-Jan-19	134 Acc	LW 1st ref plug in acc	433680	7558379	-132	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041488	C.A.	10-Jan-19	94 Acc	LW acc just after remuck	433711	7558376	-92	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041489	C.A.	10-Jan-19	DCN Ramp	Across from remuck	433654	7558051	-190	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041490	C.A.	10-Jan-19	South Acc Ramp	South Acc ramp RW across from 110mL	433718	7558129	-108	Basalt and buffer zone	Full ABA/Metals+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl, Weak Ser
Y041491	GL	03-Mar-19	110 WV Access	End of access	433758	7558151	-107	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	-	1	Barren, <1% Carb vnlts
Y041492	GL	04-Mar-19	4690 Level Access	18.7m from RW Bar	433835	7559898	-314	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	2	Foliated w/ wk chloric alt'n
W573598	SAS	11-Mar-19	134 FAR drop raise	around 4 m from the stop face.	433648	7558372	-131	Alteration zone	Full ABA/Metals	Mineralized	1as	1	1	mod ser alter; wekly foliated
W573599	SAS	11-Mar-19	94 ECO LW	1 m from stop face along LW	433703	7558370	-91	Basalt and buffer zone	Total Sulphur/TIC+Metals	Not Mineralized	1a	<1	-	1a; Mod sheared; chl altered; no sulfides
Y041495	C.A	18-Mar-19	DCN Ramp	1 rnd past surveyed face march 16 2019	433669	7557981	-200	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1as	<1	Trace	1a, Tr V Tr S
Y041493	SAS	17-Mar-19	DCO Incline	6.5m up ramp from LW BAR	433648	758342	-88	Alteration zone	Full ABA/Metals	Mineralized	1as	2	Trace	1as; Str ser alt; 2% fg diss py
Y041494	SAS	17-Mar-19	4700 Decline	4m back from stop face along LW	433777	7559882	-322	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	0.08	1a; Mod chl alt; 8% qtz carb vnlts; no sufides
Y041496	SAS	19-Mar-19	4885 remuck extention	LW 2 m back from stop face in remuck	433749	7559349	-110	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Mineralized	1a	1	Trace	1a; Mod chl alt; tr qtz-car vnlts; 1% py
Y041497	AP/MS	21-Mar-19	West Valley Access	Face as of mar 21, 2019	433717	7558122	-110	Basalt and buffer zone	Full ABA/Metals	Mineralized	1a	1	Trace	1a: Weak sercitealteration. Local weack chlorite alteration. ~3% Qtz veinlets
R828404	GL	12-Apr-19	4702	8m from RW Ref	433829	7559904	-293	Basalt and buffer zone		Not Mineralized	1a	2	Trace	1a; Mod chl alt; <2% qtz carb vnlts; no sufides
R828405	GL	12-Apr-19	4700 Ramp	12m from Right Corner	433768	7559929	-327	Basalt and buffer zone		Not Mineralized	1a	<1	Trace	tr chloric alt'n, extremely rr dism pyr min'l
Y247802									Rinse					
R828406	GL	20-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828407	GL	20-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828408	GL	21-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828409	GL	21-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828410	GL	22-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828411	GL	22-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828412	SAS	24-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sercite Alt. Local trace qtz/carb. Trace fine grained PY
R828413	SAS	24-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sercite Alt. Local trace qtz/carb. Trace fine grained PY
R828414	GL	23-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828415	GL	23-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828418	C.A.	25-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828419	C.A.	25-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828420	C.A.	26-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828421	C.A.	26-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828422	C.A.	27-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828423	C.A.	27-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828424	C.A.	28-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828425	C.A.	28-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828426	C.A.	29-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828427	C.A.	29-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828428	C.A.	30-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828429	C.A.	30-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828430	C.A.	01-May-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828431	C.A.	01-May-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
SRK19-WR-06	D.M	02-Aug-19		Pad T	433354	7559297	86		ABA/Metals + SFE		12	Mostly none, few fragments with up to 5% cubic pyrite associated with 1as	Trace	12: quartz veins, barren; 1as: folited light brown mafic metavolcanics
SRK19-WR-03	D.M	02-Aug-19		Pad T	433341	75559268	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-03 DUP	D.M	02-Aug-19		Pad T	433341	75559268	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-05	D.M	02-Aug-19		Pad T	433328	7559315	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-07	D.M	02-Aug-19		Pad T	433369	7559286	88		ABA/Metals + SFE		1a	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Trace	1a: dark green mafic metavolcanics; 1as: foliated light brown mafic metavolcanic, rare quartz fragments
SRK19-WR-10	D.M	02-Aug-19		Pad T	433363	7559224	87		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-01	D.M	02-Aug-19		Pad T	433346	7559240	85		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics
SRK19-WR-02	D.M	02-Aug-19		Pad T	433352	7559253	83		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics, common hematite staining, weathered pinkish-brown
SRK19-WR-04	D.M	02-Aug-19		Pad T	433335	7559291	84		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics, rare quartz veins
SRK19-WR-08	D.M	02-Aug-19		Pad T	433372	7559271	87		ABA/Metals + SFE		1as	Mostly none, few fragments with up to 1% cubic pyrite	Trace	1as: foliated light brown mafic metavolcanics, some quartz veins
SRK19-WR-09	D.M	02-Aug-19		Pad T	433370	7559247	88		Full ABA/Metals		1as	Mostly none, few fragments with up to 1% cubic pyrite	Trace	1as: foliated light brown mafic metavolcanics, some quartz veins

Attachment B – Underground Waste Rock Laboratory Results – Full ABA

		Paste pH	S(T)	$S(SO_4)$	S(S-2)	AP	AP from S(T)	CO_2	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
		Std. Units	%S	%S	%S	kg $CaCO_3$/t	kg $CaCO_3$/t	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	-		-
SAMPLE #	**ROCK TYPE**	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		0.1
W571495	1a		0.17				5.3	10	238				45	
W571496	1a		0.11				3.4	8.7	199				58	
W571497	1a		0.33				10.3	12	262				25	
W571498	1a		0.16				5.0	7.2	164				33	
W571499	1a	8.4	0.17	0.02	0.15	0.15	5.3	14	310	172	167	STRONG	58	32
W571500	1a		0.12				3.8	15	352				94	
W573597	1a		0.07				2.2	9.0	205				94	
Y041487	1a		0.12				3.8	11	252				67	
Y041488	1a		0.09				2.8	10	227				81	
Y041489	1a		0.21				6.6	9.9	225				34	
Y041490	1a	8.4	0.18	0.02	0.16	0.16	5.6	14	313	156	151	STRONG	56	28
Y041491	1a		0.02				0.6	14	313				501	
Y041492	1a		0.08				2.5	5.6	128				51	
W573598	1as	9.3	0.21	0.01	0.2	0.2	6.6	14	319	149	143	STRONG	49	23
W573599	1a		0.1				3.1	4.9	112				36	
Y041495	1as		0.12				3.8	8.2	186				50	
Y041493	1as	9.2	1.07	0.01	1.06	1.06	33	14	307	142	108	STRONG	9	4
Y041494	1a		0.11				3.4	7.3	165				48	
Y041497	1a	8.9	0.19	*0.01*	0.19	0.19	5.9	14	316	144	138	STRONG	53	24

Attachment C – Underground Waste Rock Laboratory Results – Multi Element Analysis

			Mo	**Cu**	**Pb**	**Zn**	**Ag**	**Ni**	**Co**	**Mn**	**Fe**	**As**	**U**	**Au**	**Th**	**Sr**	**Cd**	**Sb**	**Bi**	**V**	**Ca**
			ppm	**ppm**	**ppm**	**ppm**	**ppb**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**
SAMPLE #	**ROCK TYPE**	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
Y041490	1a		0.1	23.9	1	103	*0.1*	1.3	23.5	2300	9.88	12.4	*0.1*	4	0.4	68	0.1	*0.1*	*0.1*	18	5.98
W573598	1as		0.2	27.6	0.9	88	*0.1*	2.9	25.7	2210	9.65	16.9	*0.1*	15.5	0.4	40	*0.1*	*0.1*	*0.1*	12	5.76
W573599	1a		0.2	25.8	1.1	109	*0.1*	1.8	26.3	2320	9.41	2.5	*0.1*	1.9	0.6	41	0.2	*0.1*	*0.1*	27	7.55
Y041493	1as		0.1	23.5	1.4	87	*0.1*	1.1	28.4	2230	9.99	58.6	*0.1*	15.2	0.3	44	0.1	*0.1*	*0.1*	10	5.88
Y041497	1a		0.4	37.4	1.3	108	*0.1*	1.1	26.4	2040	9.81	3.1	*0.1*	1.2	0.4	44	0.1	*0.1*	*0.1*	12	5.31

			P	**La**	**Cr**	**Mg**	**Ba**	**Ti**	**B**	**Al**	**Na**	**K**	**W**	**Hg**	**Sc**	**Tl**	**S**	**Ga**	**Se**	**Te**
			%	**ppm**	**ppm**	**%**	**ppm**	**%**	**ppm**	**%**	**%**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**
SAMPLE #	**ROCK TYPE**	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
Y041490	1a		0.08	3	14	1.52	12	0.002	*20*	0.74	0.061	0.04	*0.1*	*0.01*	11.6	*0.1*	0.19	3	*0.5*	*0.2*
W573598	1as		0.089	3	12	1.52	11	0.002	*20*	0.37	0.075	0.06	*0.1*	*0.01*	11.5	*0.1*	0.17	1	*0.5*	*0.2*
W573599	1a		0.08	2	11	1.61	7	0.002	*20*	1.5	0.048	0.05	*0.1*	*0.01*	12.4	*0.1*	0.15	6	*0.5*	*0.2*
Y041493	1as		0.084	2	10	1.44	10	*0.001*	*20*	0.28	0.069	0.04	*0.1*	*0.01*	12.4	*0.1*	0.97	*1*	*0.5*	*0.2*
Y041497	1a		0.088	3	11	1.51	10	0.001	*20*	0.47	0.081	0.05	*0.1*	*0.01*	12.1	*0.1*	0.16	2	*0.5*	*0.2*

Attachment D – Pad T Laboratory Results – Full ABA

		Paste pH	S(T)	S(SO_4)	S(S-2)	AP	AP from S(T)	CO_2	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
		Std. Units	%S	%S	%S	kg $CaCO_3$/t	kg $CaCO_3$/t	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-	-
SAMPLE #	**ROCK TYPE**	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		
SRK19-WR-06	12	8.2	0.98	0.01	0.98	31	31	10	222	161	130	MODERATE	7	5
SRK19-WR-03	1a	8.2	0.12	0.01	0.06	1.9	3.8	9	201	153	151	MODERATE	54	41
SRK19-WR-03 DUP	1a	8.2	0.15	0.06	0.10	3.1	4.7	9	205	143	140	MODERATE	44	31
SRK19-WR-07	1a	8.4	0.12	0.07	0.11	3.4	3.8	13	291	162	158	MODERATE	78	43
SRK19-WR-10	1a	8.3	0.25	0.04	0.22	6.9	7.8	10	233	159	7	MODERATE	30	20
SRK19-WR-01	1as	7.8	0.83	*0.01*	0.82	26	26	12	272	147	121	MODERATE	10	6
SRK19-WR-02	1as	8.1	0.19	0.01	0.18	5.6	5.9	13	291	147	141	MODERATE	49	25
SRK19-WR-04	1as	7.9	0.20	0.01	0.13	4.1	6.3	8	176	171	167	MODERATE	28	27
SRK19-WR-08	1as	8.3	0.24	*0.01*	0.23	7.2	7.5	12	266	183	176	MODERATE	35	24
SRK19-WR-09	1as	8.1	0.51	0.03	0.51	16	16	13	300	194	178	MODERATE	19	12

Attachment E – Pad T Laboratory Results – Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	**ROCK TYPE**	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
SRK19-WR-06	12		0.6	54.2	8.4	89	0.1	7.8	26.1	1970	7.84	8.8	*0.1*	78.5	0.2	38	0.1	0.2	*0.1*	39	4.82
SRK19-WR-03	1a		0.4	66.8	4.1	113	0.5	7.2	29.1	1850	8.27	23.8	*0.1*	13000	0.3	29	0.2	0.1	*0.1*	30	5.13
SRK19-WR-03 DUP	1a		0.4	44.6	5.5	100	0.2	3.4	28.4	1630	8.05	3.8	*0.1*	10.1	0.4	29	0.1	0.1	*0.1*	39	5.68
SRK19-WR-05	1a		0.5	45.2	5.7	108	0.1	4.2	27.6	1610	8.06	3.1	*0.1*	10.2	0.4	28	*0.1*	*0.1*	*0.1*	39	5.34
SRK19-WR-07	1a		0.3	84.4	3.1	126	*0.1*	20.3	39.9	1760	9.81	6.6	*0.1*	8.8	0.2	44	*0.1*	*0.1*	*0.1*	216	6.09
SRK19-WR-10	1a		0.5	62.3	4.2	107	*0.1*	40.4	35.3	1880	8.36	20.2	*0.1*	164	0.2	34	0.1	*0.1*	*0.1*	80	6.54
SRK19-WR-01	1as		0.3	45.0	5.4	28	0.5	56.9	22.6	848	3.55	84.5	*0.1*	435	0.2	34	0.2	0.2	0.3	10	5.00
SRK19-WR-02	1as		0.3	39.8	3.0	109	*0.1*	7.6	27.0	2120	8.46	7.4	*0.1*	0.9	0.3	41	0.2	*0.1*	*0.1*	35	6.05
SRK19-WR-04	1as		0.4	72.5	4.2	95	0.1	43.5	37.1	1690	7.91	44.3	*0.1*	195	0.2	35	0.2	*0.1*	*0.1*	76	6.67
SRK19-WR-08	1as		0.7	70.0	4.4	89	0.2	45.3	30.8	1830	6.51	48.2	*0.1*	919	0.2	37	0.3	0.2	*0.1*	21	7.58
SRK19-WR-09	1as		0.3	229	4.3	113	*0.1*	37.9	41.9	2060	9.26	17.2	*0.1*	21.9	0.2	38	*0.1*	0.2	*0.1*	153	6.09

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
SAMPLE #	**ROCK TYPE**	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
SRK19-WR-06	12		0.076	1	22	1.46	13	0.002	*20*	1.02	0.045	0.06	1.4	*0.01*	9.5	*0.1*	0.72	4	*0.5*	*0.2*
SRK19-WR-03	1a		0.085	2	15	1.46	10	0.003	*20*	1.04	0.067	0.04	*0.1*	*0.01*	11.4	*0.1*	0.19	4	*0.5*	*0.2*
SRK19-WR-03 DUP	1a		0.107	3	16	1.19	9	0.003	*20*	2.49	0.060	0.06	*0.1*	*0.01*	13.3	*0.1*	0.10	8	*0.5*	*0.2*
SRK19-WR-05	1a		0.096	3	13	1.21	11	0.004	*20*	2.37	0.046	0.06	0.1	*0.01*	13.0	*0.1*	0.14	8	*0.5*	*0.2*
SRK19-WR-07	1a		0.069	3	17	1.91	11	0.007	*20*	3.94	0.037	0.02	*0.1*	*0.01*	28.1	*0.1*	0.18	15	*0.5*	*0.2*
SRK19-WR-10	1a		0.064	2	38	1.94	9	0.003	*20*	2.28	0.068	0.04	*0.1*	*0.01*	16.3	*0.1*	0.20	8	*0.5*	*0.2*
SRK19-WR-01	1as		0.054	1	49	1.61	5	-0.001	*20*	0.13	0.068	0.03	0.2	*0.01*	6.4	*0.1*	0.98	-1	*0.5*	0.4
SRK19-WR-02	1as		0.076	3	19	1.43	8	0.003	*20*	1.58	0.024	0.04	*0.1*	*0.01*	12.0	*0.1*	0.11	6	*0.5*	*0.2*
SRK19-WR-04	1as		0.050	2	30	2.05	7	0.006	*20*	2.22	0.025	0.04	0.5	*0.01*	14.7	*0.1*	0.21	7	*0.5*	*0.2*
SRK19-WR-08	1as		0.052	2	31	1.47	11	0.002	*20*	1.21	0.025	0.06	0.1	*0.01*	8.7	*0.1*	0.48	3	*0.5*	*0.2*
SRK19-WR-09	1as		0.059	2	35	2.27	5	0.005	*20*	3.08	0.023	0.04	*0.1*	*0.01*	21.4	*0.1*	0.24	11	*0.5*	*0.2*

Attachment F – Pad T Laboratory Results – SFE

Shake Flask Extraction Results					
		LOD	SRK19-WR-01 -2 mm rock	SRK19-WR-04 -2 mm rock	SRK19-WR-09 -2 mm rock
pH	pH Units	N/A	8.1	8.3	8.2
EC	uS/cm	0.5	2330	2430	2440
SO4	mg/L	0.5	48	40	43
Total Alkalinity	mg/L	0.5	73	33	30
Bicarbonate	mg/L	0.5	89	40	37
Carbonate	mg/L	0.5	*0.5*	*0.5*	*0.5*
Hydroxide	mg/L	0.5	*0.5*	*0.5*	*0.5*
Dissolved Chloride	mg/L	0.5	176	491	423
Nitrate-N	mg/L	0.02	172	140	158
Nitrite-N	mg/L	0.005	1.83	1.06	1.44
Total Ammonia	mg/L	0.005	-	-	-
Total Dissolved Solids	mg/L	10	1300	1700	1900
Hardness (CaCO3)	mg/L	0.5	299	485	543
Dissolved Aluminum (Al)	mg/L	0.0005	0.038	0.076	0.069
Dissolved Antimony (Sb)	mg/L	0.00002	0.00045	0.00034	0.00038
Dissolved Arsenic (As)	mg/L	0.00002	0.00025	0.0022	0.0042
Dissolved Barium (Ba)	mg/L	0.00002	0.029	0.020	0.019
Dissolved Beryllium (Be)	mg/L	0.00001	*0.00001*	*0.00001*	*0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*
Dissolved Boron (B)	mg/L	0.05	0.12	0.098	0.086
Dissolved Cesium (Cs)	mg/L	0.00005	0.0042	0.0053	0.0059
Dissolved Cadmium (Cd)	mg/L	0.000005	0.0000120	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	71	130	139
Dissolved Chromium (Cr)	mg/L	0.0001	0.00073	0.00015	0.00020
Dissolved Cobalt (Co)	mg/L	0.000005	0.0023	0.0018	0.0043
Dissolved Copper (Cu)	mg/L	0.00005	0.0035	0.00098	0.00081
Dissolved Lanthanum (La)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*
Dissolved Iron (Fe)	mg/L	0.001	*0.001*	0.0030	*0.001*
Dissolved Lead (Pb)	mg/L	0.000005	0.000018	0.000093	0.0000094
Dissolved Lithium (Li)	mg/L	0.0005	0.0072	0.0076	0.0065
Dissolved Magnesium (Mg)	mg/L	0.05	29	39	48
Dissolved Manganese (Mn)	mg/L	0.00005	0.25	0.15	0.22
Dissolved Phosphorus (P)	mg/L	0.002	0.0086	0.015	0.0091
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.00090	0.0013	0.0022
Dissolved Nickel (Ni)	mg/L	0.00002	0.000053	0.0012	0.0052
Dissolved Potassium (K)	mg/L	0.05	22	20	36
Dissolved Rubidium (Rb)	mg/L	0.00005	0.059	0.055	0.091
Dissolved Selenium (Se)	mg/L	0.00004	0.00072	0.00064	0.0017
Dissolved Silicon (Si)	mg/L	0.1	0.56	0.50	0.47
Dissolved Silver (Ag)	mg/L	0.000005	0.000010	*0.000005*	*0.000005*
Dissolved Sodium (Na)	mg/L	0.05	113	246	220
Dissolved Strontium (Sr)	mg/L	0.00005	0.26	0.66	0.60
Dissolved Sulphur (S)	mg/L	*10*	17	16	16
Dissolved Tellurium (Te)	mg/L	0.00002	*0.00002*	0.000040	0.000033
Dissolved Thallium (Tl)	mg/L	0.000002	0.000061	0.000066	0.00011
Dissolved Thorium (Th)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	*0.0005*	*0.0005*	*0.0005*
Dissolved Tungsten (W)	mg/L	0.00001	0.00035	0.00034	0.00039
Dissolved Uranium (U)	mg/L	0.000002	0.0000049	0.000011	0.0000051
Dissolved Vanadium (V)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*
Dissolved Zinc (Zn)	mg/L	0.0001	0.00012	0.0018	0.00078
Dissolved Zirconium (Zr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*

Notes:
Italicized font indicates result is below the detection limit
°All element concentrations are given as dissolved

Attachment G – CPR Laboratory Results – Full ABA

		Paste pH	**S(T)**	**S(SO_4)**	**S(S-2)**	**AP**	**AP from S(T)**	**CO_2**	**TIC**	**Mod NP**	**Net NP**	**Fizz Test**	**TIC/AP**	**NP/AP**
		Std. Units	**%S**	**%S**	**%S**	**kg $CaCO_3$/t**	**kg $CaCO_3$/t**	**wt%**	**kg $CaCO_3$/t**	**kg $CaCO_3$/t**	**kg $CaCO_3$/t**	**-**	**-**	**-**
SAMPLE #	**ROCK TYPE**	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		
R828406	1as	9.1	0.23	*0.01*	0.23	7.2	7.2	13	288	180	173	MODERATE	40	25
R828407	1as	8.9	0.19	0.01	0.18	5.6	5.9	10	230	168	163	MODERATE	39	28
R828408	1as	9.0	0.28	0.01	0.27	8.4	8.8	12	269	165	157	MODERATE	31	19
R828409	1as	8.9	0.27	0.01	0.26	8.1	8.4	11	244	181	173	MODERATE	29	21
R828410	1as	8.8	0.32	0.01	0.31	9.7	10	11	241	164	154	MODERATE	24	16
R828411	1as	9.0	0.55	0.02	0.53	17	17	10	218	154	138	MODERATE	13	9.0
R828412	1as	9.0	0.59	*0.01*	0.59	18	18	13	298	194	176	MODERATE	16	11
R828413	1as	9.1	0.19	0.01	0.18	5.6	5.9	13	300	177	171	MODERATE	51	30
R828414	1as	8.8	0.36	0.01	0.35	11	11	11	259	163	152	MODERATE	23	14
R828415	1as	8.6	0.23	0.01	0.22	6.9	7.2	12	264	167	160	MODERATE	37	23
R828418	1a	8.8	0.21	0.03	0.18	5.6	6.6	11	260	162	156	MODERATE	40	25
R828419	1a	8.9	0.25	0.01	0.24	7.5	7.8	12	270	148	140	MODERATE	35	19
R828420	1a	9.0	0.78	*0.01*	0.78	24	24	11	245	175	151	MODERATE	10	7.2
R828421	1a	8.5	0.32	*0.01*	0.32	10	10	11	245	155	145	MODERATE	25	16
R828422	1a	9.4	0.14	*0.01*	0.14	4.4	4.4	16	368	188	184	MODERATE	84	43
R828423	1a	9.0	0.22	0.01	0.21	6.6	6.9	10	234	174	168	MODERATE	34	25
R828424	1a	8.6	0.10	0.01	0.09	2.8	3.1	14	317	176	174	MODERATE	102	56
R828425	1a	9.2	0.10	*0.01*	0.10	3.1	3.1	13	303	178	175	MODERATE	97	57
R828426	1a	9.0	0.17	*0.01*	0.17	5.3	5.3	13	296	177	171	MODERATE	56	33
R828427	1a	9.0	0.14	*0.01*	0.14	4.4	4.4	15	330	168	163	MODERATE	75	38
R828428	1a	8.8	0.32	*0.01*	0.32	10	10	14	310	177	167	MODERATE	31	18
R828429	1a	9.0	0.20	*0.01*	0.20	6.3	6.3	16	362	182	176	MODERATE	58	29
R828430	1a	9.1	0.49	*0.01*	0.49	15	15	12	283	165	150	MODERATE	18	11
R828431	1a	9.1	0.050	*0.01*	0.05	1.6	1.6	12	282	175	173	MODERATE	181	112

Attachment H – CPR Laboratory Results – Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	ROCK TYPE	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
R828406	1as		0.2	69.7	3.0	82	0.1	70.2	39.2	1570	6.90	16.4	0.1	15.3	0.2	26	0.1	0.1	0.1	54	5.85
R828407	1as		0.3	56.1	3.2	100	0.1	24.2	32.7	1990	8.81	17.1	0.1	102	0.6	33	0.1	0.1	0.1	34	5.36
R828408	1as		0.4	71.3	3.8	81	0.1	40.6	33.2	1740	7.68	23.6	0.1	497	0.3	32	0.1	0.1	0.1	40	5.54
R828409	1as		0.4	61.1	9.0	80	0.1	42.1	30.8	1680	7.16	17.9	0.1	136	0.3	27	0.1	0.2	0.1	41	5.47
R828410	1as		0.4	68.0	2.3	93	0.2	31.2	33.1	1740	8.11	22.3	0.1	1350	0.5	29	0.1	0.1	0.1	37	4.93
R828411	1as		0.5	67.3	3.3	102	0.3	29.9	34.7	1560	8.24	30.8	0.1	566	0.5	29	0.1	0.1	0.1	47	4.43
R828412	1as		0.4	58.9	2.1	75	0.1	58.4	38.7	2010	8.05	25.1	0.1	85.4	0.2	37	0.1	0.1	0.1	45	7.06
R828413	1as		0.3	43.3	1.2	80	0.1	31.6	32.3	1930	7.82	21.2	0.1	354	0.2	47	0.1	0.1	0.1	26	6.33
R828414	1as		0.3	56.8	3.0	116	0.2	22.4	35.7	1790	9.07	34.9	0.1	287	0.4	31	0.1	0.1	0.1	38	5.08
R828415	1as		0.5	65.6	1.4	116	0.1	32.9	36.5	1820	8.57	29.7	0.1	732	0.3	30	0.2	0.1	0.1	35	5.33
R828418	1a		0.3	64.7	1.2	114	0.1	36.7	36.0	1760	8.66	19.6	0.1	43.9	0.3	32	0.1	0.1	0.1	46	5.34
R828419	1a		0.3	44.8	1.3	83	0.1	24.0	33.4	1880	8.29	25.7	0.1	328	0.3	33	0.1	0.1	0.1	37	5.28
R828420	1a		0.5	73.3	1.8	76	1.9	54.6	50.9	1630	7.94	45.7	0.1	12800	0.2	32	0.1	0.1	0.3	28	5.79
R828421	1a		0.2	81.9	1.4	339	0.1	21.5	31.1	1800	8.98	26.1	0.1	98.1	0.6	42	1.2	0.1	0.1	34	5.34
R828422	1a		0.2	77.6	0.7	59	0.1	71.9	36.4	1650	6.87	26.9	0.1	169	0.1	20	0.1	0.1	0.1	32	7.14
R828423	1a		0.3	59.8	1.7	88	0.1	58.7	36.8	1580	7.65	18.3	0.1	5.3	0.5	27	0.1	0.1	0.1	49	5.73
R828424	1a		0.2	49.5	0.9	107	0.1	29.5	31.7	2320	9.38	18.5	0.1	14.6	0.3	38	0.1	0.1	0.1	50	6.80
R828425	1a		0.3	104	2.0	67	0.1	60.8	37.1	1630	6.93	46.0	0.1	43.8	0.1	26	0.1	0.1	0.1	34	6.42
R828426	1a		0.2	91.2	1.8	68	0.1	85.9	58.3	1550	7.11	73.6	0.1	85.2	0.5	25	0.1	0.1	0.1	35	6.03
R828427	1a		0.2	47.2	1.0	87	0.5	32.3	28.7	1930	8.41	19.8	0.1	3200	0.2	36	0.1	0.1	0.1	23	6.56
R828428	1a		0.3	82.9	1.1	85	0.1	70.2	42.8	1660	7.50	22.7	0.1	14.9	0.2	26	0.1	0.1	0.1	40	6.44
R828429	1a		0.2	53.1	1.0	88	0.1	53.4	33.8	2000	8.85	13.7	0.1	12.6	0.2	32	0.1	0.1	0.1	48	7.18
R828430	1a		0.3	58.8	1.0	89	0.2	53.9	37.5	1680	8.08	20.1	0.1	856	0.3	23	0.2	0.1	0.1	39	5.46
R828431	1a		0.2	56.6	1.1	72	0.1	48.5	33.6	1530	6.81	28.2	0.1	7.5	0.2	33	0.1	0.1	0.1	32	5.71

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
SAMPLE #	ROCK TYPE	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
R828406	1as		0.040	2	56	2.25	14	0.005	20	1.49	0.059	0.05	0.1	0.01	15.3	0.1	0.24	5	0.5	0.2
R828407	1as		0.065	3	26	1.90	11	0.004	20	1.63	0.042	0.07	0.6	0.01	13.9	0.1	0.20	6	0.5	0.2
R828408	1as		0.055	2	42	1.93	7	0.004	20	1.46	0.041	0.05	0.1	0.01	15.5	0.1	0.27	6	0.5	0.2
R828409	1as		0.043	2	48	1.98	7	0.003	20	1.37	0.030	0.04	0.1	0.01	15.1	0.1	0.21	5	0.5	0.2
R828410	1as		0.065	3	30	1.76	7	0.006	20	1.66	0.033	0.05	0.1	0.01	13.7	0.1	0.28	6	0.5	0.2
R828411	1as		0.066	3	50	1.67	9	0.009	20	1.83	0.040	0.06	0.1	0.01	15.7	0.1	0.56	8	0.5	0.2
R828412	1as		0.037	1	45	2.48	4	0.010	20	1.50	0.031	0.03	0.1	0.01	15.3	0.1	0.55	5	0.5	0.2
R828413	1as		0.063	2	20	1.90	6	0.002	20	1.19	0.034	0.06	0.1	0.01	13.2	0.1	0.19	4	0.5	0.2
R828414	1as		0.072	3	29	1.79	8	0.012	20	1.59	0.035	0.06	0.3	0.01	14.1	0.1	0.38	6	0.5	0.2
R828415	1as		0.066	3	23	1.83	6	0.003	20	1.51	0.041	0.06	0.1	0.01	14.4	0.1	0.24	6	0.5	0.2
R828418	1a		0.065	3	33	1.96	5	0.006	20	1.84	0.028	0.04	0.1	0.01	16.7	0.1	0.20	7	0.5	0.2
R828419	1a		0.059	3	31	1.87	5	0.003	20	1.48	0.032	0.04	0.1	0.01	14.7	0.1	0.28	6	0.5	0.2
R828420	1a		0.049	1	28	1.86	7	0.003	20	1.11	0.034	0.05	0.1	0.01	13.2	0.1	0.81	5	0.5	1.4
R828421	1a		0.072	3	27	1.69	8	0.011	20	1.65	0.027	0.06	1.2	0.01	14.5	0.1	0.32	6	0.5	0.2
R828422	1a		0.029	1	38	2.36	4	-0.001	20	0.71	0.051	0.04	0.1	0.01	14.8	0.1	0.13	2	0.5	0.2
R828423	1a		0.054	3	43	2.15	14	0.013	20	1.63	0.061	0.07	0.1	0.01	17.0	0.1	0.22	6	0.5	0.2
R828424	1a		0.062	3	24	2.52	5	0.005	20	2.08	0.031	0.04	0.1	0.01	16.9	0.1	0.10	8	0.5	0.2
R828425	1a		0.033	1	32	2.02	5	0.003	20	1.08	0.045	0.04	0.1	0.01	15.2	0.1	0.14	4	0.5	0.2
R828426	1a		0.033	3	38	2.08	7	0.005	20	1.02	0.051	0.05	0.1	0.01	14.7	0.1	0.16	4	0.5	0.2
R828427	1a		0.056	2	26	1.93	6	0.001	20	1.06	0.036	0.05	0.1	0.01	13.5	0.1	0.10	4	0.5	0.2
R828428	1a		0.042	1	41	2.26	4	0.003	20	1.27	0.048	0.04	0.1	0.01	15.8	0.1	0.33	4	0.5	0.2
R828429	1a		0.049	2	30	2.54	5	0.004	20	1.47	0.042	0.03	0.1	0.01	16.4	0.1	0.20	5	0.5	0.2
R828430	1a		0.053	2	35	2.00	7	0.005	20	1.13	0.070	0.06	0.1	0.01	14.9	0.1	0.50	4	0.5	0.3
R828431	1a		0.040	2	37	1.95	7	0.002	20	1.06	0.043	0.05	0.1	0.01	13.1	0.1	0.06	4	0.5	0.3

Attachment I – CPR Laboratory Results – SFE

Shake Flask Extraction Results

		LOD	R828408	R828410	R828411	R828415	R828419	R828420	R828423	R828425	R828426	R828431
			1as	1as	1as	1as	1a	1a	1a	1a	1a	1a
pH	pH Units	N/A	9.3	9.3	9.3	9.4	9.3	9.4	9.1	9.4	9.3	9.4
EC	uS/cm	0.5	152	180	194	199	146	136	142	124	134	172
SO4	mg/L	0.5	9.9	9.4	13.1	8.9	3.6	7.3	1.9	1.6	3.0	3.5
Total Alkalinity	mg/L	0.5	37	37	35	39	43	42	38	42	48	38
Bicarbonate	mg/L	0.5	45	45	42	48	52	52	47	51	59	46
Carbonate	mg/L	0.5	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Hydroxide	mg/L	0.5	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Dissolved Chloride	mg/L	0.5	12	22	21	27	15	11	23	11	9.6	24
Nitrate-N	mg/L	0.02	0.5	0.9	1.1	1.0	0.4	0.3	*0.2*	*0.2*	0.3	0.3
Nitrite-N	mg/L	0.005	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Total Ammonia	mg/L	0.005	0.098	0.13	0.3	0.25	0.09	0.077	0.035	0.11	0.051	0.067
Total Dissolved Solids	mg/L	10	68	90	94	110	92	78	72	62	78	82
Hardness (CaCO3)	mg/L	0.5	29	32	32	30	34	31	26	29	34	34
Dissolved Aluminum (Al)	mg/L	0.0005	0.70	0.48	0.51	0.54	0.66	0.54	0.38	0.54	0.61	0.51
Dissolved Antimony (Sb)	mg/L	0.00002	0.00055	0.00037	0.00039	0.00036	0.00033	0.00080	0.00024	0.00061	0.00070	0.00032
Dissolved Arsenic (As)	mg/L	0.00002	0.0079	0.0038	0.0054	0.0035	0.0029	0.0030	0.00056	0.0054	0.0098	0.0017
Dissolved Barium (Ba)	mg/L	0.00002	0.00084	0.00060	0.00080	0.00052	0.00080	0.00044	0.00032	0.00047	0.00087	0.00057
Dissolved Beryllium (Be)	mg/L	0.00001	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Boron (B)	mg/L	0.05	0.061	0.055	0.096	0.061	0.058	*0.05*	*0.05*	0.052	0.060	*0.05*
Dissolved Cesium (Cs)	mg/L	0.00005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Cadmium (Cd)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	8.0	9.0	8.8	8.2	9.2	8.3	6.9	7.5	9.0	8.9
Dissolved Chromium (Cr)	mg/L	0.0001	0.00022	*0.0001*	*0.0001*	*0.0001*	0.00014	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Cobalt (Co)	mg/L	0.000005	0.00030	0.00025	0.00041	0.00040	0.00025	0.000087	0.000049	0.00022	0.00054	0.000078
Dissolved Copper (Cu)	mg/L	0.00005	0.00054	0.00034	0.00047	0.00028	0.00028	0.00019	*0.00005*	0.00013	0.00071	0.00006
Dissolved Lanthanum (La)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*
Dissolved Iron (Fe)	mg/L	0.001	0.34	0.014	0.13	0.030	0.31	0.018	0.023	0.025	0.12	0.064
Dissolved Lead (Pb)	mg/L	0.000005	0.00022	0.00012	0.00018	0.00013	0.000075	0.000051	0.000027	0.000046	0.000040	0.000036
Dissolved Lithium (Li)	mg/L	0.0005	0.0010	0.0010	0.0010	0.0012	0.0011	0.00098	0.0010	0.00089	0.00094	0.0011
Dissolved Magnesium (Mg)	mg/L	0.05	2.3	2.3	2.5	2.4	2.8	2.6	2.1	2.4	2.7	2.9
Dissolved Manganese (Mn)	mg/L	0.00005	0.0081	0.00237	0.00419	0.00307	0.0098	0.0037	0.0053	0.0031	0.0058	0.0046
Dissolved Phosphorus (P)	mg/L	0.002	0.0062	0.0029	0.0027	0.0026	0.0065	*0.002*	*0.002*	*0.002*	0.0056	0.0035
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.00079	0.0018	0.0014	0.0012	0.00052	0.00056	0.00033	0.00030	0.00027	0.00036
Dissolved Nickel (Ni)	mg/L	0.00002	0.00038	0.00011	0.00020	0.00011	0.00021	0.00014	0.000071	0.00011	0.00043	0.00010
Dissolved Potassium (K)	mg/L	0.05	3.5	3.8	4.2	4.7	3.4	3.4	2.6	2.4	2.5	3.4
Dissolved Rubidium (Rb)	mg/L	0.00005	0.0015	0.0016	0.0019	0.0027	0.0019	0.0020	0.0014	0.0013	0.0011	0.0022
Dissolved Selenium (Se)	mg/L	0.00004	0.00042	0.00045	0.00053	0.00044	0.00042	0.00063	0.00019	0.00024	0.00038	0.00021
Dissolved Silicon (Si)	mg/L	0.1	1.3	0.82	0.99	0.84	1.05	0.71	0.52	0.76	0.93	0.77
Dissolved Silver (Ag)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Sodium (Na)	mg/L	0.05	16	19	21	23	14	14	19	12	14	18
Dissolved Strontium (Sr)	mg/L	0.00005	0.010	0.013	0.012	0.012	0.013	0.0099	0.0084	0.0099	0.0094	0.013
Dissolved Sulphur (S)	mg/L	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*
Dissolved Tellurium (Te)	mg/L	0.00002	*0.00002*	*0.00002*	*0.00002*	*0.00002*	*0.00002*	0.000047	*0.00002*	*0.00002*	*0.00002*	*0.00002*
Dissolved Thallium (Tl)	mg/L	0.000002	0.0000046	0.0000035	0.0000057	0.0000042	0.0000042	0.0000036	*0.000002*	*0.000002*	*0.000002*	0.0000041
Dissolved Thorium (Th)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	0.00191	*0.0005*	0.00074	*0.0005*	0.00252	*0.0005*	*0.0005*	*0.0005*	0.00107	*0.0005*
Dissolved Tungsten (W)	mg/L	0.00001	0.00018	0.00012	0.00016	0.00029	0.00015	0.00017	0.000022	0.000069	0.000061	0.000049
Dissolved Uranium (U)	mg/L	0.000002	0.000041	0.000039	0.000041	0.000020	0.000022	0.000023	0.0000022	0.000010	0.00015	0.000005
Dissolved Vanadium (V)	mg/L	0.0002	0.0012	0.00055	0.00076	0.00056	0.00077	0.00069	0.00030	0.00089	0.00126	0.00063
Dissolved Zinc (Zn)	mg/L	0.0001	0.00092	0.00043	0.00085	0.00043	0.00062	*0.0001*	0.00011	*0.0001*	0.00019	*0.0001*
Dissolved Zirconium (Zr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.00040	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*

Notes:

Italicized font indicates result is below the detection limit

°All element concentrations are given as dissolved

Appendix B – 2019 Geochemical Monitoring of Waste Rock, Madrid North Mine

Note: Data interpretation for the geochemical and geological monitoring of Madrid North waste rock is in progress and will be provided as a supplementary submission.

Appendix C – 2019 Hope Bay Quarry and Construction Rock Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter, SRK Lisa Barazzuol, SRK	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 25, 2020
Subject:	2019 Hope Bay Construction Rock Geochemical Monitoring		

1 Introduction

Between mid-2018 and mid-2019, TMAC Resources Inc. (TMAC) constructed the following infrastructure at Doris and Madrid North (Attachment A):

- Doris: access road to the vent raise; access road to the Doris crown pillar recovery (CPR); cover for the Doris CPR; and access road and jetty at Roberts Bay to the effluent discharge point.
- Madrid North: access road to the Naartok East CPR; Madrid North contact water pond (CWP); access road to the Madrid North CWP; and Naartok East overburden pad berm.

Infrastructure at Doris and Madrid North were constructed using rock from Quarry 2 and Quarry D, respectively (Attachment A) except for the Doris CPR cover, which was built using of a combination of Doris waste rock (underground and CPR) and rock from Quarry 2.

Prior to use as construction rock, TMAC geochemically characterized the stockpile of Doris CPR waste rock on Pad T and determined this material to be suitable as construction rock prior to using it to build the CPR cover (SRK 2020). Monitoring requirements for waste rock used as construction rock are specified in in Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018), *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019) and the Quarry Management and Monitoring Plan (TMAC 2017).

Prior to development, the rock from Quarry 2 and Quarry D was geochemically characterized and classified as not potentially acid generating with low potential for metal leaching (SRK 2008; SRK 2010). Operational quarry rock characterization and construction monitoring has assessed the ARD potential of the run-of-quarry (ROQ) rock and confirmed these conclusions (e.g. SRK 2019).

Monitoring requirements for quarries and quarry rock associated with the Doris Mine, Doris-Windy Road and Madrid North Mine are specified in Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018), Water Licence 2BE-HOP1222 (Nunavut Water Board 2012), and the Framework Agreement signed between TMAC and the Kitikmeot Inuit Association (KIA) for belt wide land tenure. Details on how the requirements are implemented for quarries and quarry rock associated with the Doris-Windy Road are documented in the Quarry Management and Monitoring Plan (TMAC 2017).

This memo documents the results of the 2019 geochemical monitoring programs for run-of quarry (ROQ) rock from Quarry 2 and Quarry D, and construction materials (quarry rock and suitable waste rock) collected from as-built infrastructure. It was not necessary to discharge water from Quarry 2 or Quarry D during 2019 therefore no seep or sump sampling was undertaken.

2 Methods

2.1 Quarry Monitoring

In order to comply with the Quarry Management and Monitoring Plan (TMAC 2017), monitoring includes geological inspections of active quarry blast faces and collection of ROQ rock for geochemical characterization. A summary of monitoring activities at Quarry 2 and Quarry D is presented in Table 2-1. Active blasting was conducted in Quarry 2 in May, June, October and December 2019. Active blasting was conducted in Quarry D in May, June and September 2019. Attachment B includes the quarry inspection and sample descriptions.

Table 2-1: Summary of Quarry Inspections and Samples Collected

Inspection Month	Quarry 2		Quarry D	
	Inspections	Samples Collected	Inspections	Samples Collected
May	1	2	3	2
June	-	-	3	-
July	2	2	1	2
August	1*	1*	-	-
September	-	-	2	4

Notes:

*Argillite in quarry wall.

TMAC documented each blast face inspection including lithology, sulphide content and veining and presence/absence of fibrous actinolite (Attachment B). TMAC collected samples of ROQ rock as two fractions: a sieved coarse fraction (screened to -1 cm) and a finer fraction (screened to -2 mm). TMAC visually described the samples, including lithology, visible sulphide content, carbonate content and presence of veining (Attachment B). In addition, SRK collected one composite sample of argillite from the quarry wall of Quarry 2 in August.

TMAC and SRK shipped their respective samples to BV in Burnaby, BC for analysis of total sulphur by Leco. Samples containing total sulphur concentrations >0.1% were subsequently tested for acid-base accounting (ABA) and trace element content by aqua regia digestion followed by ICP-MS scan. ABA included paste pH, electrical conductivity (EC), sulphate sulphur by hydrochloric acid leach, Modified Sobek NP (MEND 1991), and total inorganic carbon (TIC).

TIC was determined by using a Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample. The -2 mm samples also underwent a shake flask extraction (SFE) test on the as-received fraction using the MEND (2009) method with a 3:1 solution to solid ratio and a 24-hour shaking period. The SFE leachate was analyzed for pH, EC, SO_4, acidity, alkalinity, chloride, ammonia, total dissolved solids (TDS), and low-level dissolved metals including mercury and selenium. Geochemical analyses were coordinated by TMAC and SRK for their respective sample sets.

2.2 Construction Monitoring

In August 2019, SRK geochemist Derrick Midwinter, PGeo. conducted a geological inspection of infrastructure and roads constructed between August 2018 and August 2019 and collected 12 samples from the areas noted in Section 1 (Attachment A).

The geological inspection entailed walking the periphery of infrastructure with the objective of inspecting the construction materials to confirm the visual geological and geochemical composition were consistent with expected material sources.

SRK collected 12 samples and one field duplicate (SRK19-CR08-Dup) from the infrastructure areas inspected. Samples were collected from pre-determined locations with one sample taken from each infrastructure area inspected or at a minimum of every 500 m along roads. SRK visually described the samples, including lithology, visible sulphide content, carbonate content, and presence of veins (Attachment C). Photos of the inspected areas and sampling locations are included in Attachment D. Sample collection entailed sieving material to generate two size fractions (-1 cm and -2 mm). SRK conducted rinse tests using a 1 to 1 distilled water to solids ratio with a split of the -2 mm sieved portion and recorded the resulting pH and EC.

TMAC shipped samples to BV in Burnaby, BC with SRK providing test work instructions to the lab. The -1 cm fraction was initially analyzed of total sulphur by Leco, with samples containing total sulphur concentrations >0.1% subsequently analyzed for ABA and trace element content, using the same methods as outlined in Section 2.1. Seven samples were selected by SRK for SFE tests. One sample from each area was selected for SFE. In areas where there were multiple samples, SRK selected samples on the basis of high rinse EC values and high total sulphur values. SFE test methods are outlined in Section 2.1.

2.3 Quality Assurance and Control

SRK reviewed all data for QA/QC purposes, including BV's internal QC program.

Field rinse tests were carried out using deionized water and a handheld pH / EC meter that was calibrated prior to taking measurements. One field duplicate was collected by SRK (SRK19-CR-08-DUP) which passed all QA/QC criteria for rinse tests.

Table 2-2 presents the QAQC results for the ABA, trace element and SFE data. Laboratory results passed all QA/QC criteria except one sample. One sample initially failed the QC criterion for Leco and ICP sulphur but after the sample was re-run for both parameters, the data passed and the new results accepted. SRK deemed all results to be acceptable.

Table 2-2: QAQC Summary Table

QC Test	SRK QC Criteria	Quarry Monitoring		Construction Monitoring	
paste pH					
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=0)	#N/A	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=5)	All Passed	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5)	All Passed	(n=1)	All Passed
Total C and TIC					
Method Blank	<2X detection limit (DL)	(n=4) for TIC	All Passed	(n=1) for TIC	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1) for TIC	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for TIC	All Passed	(n=2) for TIC	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5) for TIC	All Passed	(n=2) for TIC	All Passed
Total S & Total Sulphate					
Method Blank	<2X detection limit (DL)	(n=5) for Total S and (n=5) for SO4	All Passed	(n=1) for Total S and (n=1) for SO4	All Passed
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within +/-20%	(n=16)	All Passed	(n=12)	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1) for Total S and (n=1) for SO4	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for Total S and (n=4) for SO4	All Passed	(n=0) for Total S and (n=1) for SO4	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=12) for Total S and (n=8) for SO4	All Passed	(n=2) for Total S and (n=2) for SO4	All Passed
Modified NP					
Method Blank (n=0)	<2X detection limit (DL)	(n=5) for NP	All Passed	(n=1) for NP	All Passed
NP consistent with paste pH	Negative NP has paste pH <= 5	(n=16)	All Passed	(n=12)	All Passed
Field Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=0)	#N/A	(n=1)	All Passed
Pulp Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=5) for NP and (n=5) for Fizz Rating	All Passed	(n=1) for NP and (n=1) for Fizz Rating	All Passed
Fizz test rating with NP	Max NP does not exceed fizz test rating	(n=16)	All Passed	(n=12)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5) for NP	All Passed	(n=1) for NP	All Passed
Modified NP and TIC					
Comparison between Modified NP and TIC	Check for trends/co-relation	(n=16)	NP generally higher than TIC	(n=12)	NP generally higher than TIC
Total S-Leco and S-ICP					
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n=11)	Y247801 -1CM – Sample initially failed QC criterion but upon re-run the sample passed. New data accepted.	(n=12)	All Passed
Trace Elements (Aqua Regia Digestion with ICP Finish)					
Method Blank	<2X Detection Limit	(n=4)	All Passed	(n=1)	All Passed
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=0)	#N/A	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=8)	All Passed	(n=2)	All Passed
Shake Flask Extraction					
Method Blank	<5X Detection Limit	(n=5) for SO4, Total Alkalinity, Bicarbonate, Carbonate and Hydroxide and (n=4) for the rest of the parameters	All Passed	(n=1)	All Passed
Lab Blank	<5X Detection Limit	(n=2) for TIC	All Passed	(n=0)	#N/A
Ion Balance	EC>100uS/cm, % difference should be within +/-10%	(n=8)	All Passed	(n=7)	All Passed
Leachate Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=8)	All Passed	(n=0)	#N/A
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for Total Alkalinity, (n=1) for the rest of the parameters	All Passed	(n=0)	#N/A

Source: \\VAN-SVR0\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!020_Project_Data\Lab\Quarry Rock\1CT022.037_HopeBay_Summary_QAQC_Table_Quarry_Construction_2019_rev02_mlt.xlsx

2.4 Data Interpretation

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample, where total sulphur was used to calculate AP. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when TIC/AP ratios are less than 1 and as having an uncertain potential for ARD when TIC/AP ratios are between 1 and 3. For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

3 Results

3.1 Quarry Monitoring

3.1.1 Quarry Face Inspections

Quarry 2

In 2019, TMAC conducted 3 active face inspections of Quarry 2 between May and August. See Attachment B for completed inspection forms. All inspections identified quarry faces as mafic metavolcanics (1a) except for the inspection in August that identified a band of argillite (5a).

The key observations recorded by TMAC geologists were that active quarry faces inspected between May and July were light to dark grey mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately <2%) and up to 10 mm wide. Small amounts of hematite staining were observed on the joint surfaces during all three inspections. No epidote or chlorite alteration was observed. All inspections noted the absence of fibrous actinolite.

TMAC’s inspection of the quarry in August 2019 indicated the occurrence of a 3 to 4 m thick argillite band in one quarry face in the western extent of Quarry 2. TMAC mapped the occurrence of the argillite (Attachment B).

Quarry D

In 2019, TMAC conducted nine active face inspections in Quarry D between May and September. See Attachment B for completed inspection forms.

The key observations recorded by TMAC geologists were that all active quarry faces inspected were light to medium grey mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately <2%) and <1 cm. Small amounts of hematite stringers/staining were observed on joint and fracture surfaces during the majority of inspections. Weak to moderate epidote alteration was noted during one inspection (June 2019). In July, the visual inspection by the TMAC geologist described the quarry face as having 10% fine- to medium-grained gabbroic fragments with mafic metavolcanics. No chlorite alteration was reported. All inspections noted the absence of fibrous actinolite.

3.1.2 ABA

The ABA results for Quarry 2 and Quarry D are presented in Table 3-1, Figure 3-1 to Figure 3-4 and included in Attachment E.

Quarry 2

Samples collected from Quarry 2 were geologically logged as mafic metavolcanics (1a) or argillite (5a).

Paste pH for mafic metavolcanics (1a) samples ranged from 7.6 to 8.4 compared to a pH of 7.5 for the argillite (5a) sample.

Total sulphur concentrations ranged between 0.14 and 0.41% for mafic metavolcanics (1a) and were highest for the sample of argillite (2.3%). For mafic metavolcanics, sulphur content was greater in the fine fraction than the coarse fraction (Figure 3-1). Sulphate sulphur content was below the limit of detection (0.01%) or within the range of analytical error for all samples and rock types. Sulphide sulphur was at near parity with total sulphur content for the coarser fraction except for two samples of mafic metavolcanics (-2 mm) that contained a high proportion of sulphur as sulphate (Figure 3-1).

Modified NP and TIC content ranged between 150 and 220 kg $CaCO_3$/t and 140 and 200 kg $CaCO_3$/t, respectively for mafic metavolcanics (1a) samples. For the sample of argillite, Modified NP and TIC content was 70 and 75 kg $CaCO_3$/t, respectively. TIC content was generally at near parity with modified NP for all samples (Figure 3-2).

The mafic metavolcanics (1a) samples were classified as non-PAG whereas the argillite (5a) sample was classified as uncertain on the basis of TIC/AP and NP/AP (Figure 3-3 and Figure 3-4).

Quarry D

Paste pH for all mafic metavolcanics (1a) samples ranged from 7.5 to 9.0.

Total sulphur concentrations ranged between 0.09 and 0.26%. Total sulphur in the fine and coarse size fractions were roughly equivalent or greater in the fine fraction than the coarse fraction. Sulphate sulphur content below the limit of detection (0.01%) or within the range of analytical error. Sulphide and total sulphur content were near parity (Figure 3-1). Full ABA was not completed for sample Y250342 since total sulphur was less than 0.1%.

Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively. TIC content was generally at parity with modified NP (Figure 3-2).

All samples were classified as non-PAG on the basis of TIC/AP and NP/AP (Figure 3-3 and Figure 3-4).

Table 3-1: Acid Base Accounting Results for the 2019 Quarry 2 and Quarry D Rock Samples

Quarry	Rock Type	Sampling Month	Grain Size	Sample ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	Modified NP	TIC	NP/AP	TIC/AP
				Units	s.u.	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg CaCO3/t		
Quarry 2	1a	May	-1 cm	Y247801 <1CM	7.7	0.22	0.03	0.19	6.9	150	140	22	20
			-2 mm	Y247801 <2MM	7.7	0.34	0.05	0.29	10	220	190	21	18
			-1 cm	Y247802 <1CM	7.6	0.23	0.10	0.13	7.2	200	180	28	25
			-2 mm	Y247802 <2MM	7.6	0.34	<0.01	0.34	7.5	200	200	19	19
		July	-1 cm	WJ8404	8.4	0.14	0.10	0.04	4.4	170	190	40	42
			-2 mm	WJ8403	8.1	0.41	0.07	0.34	13	180	190	14	15
	5a	August	-1 cm*	SRK19-QR2-01	7.5	2.3	0.14	2.1	71	70	75	1.0	1.1
Quarry D	1a	May	-1 cm	Y264562 <1CM	7.5	0.14	<0.01	0.14	4.4	100	87	23	20
			-2 mm	Y264561 <2MM	7.5	0.12	<0.01	0.12	3.8	120	100	32	27
		July	-1 cm	Y250342**	--	0.09	--	--	--	--	--	-	-
			-2 mm	Y250341	8.2	0.18	0.02	0.16	5.6	160	150	29	26
		September	-1 cm	Y264152	9.0	0.15	<0.01	0.15	4.7	150	140	31	30
			-2 mm	Y264151	8.5	0.26	0.01	0.25	8.1	210	180	26	22
			-1 cm	Y264154	8.8	0.19	<0.01	0.19	5.9	130	150	23	26
			-2 mm	Y264153	8.7	0.15	<0.01	0.15	4.7	190	170	40	36

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Note: AP calculated from total sulphur content;

N/A denotes not applicable based on total sulphur content <0.1%

*Sample was collected from quarry wall and is not ROQ rock.

** ABA was not completed because total sulphur was <0.1%.

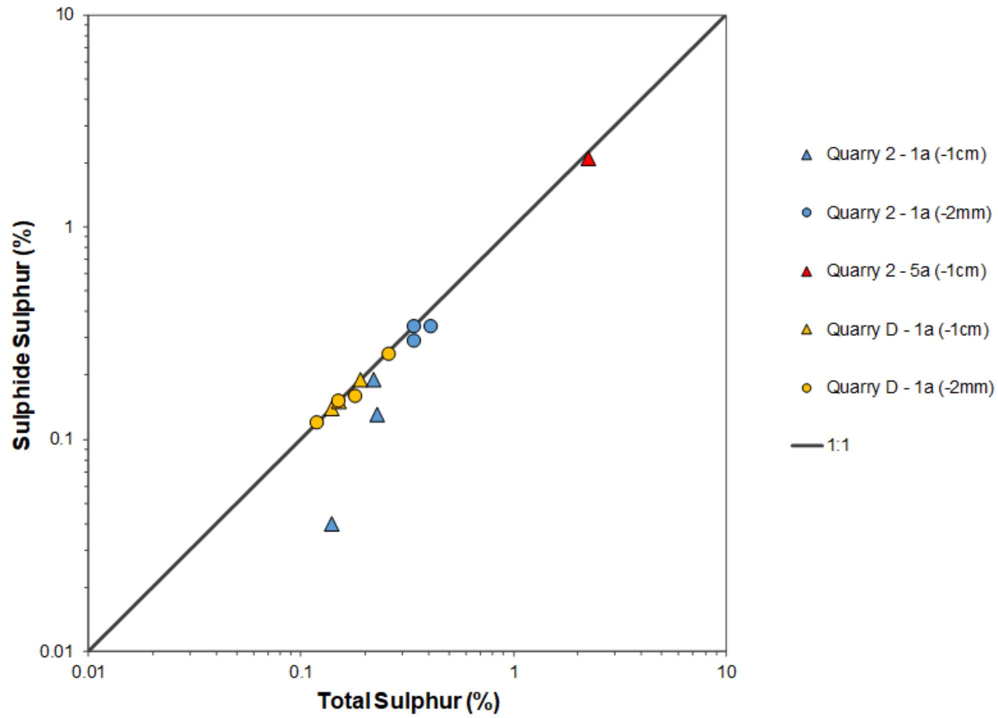

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Figure 3-1: Comparison of Total Sulphur versus Sulphide, Quarry Samples

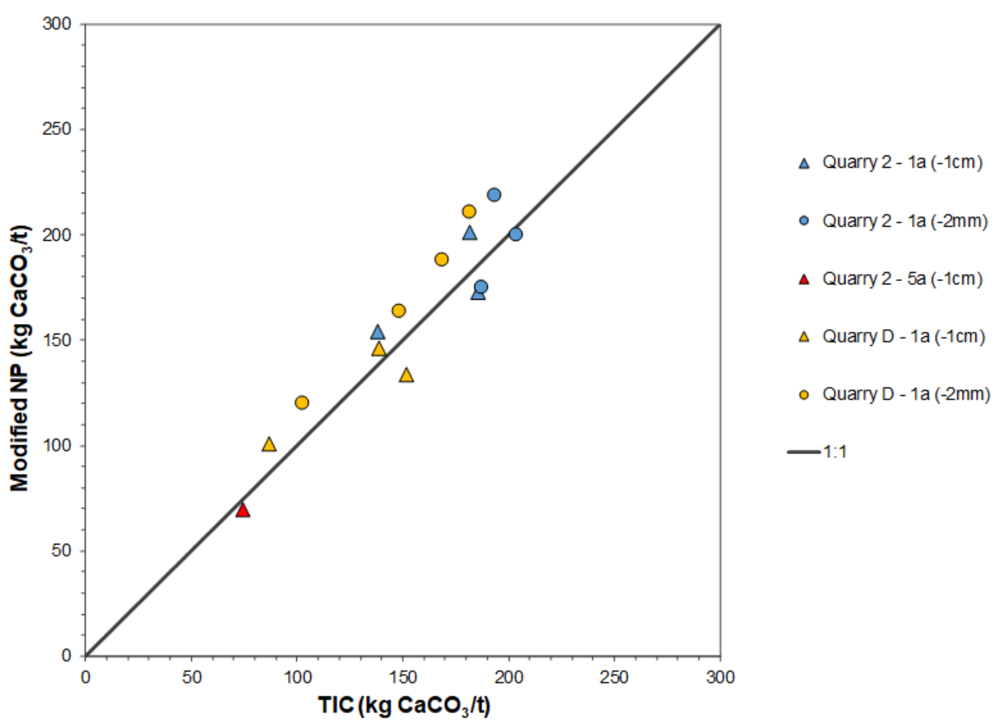

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Figure 3-2: Comparison of Modified NP versus TIC, Quarry Samples

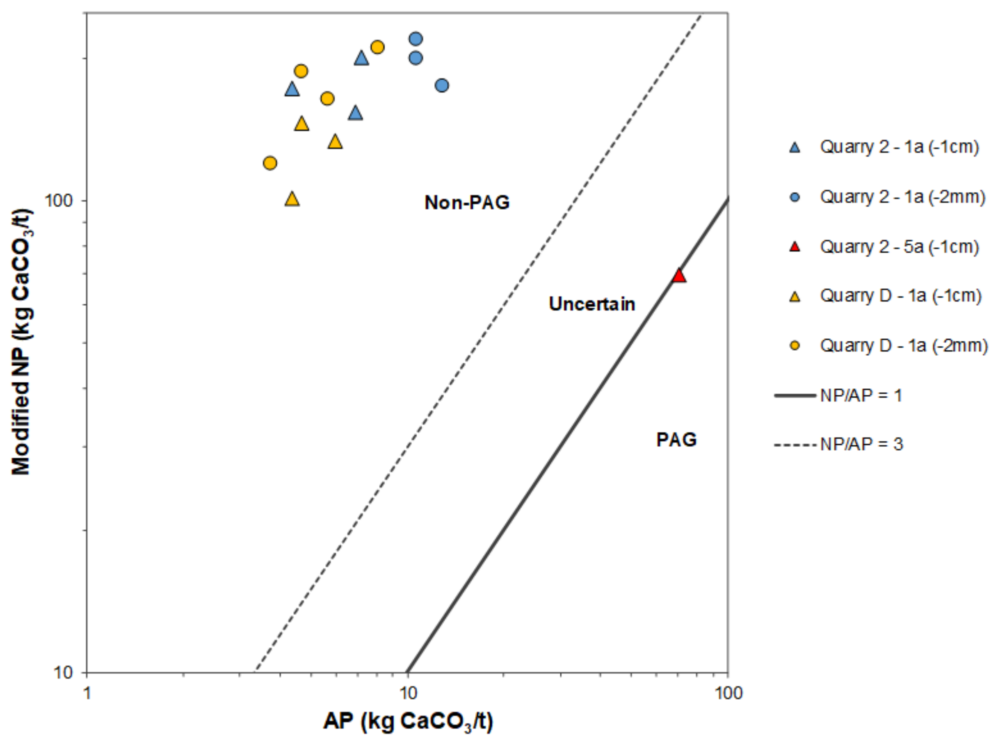

Figure 3-3: ARD Classifications by NP/AP, Quarry Samples

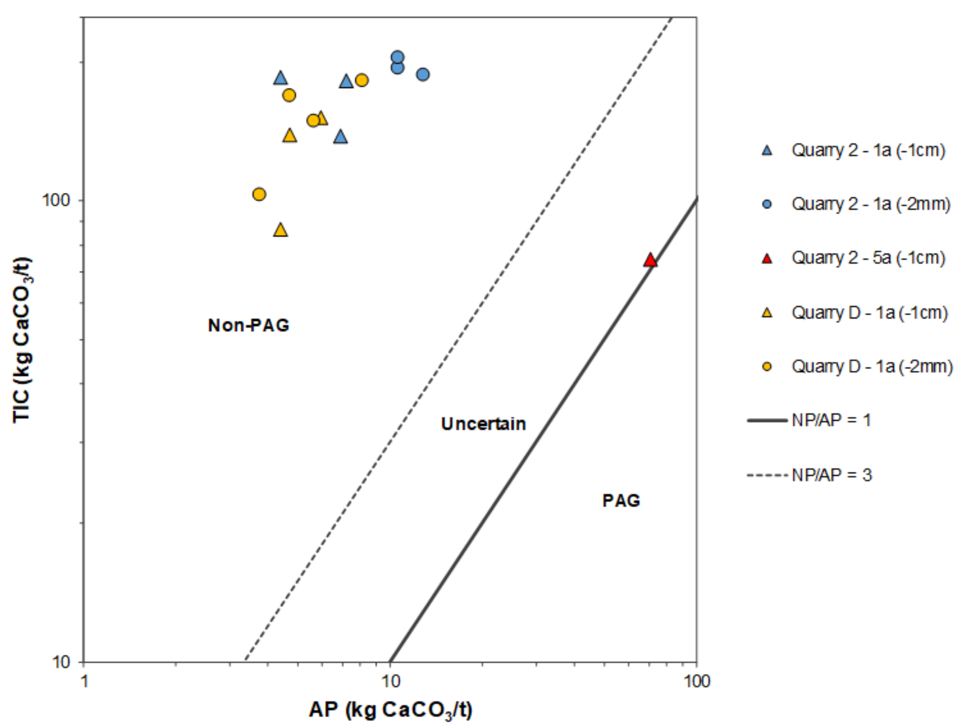

Figure 3-4: ARD Classifications by TIC/AP, Quarry Samples

3.1.3 Elemental Analyses

Selected key parameter results are presented in Table 3-2 and full laboratory results are included in Attachment E. The data were compared to ten times the average crustal abundance for basaltic rocks (Price 1997) to screen for enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

Quarry 2

For mafic metavolcanics (1a) the fine fraction had higher levels of sulphur and arsenic in the fine fraction, with enrichment of sulphur in all -2 mm samples, and arsenic in two samples. All -1 cm samples of mafic metavolcanics were below the screening criteria indicating no appreciable enrichment.

Similarly, for argillite (5a) selenium, sulphur and arsenic were enriched. All other parameters for the argillite were below the screening criteria indicating no appreciable enrichment.

Quarry D

All size fractions and samples were below the screening criteria indicating no appreciable enrichment.

Table 3-2: Metals Analysis of Key Parameters for Quarry 2 and Quarry D Rock Samples

		Quarry>	**Quarry 2**							**Quarry D**						
		Rock type>	**Mafic metavolcanics (1a)**						**Argillite (5a)**	**Mafic metavolcanics (1a)**						
		Inspection Month>	**May**				**July**		**August**	**May**		**July**	**September**			
		Sample ID>	**Y247801**	**Y247801**	**Y247802**	**Y247802**	**WJ8404**	**WJ8403**	**SRK19-QR2-01**	**Y264562**	**Y264561**	**Y250341**	**Y264152**	**Y264151**	**Y264154**	**Y264153**
Parameter	**Units**	***Screening Criteria**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1cm rock**	**-1 cm rock**	**-2 mm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**
Mo	ppm	*15*	0.30	0.40	0.40	0.50	0.30	0.50	1.2	0.90	1.50	0.80	0.50	0.30	0.20	0.20
Cu	ppm	*870*	160	150	140	150	110	130	410	100	110	110	110	110	85	89
Pb	ppm	*60*	2.7	5.6	7.3	20	1.8	2.4	9.8	1.7	4.0	3.6	1.9	3.7	1.1	2.1
Zn	ppm	*1050*	250	190	180	190	98	97	85	64	70	76	66	66	54	57
Ni	ppm	*1300*	42	41	41	41	37	37	56	200	210	110	170	200	200	230
Fe	ppm	*865000*	110000	110000	110000	110000	91000	89000	55000	53000	55000	55000	58000	55000	50000	53000
As	ppm	*20*	1.2	2.6	2.9	**<u>24</u>**	16	**<u>26</u>**	**<u>33</u>**	1.9	16	3.7	1.1	1.7	0.90	1.4
Au	ppm		0.023	0.032	0.018	0.012	0.0034	0.015	0.0028	0.001	0.005	0.007	0.0015	0.0031	0.0011	0.0019
Cd	ppm	*2.2*	0.70	0.50	0.40	0.50	<0.1	<0.1	0.1	<0.1	0.20	0.20	<0.1	<0.1	<0.1	<0.1
Al	ppm	*780000*	49000	49000	50000	49000	39000	38000	25000	36000	37000	35000	38000	37000	34000	38000
Hg	ppm	*0.9*	<0.01	<0.01	0.01	0.07	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S	ppm	*3000*	2300	**<u>3300</u>**	2400	**<u>3100</u>**	2800	**<u>3300</u>**	**<u>24000</u>**	800	1100	1600	1000	2100	900	1200
Se (1)	ppm	*0.5*	0.70	0.80	0.70	0.80	0.70	0.70	3.5	<0.50	0.60	0.60	0.50	0.70	<0.50	<0.50

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Notes:

°All element concentrations are given as dissolved

*Screening criteria is ten times average crustal abundance for basaltic rocks from Price (1997).

(1) Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error

Bold and underlined values indicate value is above the screening criteria

3.1.4 SFE Tests

A summary of SFE test results for Quarry 2 and Quarry D is presented in Table 3-3, with complete results presented in Attachment E. The results are compared to the maximum concentration in any grab sample guideline from the Quarry Effluent Quality Limits (Table 2.2, TMAC 2017); however, this is for screening purposes only as SFE results do not necessarily represent quarry water quality.

Quarry 2

For mafic metavolcanics (1a) samples, pH ranged from 9.0 to 9.2 and EC ranged from 110 to 310 µS/cm. Comparatively, the argillite (5a) sample had a pH of 7.5 and EC of 1,300 µS/cm. The conductivity value for argillite (5a) was greater than the screening criteria (500 µS/cm), and the pH of the mafic metavolcanics (1a) samples were greater than the screening criteria (pH 9.0).

For mafic metavolcanics (1a), major cation chemistry was dominated by sodium (29 to 40 mg/L) and calcium (12 to 15 mg/L), while major anion chemistry was dominated by chloride (32 to 56 mg/L), sulphate (27 to 29 mg/L) and alkalinity (23 to 24 mg/L as $CaCO_3$). Nitrate and ammonia concentrations ranged from 0.2 to 8.9 mg/L and 1.3 to 1.5 mg/L, respectively.

For the argillite sample, major cation chemistry was dominated by calcium (290 mg/L) while major anion chemistry was dominated by sulphate (780 mg/L). Magnesium, sodium and potassium were a magnitude lower than calcium. Nitrate (below detection limit, 0.2 mg/L), and chloride (4 mg/L) concentrations ranged were one to two magnitudes lower than sulphate.

All metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that sulphate concentrations for argillite suggest sulphide oxidation.

Quarry D

For all samples, pH ranged from 8.6 to 9.1 and EC ranged from 160 to 430 µS/cm. One sample exceeded the pH criteria.

Major cation chemistry was dominated by sodium (8.5 to 49 mg/L) and calcium (4.9 to 16 mg/L), while major anion chemistry was dominated by alkalinity (32 to 37 mg/L as $CaCO_3$), sulphate (7.9 to 25 mg/L) and chloride (6.9 to 49 mg/L). Nitrate and ammonia concentrations ranged from 2.7 to 15 mg/L and 0.011 to 6.0 mg/L, respectively. One sample exceeded the ammonia criteria.

All other parameters were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low.

Table 3-3: Shake Flask Extraction Results for Quarry 2 and Quarry D Monitoring Samples (-2 mm fraction)

Parameter	Units	Detection Limit	*Screening Criteria	Quarry 2				Quarry D			
				1a			5a	1a			
				May		July	August	May	July	September	
				Y247801	Y247802	R828433	SRK19-QR2-01	Y264561	Y250341	Y264151	Y264153
pH*	pH Units	N/A	9.0	**9.2**	**9.1**	9.0	7.7	8.6	8.9	**9.1**	8.9
EC*	uS/cm	0.5	500	320	340	290	1300	160	430	230	270
Sulphate	mg/L	0.5		27	29	28	780	21	25	7.9	14
Total Alkalinity ($CaCO_3$)	mg/L	0.5		23	23	24	15	32	35	37	35
Dissolved Chloride	mg/L	0.5		56	54	32	4	6.9	49	30	43
Nitrate-N	mg/L	0.02		3.7	4.2	8.9	< 0.2	3.0	15	2.7	6.8
Total Ammonia*	mg/L as N	0.005/ 0.25(1)	4.0	1.3 (1)	1.3 (1)	1.5	-	0.011	**6.0** (1)	1(1)	0.81 (1)
Total Dissolved Solids	mg/L	10		-	-	170	1300	90	190	130	180
Total Hardness ($CaCO_3$)	mg/L	0.5		42	51	48	820	52	48	15	18
Calcium (Ca)	mg/L	0.05		12	14	15	290	16	13	4.9	5.8
Magnesium (Mg)	mg/L	0.05		3.0	3.7	2.8	25	3.1	3.8	0.77	0.93
Potassium (K)	mg/L	0.05		4.6	5.0	6.2	8.3	1.9	4.8	2.6	3.5
Sodium (Na)	mg/L	0.05		40	40	29	5.3	8.5	49	36	46
Aluminum (Al)	mg/L	0.0005	2.0	0.33	0.33	0.21	0.029	0.17	0.18	0.25	0.20
Arsenic (As)	mg/L	0.00002	0.10	0.00040	0.00063	0.0037	0.00032	0.0064	0.00093	0.0012	0.0014
Cadmium (Cd)*	mg/L	0.000005		<0.000005	<0.000005	<0.000005	0.00018	<0.000005	<0.000005	<0.000005	<0.000005
Copper (Cu)*	mg/L	0.00005	0.04	0.00057	0.001	0.00049	0.004	0.0020	0.00085	0.00078	0.00087
Iron (Fe)*	mg/L	0.001	0.60	0.0098	0.022	0.003	0.0026	0.0021	0.0085	0.061	0.023
Lead (Pb)*	mg/L	0.000005	0.02	0.00012	0.00026	0.000022	0.00027	<0.000005	0.000073	0.000077	0.000018
Molybdenum (Mo)	mg/L	0.00005		0.0018	0.0017	0.0031	0.0035	0.0031	0.0053	0.0021	0.0028
Nickel (Ni)*	mg/L	0.00002	0.10	0.000085	0.000069	0.000049	0.00063	0.00043	0.00022	0.00022	0.0001
Selenium (Se)	mg/L	0.00004		0.0005	0.00048	0.0025	0.0027	0.00037	0.00046	0.00087	0.00081
Zinc (Zn)*	mg/L	0.0001	0.02	0.0018	0.0018	0.0028	0.0058	<0.0001	0.0027	0.0025	<0.0001
Mercury (Hg)	mg/L	0.00005		<0.00005	<0.00005	<0.00005	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

°All element concentrations are given as dissolved.

(1) Detection limits raised from 0.005 mg/L to 0.25 mg/L due to dilution to bring analyte within the calibrated range.

Values in bold indicates value exceeds respective water quality guideline for the parameter.

*Guideline from maximum concentration in any grab sample from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

3.2 Construction Monitoring

3.2.1 Geological Inspections

Doris

SRK understands ROQ rock was used to construct all infrastructure at Doris except for the Doris CPR cover, which was a combination of waste rock and ROQ rock.

As shown in Figure 3-5, the majority of the CPR cover material was CPR waste rock with selected area of ROQ rock. With some minor exceptions, rock used to construct the cover were mafic metavolcanics (1) but with compositional and/or textural differences. The ROQ rock in the CPR cover was mafic metavolcanics (1a) with trace (<1%) to no visible sulphides as cubic pyrite and minor carbonate and quartz veins. Waste rock was primarily foliated black-brown metavolcanics (1ay) and light brown altered metavolcanics (1as) with lesser mafic metavolcanics (1a) with <1% of waste rock present as quartz veins (12q) and lesser diabase (11). The mafic volcanics contained minor carbonate and quartz veining and also rare hematite staining and no sulphides observed except for a localized fragments of mafic metavolcanics with up to 1% cubic pyrite.

The geological inspection of all other infrastructure areas indicated that construction rock was typically dark green mafic metavolcanics (1a) except for a 120 m segment of the access road to the Doris vent raise that contained ~5-10% of argillite (5a) present as black fragments (~5-20 cm) mixed with mafic metavolcanics (1a). The argillite contained visible sulphides (3 to 5% as cubic pyrite associated with quartz veining) and no carbonate veins.

Typical ROQ mafic metavolcanics (1a) contained no to trace amounts (< 1%) of visible sulphides that were typically present as very fine grained cubic pyrite that were disseminated or associated with veining. There were few carbonate and quartz veins, typically < 1 cm wide. Also common was hematite staining (~5%). Mafic metavolcanics (1a) fragments containing greater sulphides (~5%), typically cubic and associated with quartz veins were observed in localized areas. Rare (< 1%) granitic boulders (~10-50 cm) were also encountered throughout the infrastructure. These boulders were often well-rounded and are interpreted to represent glacial erratics. One occurrence of chalcopyrite (< 1%) was observed at Roberts Bay. Rare epidote veins were also observed at Roberts Bay (Figure 3-6).¶

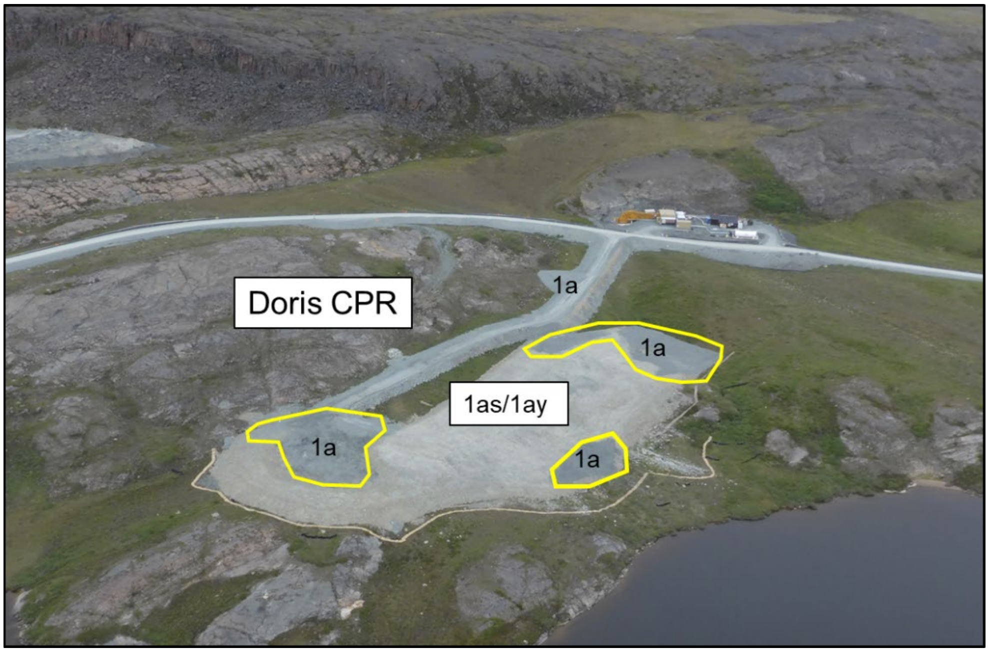


Figure 3-5: Photo of the Doris CPR Cover which was Constructed using Waste Rock (altered mafic metavolcanics and foliated metavolcanics (1as/1ay)) and ROQ Rock (mafic metavolcanics (1a)). Areas of ROQ rock are circled in in yellow (Dated July 31, 2019).

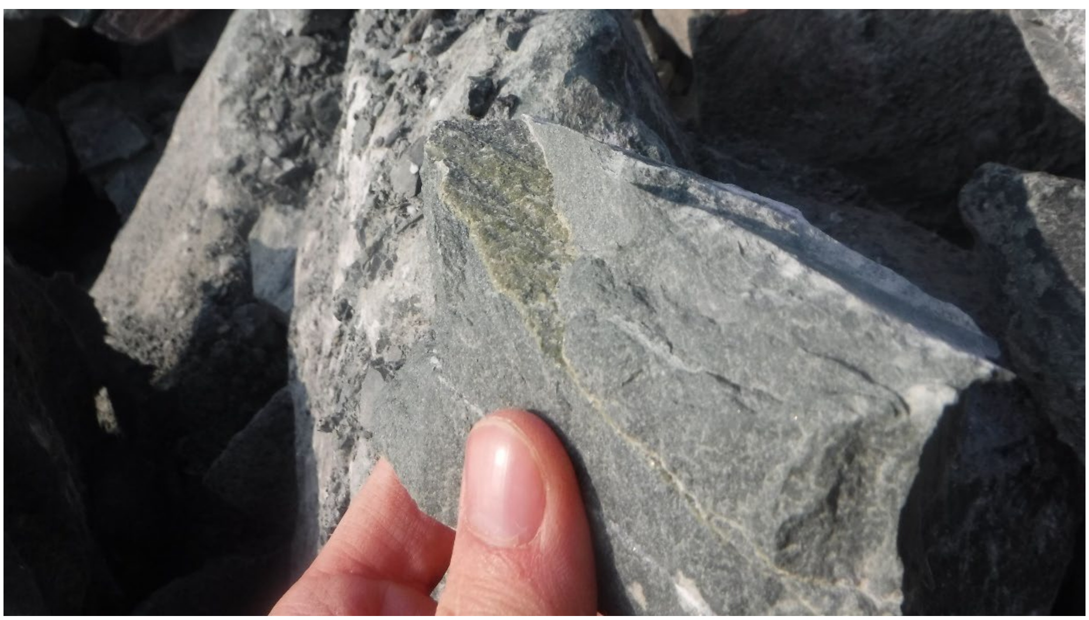


Figure 3-6: Epidote Vein within Mafic Metavolcanic (1a) (near SRK19-CR01)

Madrid North

Typical construction rock observed in infrastructure at Madrid North was dark green mafic metavolcanics (1a) with no to trace (< 1 %) visible sulphides in the form of cubic pyrite. The mafic metavolcanics contained rare to few quartz-carbonate vein that were typically < 1 cm wide. In all surveyed areas, <5% of construction material contained hematite (Figure 3-7). An estimated 5% of construction material was granitic boulders observed in all areas (Figure 3-8). These fragments were often well-rounded and are interpreted to represent glacial erratics. Rare epidote veins were observed in construction material at the overburden pad berm. A single rock (<15 cm) of graphitic argillite (5a) was observed along the access road to the Madrid North CWP, near where the SRK19-CR06 sample was collected (Attachment C).

Figure 3-7: Mafic Metavolcanic (1a) with Hematite Staining (near SRK19-CR05)

Figure 3-8: Mafic Metavolcanics with a Granitic Boulder and the Plan View of a Quartz Vein in the Top-right (near SRK19-CR03)

3.2.2 Contact Tests

Contact rinse tests results for infrastructure at Doris and Madrid North are presented in Table 3-4.

Doris

Rinse pH values for all samples ranged between 8.6 and 9.0 s.u. Rinse EC results ranged between 180 and 450 µS/cm for all samples except the waste rock material used to construct the CPR cover (4,000 and 4,900 µS/cm).

Madrid North

Rinse pH values were alkaline ranging between 8.6 and 9.0 s.u. Samples collected from the Madrid North CWP and access road to Madrid North CWP had lower EC values (ranging between 550 and 830 µS/cm) than samples collected from the access road to the Naartok East CPR and berm for the overburden pad (1600 and 2500 µS/cm, respectively).

Table 3-4: Rinse Test Results for 2019 Construction Rock Samples (-2 mm Fraction)

Mine Area	Rock Type	Area	Sample ID	Rinse pH	Rinse EC
				s.u.	uS/cm
Doris	1a	Access Road (Roberts Bay)	SRK19-CR01	8.6	450
			SRK19-CR02	9.0	180
		Access Road to Doris CPR	SRK19-CR10	8.9	370
	1a w. 5a	Access Road to Vent Raise	SRK19-CR09	8.6	320
	1as/ay	CPR Cover	SRK19-CR11	8.5	4900
			SRK19-CR12	8.6	4000
Madrid North	1a	Access Road to Madrid North CWP	SRK19-CR03	9.2	700
			SRK19-CR04	9.0	550
			SRK19-CR05	8.6	720
		Madrid North CWP	SRK19-CR06	8.8	830
		Access Road to Naartok East CPR	SRK19-CR07	8.9	1600
		Berm for Overburden Pad	SRK19-CR08	9.0	2500

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

3.2.3 ABA

ABA results are presented in Table 3-5, Figure 3-9 to Figure 3-12, and Attachment F.

Doris

Samples collected represent construction rock at Doris including waste rock used as construction rock on the Doris CPR cover (SRK19-CR11 and SRK19-CR12) and for all other areas, ROQ rock that was geologically classified as mafic metavolcanics (1a). The one exception was sample SRK19-CR09 from the access road to the Doris vent raise that was a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a).

Paste pH readings for all samples ranged between 8.2 and 8.8 s.u.

For all samples, total sulphur ranged between 0.18% and 0.45%. The sample containing argillite (SRK19-CR09) contained the highest total sulphur. Sulphate content was below the limit of detection (0.01%) or within the range of analytical error for all samples. Sulphide sulphur calculated as the difference between total sulphur and sulphate, was at near parity with total sulphur, indicating that the sulphide sulphur was the predominant sulphur species (Figure 3-9).

For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity (Figure 3-10). All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP (Figure 3-11 and Figure 3-12).

Madrid North

Full ABA was completed for all samples except for sample SRK19-CR07, the latter which had total sulphur content of less than 0.1% (Section 2.2).

Paste pH readings ranged between 8.2 and 8.8 s.u.

Total sulphur ranged between 0.07% and 0.22% and sulphate sulphur values were below or near the limit of detection (0.01%). Sulphide sulphur, calculated as the difference between total sulphur and sulphate sulphur, was at near parity with total sulphur, indicating that the sulphide sulphur was the predominant sulphur species (Figure 3-9).

Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method (Figure 3-10). All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP (Figure 3-11 and Figure 3-12).

Table 3-5: Acid Base Accounting Results for the 2019 Construction Rock Samples (-1 cm Fraction)

Mine Area	Rock Type	Area	SRK ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
				pH Units	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A	N/A
Doris	1a	Access Road (Roberts Bay)	SRK19-CR01	8.2	0.20	<0.01	0.19	5.9	110	140	18	23
			SRK19-CR02	8.4	0.18	<0.01	0.18	5.6	110	140	19	24
		Access Road to Doris CPR	SRK19-CR10	8.8	0.38	<0.01	0.38	12	220	200	18	16
	1a w. 5a*	Access Road to Vent Raise	SRK19-CR09	8.4	0.45	<0.01	0.44	14	130	150	9	10
	1as/ay	Doris CPR	SRK19-CR11	8.3	0.29	<0.01	0.28	9.1	220	200	25	22
			SRK19-CR12	8.8	0.21	<0.01	0.21	6.6	250	210	38	31
Madrid North	1a	Access Road to Madrid North CWP	SRK19-CR03	8.8	0.15	<0.01	0.15	4.7	120	140	26	31
			SRK19-CR04	8.6	0.17	<0.01	0.16	5.0	130	150	25	27
			SRK19-CR05	8.2	0.11	<0.01	0.11	3.4	120	130	35	39
		Madrid North CWP	SRK19-CR06	8.4	0.22	<0.01	0.22	6.9	130	150	18	22
		Access Road to Naartok East CPR	SRK19-CR07	--	0.07	--	--	--	--	--	--	--
		Berm for Overburden Pad	SRK19-CR08	8.3	0.11	<0.01	0.11	3.4	170	200	50	57

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

AP is acid generation potential, calculated from total sulphur

NP is neutralization potential

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

-- denotes not applicable based on total sulphur content <0.1%

*Sample was ~90 to 95% mafic metavolcanics (1a) and 5 to 10% argillite (5a)

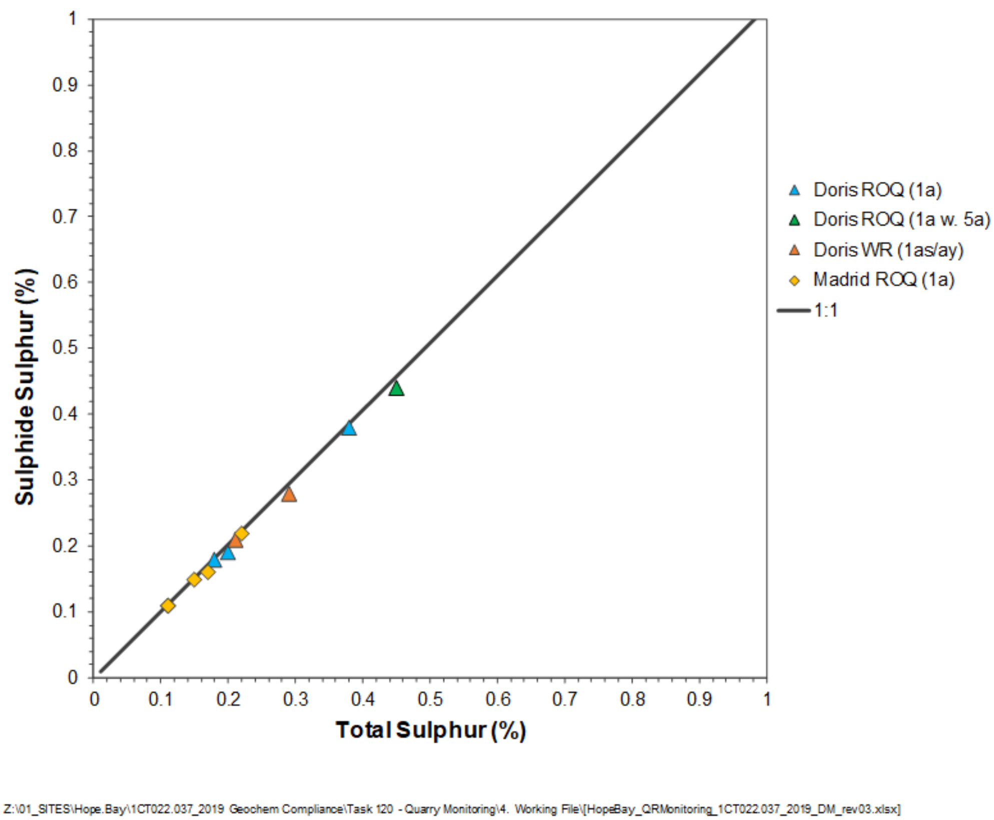


Figure 3-9: Comparison of Total Sulphur versus Sulphide, Construction Rock Samples

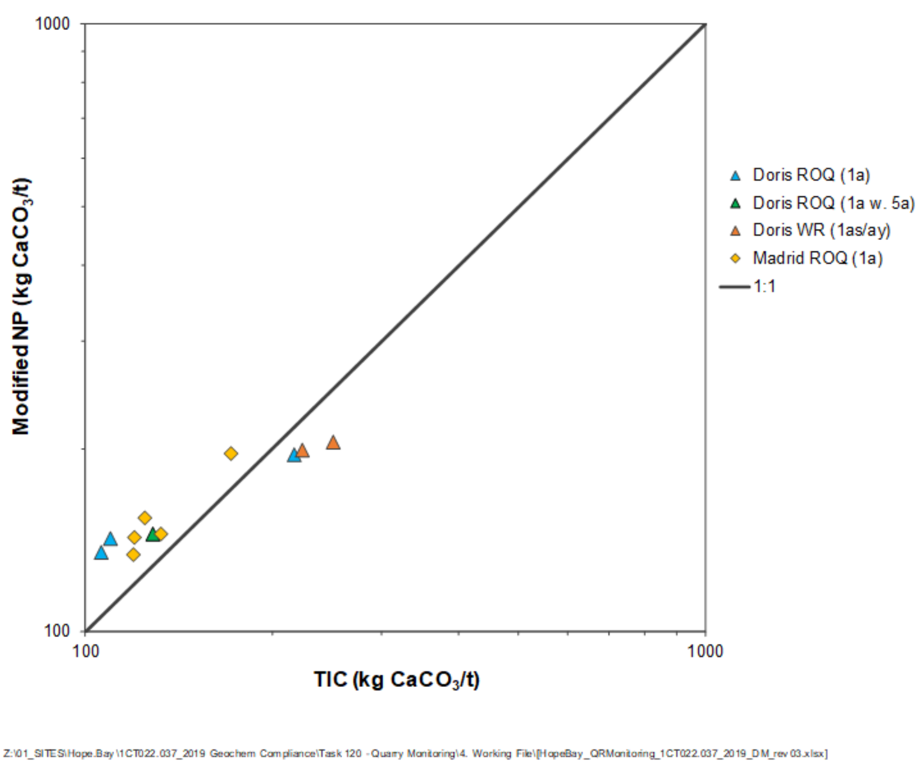


Figure 3-10: Comparison of Modified NP versus TIC, Construction Rock Samples

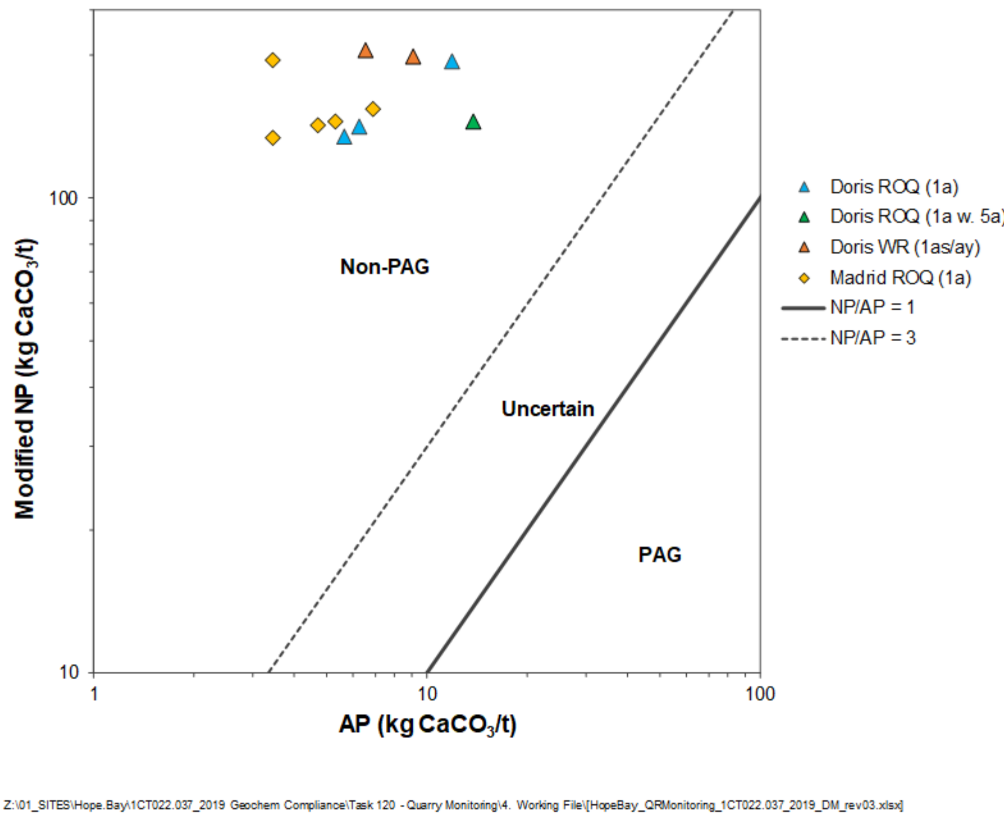


Figure 3-11: ARD Classifications by NP/AP, Construction Rock Samples

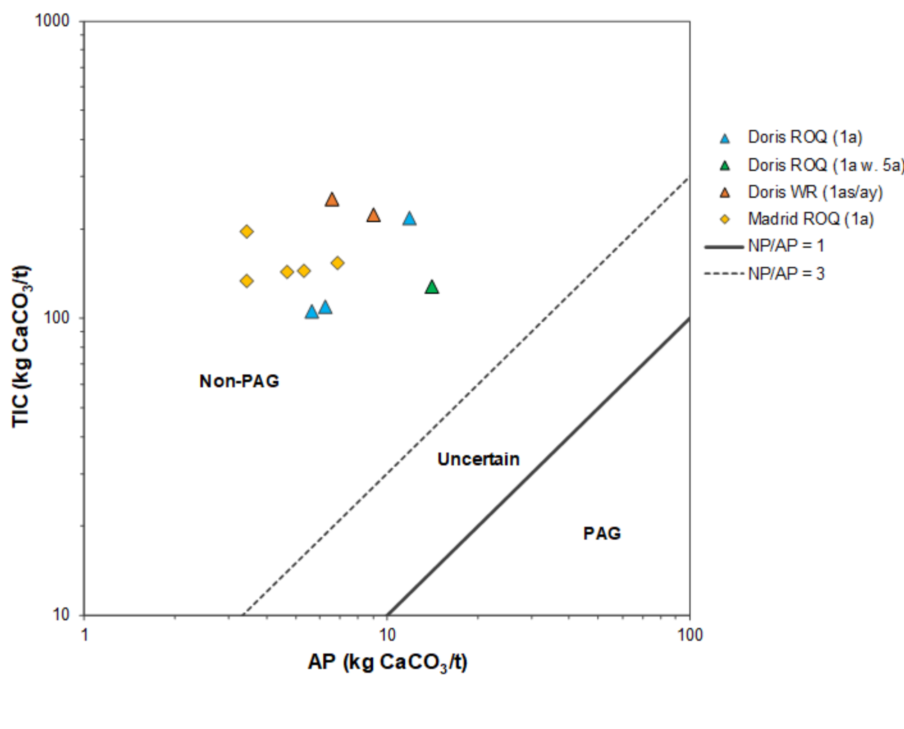


Figure 3-12: ARD Classifications by TIC/AP, Construction Rock Samples

3.2.4 Elemental Analyses

Table 3-6 presents a summary of elemental content with full laboratory results presented in Attachment F. Elemental content was compared to ten times the average crustal abundance for basaltic rocks (Price 1997) to screen for enrichment.

Doris

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria as follows:

- Sample SRK19-CR10 of ROQ mafic metavolcanics (1a) was enriched in arsenic and sulphur.
- Sample SRK19-CR09 (ROQ sample containing a mixture of mafic metavolcanics (1a) and argillite (5a)) was enriched in sulphur only.
- The waste rock samples (SRK19-CR11 and SRK19-CR12) were both enriched in sulphur and one was enriched in arsenic.

All other parameters were below the screening criteria, suggesting no appreciable enrichment.

Madrid North

All parameters for Madrid North samples were below the screening criteria, suggesting no appreciable enrichment.

Table 3-6: Summary of Element Analysis for the 2019 Construction Rock Samples (-1 cm Size Fraction)

		Mine Area>	Doris						Madrid North				
		Rock Type>	1a			1a w. 5a	1as/ay		1a				
Parameter	Units	*Screening Criteria	Roberts Bay		Access Road to Doris CPR	Access Road to Vent Raise	Doris CPR		Access Road to Madrid North CWP			Madrid North CWP	Overburden Pad Berm
			SRK19-CR01	SRK19-CR02	SRK19-CR10	SRK19-CR09	SRK19-CR11	SRK19-CR12	SRK19-CR03	SRK19-CR04	SRK19-CR05	SRK19-CR06	SRK19-CR08
As	ppm	*20*	5.2	2.4	**45**	12	**31**	**31**	3.2	4.3	2.9	4.3	1.5
Cd	ppm	*2.2*	0.40	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.20	< 0.1	0.20	< 0.1
Co	ppm	*480*	42	41	45	37	37	39	38	41	44	41	43
Cr	ppm	*1700*	150	160	50	69	40	45	230	320	350	180	540
Cu	ppm	*870*	130	150	120	160	72	88	120	100	100	120	92
Hg	ppm	*0.9*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mo	ppm	*15*	0.3	0.8	1.0	0.5	0.5	0.7	1.1	0.3	0.3	0.6	0.3
Ni	ppm	*1300*	64	61	73	46	54	64	69	110	130	79	170
Pb	ppm	*60*	4.4	2.1	2.0	2.5	1.8	2.6	2.0	2.8	3.1	1.9	2.5
S	%	*0.3*	0.16	0.14	**0.35**	**0.39**	**0.31**	0.23	0.14	0.12	0.10	0.19	0.08
Se	ppm	*0.5*	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sr	ppm	*4650*	24	27	27	29	27	26	24	22	19	25	19
Zn	ppm	*1050*	120	89	61	95	69	59	79	77	80	110	58

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

* Screening criteria corresponds to 10 times the average crustal abundance for basaltic rocks as per Price (1997)

All values have been rounded to two significant figures

BOLD values indicate result exceeds screening criteria

3.2.5 SFE Tests

A summary of results for key parameters analyzed is presented in Table 3-7 and full results are included in Attachment F. The results are compared to the maximum concentration in any grab sample guideline from the Quarry Effluent Quality Limits (Table 2.2, TMAC 2017), however this screening is for screening purposes only as SFE do not necessarily represent quarry water quality.

Doris

SFE tests were conducted on two samples of Doris ROQ (including sample SRK19-CR09 containing argillite) and one sample of Doris waste rock used to construct the CPR cover (SRK19-CR11).

The pH for all samples ranged between 8.7 and 8.8 s.u. Consistent with rinse test data, EC values for Doris ROQ samples (42 and 200 µS/cm) were lower than the waste rock sample SRK19-CR11 (1500 µS/cm). The EC for sample SRK19-CR11 was above the screening criterion.

For all samples, major cation chemistry was dominated by sodium and calcium, however concentrations were lower for ROQ rock samples (4 and 22 mg/L for sodium and 10 and 16 mg/L for calcium) than the waste rock sample (230 and 30 mg/L, respectively). Major anion chemistry was different for ROQ and waste rock samples with ROQ samples dominated by alkalinity (27 and 29 mg/L as $CaCO_3$) and chloride (3.1 and 14 mg/L) and waste rock samples dominated by chloride (350 mg/L) and sulphate (120 mg/L). Notable nitrate concentrations were lower for ROQ samples (0.2 and 0.9 mg/L) that the waste rock sample (19 mg/L).

No dissolved metals were above the screening criteria. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover material.

Madrid North

The pH ranged from 8.7 and 8.9 s.u. EC values ranged between 250 and 890 µS/cm. The EC values for the two samples from the access road to the Naartok East CPR and berm for the overburden pad (SRK19-CR07 and SRK19-CR08) were higher than the screening criteria.

Major ion composition was similar for all samples with a few notable differences. Major cation chemistry was dominated by sodium and calcium for all samples; however, concentrations of sodium were higher for samples SRK19-CR07 and SRK19-CR08 (88 and 150 mg/L) compared to samples SRK19-CR05 and SRK19-CR06 (23 and 41 mg/L). Notable differences in major anion chemistry included chloride for samples SRK19-CR07 and SRK19-CR08 (120 and 200 mg/L), which was at least 2 to 4 times higher than other samples.

For the two samples with the lowest values of EC (SRK19-CR05 and SRK19-CR06), major cation chemistry was dominated by sodium (23 and 41 mg/L) and calcium (15 and 16 mg/L), while the major anion chemistry was dominated by sulphate (16 and 29 mg/L), alkalinity (23 mg/L), nitrate (7.6 and 19 mg/L) and chloride (6.7 to 52 mg/L).

For samples SRK19-CR07 and SRK19-CR08 (samples with the highest EC values), major cation chemistry was dominated sodium (88 and 150 mg/L), while the major anion chemistry was dominated by chloride (120 and 200 mg/L) one to two magnitudes greater than other Madrid North construction samples. Concentrations of nitrate have a maximum value of 19 mg/L.

No dissolved metals were above the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

Table 3-7: Shake Flask Extraction Results for 2019 Construction Rock Samples (-2 mm Fraction)

			Mine Area>	Doris			Madrid North			
			Rock Type>	1a	1a w. 5a	1as/ay	1a			
Parameter	Units	Detection Limit	Screening Criteria*	Roberts Bay	Access Road to Vent Raise	Doris CPR Cover	Access Road to Madrid North CWP		Access Road to Naartok East CPR	Overburden Pad Berm
				SRK19-CR01	SRK19-CR09	SRK19-CR11	SRK19-CR05	SRK19-CR06	SRK19-CR07	SRK19-CR08
pH	pH Units	N/A	9.0	8.8	8.7	8.7	8.7	8.7	8.9	8.9
EC	uS/cm	0.5	500	200	140	**1500**	250	350	**560**	**890**
SO_4	mg/L	0.5		49	30	120	16	29	45	46
Total Alkalinity	mg/L	0.5		27	29	22	23	23	31	28
Chloride	mg/L	0.5		14	3.0	350	6.7	52	120	200
Nitrate-N	mg/L	0.02		0.2	0.9	19	19	7.6	2.4	8.2
Total Dissolved Solids	mg/L	10		130	92	920	180	210	310	490
Hardness ($CaCO_3$)	mg/L	0.5		40	56	200	62	63	51	62
Calcium (Ca)	mg/L	0.05		10	16	30	16	15	11	12
Sodium (Na)	mg/L	0.05		22	4	230	23	41	88	150
Aluminum (Al)	mg/L	0.0005	2.0	0.25	0.18	0.090	0.15	0.18	0.14	0.11
Antimony (Sb)	mg/L	0.00002		0.00016	0.00025	0.00023	0.00011	0.00011	0.00011	0.00008
Arsenic (As)	mg/L	0.00002	0.1	0.00096	0.0012	0.021	0.0015	0.0015	0.001	0.00048
Cadmium (Cd)	mg/L	0.000005		<0.0000050	<0.0000050	< 0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Copper (Cu)	mg/L	0.00005	0.04	0.00075	0.0016	0.0018	0.0008	0.0019	0.0012	0.00062
Iron (Fe)	mg/L	0.001	0.6	0.020	0.0025	0.0050	0.0091	0.001	0.013	0.0036
Lead (Pb)	mg/L	0.000005	0.02	0.000022	0.000009	0.0000065	0.000012	0.000008	0.000010	0.000009
Molybdenum (Mo)	mg/L	0.00005		0.0018	0.0021	0.0026	0.0014	0.0017	0.0029	0.0022
Nickel (Ni)	mg/L	0.00002	0.1	0.000091	0.000057	0.00049	0.00023	0.00020	0.00045	0.00028
Selenium (Se)	mg/L	0.00004		0.00033	0.00130	0.0023	0.00060	0.00130	0.00060	0.00064
Thallium (Tl)	mg/L	0.000002		0.0000099	0.000009	0.000014	0.000013	0.000010	0.000015	0.000020
Zinc (Zn)	mg/L	0.0001	0.02	0.00042	0.00020	0.00025	0.00034	0.00011	0.00038	0.00017

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

°All element concentrations are given as dissolved. Bold and underlined value indicates value greater than the screening criteria.

*Guideline from maximum concentration in any grab sample from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

4 Summary and Conclusions

4.1 Quarry Monitoring

4.1.1 Quarry 2

In 2019, TMAC conducted geological inspections in Quarry 2 between May and August. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets except for the August inspection. In August, a 3 to 4 m thick band argillite (5a) within mafic metavolcanics was observed in one active face in the western extent of the quarry. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated all samples of mafic metavolcanics (1a) were non-PAG according to values of NP/AP and TIC/AP. The argillite (5a) sample was classified as having an uncertain potential for ARD owing to higher levels of total sulphur (2.3% compared to 0.14 and 0.41% for mafic metavolcanics (1a)) and lower NP and TIC (70 and 75 $CaCO_3$/t, respectively for argillite compared to an overall range of 140 to 220 kg $CaCO_3$/t for mafic metavolcanics (1a)).

Compared to the screening criteria, sulphur and arsenic were enriched for argillite (5a) and in the fine fraction (-2 mm) of mafic metavolcanics (1a). The -1 cm fraction of mafic metavolcanics were not enriched in arsenic and sulphur compared to the screening criteria. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results for mafic metavolcanics (1a) indicated non-acidic pH and metal concentrations below the screening criteria indicating the risk of ML/ARD from Quarry 2 metavolcanics (1a) is low.

SFE test results for argillite (5a) indicated non-acidic pH with sulphate concentrations (780 mg/L) suggestive of sulphide oxidation. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

4.1.2 Quarry D

In 2019, TMAC conducted geological inspections in Quarry D in May, July and September. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets. All inspections noted the absence of fibrous actinolite

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG for all mafic metavolcanics (1a) according to values of NP/AP and TIC/AP. Total sulphur content ranged between 0.09 and 0.26% and Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively.

Elemental analyses indicated no appreciable enrichment compared to the screening criteria.

SFE test results indicated that all test leachates were non-acidic and that all parameters were below the screening criteria indicating the risk of ML/ARD from Quarry D ROQ rock is low.

4.2 Construction Monitoring

4.2.1 Doris

SRK conducted a geological inspection of as-built construction at Doris that confirmed that construction materials for the access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay were characteristic of Quarry 2: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). The geological inspection of the Doris CPR and access road to Doris vent raise identified material that was not exclusively or typical of Quarry 2 and are described as follows:

- Doris CPR cover: TMAC constructed the cover primarily using waste rock with selected areas using ROQ rock from Quarry 2. Waste rock was geochemically characterized prior to use as construction material according to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019), with results of this program presented in SRK (2020). The majority of construction material (both waste rock and ROQ rock) in the cover were both geologically classified as mafic metavolcanics (1) with varying textural and compositional differences.
- Access road to Doris vent raise: the geology of construction material used for the access road was characteristic of Quarry 2, except for a 120 m segment that contained a minor amount (~5-10%) of black intermixed fragments of argillite (5a) mixed with mafic metavolcanics (1a).

Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads, including two samples of waste rock from the CPR cover and one sample from the access road to the vent raise containing argillite (5a).

Total sulphur ranged between 0.18% and 0.45% with the highest sulphur value from the sample containing a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a). For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover material. TMAC notes that the cover design specified that underground waste rock be placed below the active layer and CPR waste rock to be placed as the cover.

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, construction rock used to construct the access road to the vent raise, access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay was geochemically suitable for use as construction rock. This includes the ROQ rock from the access road to the vent raise that contained 5 to 10% argillite and also the waste rock samples collected from the cover of the CPR.

Waste rock and ROQ rock used to construct the CPR cover has a low risk of ML/ARD however shake flask test indicate the potential for elevated chloride and nitrate. No seepage was observed from the CPR cover during TMAC's 2019 seepage survey. The Doris CPR cover will be included in subsequent seepage surveys to assess the potential for contaminant leaching from the Doris CPR.

4.2.2 Madrid North

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, the quarry rock used to construct the access road to the Naartok East CPR; Madrid North CWP; access road to the Madrid North CWP; and Naartok East overburden pad berm was geochemically suitable for use as construction rock.

SRK conducted a geological inspection of as-built construction at the Madrid North mine and confirmed that construction materials were characteristic of Quarry D: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads.

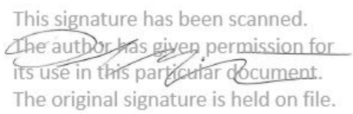
Total sulphur content ranged between 0.07% and 0.22%. Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t. Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

In terms of elemental content, concentrations of all parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that dissolved metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

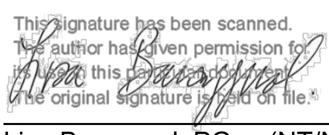
Regards,
SRK Consulting (Canada) Inc.

Prepared by:



Derrick Midwinter, PGeo (ON)
Staff Consultant (Geochemistry)

Reviewed by:



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant (Geochemistry)

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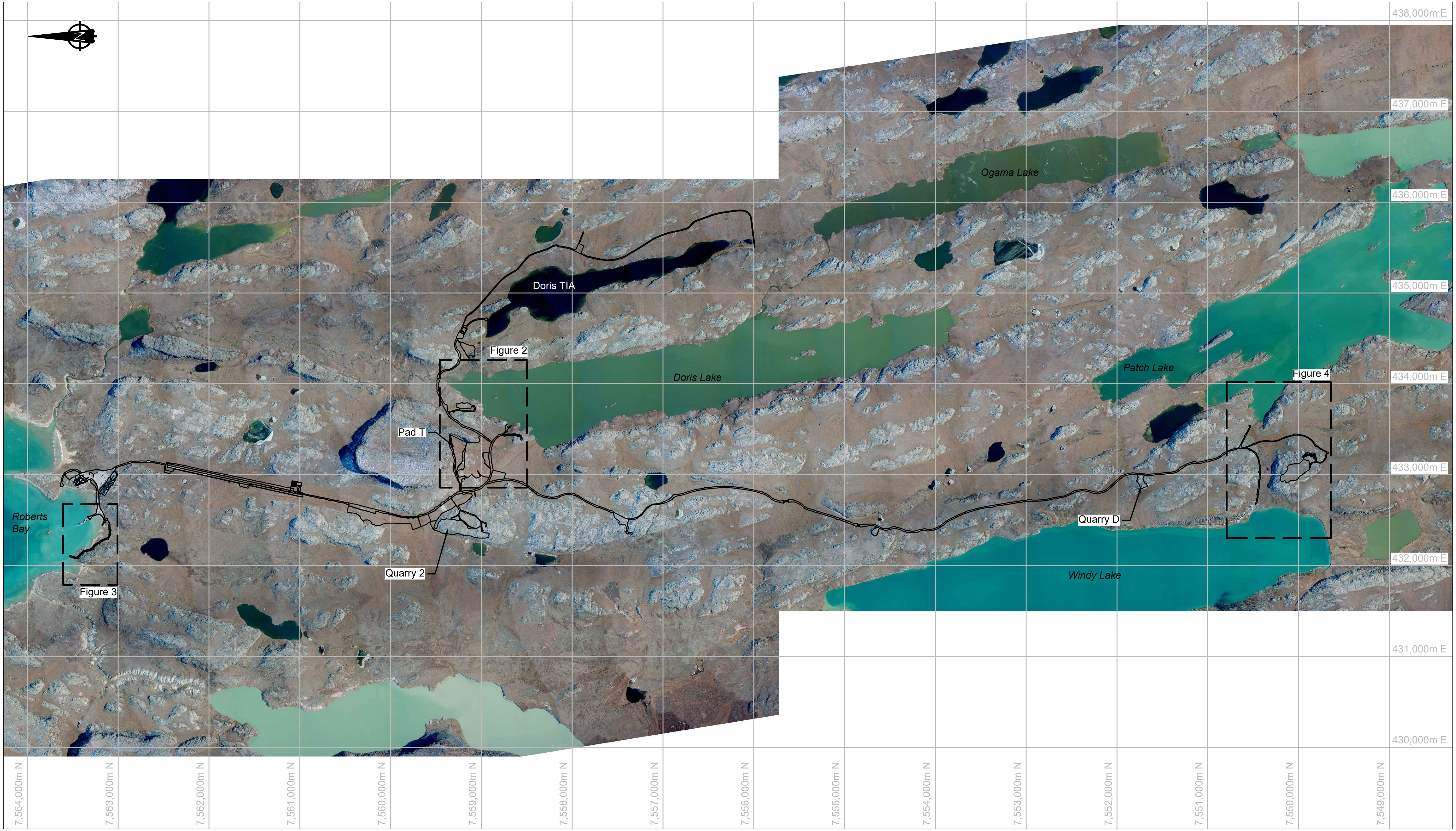
Attachment A – Map of Construction Monitoring Sample Locations



LEGEND

Existing Infrastructure

REFERENCE

NAD83 UTM Zone 13.

0m 400 800 1200 1600

srk consulting

SRK JOB NO.: 1CT022.037

FILE NAME: 1CT022.037 - GA.dwg

MAC RESOURCES

Hope Bay Project

2019 Rock Samples

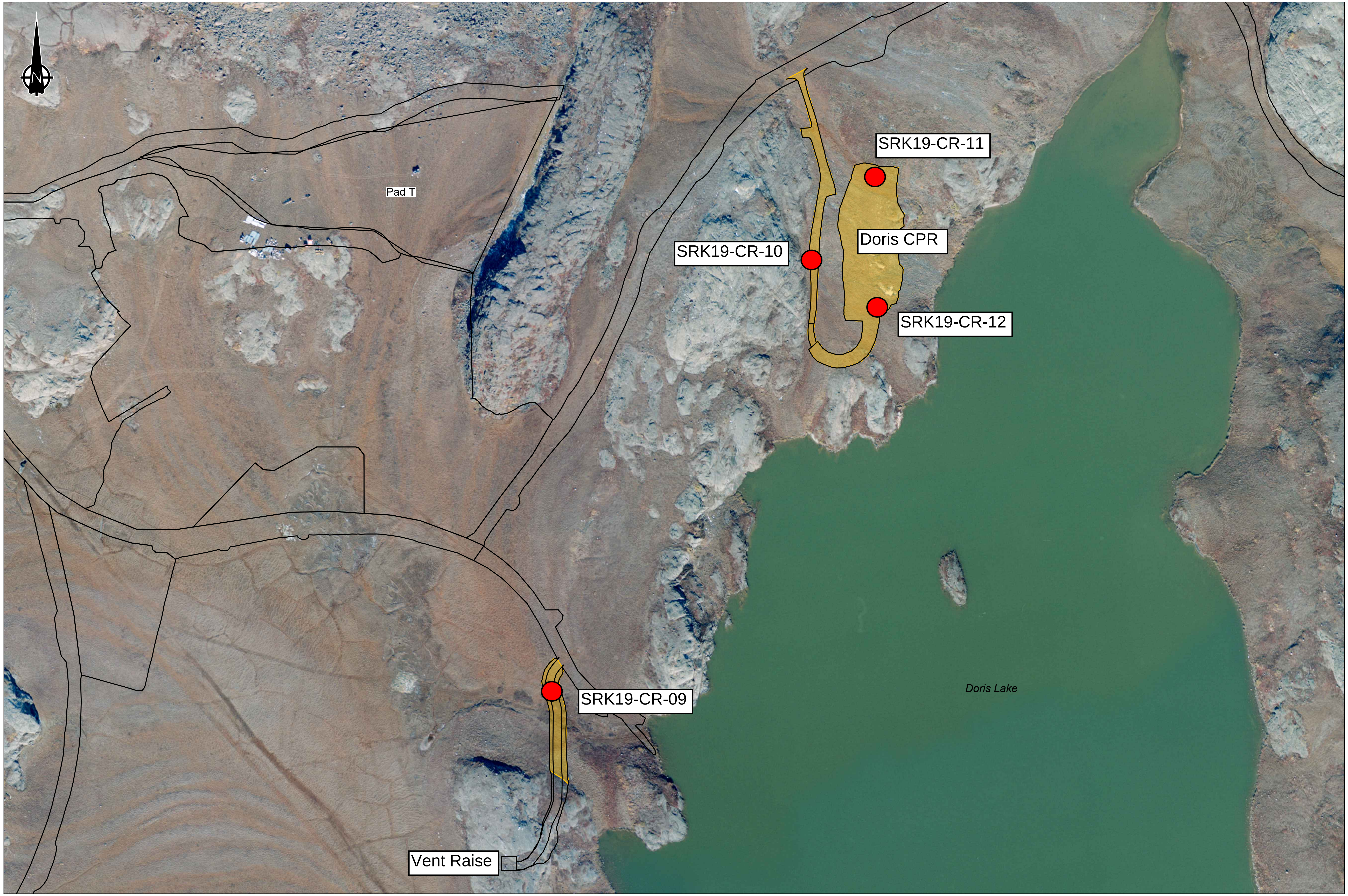
General Arrangement

DATE: July 2019

APPROVED:

FIGURE: 1

P:\01_SITES\Hope Bay\!ACAD\2019 Drawings\Doris - Construction Rock\1CT022.037 - GA.dwg



LEGEND

Existing Infrastructure

Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

0m 40 80 120 160

srk consulting

MAC RESOURCES

SRK JOB NO.: 1CT022.037	Hope Bay Project	2019 Rock Samples
FILE NAME: 1CT022.037 - GA.dwg		Doris CPRT and Vent Raise Access Construction Rock Sampling
		DATE: July 2019 / APPROVED: / FIGURE: 2

P:\01_SITES\Hope Bay\!ACAD\2019 Drawings\Doris - Construction Rock\1CT022.037 - GA.dwg

LEGEND

Existing Infrastructure

Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

0m 20 40 60 80 100

srk consulting

SRK JOB NO.: 1CT022.037

FILE NAME: 1CT022.037 - GA.dwg

TMAC RESOURCES

Hope Bay Project

2019 Rock Samples

Roberts Bay Discharge System Access Road and Marine Outfall Berm Construction Rock Sampling

DATE:	APPROVED:	FIGURE:
July 2019		3

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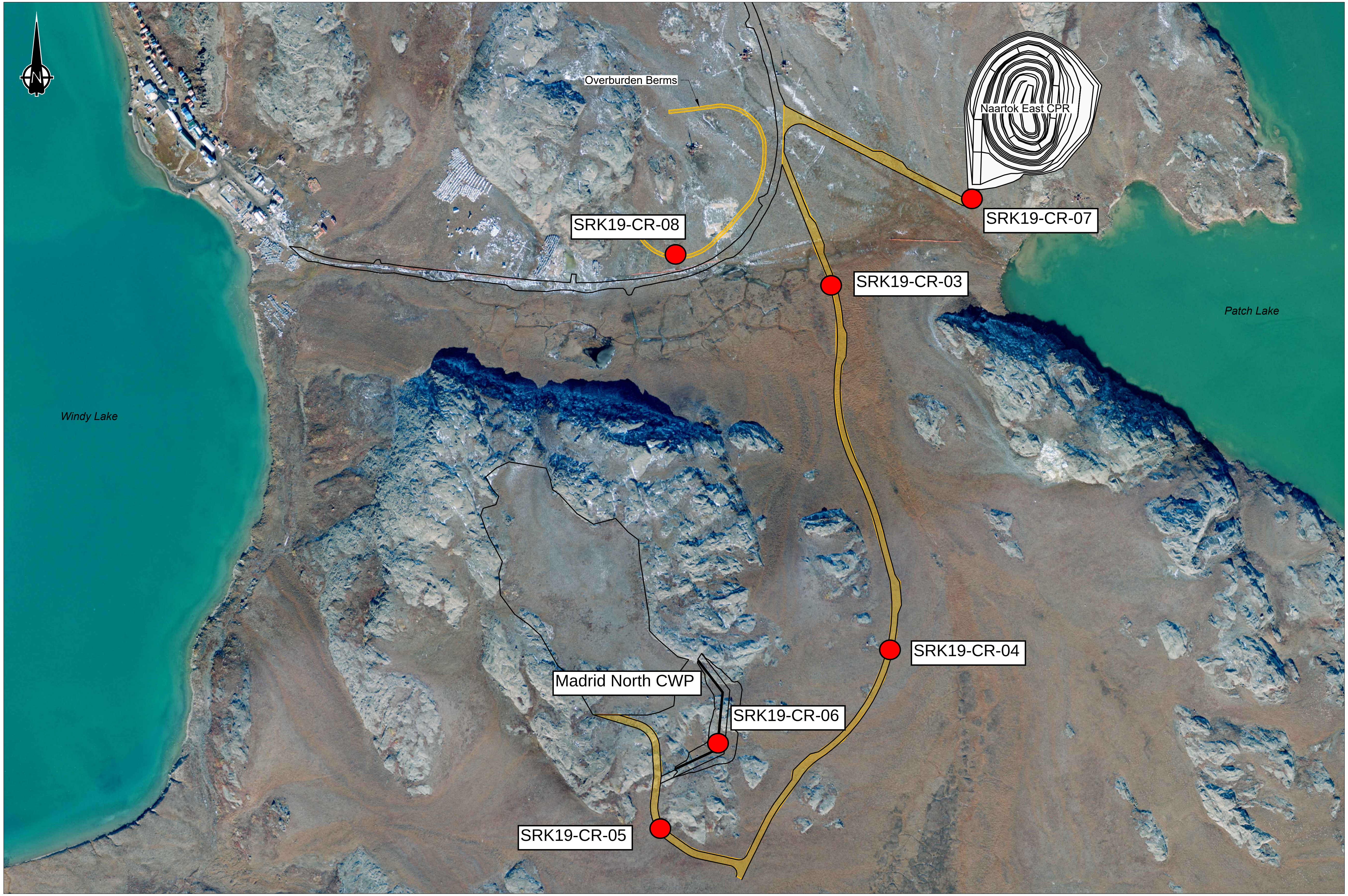


LEGEND

Existing Infrastructure

Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

0m 50 100 150 200

srk consulting

SRK JOB NO.: 1CT022.037

FILE NAME: 1CT022.037 - GA.dwg

MAC RESOURCES

Hope Bay Project

2019 Rock Samples

Madrid South All-Weather Road, Madrid North Waste Rock Pile Road, Naartok East CPRT Access Road, and Overburden Stockpile Berms Construction Rock Sampling

DATE:	APPROVED:	FIGURE:
July 2019		4

P:\01_SITES\Hope Bay\!ACAD\2019 Drawings\Doris - Construction Rock\1CT022.037 - GA.dwg

Attachment B – Geological Inspections, Quarry Monitoring Program

TMAC RESOURCES

Quarry Inspection

Inspection Date: 06-May-19 Blast Date: 20-Apr-19
Geologist: Annette Pardy/ Chris Annan
Quarry Location: Quarry 2

General Visual Inspection

Rock Type	**Mafic Volcanics**	Description: **Light to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed**
Vein	Y	If yes, describe (min, %, size): **1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling.**
Sulphides	Y	If yes: **Trace fine to coarse grained disemminated Pyrite.** Percentage: **0.01%**
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-70m	Only partial blast face exposed due to blasted muck. Rock Type description from observed muck pile.
	Blast Face: Light to med grey in color. Weak to moderate, pink to red heamaitie alteration concentrated on the far west side of blast face. Blast face is intensly fractured and blocky.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y247801 2.15 kg

Description: **UTM: 13W0432354; 7559143; Elevation: 53m** **Li**ght to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed. 1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling. Trace fine to coarse grained disemminated Pyrite**.**

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y247802 2.3 gk

Description:UTM: 13W0432354; 7559143; Elevation: 53m Light to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed. 1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling. Trace fine to coarse grained disemminated Pyrite.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting

TMAC RESOURCES

Quarry Inspection

Inspection Date: 04-Jul-19 Blast Date: 30-Jun-19
Geologist: Gary Low
Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	(Blasted Muck Pile) Ver fine - fine grained, medium to dark greenish grey mafics. Occasional light to pale red Oxidation along some joint surfaces.
Vein	Y	(<0.1%) 5-10mm scale Quartz / Carbonate secondary fracture infilling.
Sulphides	Y	<0.1% disseminated very fine lower grain sized pyritic flakes. Percentage: Trace
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
90 - 120m	Blasted Muck pile. No visibly exposed face looking NW. Rock is medium - dark grey in colour with trace oxidation on some joint surfaces. No visible veining, secondary qtz/carb fracture infill. Foliated in part trending NNW with rare secondary chloritic alternation along some surfaces.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: __________

Description:

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: __________

Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting

TMAC RESOURCES

Quarry Inspection

Inspection Date:	July 17th, 2019	Blast Date:	July 15th, 2019
Geologist:	Gary Low		
Quarry Location:	Quarry 2		

General Visual Inspection

Rock Type	Mafic Volcanics	Light Grey / green, very fine to fine grained, massive, affinitic. Rare oxidation exhibited on some joint surfaces.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <1%, mm scale, random.
Sulphides	Y	Trace scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: **N**	
UTM: 432365, 7559198		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
140 - 170	Light Grey / green mafic volcanics with oxidized joint surfaces that trend NNE - SSW.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: **R828432**

Description: -> Light Grey / green mafic volcanics with oxidized joint surfaces that trend NNE - SSW. Rare Quartz / Carbonate fracture infill veinlets, <1%, mm scale, ramdomly orientated throughout. Trace scattered disseminated pyrite flakes (<0.01%).

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: **R828433**

Description: -> Light Grey / green, very fine to fine grained, massive, affinitic. Rare oxidation exhibited on some joint surfaces.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting

TMAC RESOURCES

TMAC Resources Doris Mine UNDERGROUND FACE SHEET

General Information		Location/Orientation		Blast Attributes	Assig. Grade:
Heading:	QUARRY 2	Easting:	432310.	Ore/Waste Call	BM Grade:
Faceplate Number:	ARGILLITE / GRAPHITE	Northing:	7559.144	O / W	Survey Station:
Project:		Elevation:		Width:	Distance to face:
Geologist / Tech:		Face Azi:		Height:	Location Sketch:
Blast Date (DD/MM/YY):		Vein Strike:		Depth:	
Shift (DS/NS):		Vein Dip:		Round / Breast / Slash /Long Hole / Bench	
Sample Date (DD/MM/YY):		% Vein:			

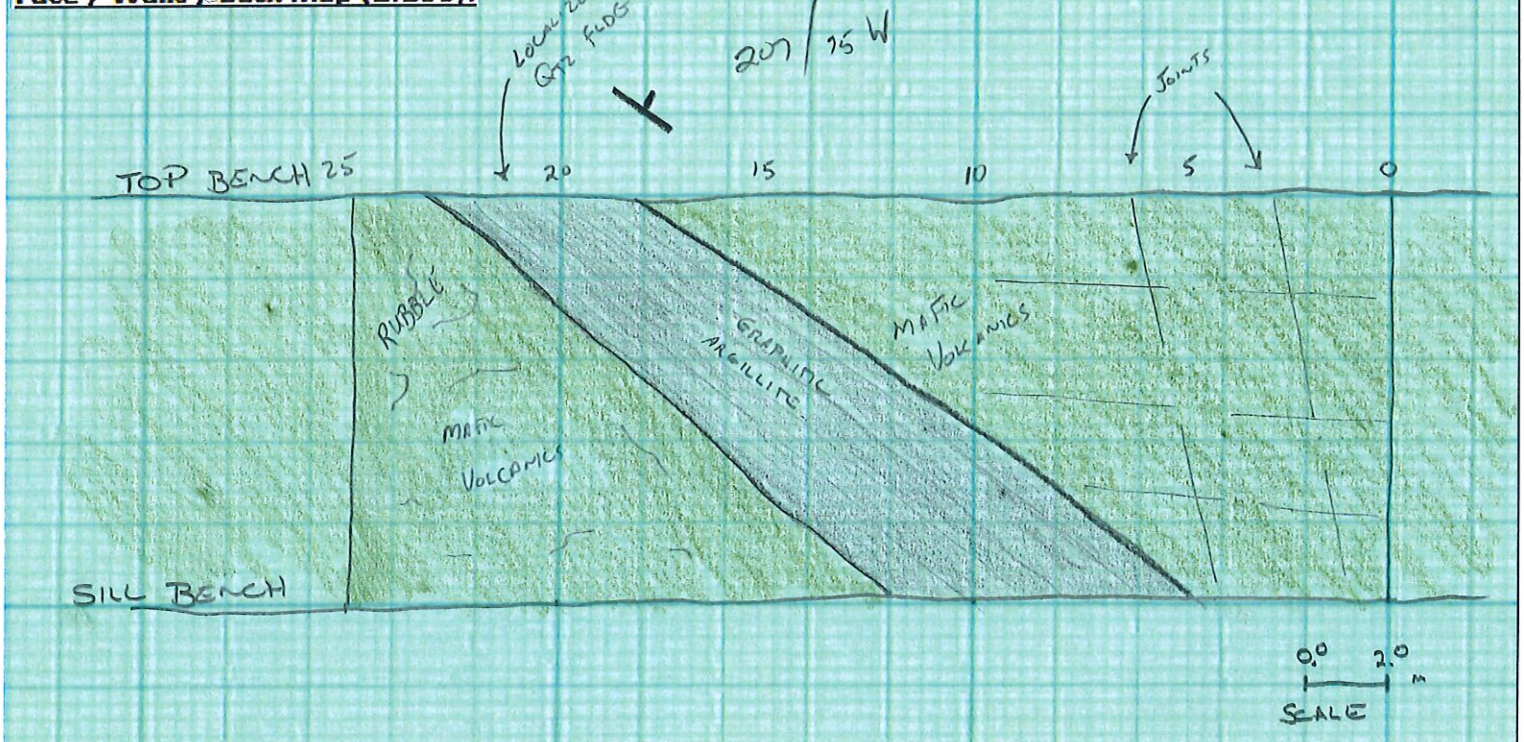
	Sample ID	FR.	TO	LITHO	Vn%	Vn Style	Septa %	Septa Style	Min %	Min or Alt type	Au
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Abbreviations

Vein styles	
Quartz vein	QTZ VN
Veinlet	VNLT
Extensional	EXT
Breccia	BX
Fault filled	FLTF
Shear	SHR
Stockwork	STOCK
Septa Style	
Tourmaline	TUR
Light green	LTGR
Black	BLK
Dark Green	DKGR
Mineralization	
Pyrite	PY
Chalcopyrite	CPY
Alteration	
Sericite	SER
Hematite	HEM
Magnetite	MAG
Chlorite	CHL
Fuchsite	FUCH
Carbonate	CARB

Geological Observations / Mining Recommendations:

Face / Walls / Back Map (1:100):



TMAC RESOURCES

Quarry Inspection

Inspection Date:	16-May-19	Blast Date:	11-May-19
Geologist:	Eric Alexander		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type	**Mafic Volcanics**	Description: **Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces.**
Vein	Y	If yes, describe (min, %, size): **1-2% quartz/carbonate veinlets randomly oriented. Mm scale, randomly oriented and fracure**
Sulphides	Y	If yes: **Trace fine grained disemminated pyrite.** Percentage: **0.01%**
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	Blast Face: Light to med grey/green in color. Local reddish hematite alteration concentrated on west side of blast face. Blast face is moderate to highly fractured and blocky.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y264562 (6.00lbs)

Description: **UTM: 432929.00E 7551736.00N**
Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces. Trace disseminated pyrite.

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264561 (2.00lbs)

Description:UTM: UTM: 432929.00E 7551736.00N Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces. Trace disseminated pyrite.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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TMAC RESOURCES

Quarry Inspection

Inspection Date:	May 23rd, 2019	Blast Date:	May 17th, 2019
Geologist:	Scott Snider		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type	Mafic Volcanics	Light to med grey-green; fine grained basalt; 15% meter scale jointing; wk hemitite alt.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <2%, mm scale, random.
Sulphides	Y	Occasionally scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
30m	Light to med grey-green; fine grained basalt; 15% meter scale jointing; wk hemitite alt.
	Blast face: Partially exposed; stong fracted and blocky. See photos.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID:
Description:
2 mm screen sample (same material as Whole Rock Sample)
Sample ID:
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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TMAC RESOURCES

Quarry Inspection

Inspection Date: May 31st, 2019 Blast Date: May 26th, 2019
Geologist: Gary Low
Quarry Location: Quarry D

General Visual Inspection

Rock Type	Mafic Volcanics	Medium Grey / green, very fine to fine grained, affinitic. Trace oxidation exhibited on joint surfaces.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <2%, mm scale, random.
Sulphides	Y	Occasionally scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
100 - 140	Medium Grey / green - dark green mafic volcanics with oxidized joint surfaces that trend NNE - SSW with an (approx) 80Deg dip to the East

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: ____________

Description:

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: ____________

Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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TMAC RESOURCES

Quarry Inspection

Inspection Date:	07-Jun-19	Blast Date:	2019-06-06
Geologist:	Daniel Mwagura		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type		Description: **Mafic Volcanics,light-med grey, fg-mg, massive, with trace calcite stringers, trace disseminated pyrite ~0.01%, predominant haematite staining on fracture faces**
Vein	Y	If yes, describe (min, %, size): **Quartz- Carbonate veining ~1%, with some pink alteration staining**
Sulphides	N	If yes: Disseminated/Vein/Stringer/Other: **Disseminated fg Pyrite ~0.01%** Percentage:
Fibrous Actinolite	N	If yes, describe (min, %, size): **None**
If anomalous rock types/significant sulphides:	TAGGED: N	None Observed
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
140-180m	Mafic Volcanics, light-med grey, fg-mg, massive, with trace calcite stringers, trace disseminated pyrite ~0.01%, predominant haematite staining on fracture face
	Blast Face: Strong Haematite staining, Weak-moderately sheared on the far East side of the face, Oberseved 2-predominant fracture sets, NW-SE/NE-SW

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID:
Description:
2 mm screen sample (same material as Whole Rock Sample)
Sample ID:
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Quarry Inspection

Inspection Date: 16-Jun-19 Blast Date: 12-Jun-19
Geologist: Annette Pardy
Quarry Loca Quarry D

General Visual Inspection

Rock Type	Mafic Volcanics	Description:Greenish grey, fine to mediourn grained massive mafic volcanics. Week to moderiate epidote alteration. Local Fe staining along fracture surfaces.
Vein	Y	<1% mm scale qtz/carb veinlets randomly oreinted throught. Hematite alteration associated with local veinlets
Sulphides	N	No visible sulphides observed
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	Could not see blast face due to blasted muck pile. Observations were taken from broken material. Massive mafic volcanics.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: ____________

Description:

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: ____________

Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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TMAC RESOURCES

Quarry Inspection

Inspection Date: 16-Jun-19 Blast Date: 2019-06-07
Geologist: Daniel Mwagura
Quarry Location: Quarry D

General Visual Inspection

Rock Type		Description: **Mafic Volcanic, med-dark grey green, weakly foliated, <0.01% dis pyrite, trace calcite stringers, occassional haematite staining on frac faces,**
Vein	Y	If yes, describe (min, %, size): **~1%** **Quartz+ carbonate veinlets on rubble,**
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other: **Disseminated** Percentage: <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	There is no exposed face to see, Descriptions based on blast rubble or muck.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: ____________
Description:
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ____________
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.
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TMAC RESOURCES

Quarry Inspection

Inspection Date: July 26 2019 Blast Date: July 25 2019
Geologist: Daniel Mwagura
Quarry Location: D

General Visual Inspection

Rock Type	Mafic Volcanic	Description:~80% Mafic Volcanic, 10% fine-med grained gabbroic fragments, medium green- grey, massive, blocky, occassional mm-scale quartz +carbonate veinlets/ stringers, <0.1% disseminated fg py
Vein	Y	If yes, describe (min, %, size): <1% Quartz +carbonate stringers/ veinlets.
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other Percentage: <0.1%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-30m	Mafic Volcanic with trace mm-scale quartz+ carbonate veinlets & random calcite stringers, medium green-grey, fine grained, massive, blocky in parts, moderate haematite staining on fracture planes

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y250342

Description:
Mafic Volcanic with fine-med grained gabbroic fragments, medium green- grey, massive, blocky, occassional mm-scale quartz +carbonate veinlets/ stringers, <0.1% disseminated fg py.
UTM: N: 7551710 E: 432959

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y250341

Description: Predominantly Mafic Volcanic fragments with traces of haematite stained fragments, traces of mm-scale Qtz+ carbonate/ Calcite stringers

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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MERC
Quarry D
July 26, 2019


Quarry D
July 26, 2019


E
SE
BLAST #8


NE

TMAC RESOURCES

Quarry Inspection

Inspection Date: 06-Sep-19 Blast Date: 04-Sep-19
Geologist: Rob Reukl
Quarry Location: Madrid - Quarry "D"

General Visual Inspection

Rock Type	1a	Description: Mafic Volcanic
Vein	Y	If yes, describe (min, %, size): <1% Quartz Carbonate veinlets & Calcite stringers
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other Dis Percentage: Trace (<0.01%)
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
Blast	**Mafic Volcanics:** Fine grained, grey/green, <1% qtz-carb mm-cm scale veinlets & calcite stringers, ocaisional traces of vfg diss'd pyrite (<0.01%)

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: No Sample

Mafic Volcanics:
UTM: N: 7550694 E: 433581

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: No Sample

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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cm
cm
Naartok East


Naartok East Pit
July 27 2019
20,000 tonnes

TMAC RESOURCES

Quarry Inspection

Inspection Date: 23-Sep-19 Blast Date: 20-Sep-19
Geologist: Juliana Morales
Quarry Location: Quarry D

General Visual Inspection

Rock Type	1a/1as	Description: light to medium grey, fine grained, massive mafic volcanics
Vein	Y/N	If yes, describe (min, %, size): 1% quartzs carbonate veins, calcite stringers
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other Percentage: <1%
Fibrous Actinolite	Y/N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-50	light to medium grey, fine grained, massive mafic volcanics, hematite stringers on the wall

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y264152

Description: Green mafic volcanics, medium grained, 2% quartz carbonate veining, <1% pyrite and some hematite staining

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264151

Description: Green mafic volcanics, medium grained, 5% quartz carbonate veining, <1% pyrite and some hematite staining

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y264154

Description: Green mafic volcanics, medium grained, 2% quartz carbonate veining, <1% pyrite and some hematite staining

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264153

Description: Green mafic volcanics, medium grained, 5% quartz carbonate veining, <1% pyrite and some hematite staining

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Attachment C – Sample Descriptions, Construction Monitoring Program

Notes from Construction and Waste Rock Inspection at Hope Bay (August 1-2, 2019) - Derrick Midwinter																	
			Coordinates (NAD83)		Elevation			Fines		Rinse Test (on <2mm size)				Analyses Requested			
Sample ID	Date	Area	Northing	Easting	(m)	Geological Description of Sampling Location	Sulphides	Fizz	Color	Colour	Weight	pH	EC (uS/cm)	Total Sulpur (<1 cm)	ABA (< 1 cm)	Aqua Regia Metals (<1 cm)	SFE (<2 mm)
SRK19-CR01	01-Aug-19	Roberts Bay (Terminus)	432105	7563528	17	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins, rare epidote veins	Mostly none, few fragments with up to 3% cubic pyrite, few chalcopyrite	Strong	medium brown	cloudy grey	50g	8.95	453	X	X	X	X
SRK19-CR02	01-Aug-19	Roberts Bay Road	432300	7563126	18	1a: Dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins, rare epidote veins	Mostly none, few fragments with up to 5% cubic pyrite	Strong	light brown	cloudy grey	50g	8.97	181.1	X	X	X	
SRK19-CR03	01-Aug-19	Road to Madrid North CWP	433364	7550427	57	1a: Dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins, rare sericitic texture; lesser granitic boulders (glacial erratic?)	Mostly none, few fragments with up to 1% cubic pyrite	Strong	light brown	cloudy grey	50g	9.19	696	X	X	X	
SRK19-CR04	01-Aug-19	Road to Madrid North CWP	433440	7549990	72	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins, rare sericitic texture; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.97	551	X	X	X	
SRK19-CR05	01-Aug-19	Road to Madrid North CWP	433146	7549725	64	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.60	720	X	X	X	X
SRK19-CR06	01-Aug-19	Madrid North CWP	433220	7549843	87	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.82	831	X	X	X	X
SRK19-CR07	01-Aug-19	Naartok Pit Road	433537	7550534	53	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins	None visible	Strong	light brown	cloudy grey	50g	8.89	1589	X		X	X
SRK19-CR08	01-Aug-19	Overburden Berm	433199	7550551	63	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins, rare epidote veins	None visible	Strong	light brown	cloudy grey	50g	9.00	2450	X	X	X	X
SRK19-CR08-Dup	01-Aug-19	Overburden Berm				1a: Dark green mafic metavolcanic, few hematite staining, few carbonate and quartz veins, rare epidote veins	None visible	Strong	light brown	cloudy grey	50g	9.02	2360	X	X	X	X
SRK19-CR09	01-Aug-19	Road to Vent Raise	433437	7558731	49	1a: Dark green mafic metavolcanic, few hematite staining, few carbonate and quartz veins; common granitic boulders; common graphitic argillite-stained metavolcanic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with graphitic rocks and metavolcanics	Strong	brownish grey	cloudy grey, bla	50g	8.63	316	X	X	X	X
SRK19-CR10	01-Aug-19	Doris Access Road to CPR	433716	7559253	62	1as: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, rare hematite stains, rare carbonate and quartz veins; 12: boulders of quartz veins; lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Strong	light brown	cloudy grey	50g	8.94	372	X	X	X	
SRK19-CR11	01-Aug-19	Doris CPR (North)	433774	7559223	56	1ay: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins; 12: boulders of quartz veins; lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Strong	light brown	cloudy grey	50g	8.53	4930	X	X	X	X
SRK19-CR12	01-Aug-19	Doris CPR (South)	433736	7559111	55	1ay: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins; 12: boulders of quartz veins; 11c: lesser diabase (one boulder); lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1as	Strong	light brown	cloudy grey	50g	8.59	3960	X	X	X	

Attachment D – Photos of Sample Locations, Construction Monitoring Program

Photo: Sampling location for SRK19-CR-01

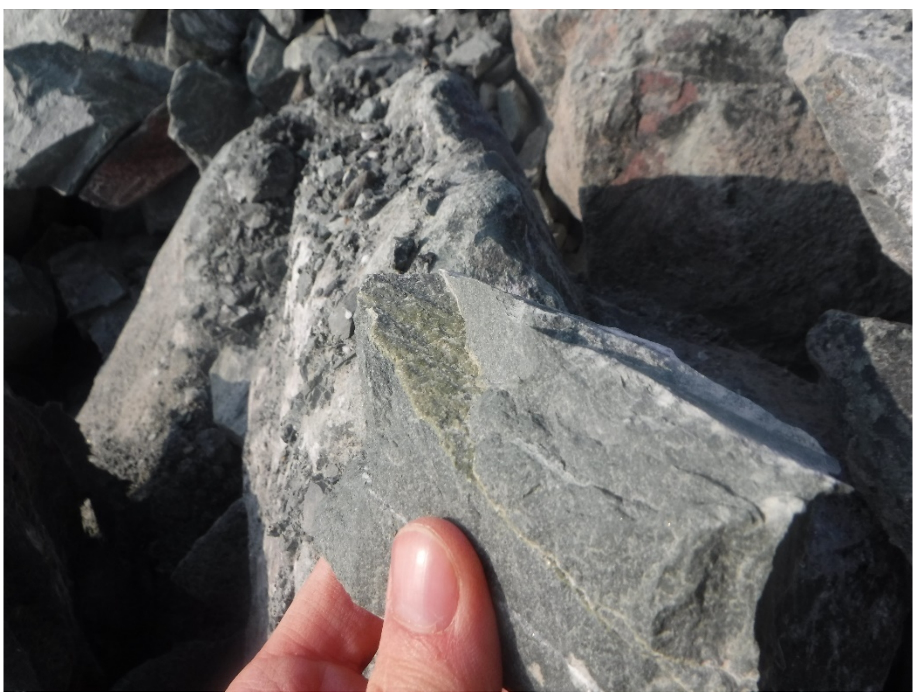

Photo: Epidote veining among rock type 1a at sampling location for SRK19-CR-01

Photo: Sampling location for SRK19-CR-02

Photo: Sulphides (pyrite) along quartz vein among rock type 1a at sampling location for SRK19-CR-02

Photo: Sampling location for SRK19-CR-03

Photo: Sulphides (pyrite) among rock type 1a at sampling location for SRK19-CR-03

Photo: Sampling location for SRK19-CR-04

Photo: Granitic boulder among rock type 1a at sampling location for SRK19-CR-04

Photo: Sampling location for SRK19-CR-05

Photo: Hematite vein among rock type 1a at sampling location for SRK19-CR-05

Photo: Sampling location for SRK19-CR-06

Photo: Graphitic rock (5a) among rock type 1a at sampling location for SRK19-CR-06

Photo: Sampling location for SRK19-CR-07

Photo: Sampling location for SRK19-CR-07

Photo: Sampling location for SRK19-CR-08

Photo: Calcite vein with hematite staining among rock type 1a at sampling location for SRK19-CR-08

Photo: Sampling location for SRK19-CR-09

Photo: Graphitic rock (5a) and granite among rock type 1a at sampling location for SRK19-CR-09

Photo: Sampling location for SRK19-CR-10

Photo: Quartz vein fragments (12q) and rock type 1as among rock type 1a at sampling location for SRK19-CR-10

Photo: Cover of Doris CPR with rock type 1as among rock type 1ay, near sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, quartz vein fragment next to rock hammer, at sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, with quartz vein fragments and granitic boulder, near sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, near sampling location for SRK19-CR-12

Photo: Cubic pyrite within foliations of rock type 1ay, at sampling location for SRK19-CR-12

Photo: Diabase boulder among rock type 1as and 1ay, at sampling location for SRK19-CR-12

Attachment E – Sample Descriptions and Geochemical Data, Quarry Monitoring Program

Quarry Monitoring - ABA																	
Parameter	**Units**	**Detection Limits**	**Quarry 2**							**Quarry D**							
Sample Collected>			**May**				**July**		**August**	**May**		**July**		**September**			
Rock Type>			**1a**						**5a**	**1a**							
Sample ID>			**Y247801 <1CM**	**Y247801 <2MM**	**Y247802 <1CM**	**Y247802 <2MM**	**R828433**	**R828432**	**SRK19-QR2-01**	**Y264561 <2MM**	**Y264562 <1CM**	**Y250341**	**Y250342**	**Y264151**	**Y264152**	**Y264153**	**Y264154**
Sample Form>			**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**
Dry Weight Received	kg		1.5	0.4	0.4	1.7	2.1	2.9	3.2	0.9	2.7	1.3	5.3	0.3	2.7	0.2	3.3
Paste pH	pH Units	*N/A*	7.7	7.7	7.6	7.6	8.1	8.4	7.5	7.5	7.5	8.2	-	8.5	9.0	8.7	8.8
CO_2	wt%	*0.02*	6.1	8.5	8.0	9.0	8.2	8.2	3.3	4.5	3.8	6.5	-	8.0	6.1	7.4	6.7
TIC	kg CaCO3/t	*0.50*	140	190	180	200	190	190	75.0	100	87.0	150	-	180	140	170	150
Total S	wt%	*0.02*	0.22	0.34	0.23	0.34	0.41	0.14	2.3	0.12	0.14	0.18	0.09	0.26	0.15	0.15	0.19
Sulphate Sulphur	wt%	*0.01*	0.03	0.05	0.10	<0.01	0.07	0.10	0.1	<0.01	<0.01	0.02	-	0.01	<0.01	<0.01	<0.01
Sulphide Sulphur (by difference)	wt%	*0.02*	0.19	0.29	0.13	0.3	0.34	0.04	2.1	0.1	0.1	0.16	-	0.25	0.15	0.15	0.19
AP (calculated from total S)	kg $CaCO_3$/t	*0.6*	7	11	7.2	10.6	10.6	1.3	225	3.8	4.4	5.0	-	7.8	4.7	4.7	5.9
Mod. ABA NP	kg $CaCO_3$/t	*0.1*	150	220	200	200	180	170	70	120	100	160	-	210	150	190	130
Fizz Rating	N/A	*N/A*	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	-	MODERATE	MODERATE	MODERATE	MODERATE
Net Neutralization Potential	kg $CaCO_3$/t	*0.1*	140	210	200	190	160	170	3.4	120	100	160	-	200	140	180	130
TIC/AP (calculated from Total Sulphur)	N/A		20	18	25	19	15	42	1.1	27	20	26	-	23	30	36	25
NP/AP (calculated from Total Sulphur)	N/A		22	21	28	19	14	40	1.0	32	23	29	-	27	32	40	22

Notes:
AP is acid generation potential, calculated from Total Sulphur
NP is neutralization potential
Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

Quarry Monitoring - Elemental Analysis															
Parameter	**Units**	**Quarry 2**							**Quarry D**						
	Sample Collected>	**May**				**July**		**August**	**May**		**July**	**September**			
	Rock Type>	**1a**						**5a**	**1a**						
	Sample ID>	**Y247801**	**Y247801**	**Y247802**	**Y247802**	**Y264562**	**Y250341**	**SRK19-QR2-01**	**WJ8403**	**WJ8404**	**Y264561**	**Y264151**	**Y264152**	**Y264153**	**Y264154**
	Sample Form>	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**
Ag	mg/kg	0.20	0.70	0.20	0.40	*<0.1*	*<0.1*	0.5	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Al	mg/kg	49000	49000	50000	49000	38000	39000	25000	37000	36000	35000	37000	38000	38000	34000
As	mg/kg	1.2	2.6	2.9	24	26	16	33	16	1.9	3.7	1.70	1.10	1.40	0.90
Au	mg/kg	0.023	0.032	0.018	0.012	0.015	0.0034	0.0028	0.005	0.001	0.007	0.0031	0.0015	0.0019	0.0011
B	mg/kg	25	29	24	22	*<20*	*<20*	*<20*	77.00	63	64	41	35	*<20*	*<20*
Ba	mg/kg	7.0	13.0	28.0	20.0	7.0	6.0	11	7.0	4.0	8.0	12.00	9.00	14.00	7.00
Bi	mg/kg	*<0.1*	*<0.1*	0.10	2.40	2.30	0.30	0.7	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Ca	mg/kg	70000	91000	84000	95000	60000	58000	21000	55000	50000	66000	79000	67000	76000	65000
Cd	mg/kg	0.70	0.50	0.40	0.50	*<0.1*	*<0.1*	0.1	0.20	*<0.1*	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Co	mg/kg	49	50	49	49	46	45	60	48	46	39	47	44	47	42
Cr	mg/kg	45	51	49	46	32	32	35	550	590	330	580	540	710	650
Cu	mg/kg	160	150	140	150	130	110	410	110	100	110	110	110	89	85
Fe	mg/kg	110000	110000	110000	110000	89000	91000	72000	55000	53000	55000	55000	58000	53000	50000
Ga	mg/kg	17	17	17	17	13	14	8	8	8	7	8.00	8.00	8.00	8.00
Hg	mg/kg	*<0.01*	*<0.01*	0.01	0.07	*<0.01*	*<0.01*	0.05	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
K	mg/kg	200	300	300	300	400	400	1100	400	200	300	100	100	100	*<100*
La	mg/kg	30000	60000	50000	60000	40000	30000	5	20000	20000	20000	10000	*<10000*	10000	*<10000*
Mg	mg/kg	27000	28000	28000	28000	27000	28000	19000	37000	36000	31000	36000	35000	38000	35000
Mn	mg/kg	2100	2400	2400	2500	2000	2000	540	1200	1100	1400	1400.00	1500.00	1300.00	1200.00
Mo	mg/kg	0.30	0.40	0.40	0.50	0.50	0.30	1.2	1.50	0.90	0.80	0.30	0.50	0.20	0.20
Na	mg/kg	70	220	150	180	200	110	120	100	80	280	240	190	240	150
Ni	mg/kg	42	41	41	41	37	37	56	210	200	110	200	170	230	200
P	mg/kg	390	380	390	390	470	440	730	190	190	200	160	170	160	170
Pb	mg/kg	2.7	5.6	7.3	20	2.4	1.8	9.8	4.0	1.7	3.6	3.7	1.9	2.1	1.1
S	mg/kg	2300	3300	2400	3100	3300	2800	24000	1100	800	1600	2100	1000	1200	900
Sb	mg/kg	*<0.1*	*<0.1*	*<0.1*	0.60	*<0.1*	*<0.1*	0.6	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Sc	mg/kg	34	33	33	33	23	23	5.4	5	5	7	6.90	6.30	6.70	5.40
Se	mg/kg	0.70	0.80	0.70	0.80	0.70	0.70	3.5	0.60	*<0.50*	0.60	0.70	0.50	*<0.50*	*<0.50*
Sr	mg/kg	38	49	47	51	35	34	10	14	13	20	20.00	15.00	18.00	16.00
Te	mg/kg	*<0.20*	*<0.20*	*<0.20*	*<0.20*	0.30	*<0.20*	0.8	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*
Th	mg/kg	0.10	0.20	0.20	0.20	0.60	0.20	0.0025	0.60	0.30	0.40	0.10	*<0.1*	0.10	*<0.1*
Ti	mg/kg	1600	1600	1500	1400	200	190	80	2300	2500	2500	2500	2700	2400	2300
Tl	mg/kg	*<0.10*	0.20	*<0.10*	0.10	*<0.10*	*<0.10*	<0.10	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*
U	mg/kg	*<0.1*	*<0.1*	*<0.1*	*<0.1*	0.20	0.20	0.3	0.10	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
V	mg/kg	330	320	320	320	240	240	38	98	98	120	130.00	130.00	130.00	120.00
W	mg/kg	*<0.1*	*<0.1*	*<0.1*	*<0.1*	0.20	*<0.1*	*<0.1*	0.20	*<0.1*	0.20	0.10	<0.1	0.40	*<0.1*
Zn	mg/kg	250	190	180	190	97	98	85	70	64	76	66	66	57	54

Notes:

Quarry Monitoring - Shake Flask Extraction Results (-2 mm)										
Parameter	**Units**	**Detection Limit**	**Quarry 2**				**Quarry D**			
		Sample Collected>	**May**		**July**	**August**	**May**	**July**	**September**	
		Rock Type>	**1a**			**5a**	**1a**			
		Sample ID>	**Y247801**	**Y247802**	**R828433**	**SRK19-QR2-01**	**Y264561**	**Y250341**	**Y264151**	**Y264153**
pH	pH Units	N/A	**9.2**	**9.1**	9.0	7.7	8.6	8.9	**9.1**	8.9
EC	uS/cm	0.5	320	340	290	1300	160	430	230	270
SO4	mg/L	0.5	27	29	28	780	21	25	7.9	14
Total Alkalinity	mg/L	0.5	23	23	24	15	32	35	37	35
Bicarbonate	mg/L	0.5	28	28	30	18	39	42	45	43
Carbonate	mg/L	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Hydroxide	mg/L	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Dissolved Chloride	mg/L	0.5	56	54	32	4	6.9	49	30	43
Nitrate-N	mg/L	0.02	3.7	4.2	8.9	< 0.2	3.0	15	2.7	6.8
Nitrite-N	mg/L	0.005	1.3	1.3	0.01	< 0.5	0.09	0.05	0.05	0.2
Total Ammonia **	mg/L	0.005/0.025 (1)	1.3 (1)	1.3 (1)	1.5	-	0.011	6.0 (1)	1.0 (1)	0.81 (1)
Total Dissolved Solids	mg/L	10	-	-	170	1300	90	190	130	180
Hardness (CaCO3)	mg/L	0.5	42	51	48	820	52	48	15	18
Dissolved Aluminum (Al)	mg/L	0.0005	0.33	0.33	0.21	0.029	0.17	0.18	0.25	0.20
Dissolved Antimony (Sb)	mg/L	0.00002	0.00031	0.00034	0.00039	0.00016	0.00030	0.00035	0.00058	0.0004
Dissolved Arsenic (As)	mg/L	0.00002	0.00040	0.00063	0.0037	0.00032	0.0064	0.00093	0.0012	0.0014
Dissolved Barium (Ba)	mg/L	0.00002	0.00940	0.01500	0.005	0.012	0.0018	0.0081	0.0098	0.023
Dissolved Beryllium (Be)	mg/L	0.00001	*< 0.00001*	*< 0.00001*	*< 0.00001*	*< 0.00002*	*< 0.00001*	*< 0.00001*	*< 0.00001*	*< 0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.00001*	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Boron (B)	mg/L	0.05	0.073	0.067	0.19	0.28	0.056	0.53	0.86	0.6
Dissolved Cesium (Cs)	mg/L	0.00005	0.000093	0.000093	0.00009	*< 0.0001*	*< 0.00005*	0.00015	0.000053	0.000055
Dissolved Cadmium (Cd)	mg/L	0.000005	*< 0.000005*	0.0000086	*< 0.000005*	0.00018	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	12	14	15	290	16	13	4.9	5.8
Dissolved Chromium (Cr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*	0.00041	0.00052	*0.0001*	0.0017	0.0042
Dissolved Cobalt (Co)	mg/L	0.000005	0.00012	0.00012	0.00027	0.00039	0.0000947	0.00048	0.00073	0.00068
Dissolved Copper (Cu)	mg/L	0.00005	0.00057	0.001	0.00049	0.004	*0.0020*	0.00085	0.00078	0.00087
Dissolved Lanthanum (La)	mg/L	0.00005	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.0001*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*
Dissolved Iron (Fe)	mg/L	0.001	0.0098	0.022	0.003	0.0026	0.0021	0.0085	0.061	0.023
Dissolved Lead (Pb)	mg/L	0.000005	0.00012	0.00026	0.000022	0.00027	*0.000005*	0.000073	0.000077	0.000018
Dissolved Lithium (Li)	mg/L	0.0005	0.00063	0.0008	0.0017	0.015	0.0018	0.0024	0.00063	*0.0005*
Dissolved Magnesium (Mg)	mg/L	0.05	3.0	3.7	2.8	25	3.1	3.8	0.77	0.93
Dissolved Manganese (Mn)	mg/L	0.00005	0.0014	0.0023	0.0036	0.02	0.0025	0.0024	0.0014	0.00045
Dissolved Phosphorus (P)	mg/L	0.002	0.0036	0.0037	0.0043	*< 0.004*	0.0065	0.002	0.011	0.015
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.0018	0.0017	0.0031	0.0035	0.0031	0.0053	0.0021	0.0028
Dissolved Nickel (Ni)	mg/L	0.00002	0.000085	0.000069	0.000049	0.00063	0.00043	0.00022	0.00022	0.0001
Dissolved Potassium (K)	mg/L	0.05	4.6	5.0	6.2	8.3	1.9	4.8	2.6	3.5
Dissolved Rubidium (Rb)	mg/L	0.00005	0.0046	0.0049	0.0054	0.0039	0.00069	0.0045	0.0021	0.0026
Dissolved Selenium (Se)	mg/L	0.00004	0.0005	0.00048	0.0025	0.0027	0.00037	0.00046	0.00087	0.00081
Dissolved Silicon (Si)	mg/L	0.1	0.51	0.49	0.6	0.34	1.12	1.3	1.6	1.8
Dissolved Silver (Ag)	mg/L	0.000005	*< 0.000005*	0.0000066	0.0000055	*< 0.00001*	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Sodium (Na)	mg/L	0.05	40	40	29	5.3	8.5	49	36	46
Dissolved Strontium (Sr)	mg/L	0.00005	0.045	0.048	0.038	0.17	0.018	0.037	0.014	0.02
Dissolved Sulphur (S)	mg/L	*10*	*10*	11	*10*	*270*	*10*	*10*	*10*	*10*
Dissolved Tellurium (Te)	mg/L	0.00002	*< 0.00002*	*< 0.00002*	*< 0.00002*	*< 0.00004*	*< 0.00002*	*< 0.00002*	*< 0.00002*	*< 0.00002*
Dissolved Thallium (Tl)	mg/L	0.000002	0.000068	0.000068	0.0000081	0.000054	0.000013	0.000068	0.000018	0.0000033
Dissolved Thorium (Th)	mg/L	0.000005	*< 0.000005*	*< 0.000005*	0.0000052	< 0.00001	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*< 0.0002*	*< 0.0002*	*< 0.0002*	*< 0.0004*	*< 0.0002*	*< 0.0002*	*< 0.0002*	*< 0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	*< 0.0005*	*< 0.0005*	0.0014	*< 0.001*	*< 0.0005*	*< 0.0005*	*< 0.0005*	0.00062
Dissolved Tungsten (W)	mg/L	0.00001	0.000081	0.000081	0.0006	*< 0.00002*	0.00226	0.00044	0.0014	0.0015
Dissolved Uranium (U)	mg/L	0.000002	0.0000024	0.0000024	0.000017	0.00012	0.0000291	0.0000024	0.00001	*< 0.000002*
Dissolved Vanadium (V)	mg/L	0.0002	0.00112	0.0011	0.0052	*< 0.0004*	0.00186	0.00096	0.00087	0.0068
Dissolved Zinc (Zn)	mg/L	0.0001	0.0018	0.0018	0.0028	0.0058	*< 0.0001*	0.0027	0.0025	*< 0.0001*
Dissolved Zirconium (Zr)	mg/L	0.0001	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.0001*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*

Notes:

Italicized font indicates result is below the detection limit

Bold font indicates result is above the guideline

°All element concentrations are given as dissolved

(1) Detection limits raised to 0.025 mg/L due to dilution to bring analyte within the calibrated range.

**Guideline for ammonia is maximum average concentration from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

Attachment F – Geochemical Data, Construction Monitoring Program

Construction Monitoring - ABA														
		Mine Area>	**Doris**						**Madrid North**					
		Rock Type>	**1a**			**1a w. 5a**	**1as/ay**		**1a**					
Parameter	**Units**	**Detection Limits**	**Robert's Bay**		**Road to Doris CPR**	**Road to Vent Raise**	**Doris CPR Cover**		**Road to Madrid North CWP**			**Madrid North CWP**	**East Naartok CPR**	**Berm for Overburden**
		Sample ID>	**SRK19-CR01**	**SRK19-CR02**	**SRK19-CR10**	**SRK19-CR09**	**SRK19-CR11**	**SRK19-CR12**	**SRK19-CR03**	**SRK19-CR04**	**SRK19-CR05**	**SRK19-CR06**	**SRK19-CR07**	**SRK19-CR08**
Paste pH	pH Units		8.2	8.4	8.6	8.8	8.2	8.4	8.8	8.6	8.2	8.4	#N/A	8.3
CO2	wt%	*0.02*	4.8	4.7	5.8	5.3	5.3	5.5	5.3	5.8	5.3	5.5	#N/A	7.6
Total S	wt%	*0.02*	0.20	0.18	0.17	0.15	0.1	0.2	0.15	0.17	0.11	0.22	0.07	0.11
Sulphate Sulphur	wt%	*0.01*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	#N/A	0.01
Sulphide Sulphur	wt%	*0.02*	0.19	0.18	0.16	0.15	0.11	0.22	0.15	0.16	0.11	0.22	#N/A	0.11
AP	kg CaCO3/t	*0.60*	5.9	5.6	5.0	4.7	3.4	6.9	4.70	5.0	3	7	#N/A	3.4
AP (total S)			6.3	5.6	5.3	4.7	3.4	6.9	4.69	5.3	3	7	#N/A	3.4
TIC	kg CaCO3/t	*0.5*	110	110	130	120	120	125	120.2	132	119	125	#N/A	172
Mod. Sobek NP	kg CaCO3/t		140	140	150	140	130	154	143	145	134	154	#N/A	196
Fizz Rating	N/A	*N/A*	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	#N/A	MODERATE
Net Neutralization Potential	kg CaCO3/t		140	130	140	140	130	150	138	140	130	147	#N/A	193
TIC/AP	N/A		19	19	26	26	35	18	26	26	35	18	#N/A	50
TIC/AP (total S)			18	19	25	26	35	18	26	25	35	18	#N/A	50
NP/AP	N/A	*0.1*	20	21	27	43	33	25	43	27	33	25	#N/A	29
NP/AP (total S)			23	24	27	31	39	22	31	27	39	22	#N/A	57

Notes:

AP is acid generation potential, calculated from Total Sulphur

NP is neutralization potential

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

Attachment F: Geochemical Data, Construction Monitoring Program

Construction Monitoring - Elemental Analysis												
	Mine Area>	Doris						Madrid North				
	Rock Type>	1a			1a w. 5a	1as/ay		1a				
Parameter	Units	Robert's Bay		Road to Doris CPR	Road to Vent Raise	Doris CPR Cover		Access Road to North Madrid CWP			Madrid North CWP	Berm for Overburden Pad
		SRK19-CR01	SRK19-CR02	SRK19-CR10	SRK19-CR09	SRK19-CR11	SRK19-CR12	SRK19-CR03	SRK19-CR04	SRK19-CR05	SRK19-CR06	SRK19-CR08
Ag	*ppm*	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Al	*%*	3.3	3.3	1.7	3.3	1.2	1.05	3.7	3.9	3.7	3.6	3.2
As	*ppm*	5.2	2.4	45	12	30.8	31	3.2	4.3	2.9	4.3	1.5
Au	*ppb*	7.5	5.4	259	4.5	401	163	1.8	2.6	1.5	7.6	2
B	*ppm*	20	20	20	20	20	20	20	20	20	20	20
Ba	*ppm*	8	10	7	11	12	9	4	6	5	6	13
Bi	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ca	*%*	5.5	5.0	5.5	4.5	4.9	5.4	5.4	5.4	5.3	5.3	7.6
Cd	*ppm*	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1
Co	*ppm*	42	41	45	37	37	38.8	38	41	44	41	43
Cr	*ppm*	154	157	50	69	40	45	234	324	350	181	541
Cu	*ppm*	125	149	123	157	72	88	119	104	101	118	92
Fe	*%*	5.9	6.0	6.2	7.0	5.8	5.7	6.0	6.3	5.8	6.9	4.9
Ga	*ppm*	8	8	5	10	4	3	9	9	9	11	8
Hg	*ppm*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K	*%*	0.02	0.02	0.05	0.06	0.05	0.05	0.02	0.02	0.02	0.02	0.05
La	*ppm*	2	3	2	5	3	3	2	2	2	2	4
Mg	*%*	2.4	2.5	2.0	2.5	1.7	1.9	3.1	3.4	3.4	2.5	2.9
Mn	*ppm*	1360	1370	1630	1540	1440	1430	1480	1520	1390	1620	1470
Mo	*ppm*	0.3	0.8	1	0.5	0.5	0.7	1.1	0.3	0.3	0.6	0.3
Na	*%*	0.008	0.009	0.024	0.007	0.053	0.032	0.011	0.01	0.009	0.009	0.057
Ni	*ppm*	64	61	73	46	54	64	69	111	134	79	174
P	*%*	0.028	0.032	0.025	0.035	0.038	0.031	0.024	0.025	0.02	0.03	0.021
Pb	*ppm*	4.4	2.1	2	2.5	1.8	2.6	2	2.8	3.1	1.9	2.5
S	*%*	0.16	0.14	0.35	0.39	0.31	0.23	0.14	0.12	0.1	0.19	0.08
Sb	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sc	*ppm*	10.4	10.1	11.4	16.3	10.5	11.3	13.1	12.6	9.3	14.5	6.7
Se	*ppm*	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sr	*ppm*	24	27	27	29	27	26	24	22	19	25	19
Te	*ppm*	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Th	*ppm*	0.3	0.3	0.4	1.1	0.8	0.8	0.2	0.2	0.3	0.2	1.6
Ti	*%*	0.25	0.28	0.064	0.10	0.016	0.017	0.22	0.21	0.22	0.17	0.24
Tl	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
U	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
V	*ppm*	150	162	77	175	36	40	165	161	135	174	117
W	*ppm*	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Zn	*ppm*	119	89	61	95	69	59	79	77	80	112	58

			Mine Area>	Doris			Madrid North			
			Rock Type>	1a	1a w. 5a	1as/ay	1a			
Parameter	Units	Detection Limit	Screening Criteria	SRK19-CR01	SRK19-CR09	SRK19-CR11	SRK19-CR05	SRK19-CR06	SRK19-CR07	SRK19-CR08
				-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock
				Robert's Bay	Road to Vent Raise	Doris CPR Cover	Road to Madrid North CWP	Madrid North CWP	Road to Naartok East CPR	Berm for Overburden Pad
pH	pH Units	N/A	9	8.8	8.7	8.7	8.7	8.7	8.9	8.9
EC	uS/cm	0.5	500	200	142	1488	251	345	562	890
SO4	mg/L	0.5		49	30	124	16	29	45	46
Total Alkalinity	mg/L	0.5		27	29	22	23	23	31	28
Dissolved Chloride	mg/L	0.5		14	3.1	352	6.7	52	123	203
Nitrate-N	mg/L	0.02		0.20	0.9	19.3	19	7.6	2.4	8.2
Nitrite-N	mg/L	0.005		0.05	0.05	0.16	0.07	0.16	0.17	0.05
Total Dissolved Solids	mg/L	10		130	92	920	180	210	310	490
Hardness CaCO3	mg/L	0.5		40	56	195	62	63	51	62
Dissolved Aluminum (Al)	mg/L	0.0005	2	0.2	0.18	0.09	0.15	0.18	0.14	0.11
Dissolved Antimony (Sb)	mg/L	0.00002		0.0002	0.00025	0.00023	0.00011	0.00011	0.00011	0.00008
Dissolved Arsenic (As)	mg/L	0.00002	0.1	0.0010	0.0012	0.0205	0.0015	0.0015	0.0014	0.0005
Dissolved Cadmium (Cd)	mg/L	0.000005		0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05		10	16	30	16	15	11	12
Dissolved Chromium (Cr)	mg/L	0.0001		0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Cobalt (Co)	mg/L	0.000005		0.00004	0.000038	0.006720	0.000048	0.00004	0.00010	0.00022
Dissolved Copper (Cu)	mg/L	0.00005	0.04	0.00075	0.0016	0.0018	0.00079	0.0019	0.0012	0.00062
Dissolved Iron (Fe)	mg/L	0.001	0.6	0.020	0.0025	0.0050	0.0091	0.0010	0.0130	0.0036
Dissolved Lead (Pb)	mg/L	0.000005	0.02	0.000022	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Dissolved Magnesium (Mg)	mg/L	0.05		3.6	3.6	29.2	5.2	6.1	6.0	7.9
Dissolved Manganese (Mn)	mg/L	0.00005		0.0034	0.0050	0.0247	0.0040	0.0042	0.0030	0.0025
Dissolved Phosphorus (P)	mg/L	0.002		0.0021	0.061	0.005	0.0030	0.0033	0.0044	0.0042
Dissolved Molybdenum (Mo)	mg/L	0.00005		0.0018	0.0021	0.0026	0.0014	0.0017	0.0029	0.0022
Dissolved Nickel (Ni)	mg/L	0.00002	0.1	0.00009	0.0001	0.0005	0.0002	0.0002	0.0004	0.0003
Dissolved Potassium (K)	mg/L	0.05		2.9	3.6	18.4	3.1	4.7	5.7	7.8
Dissolved Sodium (Na)	mg/L	0.05		22	4.0	230	23	41	88	150
Dissolved Strontium (Sr)	mg/L	0.00005		0.034	0.032	0.089	0.032	0.037	0.041	0.051
Dissolved Sulphur (S)	mg/L	10		15	10	45	10	12	17	18
Dissolved Uranium (U)	mg/L	0.000002		0.000016	0.000028	0.000156	0.000008	0.000011	0.000015	0.000012
Dissolved Vanadium (V)	mg/L	0.0002		0.0020	0.00049	0.00067	0.0023	0.0011	0.0032	0.0033
Dissolved Zinc (Zn)	mg/L	0.0001	0.02	0.0004	0.00020	0.00025	0.00034	0.00011	0.00038	0.00017
Dissolved Zirconium (Zr)	mg/L	0.0001		0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005		0.0001	0.000050	0.000050	*0.00005*	*0.00005*	*0.00005*	*0.00005*

Notes:

°All element concentrations are given as dissolved

Appendix D – 2019 Hope Bay Waste Rock, Ore and Infrastructure Seep Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter Lisa Barazzuol	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 18, 2020
Subject:	2019 Seep Monitoring of Doris and Madrid Waste Rock, Ore, and Infrastructure		

1 Introduction

As part of the verification, monitoring and management plans for the Hope Bay Project (the Project), located in Nunavut, TMAC Resources Inc. (TMAC) monitors seepage downstream of mine infrastructure, pads, roads and waste rock. Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018) is the permit that governs mining activities at the Doris and Madrid areas of the Project. The 2019 seepage monitoring program was completed by TMAC in accordance with conditions outlined in Item 8, Part D “Conditions applying to Construction and Operations” of Water Licence 2AM-DOH1335 Amendment No. 2, Quarry Management and Monitoring Plan (TMAC 2017) and Waste Rock, Ore and Backfill Management Plan, Hope Bay Project, Nunavut (TMAC 2019).

In 2019, TMAC conducted a seepage survey of the waste rock influenced area (WRIA) at Doris in the following areas (Attachment 1): toe of the waste rock stockpiles on Pad T and Pad I, including the slope of the pollution control pond (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I; and toe of the access roads located down-gradient of the Doris waste rock stockpiles where contact water bypasses the PCP. At the time of the survey, there was no waste rock on surface at Madrid North.

The scope of the 2019 construction rock seepage monitoring survey included infrastructure constructed since the previous seepage survey and infrastructure surveyed for seepage in 2018 but where none was observed (SRK 2019). In the latter case, these areas were monitored again in 2019. Construction material used at Madrid North was sourced from Quarry D whereas material used at Doris was from Quarry 2 or Doris waste rock that was geochemically monitored for use as construction material according to TMAC (2019) and deemed suitable for construction by TMAC. The 2019 seepage monitoring program included the surveying of the following areas at Doris and Madrid (with waste rock used as construction rock noted in parentheses):

- Doris
  - South Dam;
  - Access Road to the Doris Crown Pillar Recovery (CPR);

  - Access Road to Doris vent raise;
  - Cover of the Doris CPR (constructed primarily of Doris waste rock and some quarry rock); and
  - Marine Outfall Berm (MOFB) Access Road.
- Madrid North
  - Access road to the Madrid North Contact Water Pond (CWP);
  - Access road to the Naartok East CPR;
  - Naartok East overburden pad berm; and
  - Madrid North CWP construction area.

2 Methods

2.1 Seepage Survey and Sample Collection

TMAC conducted the seepage survey between June 19 and 24, 2019. Seepage survey locations, outlined in Section 1, Table 2-1 and in Attachment 1, were established where seepage was observed or suspected by examining the toes of the waste rock stockpile, infrastructure, roadways, and berms. Samples were collected and field measurements were taken at locations where water was observed flowing into and out of construction rock material; this included seepage where precipitation runoff and snowmelt came into contact with rock along the roadways, building pads, and berms. Electrical conductivity (EC), pH, temperature, oxidation-reduction potential (ORP), and flow rates (where possible) were measured at each of these locations at the time of monitoring.

A total of thirty-three (33) seepage survey sites and three (3) reference survey sites were established where chemical and physical properties of seepage water were measured and samples were taken for laboratory analysis. The three reference sites, located in the undisturbed tundra and not subject to mine influences, were sampled on July 3, 2019. These samples, used as baseline reference points, were collected at approximately the same locations as the 2010 to 2018 seepage surveys (in the vicinity of the Doris-Windy Road, Attachment 1).

Table 2-1: Summary of 2019 seepage survey

Mine Area	Material Source	Surveyed Area	Surveyed Seeps
Reference	Background[1]	Reference (Doris-Windy Road)	3
Doris	Waste Rock Stockpiles	Toe of the waste rock stockpiles on Pad T and Pad I	0
		Berm of the pollution control ponds (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I	3
		Toe of the access roads located down-gradient of the Doris waste rock stockpiles	3
	Quarry 2	South Dam	1
		CPR Access Road	2
		MOFB Access Road	13
		Access Road to Vent Raise	0
	Waste Rock for Construction	Cover of Doris CPR	0
Madrid North	Quarry D	Access Road to Naartok East CPR	0
		Access Road to Madrid North CWP	11
		Madrid North CWP	0
		Overburden Pad Berm	0

Notes:

See Attachment A for surveyed areas in 2019

[1] One reference station (REF-001) may be impacted by nearby infrastructure

One duplicate sample and one field blank were collected and submitted for laboratory analysis, and one travel blank was included in sample shipments as part of SRK's recommended quality assurance/quality control (QA/QC) program.

TMAC submitted a total of 38 samples (including a duplicate and field blank) to ALS Environmental Labs in Vancouver, BC, where they were analyzed for pH, EC, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and dissolved metals (including mercury and selenium). All samples were filtered and preserved in the field, as required.

2.2 Quality Assurance

SRK conducted a QA/QC review of all data and overall, results were deemed acceptable. The general findings are outlined as below:

- Ion balances ranged from -7.2 to 8.7% for the samples. No samples exceeded SRK's criteria of ±10%.
- Field blank parameter concentrations were below detection limits, indicating that field filtration and sampling methods did not introduce contamination.

- Field duplicate results were within ±10% relative percent difference (RPD) for all parameters with measured concentrations greater than ten times the detection limit.
- Laboratory and field values of pH, EC, and TDS were compared and met SRK's QA/QC criteria with the exception of one sample (19-DC-06) that had the highest level of EC and a relative percent difference (RPD) of 24%.

3 Results

Attachment 1 presents location maps of the seepage samples, surveyed areas and of the as-built alignment of the Doris and Madrid mine areas. A complete set of field observations and measurements is provided in Attachment 2. Attachment 3 contains the laboratory water chemistry results. Table 3-1 presents median values for field pH and conductivity measurements.

3.1 Windy Road Area (Reference Stations)

3.1.1 Field Data

Field data were not collected at the three reference stations.

3.1.2 Laboratory Data

Consistent with previous years, three reference samples were taken in the Windy Road area and submitted for laboratory analysis (Table 3-1). The laboratory pH values ranged from 7.1 to 7.8 and laboratory EC measured between 50 and 160 µS/cm, both within the historical range (see Section 4.1.1).

Major cation chemistry was dominated by sodium (3.4 to 9.9 mg/L) and calcium (4.3 to 15 mg/L), while major anion chemistry was dominated by alkalinity (18 to 47 mg/L as $CaCO_3$), sulphate (0.3 to 5.3 mg/L) and chloride (3.7 to 19 mg/L).

Nitrite and nitrate values were below the limit of detection (0.005 mg/L).

3.2 Doris

3.2.1 Waste Rock Influenced Area

Six samples from the WRIA were submitted for laboratory analysis (Table 3-2). 19-DC-01, 19-DC-02 and 19-DC-03 were sampled along the northwest edge of the pollution containment pond (PCP). These three seeps are immediately downstream of the toe of the stockpile on Pad I that is composed of TMAC ore placed on top of waste rock placed in a stockpile in 2011. Accordingly, seepage from DC-01 to DC-03 were considered contact water (undiluted) from this stockpile. 19-DC-04, 19-DC-05 and 19-DC-06 were sampled along the access road located down-gradient of the Doris waste rock stockpiles.

Field Data

The samples collected within the WRIA (19-DC-01 to 19-DC-06) had the highest levels of field EC (ranging from 2000 to 3500 µS/cm) compared to other site areas. Field pH ranged from 7.6 to 8.1.

Table 3-1: Median values for field pH and conductivity measurements

Mine Area	Material Source	Site Area	No. of Samples	Conductivity (µS/cm)	pH
				Median	
Reference	-	Reference (Windy Road)	3	-	-
Doris	Waste Rock	WRIA	6	2300	8.1
	Quarry 2	South Dam	1	300	7.9
		Access Road to Doris CPR	2	270	8.0
		MOFB Access Road	13	190	7.7
Madrid	Quarry D	Access Road to Madrid North CWP	11	79	7.5

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 115 - Doris Seepage Monitoring\3. Working File\1CT022.037_2019_Doris-MadridSeep_rev01_jce.xlsx

Laboratory Data

The laboratory pH values ranged from 7.9 to 8.1 and laboratory EC measured between 2100 and 2700 µS/cm.

The major ion chemistry for WRIA samples located immediately downstream of the toe of the waste rock pile (19-DC-01 to 19-DC-03) varied from the samples located at the toe of the road (19-DC-04 to 19-DC-06) both in concentrations of chloride and sulphate and major cation composition.

For samples 19-DC-01 to 19-DC-03 major cation chemistry was dominated by sodium (290 to 350 mg/L) with lesser calcium (82 to 90 mg/L), while major anion chemistry was dominated by chloride (350 to 400 mg/L), sulphate (310 to 350 mg/L), alkalinity (130 mg/L as $CaCO_3$) and nitrate (18 to 21 mg/L).

For samples 19-DC-04 to 19-DC-06 the cation chemistry was dominated by calcium (160 to 260 mg/L) and sodium (170 to 190 mg/L) , while major anion chemistry was dominated by chloride (470 to 640 mg/L), sulphate (95 to 200 mg/L), alkalinity (74 to 88 mg/L as $CaCO_3$) and nitrate (25 to 28 mg/L).

Nitrite ranged from 0.13 to 0.44 mg/L, greater than the concentrations that were below detection (0.001 mg/L) at the reference stations. Ammonia (ranging from 5.6 to 9.7 mg/L) and chloride levels (350 to 470 mg/L) were one to three orders of magnitude greater than the reference stations. The source of ammonia, nitrate and nitrite are explosives residues and the source of chloride is drilling brines used in underground mining.

Iron concentrations at 19-DC-01 to 19-DC-03 ranged from 6.5 to 7.7 mg/L. High iron concentrations are likely due to presence of iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996).

Metals which were an order of magnitude greater at 19-DC-01 to 19-DC-03 than 19-DC-04 to 19-DC-06 were cobalt (ranging from 0.041 to 0.51 mg/L), copper (ranging from 3.5 to 3.9 mg/L), molybdenum (ranging from 0.014 to 0.016 mg/L), nickel (0.073 to 0.085 mg/L), silver (0.032 to 0.033 mg/L), and sulphur (120 to 140 mg/L). Calcium was the only parameter that 19-DC-04 to 19-DC-06 (ranging from 160 to 260 mg/L) compared to 19-DC-01 to 19-DC-03. All seepage from waste rock and at toe of the road is intercepted by water management collection systems and pumped to the Tailings Impoundment Area.

3.2.2 Infrastructure and Roads

One seepage sample was collected at the South Dam, two from along the access road to the Doris CPR, and thirteen samples along the MOFB access road. There was no seepage observed downstream of the Doris CPR cover, which was constructed primarily of waste rock, and the access road to the vent raise, constructed by Quarry 2 ROQ material.

Field Data

For all samples, the pH ranged from 7.6 to 8.3, and the EC ranged from 100 and 410 µS/cm.

Laboratory Data

For all samples, laboratory pH range from 7.7 to 8.1, and laboratory EC ranged 110 to 430 µS/cm.

The major cation chemistry for all seepage samples collected from infrastructure areas was dominated by sodium (9.1 to 48 mg/L) and calcium (7.6 to 19 mg/L) while major anion chemistry was dominated by alkalinity (26 to 77 mg/L as $CaCO_3$), sulphate (4.0 to 26 mg/L) and chloride. Chloride concentrations ranged from 5.9 to 51 mg/L except for two samples located in Roberts Bay (19-MOFB-01 and 19-MOFB-09) that had concentrations of 71 and 86 mg/L.

Nitrite and nitrate values were similar for the sixteen samples (ranging from 0.001 to 0.11 mg/L and 0.005 to 5.4 mg/L, respectively). Ammonia (ranging from 0.0056 to 3.5 mg/L) and chloride levels were one to two orders of magnitude greater than the reference stations, and one to two orders of magnitude lower than the waste rock influenced seepage. Sulphate was also more than one magnitude greater than the reference stations.

Dissolved trace metals concentrations were typically within an order of magnitude of concentrations at the reference stations with the exception of manganese and molybdenum.

3.3 Madrid North

3.3.1 Infrastructure and Roads

Eleven seepage samples were collected along the access road to the Madrid North CWP. Seepage was not observed at the Madrid North CWP, the access road to the Naartok East CPR, or the overburden pad berms; therefore, samples were not collected from these areas.

Field Data

For all samples, the pH ranged from 7.0 to 7.8 and the EC ranged from 54 and 200 µS/cm.

Laboratory Data

For all samples, laboratory pH ranged from 7.4 to 8.1, and laboratory EC ranged from 54 to 220 µS/cm.

The major cation chemistry was dominated by calcium (4.8 to 29 mg/L) and sodium (2.7 to 7.1 mg/L), while major anion chemistry was dominated by alkalinity (21 and 69 mg/L as $CaCO_3$), and chloride (3.3 and 22 mg/L). Sulphate values ranged from 0.4 to 4.9 mg/L.

Nitrite and nitrate values ranged from 0.001 and 0.032 mg/L and 0.0084 and 0.42 mg/L, respectively. Compared to the reference seeps, ammonia (ranging from 0.0074 and 0.094 mg/L) was one to two orders of magnitude greater.

Dissolved metals concentrations were similar to the reference seeps with values differing by less than an order of magnitude with the exception of manganese and for one sample zinc.

3.3.2 Waste Rock

There was no waste rock placed on surface, either as construction rock or in a stockpile at the time of the seepage survey; therefore, there are no seepage samples of waste rock.

Table 3-2: Summary of select laboratory results of 2019 seepage samples

Mine Area	Infrastructure	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	TDS	Total Ammonia	Cl	NO_3	NO_2	SO_4	Ca	Mg	K	Na	Al	As	Cd	Cu	Fe	Pb	Ni	Se	Zn
			s.u.	s.u.	μS/cm	μS/cm	mV	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	Mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference	Reference (Windy Road)	19-REF-01	-	7.1	-	50	-	60	0.015	3.7	*<0.005*	*<0.001*	0.3	4.3	2.5	0.56	3.4	0.063	0.00018	*<0.000005*	0.0013	0.13	*<0.00005*	0.002	*<0.00005*	0.0042
		19-REF-02	-	7.7	-	160	-	130	0.022	19	*<0.005*	*<0.001*	2.3	15	5	0.61	9.5	0.023	0.00025	*<0.000005*	0.0014	0.064	*<0.00005*	0.002	*<0.00005*	0.0017
		19-REF-03	-	7.8	-	130	-	98	*<0.005*	11	*<0.005*	*<0.001*	5.3	12	2.9	0.35	9.9	0.015	0.0001	*<0.000005*	0.0011	0.045	*<0.00005*	0.0005	0.000054	*<0.001*
Doris	Waste Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	160	1500	7.9	400	21	0.44	350	87	34	30	350	0.0096	0.0054	0.000064	3.8	7.7	*<0.0001*	0.082	0.0049	*<0.002*
		19-DC-02	8.1	8.1	2400	2500	150	1600	8.2	400	21	0.4	350	90	33	30	340	0.0086	0.005	0.000097	3.9	7.7	*<0.0001*	0.085	0.0048	*<0.002*
		19-DC-03	8.1	7.9	2200	2200	160	1400	6.8	350	18	0.36	310	82	31	26	290	0.0089	0.0053	0.000065	3.5	6.5	0.000068	0.073	0.0045	*<0.001*
		19-DC-04	7.7	7.9	2000	2100	140	1600	9.5	470	25	0.13	95	160	32	17	170	0.0092	0.0031	0.000058	0.012	0.013	*<0.00005*	0.0018	0.0011	0.0018
		19-DC-05	8.0	7.9	2100	2100	130	1600	9.7	480	25	0.15	95	170	32	16	160	0.0082	0.003	0.000048	0.011	0.012	*<0.00005*	0.0016	0.0013	*<0.001*
		19-DC-06	7.6	8.0	3500	2700	130	2100	5.6	640	28	0.37	200	260	56	16	190	0.0055	0.0027	0.000049	0.0041	0.01	*<0.00005*	0.004	0.0021	*<0.001*
	South Dam	19-TLA-01	7.9	8.0	300	260	120	180	0.31	19	0.61	0.016	26	32	5.2	1.5	15	0.034	0.00071	*<0.000005*	0.0072	0.063	0.000061	0.0011	0.00017	*<0.001*
	Access Road to Doris CPR	19-DCPRT-01	8.0	8.1	180	190	89	140	0.26	15	0.87	0.028	8.9	31	5.1	1.4	14	0.038	0.00022	*<0.000005*	0.0088	0.056	*<0.00005*	0.00081	0.00008	*<0.001*
		19-DCPRT-02	7.9	8.0	360	350	100	220	0.90	51	4.2	0.11	18	15	8.3	3	26	0.048	0.00032	0.00001	0.016	0.062	*<0.00005*	0.0013	0.00036	0.0014
	MOFB Access Road	19-MOFB-01	7.7	7.8	410	430	35	250	0.013	86	*<0.005*	*<0.001*	7.6	17	3.9	1.6	13	0.029	0.00018	*<0.000005*	0.0019	0.13	*<0.00005*	0.0011	*<0.00005*	*<0.001*
		19-MOFB-02	7.7	7.8	200	220	64	140	0.006	35	*<0.005*	*<0.001*	4.6	16	5.4	3.4	41	0.014	0.00016	*<0.000005*	0.0012	0.062	*<0.00005*	0.00075	*<0.00005*	*<0.001*
		19-MOFB-03	7.7	7.8	190	210	81	130	0.0074	32	*<0.005*	*<0.001*	4.4	19	9.5	2.2	48	0.018	0.00014	*<0.000005*	0.0012	0.06	*<0.00005*	0.00073	*<0.00005*	*<0.001*
		19-MOFB-04	7.6	7.8	190	200	88	130	0.008	31	*<0.005*	*<0.001*	4.3	14	5.4	1.4	21	0.014	0.00014	*<0.000005*	0.0011	0.059	*<0.00005*	0.00074	*<0.00005*	*<0.001*
		19-MOFB-05	7.6	7.9	180	210	100	130	0.007	30	*<0.005*	*<0.001*	4.2	14	5.4	1.3	20	0.013	0.00016	*<0.000005*	0.0011	0.058	*<0.00005*	0.00064	*<0.00005*	*<0.001*
		19-MOFB-06	7.7	7.9	180	200	96	120	0.0056	28	*<0.005*	*<0.001*	4.1	14	5.3	1.3	19	0.02	0.00015	*<0.000005*	0.0012	0.073	*<0.00005*	0.0007	*<0.00005*	*<0.001*
		19-MOFB-07	7.7	7.9	180	200	89	120	0.0084	27	*<0.005*	*<0.001*	4	13	5.4	1.3	19	0.02	0.00014	*<0.000005*	0.00099	0.088	*<0.00005*	0.00066	*<0.00005*	*<0.001*
		19-MOFB-08	7.8	7.9	200	210	57	130	0.039	30	0.078	*<0.001*	4.3	14	5.2	1.3	18	0.013	0.00013	*<0.000005*	0.001	0.071	*<0.00005*	0.00075	*<0.00005*	*<0.001*
		19-MOFB-09	7.8	7.7	340	340	95	180	0.03	71	*<0.005*	*<0.001*	13	14	5.2	1.3	18	0.044	*<0.0001*	*<0.000005*	0.0014	0.065	*<0.00005*	0.0005	*<0.00005*	*<0.001*
		19-MOFB-10	7.9	7.9	230	260	88	140	0.15	36	0.23	0.0051	7.6	14	5.6	1.4	20	0.03	0.00015	0.000012	0.0021	0.049	*<0.00005*	0.0005	*<0.00005*	*<0.001*
		19-MOFB-11	8.0	8.0	170	180	90	130	0.23	11	0.95	0.021	5.2	9.9	9.2	1.4	45	0.096	0.00019	0.0000064	0.004	0.033	*<0.00005*	0.00057	0.000084	*<0.001*
		19-MOFB-12	8.3	7.8	100	110	100	72	0.26	5.9	2.2	0.02	6.7	13	7.1	1.7	29	0.032	0.00017	0.0000065	0.0035	0.023	*<0.00005*	0.0005	0.0001	*<0.001*
		19-MOFB-13	8.1	7.7	170	150	110	90	3.5	8.6	5.4	0.11	6.6	13	6.2	1.8	15	0.037	0.00014	*<0.000005*	0.0035	0.022	*<0.00005*	0.0005	0.00011	*<0.001*
Madrid North	Access Road to Madrid North CWP	19-MAD-01	7.5	7.8	120	110	120	77	0.019	3.4	0.12	0.0033	1.3	17	2.3	0.76	3.3	0.016	0.00016	*<0.000005*	0.0011	0.017	*<0.00005*	0.00072	*<0.00005*	0.0018
		19-MAD-02	7.6	7.5	76	74	60	69	0.012	5.1	0.053	0.0035	0.92	7.7	2.4	1.1	4.2	0.054	0.00016	*<0.000005*	0.0017	0.071	*<0.00005*	0.0021	*<0.00005*	0.0036
		19-MAD-03	7.4	7.4	55	55	100	62	0.0077	3.4	0.011	*<0.001*	0.48	4.8	2	1	2.7	0.052	0.00015	*<0.000005*	0.0015	0.086	*<0.00005*	0.0021	*<0.00005*	0.0044
		19-MAD-04	7.1	7.4	54	54	99	60	0.0074	3.3	0.015	*<0.001*	0.42	4.9	1.9	1.1	2.7	0.051	0.00013	*<0.000005*	0.0015	0.088	*<0.00005*	0.002	*<0.00005*	0.0044
		19-MAD-05	7.5	7.6	83	81	70	72	0.0084	3.9	0.091	0.0029	0.48	9.5	2.6	1.2	3.1	0.046	0.00022	*<0.000005*	0.0018	0.078	*<0.00005*	0.0022	*<0.00005*	0.0039
		19-MAD-06	7.7	7.6	69	68	78	65	0.0099	3.4	0.019	0.0011	0.4	7.6	2.4	1.1	2.7	0.055	0.00021	*<0.000005*	0.0019	0.095	*<0.00005*	0.0022	*<0.00005*	0.0034
		19-MAD-07	7.7	7.6	71	70	99	64	0.02	3.6	0.074	0.0014	0.45	7.9	2.4	1.1	2.9	0.055	0.00018	*<0.000005*	0.0019	0.097	*<0.00005*	0.0023	*<0.00005*	0.0034
		19-MAD-08	7.4	7.9	180	150	100	110	0.094	8.8	0.42	0.032	1.7	17	4.6	1.8	7.1	0.054	0.00025	0.0000087	0.0025	0.097	*<0.00005*	0.0027	*<0.00005*	0.022
		19-MAD-09	7.0	7.7	79	85	92	75	0.011	4.1	0.0084	0.0014	0.49	9.5	3.2	1.1	3.4	0.076	0.00023	*<0.000005*	0.0021	0.12	*<0.00005*	0.0024	*<0.00005*	0.0032
		19-MAD-10	7.6	8.0	190	220	80	120	0.038	22	0.19	0.0094	4.9	29	5.2	1.4	7.1	0.016	0.00046	*<0.000005*	0.0025	0.035	*<0.00005*	0.0017	*<0.00005*	0.0025
		19-MAD-11	7.8	8.1	200	220	59	140	0.02	22	0.11	0.0072	4.7	29	5.5	1.4	7.1	0.018	0.00044	*<0.000005*	0.0025	0.034	*<0.00005*	0.0016	*<0.00005*	0.0049

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Notes:

Italics indicate values below the method detection limit.

[1] Seepage samples collected at these stations were outside the scope of the 2019 monitoring program. Results are included for completeness

4 Comparison to Previous Surveys

Table 4-1 compares the results of samples collected in 2019 from the waste rock influenced area at Doris and reference stations (Windy Road area) with a statistical summary of historical seepage samples collected from those same areas between 2011 and 2018 (Attachment 1). Table 4-1 presents the historical data as 5th, 50th, and 95th percentile statistics, with concentrations below the detection limit assumed to be equal to the detection limit.

Figure 1 to Figure 3 present all seepage monitoring data from these areas for parameters that are relevant to metal leaching. This includes sulphate and contaminants of potential concern with 2019 median values at least ten times greater than the historic median (copper, and iron). Figure 4 to Figure 6 present all seepage monitoring data from these areas for parameters that are related to leaching of blasting residues (ammonia and nitrate) and drilling brines (chloride).

There are no historical seepage samples for the South Dam, access road to the Doris CPR, MOFB Access Road in the Doris mine area and for the access road to Naartok East CPR, Madrid North CWP and overburden pad berm in the Madrid North mine area.

Table 4-1: Comparison of analytical results between 2019 survey data and 5th, 50th, and 90th percentile of 2011 to 2018 survey data

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	Total Hardness	TDS	Total Ammonia	Cl	NO_3	SO_4	Al	As	Cd	Cu	Fe	Pb	Ni	Se	Zn
		s.u.	s.u.	µS/cm	µS/cm	mg $CaCO_3$/L	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2015 Source Term	-	*7.7*	-	-	*1200*	-	*24*	*1100*	*45*	*46*	*0.011*	*0.00072*	*0.000075*	*0.0095*	*0.041*	*0.00011*	*0.0023*	*0.0009*	*0.028*
Waste-Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	360	1500	7.9	400	21	**350**	0.0096	0.0054	0.000064	**3.8**	**7.7**	0.0001	0.082	0.0049	0.002
	19-DC-02	8.1	8.1	2400	2500	360	1600	8.2	400	21	**350**	0.0086	0.005	0.000097	**3.9**	**7.7**	0.0001	0.085	0.0048	0.002
	19-DC-03	8.1	7.9	2200	2200	330	1400	6.8	350	18	**310**	0.0089	0.0053	0.000065	**3.5**	**6.5**	0.000068	0.073	0.0045	0.001
	19-DC-04	7.7	7.9	2000	2100	540	1600	9.5	470	25	**95**	0.0092	0.0031	0.000058	**0.012**	0.013	0.00005	0.0018	0.0011	0.0018
	19-DC-05	8	7.9	2100	2100	540	1600	9.7	480	25	**95**	0.0082	0.003	0.000048	**0.011**	0.012	0.00005	0.0016	0.0013	0.001
	19-DC-06	7.6	8	3500	2700	880	2100	5.6	640	28	**200**	0.0055	0.0027	0.000049	0.0041	0.01	0.00005	0.004	0.0021	0.001
	P05	7.6	7.6	300	320	100	200	0.083	33	0.99	13	0.006	0.00059	8.3E-06	0.0034	0.01	0.00005	0.00061	0.00021	0.001
	P50	8.0	7.9	2100	2200	360	1600	9.1	470	22	76	0.0092	0.0016	0.000063	0.01	0.036	0.000084	0.0033	0.0014	0.0018
	P95	8.3	8.1	3800	8100	2400	6300	64	2400	140	330	0.027	0.0073	0.00031	3.7	7.1	0.00025	0.081	0.0047	0.005
	n	13	18	13	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Reference (Windy Road)	19-REF-01	-	7.1	-	50	21	60	0.015	3.7	0.005	0.3	0.063	0.00018	0.000005	0.0013	0.13	0.00005	0.002	0.00005	0.0042
	19-REF-02	-	7.7	-	160	58	130	0.022	19	0.005	2.3	0.023	0.00025	0.000005	0.0014	0.064	0.00005	0.002	0.00005	0.0017
	19-REF-03	-	7.8	-	130	41	98	0.005	11	0.005	5.3	0.015	0.0001	0.000005	0.0011	0.045	0.00005	0.0005	0.000054	0.001
	P05	6.6	6.9	36	50	17	34	0.005	3.5	0.005	0.3	0.006	0.0001	0.000005	0.00086	0.03	0.00005	0.0005	0.00005	0.001
	P50	7.3	7.5	79	70	23	58	0.0063	6.3	0.005	0.74	0.02	0.00015	0.00001	0.0012	0.064	0.00005	0.0019	0.0001	0.0033
	P95	7.8	8.0	290	190	71	120	0.021	26	0.005	5	0.058	0.00024	0.00005	0.0025	0.18	0.00005	0.0026	0.001	0.005
	n	12	19	12	15	19	19	16	19	19	19	19	19	19	19	19	19	19	19	19

Notes:

(1) All metal concentrations are dissolved.

(2) Values below the detection limit are included in statistics as being equal to the detection limit.

(3) Bolded values are greater than those from the 2015 Waste Rock Source Term (SRK 2015a).

(4) Percentiles 5th (P05), 50th (P50), and 95th (P95)

4.1.1 Doris Waste Rock Influenced Area

Sulphate and Trace Elements

Figure 1 to Figure 3 present temporal trends of sulphate, copper and iron compared to the average of the 2012 data set for SNP station ST-2 (pollution control pond), which was used as an input for derivation of the Doris waste rock source term for the 2015 water and load balance (SRK 2015a). Sulphate is presented in the context of sulphide oxidation in relation to metal leaching.

Sulphate concentrations have increased since 2015 with seepage concentrations typically higher than the source term input (Figure 1). The increasing sulphate concentrations in seepage may be due to the increased source of sulphide in the stockpiled ore. From 2014 to 2015 TMAC initiated the practice of placing ore in stockpiles on the waste rock dump immediately upstream of the toe seepage samples. Prior to this, ore and waste rock were placed in separate stockpiles. Ore has higher sulphide content than waste rock, with average concentrations typically greater than 1% and <0.5%, respectively (SRK 2015b). Increasing sulphate concentrations in seepage may be due to sulphide oxidation from ore. SRK's humidity cell test program (SRK 2015c) demonstrated that sulphate leaching rates were higher for samples of ore (average stable rate of 3.2 mg/kg/week, n=4) compared to waste rock (average stable rate of 1.1 mg/kg/week, n=12).

Copper and cobalt have also exhibited increasing trends since ore was placed on the waste rock stockpile in 2015. Copper concentrations prior to 2016 ranged from 0.0023 to 0.01 mg/L and from 0.0080 to 3.9 mg/L since 2016. All copper concentrations prior to 2018 have been at near parity or below the source term input of 0.0095 mg/L.

Iron has also exhibited increasing concentrations, but only for samples collected at the toe of the waste rock stockpile and within the berm of the PCP. High iron concentrations in these samples are likely due to iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996). For other waste rock samples, iron concentrations are typically below the source term input values. All waste rock seepage is collected in the PCP and downstream sumps after which it is pumped to the TIA. In 2019, water from the PCP accounted for ~5% of total inflow volumes entering the TIA and ~2% of the total volume stored in the TIA.

Ammonia, Nitrate and Chloride

Trends in ammonia, nitrate and chloride concentrations increased after the placement of ore on the stockpile due to the re-initiation of mining by TMAC in 2015, and have continuously decreased since 2016 due to the flushing of salts from drilling brines (chloride) and explosives residues (ammonia, nitrate, and nitrite) from the waste rock stockpile (Figure 4 to Figure 6). Concentrations of these parameters are below the 2015 source term input values.

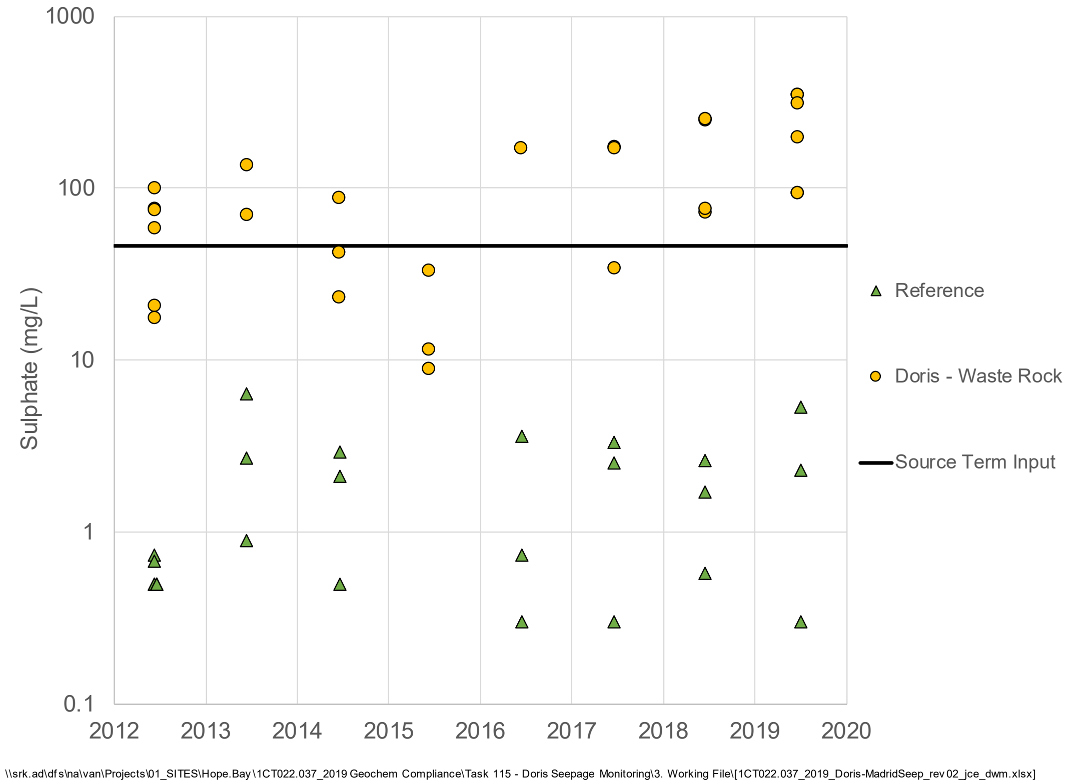

Figure 1: Sulphate seepage monitoring data, waste rock influenced area and reference areas

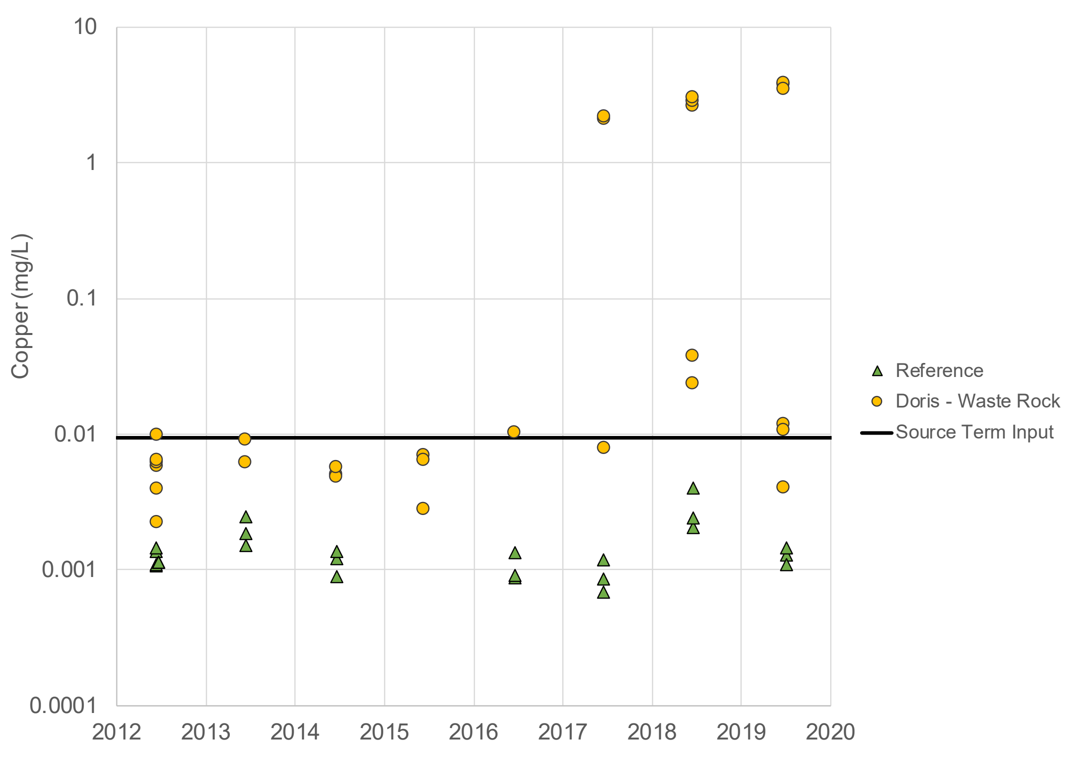

Figure 2: Copper seepage monitoring data, waste rock influenced area and reference areas

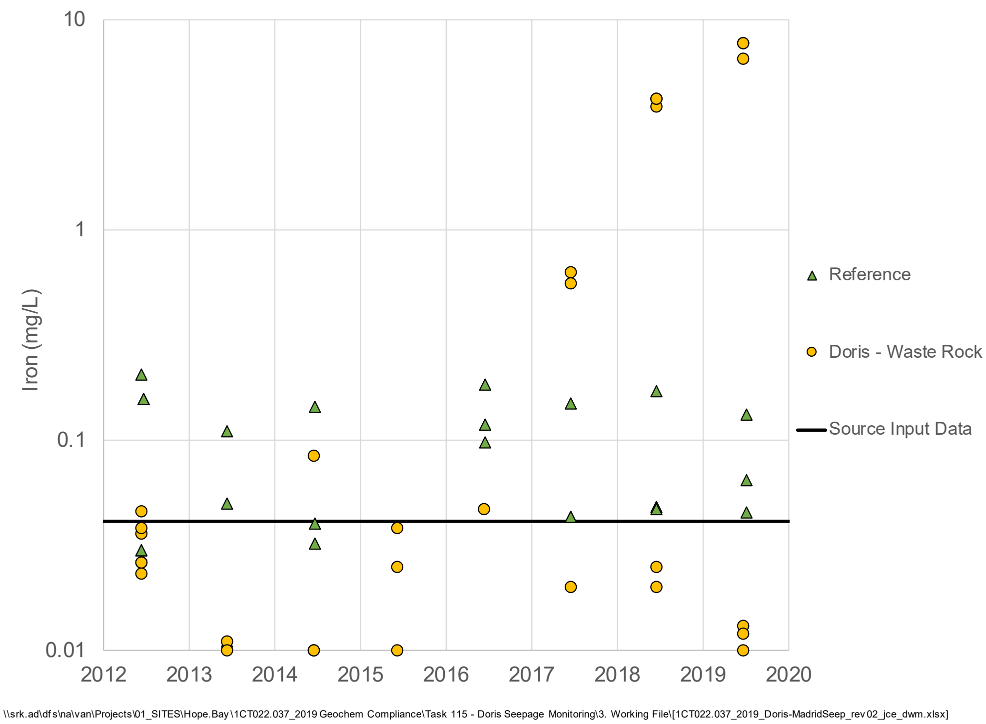

Figure 3: Iron seepage monitoring data, waste rock influenced area and reference areas

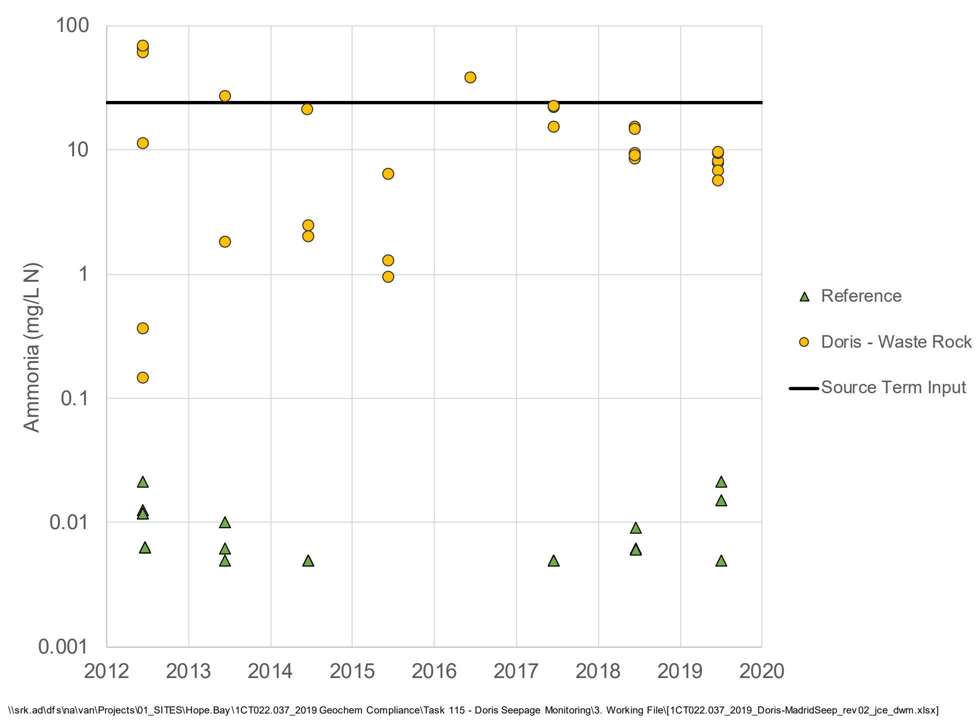

Figure 4: Ammonia seepage monitoring data, waste rock influenced area and reference areas

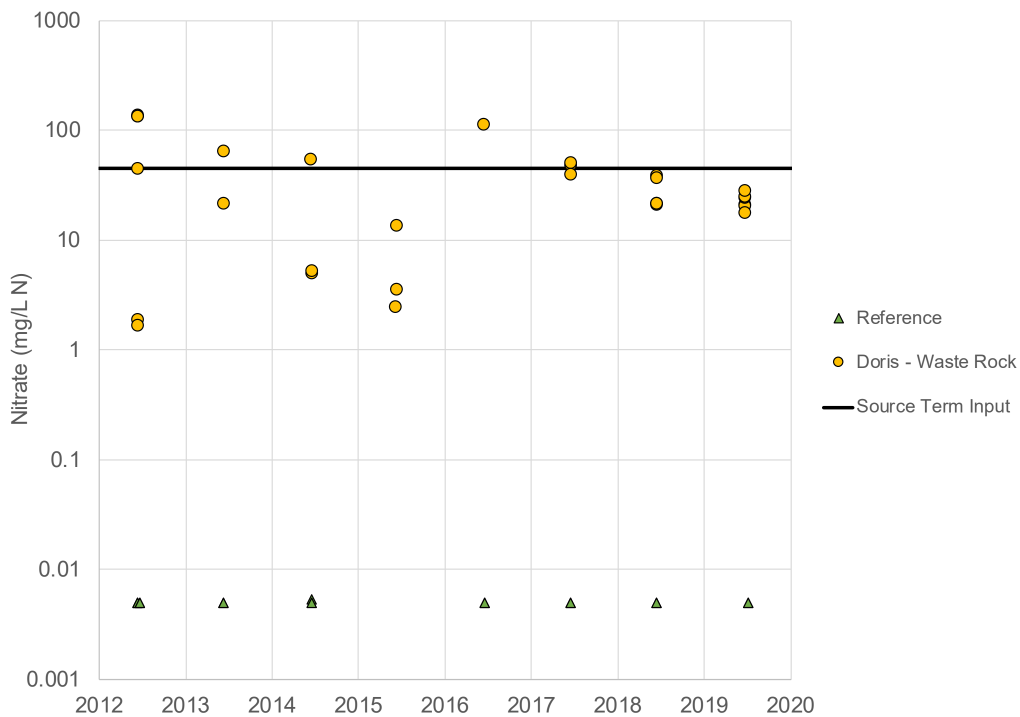

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Figure 5: Nitrate seepage monitoring data, waste rock influenced area and reference areas

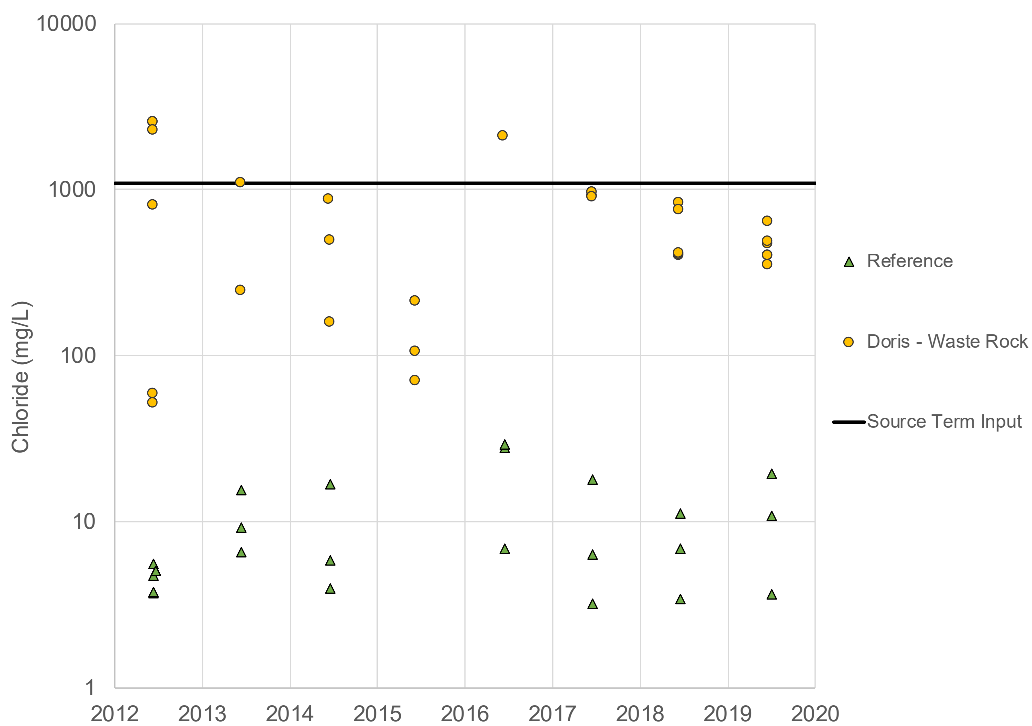

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Figure 6: Chloride seepage monitoring data, waste rock influenced area and reference areas

4.1.2 Windy Road Area (Reference Stations)

Parameters concentrations for reference samples collected in 2019 were generally stable and consistent with the historical dataset, including sulphate, arsenic, cobalt, iron, selenium, ammonia, nitrate and nitrite.

5 Conclusions and Recommendations

The scope of the 2019 Hope Bay seepage monitoring survey included infrastructure constructed between fall 2018 and spring 2019 at Doris and Madrid North, three reference stations and areas downstream of the Doris waste rock stockpiles. There were no stockpiles of waste rock from Madrid North (Naartok East CPR) at the time of the survey.

Concentrations for reference area seeps were consistent and stable with the historical data record.

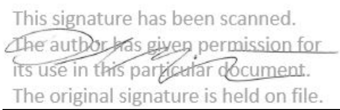
Infrastructure surveyed at Doris included the TIA south dam, MOFB access road at Robert's Bay, access road to the Doris Central vent raise, access road to the Doris CPR and Doris CPR cover. Construction rock at Doris was sourced from Quarry 2 except for the Doris CPR cover, which was constructed primarily of Doris waste rock and some quarry rock. Infrastructure surveyed at Madrid North included the access road to Naartok East CPR, overburden pad berm, Madrid North CWP, and access road to the Madrid North CWP. Construction rock at Madrid was sourced from Quarry D. Seepage was observed and samples collected representing construction rock from all aforementioned areas except the Doris CPR cover. The results of the 2019 seepage sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay.

Seepage from areas impacted by waste rock had concentrations of sulphate, copper and cobalt that have exhibited increasing trends since TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile in 2015. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, cobalt, and copper may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of iron for the 2019 waste rock seepage samples were increasing for samples collected from the berm of the PCP; however, this was attributed to the presence of particulate material less than 0.45 µm that are not truly dissolved species. Chloride, nitrate and ammonia levels increased after ore was placed on the stockpile but have since continuously decreased in relation to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock. All waste rock seepage is intercepted, managed and pumped to the TIA.

The waste rock seepage monitoring was initiated in 2012. An assessment of the waste rock seepage monitoring record for sulphate, copper, iron, chloride, ammonia and nitrate indicated that overall, monitoring data approximates the Doris waste rock source term inputs for the 2015 water and load balance (SRK 2015a). Continued monitoring will establish trends in parameter concentrations.

SRK recommends that the 2020 seepage survey include infrastructure areas monitored in 2019, including sites where seepage was not observed at Doris (CPR cover, access road to vent raise) and Madrid North (Madrid North CWP, overburden pad berm, access road to Naartok East CPR).

Regards,
SRK Consulting (Canada) Inc.



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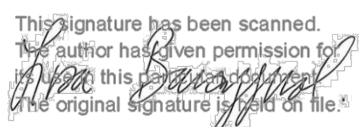
Staff Consultant (Geochemistry)

Reviewed by



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant (Geochemistry)

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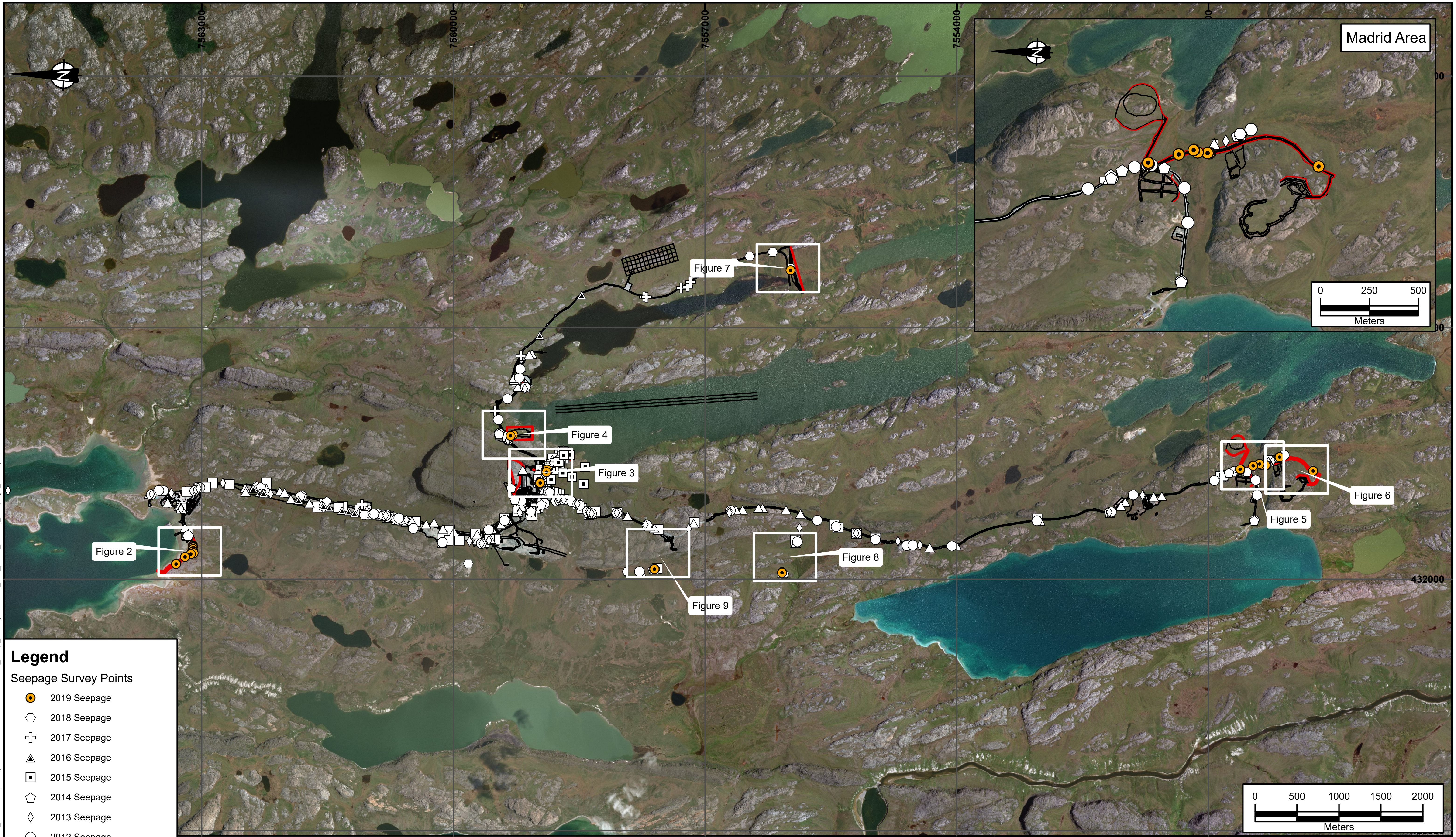
Attachment 1 – Maps of 2019 Seepage Survey Locations



srk consulting

SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

MAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seepage Survey
General Arrangement

DATE: Feb 2020 | APPROVED: | FIGURE: 1

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Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

MAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020

APPROVED:

FIGURE: 2

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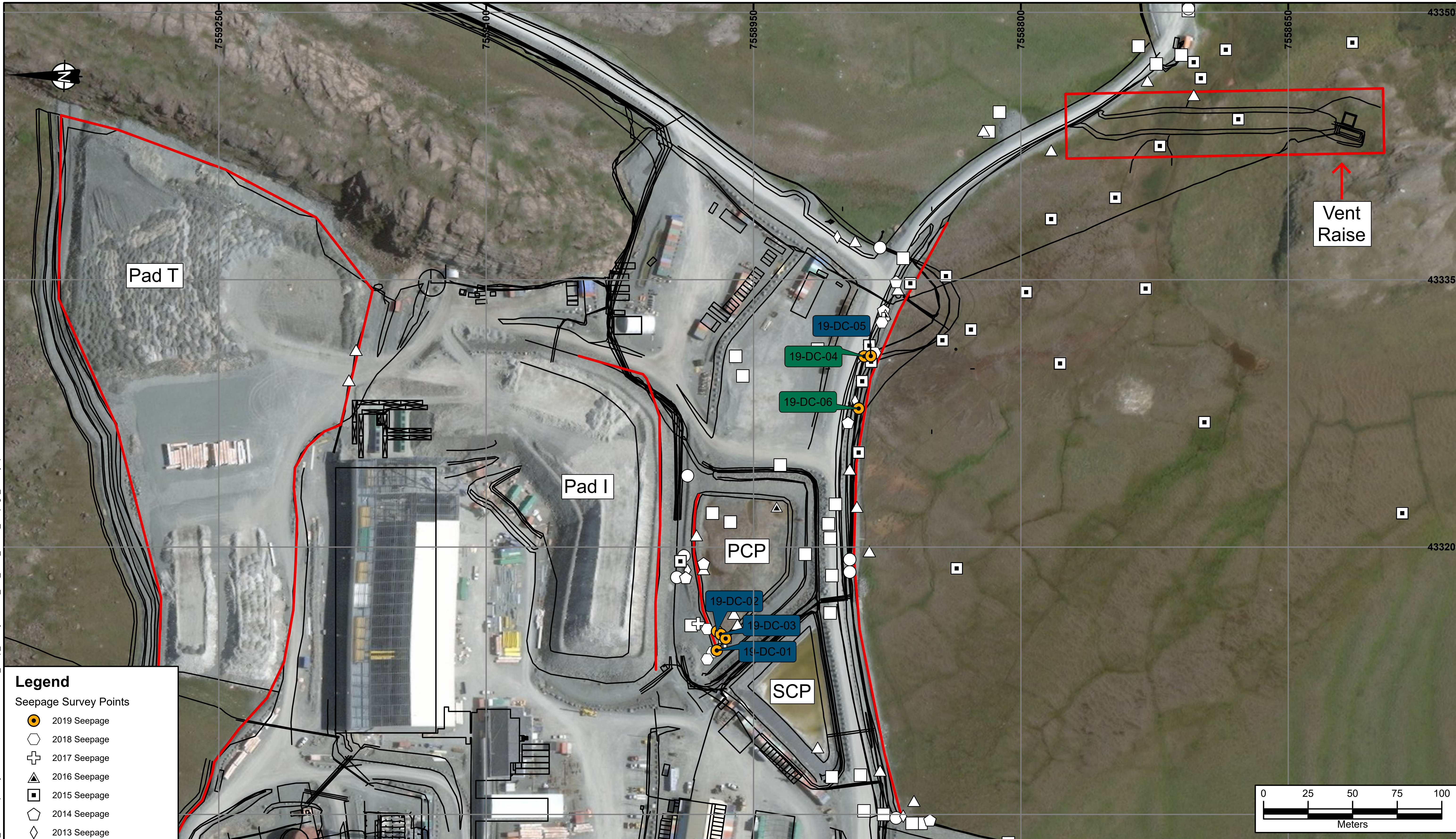

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020

APPROVED:

FIGURE: 3

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Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020

APPROVED:

FIGURE: 4

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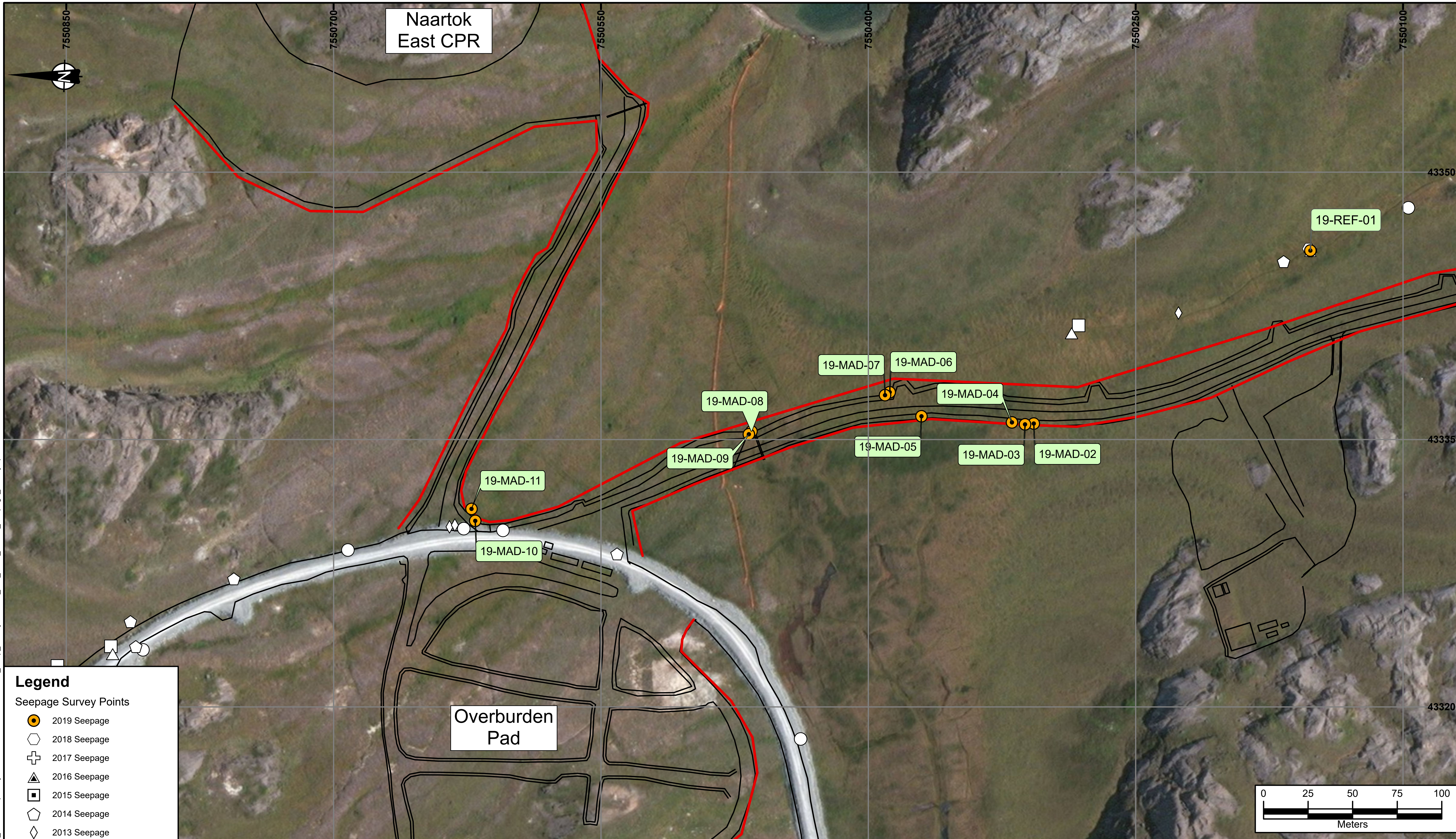

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020 | APPROVED: | FIGURE: 5

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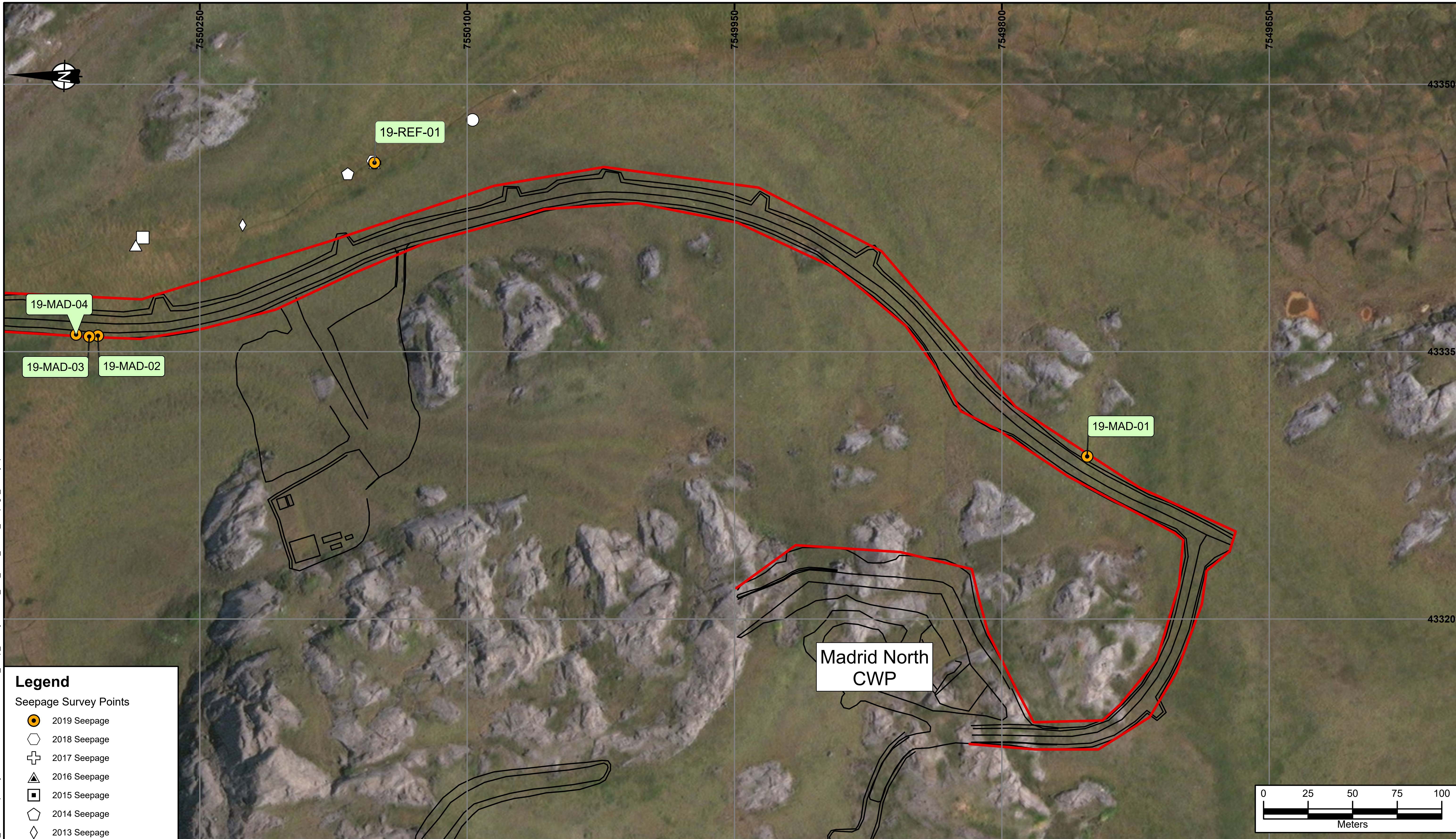

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 μS/cm			
500μS/cm<EC<2000μS/cm			
EC>2000μS/cm			

srk consulting

SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

MAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020 | APPROVED: | FIGURE: 6

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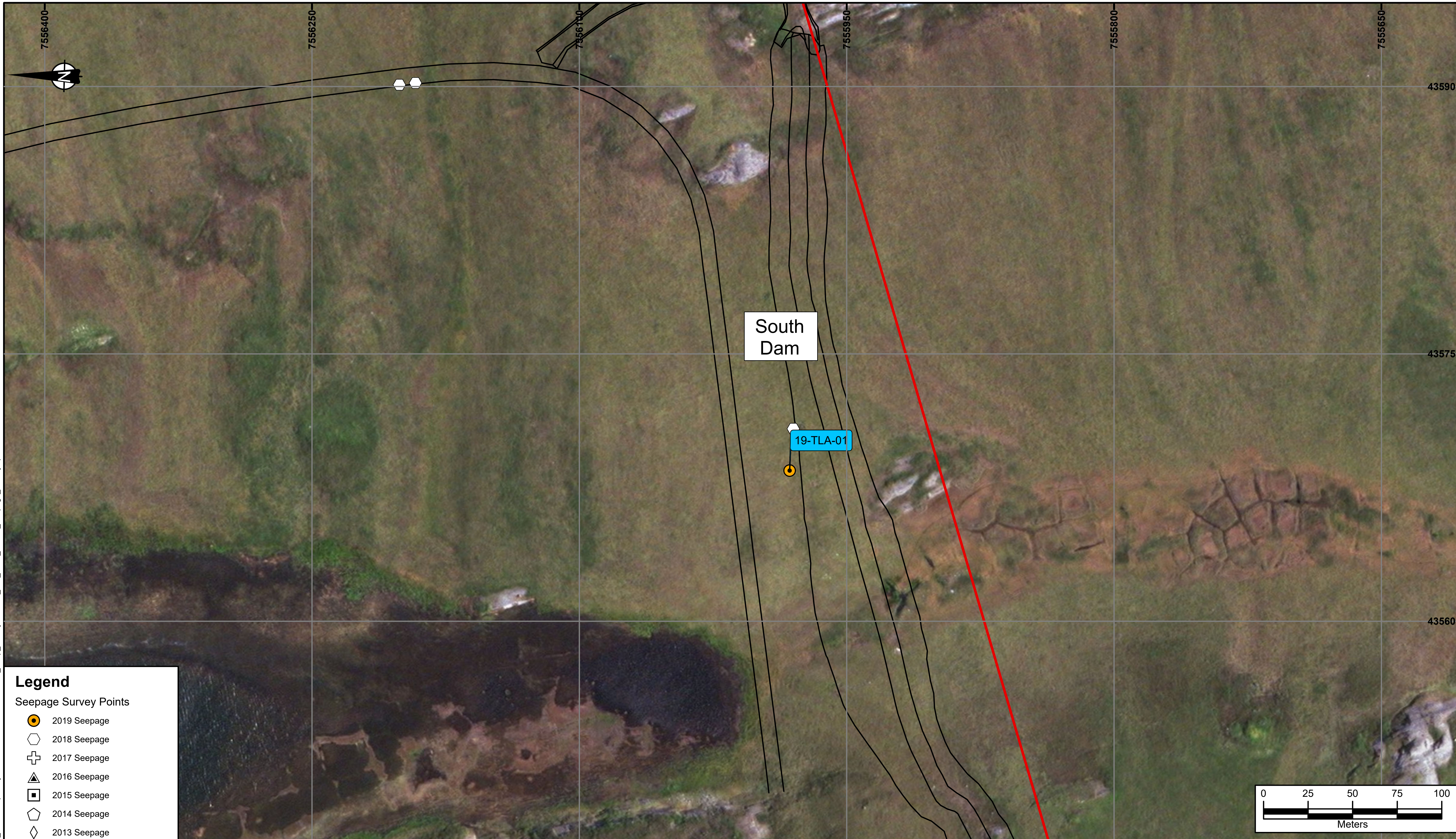

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

MAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020

APPROVED:

FIGURE: 7

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	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020

APPROVED:

FIGURE: 8

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

DATE: Feb 2020 | APPROVED: | FIGURE: 9

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Attachment 2 – 2019 Field Observations and Measurements

Region	Material Source	Area	Sample ID	Date	Description of Location	Field Measurements												Duplicate	Field Blank
						pH	Conductivity	ORP	Water Temperature	Water Colour	Turbidity	t1	t2	t3	Amount	Capture	Flow		
						pH units	µS/cm	mV	ºC			sec	sec	sec	mL	%	L/s		
Reference	-	Reference (Windy Road)	19-REF-01	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
			19-REF-02	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
			19-REF-03	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
Doris	Waste Rock	Waste Rock Influenced Area	19-DC-01	19-Jun-19	In NW corner of PCP. Multiple seeps in area. Shallow flow with some pools, large seep. Fans out over large area.	8.1	2490	159	0.4	--	N	0.98	0.89	0.86	100	40	0.0027	N	N
			19-DC-02	19-Jun-19	Multiple seeps in area. Very shallow surface trickle our of NW edge of PC pond. Largest of small shallow surface seeps in area.	8.1	2430	152	3.5	--	--	5.2	4.94	5.82	100	80	0.0006	N	N
			19-DC-03	19-Jun-19	Multiple seeps in area. Strong flow from NW edge of PCP.	8.1	2210	160	0.1	--	--	0.76	0.83	0.78	100	75	0.0016	N	N
			19-DC-04	20-Jun-19	On southern edge of roadway and the U/G laydown. Flow is through larger rocks and into tundra toward sump locations.	7.7	2030	137	0.2	--	N	2.0	2.3	2.3	100	75	0.00086	N	N
			19-DC-05	20-Jun-19	Approximately 10m from 19-DC-04. Shallow flow out of rocks towards sumps.	8.0	2130	125	1.4	--	--	2.4	2.5	2.5	100	80	0.00075	N	N
			19-DC-06	20-Jun-19	Approximately 20m from 19-DC-05. Very shallow, upwelling from rocks. Slower flow.	7.6	3450	134	0.9	--	N	2.7	3.4	3.3	50	--	--	N	N
	Quarry 2	South Dam (Tail Lake Area)	19-TLA-01	19-Jun-19	Located upstream of S.dam into pond. Strong flows with some channeling through sediment.	7.9	303	115	2.1	--	N	1.5	1.7	1.7	250	70	0.0023	N	N
		Access Road to Doris CPR	19-DCPRT-01	19-Jun-19	Located at road leading to CPRT. Strong flow. Seeps meet in a pool.Flow measured just downstream.	8.0	178.6	89	0.6	--	N	0.91	0.91	0.92	250	65	0.0033	Y	Y
			DUP	19-Jun-19	Duplicate of 19-DCPRT-01	--	--	--	--	--	--	--	--	--	--	--	--	Y	N
			FB	19-Jun-19	Field blank collected at 19-DCPRT-01	--	--	--	--	--	--	--	--	--	--	--	--	N	Y
			19-DCPRT-02	19-Jun-19	Shallow seep leading out of road to CPRT. Low flow with small pools.	7.9	355	102	5.1	--	--	2.32	2.59	2.29	100	95	0.00066	N	N
		Marine Outfall Berm Access Road	19-MOFB-01	20-Jun-19	Multiple seeps in area. Flowing strongly through large aggregate. Little turbidity. Located approx. 75m E of large pad. Approx. 100-125m from culvert. Large creek on upstream side.	7.7	407	35	8.1	--	Y	2.46	2.41	2.4	100	25	0.0024	N	N
			19-MOFB-02	20-Jun-19	Located approx. 20m from 19-MOFB-01. Multiple seeps in area. Steady flow through large aggregate at base of road. Large creek flowing on upstream side.	7.7	204	64	8.2	--	--	1	1.16	1.1	100	45	0.0022	N	N
			19-MOFB-03	20-Jun-19	Multiple seeps in area. Located approx. 15m E of MOFB-02. Strong flow through large agg. @ base of road. Clear, no visible turbidity.	7.7	193.2	81	7.8	Clear	N	0.93	1.06	0.965	100	25	0.0041	N	N
			19-MOFB-04	20-Jun-19	Approx. 10m from MOFB-03. Strong flow through smaller medium sized rocks. Multiple seeps in area.	7.6	188.5	88	7.3	--	--	1.8	1.9	1.7	100	25	0.0029	N	N
			19-MOFB-05	20-Jun-19	Steady flow through large agg. @ base of road. Approx. 15m from MOFB-04 (E). Multiple seeps in area. Snow approx. 15m from seep.	7.6	183.9	104	6.9	--	--	1.2	1.3	1.2	250	40	0.0045	N	N
			19-MOFB-06	20-Jun-19	Multiple seeps in area flowing through medium/large sized aggregate. Strong and steady flow.	7.7	183.3	96	6.4	--	--	2.6	2.9	2.8	250	10	0.013	N	N
			19-MOFB-07	20-Jun-19	Multiple steady flowing seeps in area, through the base of large agg. No visible turbidity.	7.7	176.9	89	6.5	--	N	1.2	1.2	1.1	250	10	0.018	N	N
			19-MOFB-08	20-Jun-19	Multiple seeps in area. Steady flow at base of large agg. No visible turbidity.	7.8	203	57	6.2	--	N	1.2	1.3	1.2	250	30	0.0060	N	N
			19-MOFB-09	22-Jun-19	Flow through base of road and large aggreagte at road bend. Approx. 30m from culvert. Low, but steady flow.	7.8	342	95	4.2	--	--	1.4	1.4	1.5	250	60	0.0028	N	N
			19-MOFB-10	22-Jun-19	Very small, shallow flow through agg. No visible turbidity.	7.9	232	88	4.2	--	N	4.5	4.7	4.7	100	50	0.0010	N	N
			19-MOFB-11	22-Jun-19	Very small shallow flow through agg. Rock. No visible turbidity.	8.0	166.3	90	0.5	--	N	2.3	2.4	2.2	100	70	0.00090	N	N
			19-MOFB-12	22-Jun-19	Multiple seeps in area, at base of hill. Shallow flow with some pooling downstream. Flowing through large and medium sized agg.	8.3	104.1	104	0.2	--	--	2.1	2.1	2.1	100	80	0.00081	N	N
			19-MOFB-13	22-Jun-19	Multiple seeps in area. 10m from MOFB-12, slightly up hill. Flowing through medium and large sized agg. at base of road.	8.1	174.4	109	-0.1	--	--	1.5	1.7	1.6	250	90	0.0018	N	N
Madrid	Quarry D	Access Road to Madrid North CWP	19-MAD-01	23-Jun-19	Approx. 100m N of Madrid-Boston intersection. Small, shallow flow from road at base of large aggregate material. Grass around location dusty.	7.5	117	124	2.7	--	--	2.3	2.3	2.4	100	60	0.0010	N	N
			19-MAD-02	23-Jun-19	Multiple seeps in area, steady flow. Seeping from road base through medium/large aggregate toward Windy	7.6	76	60	7.8	Tea colour (?)	--	1.6	1.6	1.7	100	60	0.0012	N	N
			19-MAD-03	23-Jun-19	Multiple seeps in area. Strong flow from base of road, medium to large aggregate. ~10m from MAD-02. Sample collected tea colour.	7.4	55	104	9.1	Tea colour (?)	--	1.6	1.7	1.8	100	10	0.0073	N	N
			19-MAD-04	23-Jun-19	Multiple seeps in area. Strong flow from base of road, medium to large aggregate. ~10m from MAD-02. Light tea coloured sample.	7.1	54	99	9.5	Light tea colour (?)	--	1.6	1.6	1.7	100	95	0.00078	N	N
			19-MAD-05	23-Jun-19	Multiple seeps in area. Strong flow from base of roadway. Approx. 300m from culvert. Unable to capture flow.	7.5	83	70	6.4	--	--	--	--	--	--	--	--	N	N
			19-MAD-06	23-Jun-19	Flow through road turnout, stead. Multiple seeps in area. Through medium sized agg. Light tea coloured sample.	7.7	69	78	9	Light tea colour (?)	--	3.3	3.3	3.3	100	80	0.0007	N	N
			19-MAD-07	23-Jun-19	Multiple seeps in area. At base of road, coming from elbow where turnout meets roadway. Steady flow through large agg. Light tea colour sample.	7.7	71	99	8	Light tea colour (?)	--	1.2	1.3	1.3	100	75	0.0012	N	N
			19-MAD-08	24-Jun-19	Seep located next to culvert, with flow towards Patch Lake. Multiple in area, through medium sized aggregate. Stready flow.	7.4	184.9	100	2.9	--	--	1.5	1.5	1.5	100	80	0.0010	N	N

Region	Material Source	Area	Sample ID	Date	Description of Location	Field Measurements												Duplicate	Field Blank
						pH	Conductivity	ORP	Water Temperature	Water Colour	Turbidity	t1	t2	t3	Amount	Capture	Flow		
						pH units	µS/cm	mV	ºC			sec	sec	sec	mL	%	L/s		
			19-MAD-09	24-Jun-19	Multiple seeps in area. Flowing from base of roadway, medium sized agg. Light tea coloured sample. Flowing b/w 2 culverts.	7.0	78.8	92	7.1	Light tea colour (?)	--	0.95	0.9	1	100	70	0.0015	N	N
			19-MAD-10	24-Jun-19	Shallow flow through base of road, through medium sized agg. Located near Madrid offices, through Windy Road. Flows into organics. Multiple seeps in area. Some organics present in sample.	7.6	189.8	80	7.1	--	--	1.5	1.6	1.6	100	80	0.0010	N	N
			19-MAD-11	24-Jun-19	Multiple seeps in area. Flows through medium-large agg. At corner leading to Naartok E from Windy Rd. Flows into organics.	7.8	197.9	59	7.5	--	--	0.83	0.83	0.8	100	60	0.0019	N	N

Attachment 3 – 2019 Laboratory Water Quality Data

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	Total Hardness	TSS	TDS	Acidity	Total Alkalinity	Ammonia	Cl	F	NO_3	NO2	Total P	SO_4	Al
		s.u.	s.u.	µS/cm	µS/cm	mV	mg $CaCO_3$/L	mg/L	mg/L	mg $CaCO_3$/L	mg CaCO3/L	mg N/L	mg/L	mg/L	mg /L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	--	7.1	--	50	--	21	*3*	60	3.7	18	0.015	3.7	0.061	*0.005*	*0.001*	0.0056	*0.3*	0.063
	19-REF-02	--	7.7	--	160	--	58	*3*	130	2.8	47	0.022	19	0.065	*0.005*	*0.001*	0.0052	2.3	0.023
	19-REF-03	--	7.8	--	130	--	41	*3*	98	2.3	44	*0.005*	11	0.02	*0.005*	*0.001*	0.003	5.3	0.015
Waste Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	160	360	140	1500	6.6	130	7.9	400	*0.4*	21	0.44	0.25	350	0.0096
	19-DC-02	8.1	8.1	2400	2500	150	360	6.4	1600	6.8	130	8.2	400	*0.4*	21	0.4	0.23	350	0.0086
	19-DC-03	8.1	7.9	2200	2200	160	330	6.6	1400	7.6	130	6.8	350	*0.4*	18	0.36	0.22	310	0.0089
	19-DC-04	7.7	7.9	2000	2100	140	540	59	1600	3.7	77	9.5	470	*0.2*	25	0.13	0.023	95	0.0092
	19-DC-05	8.0	7.9	2100	2100	130	540	24	1600	3.9	74	9.7	480	*0.2*	25	0.15	0.0089	95	0.0082
	19-DC-06	7.6	8	3500	2700	130	880	3.9	2100	3.5	88	5.6	640	*0.4*	28	0.37	0.0078	200	0.0055
TLA	19-TLA-01	7.9	8	300	260	120	72	7	180	2	77	0.31	19	0.065	0.61	0.016	0.033	26	0.034
CPR Access Road	19-DC-02	8	8.1	180	190	89	58	11	140	1	59	0.26	15	0.031	0.87	0.028	0.023	8.9	0.038
	19-DC-03	7.9	8	360	350	100	62	23	220	1.3	50	0.9	51	0.037	4.2	0.11	0.049	18	0.048
Marine Outfall Berm Access Road	19-MOFB-01	7.7	7.8	410	430	35	85	*3*	250	1.3	46	0.013	86	0.051	*0.005*	*0.001*	0.0086	7.6	0.029
	19-MOFB-02	7.7	7.8	200	220	64	57	*3*	140	1.2	49	0.006	35	0.043	*0.005*	*0.001*	0.0072	4.6	0.014
	19-MOFB-03	7.7	7.8	190	210	81	56	*3*	130	1.3	49	0.0074	32	0.043	*0.005*	*0.001*	0.0084	4.4	0.018
	19-MOFB-04	7.6	7.8	190	200	88	55	*3*	130	1.9	50	0.008	31	0.045	*0.005*	*0.001*	0.0081	4.3	0.014
	19-MOFB-05	7.6	7.9	180	210	100	54	*3*	130	1.8	50	0.007	30	0.038	*0.005*	*0.001*	0.0081	4.2	0.013
	19-MOFB-06	7.7	7.9	180	200	96	57	*3*	120	1.7	51	0.0056	28	0.041	*0.005*	*0.001*	0.0079	4.1	0.02
	19-MOFB-07	7.7	7.9	180	200	89	56	*3*	120	1.9	49	0.0084	27	0.041	*0.005*	*0.001*	0.0075	4	0.02
	19-MOFB-08	7.8	7.9	200	210	57	57	*3*	130	1.8	52	0.039	30	0.044	0.078	*0.001*	0.0095	4.3	0.013
	19-MOFB-09	7.8	7.7	340	340	95	63	3.4	180	2	38	0.03	71	0.027	*0.005*	*0.001*	0.0097	13	0.044
	19-MOFB-10	7.9	7.9	230	260	88	62	*3*	140	1.7	62	0.15	36	0.037	0.23	0.0051	0.016	7.6	0.03
	19-MOFB-11	8	8	170	180	90	59	*3*	130	1.7	62	0.23	11	0.046	0.95	0.021	0.029	5.2	0.096
	19-MOFB-12	8.3	7.8	100	110	100	31	17	72	1.7	29	0.26	5.9	*0.02*	2.2	0.02	0.02	6.7	0.032
	19-MOFB-13	8.1	7.7	170	150	110	30	8.2	90	2.3	26	3.5	8.6	0.020	5.4	0.11	0.011	6.6	0.037
Access Road to Madrid North CWP	19-MAD-01	7.5	7.8	120	110	120	51	*3*	77	1.4	51	0.019	3.4	*0.02*	0.12	0.0033	0.015	1.3	0.016
	19-MAD-02	7.6	7.5	76	74	60	29	*3*	69	1.6	28	0.012	5.1	0.057	0.053	0.0035	0.0091	0.92	0.054
	19-MAD-03	7.4	7.4	55	55	100	20	5.8	62	1.7	22	0.0077	3.4	0.057	0.011	*0.001*	0.0094	0.48	0.052
	19-MAD-04	7.1	7.4	54	54	99	20	*3*	60	1.7	21	0.0074	3.3	0.057	0.015	*0.001*	0.0098	0.42	0.051
	19-MAD-05	7.5	7.6	83	81	70	35	*3*	72	1.6	34	0.0084	3.9	0.057	0.091	0.0029	0.014	0.48	0.046
	19-MAD-06	7.7	7.6	69	68	78	29	*3*	65	1.6	28	0.0099	3.4	0.058	0.019	0.0011	0.0098	0.4	0.055
	19-MAD-07	7.7	7.6	71	70	99	29	*3*	64	1.6	28	0.02	3.6	0.059	0.074	0.0014	0.01	0.45	0.055
	19-MAD-08	7.4	7.9	180	150	100	60	*3*	110	1.9	59	0.094	8.8	0.067	0.42	0.032	0.016	1.7	0.054
	19-MAD-09	7	7.7	79	85	92	37	*3*	75	3.1	35	0.011	4.1	0.065	0.0084	0.0014	0.0094	0.49	0.076
	19-MAD-10	7.6	8	190	220	80	94	4.2	120	2.2	66	0.038	22	0.048	0.19	0.0094	0.019	4.9	0.016
	19-MAD-11	7.8	8.1	200	220	59	95	*3*	140	1.7	69	0.02	22	0.044	0.11	0.0072	0.013	4.7	0.018

Italicized text indicates value below the method detection limit.

Area	Sample ID	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	*0.0001*	0.00018	0.0031	*0.00002*	*0.00005*	0.01	*0.000005*	4.3	0.00072	*0.0001*	0.0013	0.13	*0.00005*	0.003	2.5	0.0013	0.0000051	0.00019
	19-REF-02	*0.0001*	0.00025	0.0032	*0.00002*	*0.00005*	0.01	*0.000005*	15	0.00049	*0.0001*	0.0014	0.064	*0.00005*	0.0022	5	0.00088	0.0000059	0.000096
	19-REF-03	*0.0001*	0.0001	0.0025	*0.00002*	*0.00005*	0.01	*0.000005*	12	0.00013	*0.0001*	0.0011	0.045	*0.00005*	*0.001*	2.9	0.0028	0.0000086	0.00005
Waste Rock Influenced Area	19-DC-01	0.0013	0.0054	0.025	*0.00004*	*0.0001*	0.5	0.000064	87	0.0044	0.051	3.8	7.7	*0.0001*	0.0058	34	0.12	0.0000067	0.014
	19-DC-02	0.0013	0.005	0.026	*0.00004*	*0.0001*	0.5	0.000097	90	0.0045	0.051	3.9	7.7	*0.0001*	0.0067	33	0.15	0.0000073	0.014
	19-DC-03	0.0012	0.0053	0.025	*0.00002*	*0.00005*	0.43	0.000065	82	0.0039	0.041	3.5	6.5	0.000068	0.0048	31	0.1	0.0000065	0.016
	19-DC-04	0.00045	0.0031	0.034	*0.00002*	*0.00005*	0.16	0.000058	160	0.00094	0.001	0.012	0.013	*0.00005*	0.0059	32	0.076	*0.000005*	0.0048
	19-DC-05	0.00046	0.003	0.038	*0.00002*	*0.00005*	0.16	0.000048	170	0.001	0.00093	0.011	0.012	*0.00005*	0.0058	32	0.068	*0.000005*	0.0049
	19-DC-06	0.00046	0.0027	0.043	*0.00002*	*0.00005*	0.26	0.000049	260	0.0011	0.0015	0.0041	0.01	*0.00005*	0.0074	56	0.11	*0.000005*	0.011
TLA	19-TLA-01	0.00011	0.00071	0.0043	*0.00002*	*0.00005*	0.041	*0.000005*	15	0.00023	0.00032	0.0072	0.063	0.000061	0.0023	8.3	0.058	*0.000005*	0.0012
CPR Access Road	19-DC-02	*0.0001*	0.00022	0.0043	*0.00002*	*0.00005*	0.022	*0.000005*	17	0.00022	0.00015	0.0088	0.056	*0.00005*	*0.001*	3.9	0.044	*0.000005*	0.00049
	19-DC-03	*0.0001*	0.00032	0.0054	*0.00002*	*0.00005*	0.05	0.00001	16	0.00019	0.00023	0.016	0.062	*0.00005*	*0.001*	5.4	0.0023	*0.000005*	0.0011
Marine Outfall Berm Access Road	19-MOFB-01	*0.0001*	0.00018	0.0048	*0.00002*	*0.00005*	0.022	*0.000005*	19	0.00018	0.00014	0.0019	0.13	*0.00005*	0.0031	9.5	0.052	*0.000005*	0.00017
	19-MOFB-02	*0.0001*	0.00016	0.003	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.00011	*0.0001*	0.0012	0.062	*0.00005*	0.002	5.4	0.0088	*0.000005*	0.0002
	19-MOFB-03	*0.0001*	0.00014	0.0029	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.00011	*0.0001*	0.0012	0.06	*0.00005*	0.002	5.4	0.0042	*0.000005*	0.00021
	19-MOFB-04	*0.0001*	0.00014	0.0029	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.0001	*0.0001*	0.0011	0.059	*0.00005*	0.002	5.3	0.0038	*0.000005*	0.00023
	19-MOFB-05	*0.0001*	0.00016	0.0028	*0.00002*	*0.00005*	0.013	*0.000005*	13	0.00011	*0.0001*	0.0011	0.058	*0.00005*	0.0019	5.4	0.0043	*0.000005*	0.0002
	19-MOFB-06	*0.0001*	0.00015	0.0032	*0.00002*	*0.00005*	0.014	*0.000005*	14	0.00013	*0.0001*	0.0012	0.073	*0.00005*	0.002	5.2	0.0073	*0.000005*	0.00021
	19-MOFB-07	*0.0001*	0.00014	0.003	*0.00002*	*0.00005*	0.014	*0.000005*	14	0.00014	*0.0001*	0.00099	0.088	*0.00005*	0.002	5.2	0.0091	*0.000005*	0.00021
	19-MOFB-08	*0.0001*	0.00013	0.0032	*0.00002*	*0.00005*	0.017	*0.000005*	14	0.00013	0.00014	0.001	0.071	*0.00005*	0.0021	5.6	0.034	*0.000005*	0.00024
	19-MOFB-09	*0.0001*	0.0001	0.0053	*0.00002*	*0.00005*	0.016	*0.000005*	9.9	0.0001	0.00013	0.0014	0.065	*0.00005*	0.0016	9.2	0.045	*0.000005*	0.00041
	19-MOFB-10	*0.0001*	0.00015	0.0037	*0.00002*	*0.00005*	0.036	0.000012	13	0.0001	0.00014	0.0021	0.049	*0.00005*	0.0014	7.1	0.078	*0.000005*	0.0045
	19-MOFB-11	*0.0001*	0.00019	0.0033	*0.00002*	*0.00005*	0.025	0.0000064	13	0.00012	0.00011	0.004	0.033	*0.00005*	0.0012	6.2	0.019	*0.000005*	0.00066
	19-MOFB-12	*0.0001*	0.00017	0.00083	*0.00002*	*0.00005*	0.028	0.0000065	8.2	0.0001	*0.0001*	0.0035	0.023	*0.00005*	*0.001*	2.6	0.013	*0.000005*	0.00063
	19-MOFB-13	*0.0001*	0.00014	0.0018	*0.00002*	*0.00005*	0.015	*0.000005*	7.6	0.0001	*0.0001*	0.0035	0.022	*0.00005*	*0.001*	2.6	0.015	*0.000005*	0.0004
Access Road to Madrid North CWP	19-MAD-01	*0.0001*	0.00016	0.0054	*0.00002*	*0.00005*	0.01	*0.000005*	17	0.00013	*0.0001*	0.0011	0.017	*0.00005*	*0.001*	2.3	0.0017	*0.000005*	0.000063
	19-MAD-02	*0.0001*	0.00016	0.0029	*0.00002*	*0.00005*	0.01	*0.000005*	7.7	0.00048	*0.0001*	0.0017	0.071	*0.00005*	0.0022	2.4	0.0047	*0.000005*	0.00021
	19-MAD-03	*0.0001*	0.00015	0.0027	*0.00002*	*0.00005*	0.01	*0.000005*	4.8	0.00037	*0.0001*	0.0015	0.086	*0.00005*	0.0022	2	0.0053	*0.000005*	0.00019
	19-MAD-04	*0.0001*	0.00013	0.0027	*0.00002*	*0.00005*	0.01	*0.000005*	4.9	0.00036	*0.0001*	0.0015	0.088	*0.00005*	0.0021	1.9	0.0055	*0.000005*	0.00021
	19-MAD-05	*0.0001*	0.00022	0.003	*0.00002*	*0.00005*	0.01	*0.000005*	9.5	0.0004	*0.0001*	0.0018	0.078	*0.00005*	0.0022	2.6	0.004	*0.000005*	0.00028
	19-MAD-06	*0.0001*	0.00021	0.0028	*0.00002*	*0.00005*	0.01	*0.000005*	7.6	0.00039	*0.0001*	0.0019	0.095	*0.00005*	0.0022	2.4	0.0062	*0.000005*	0.00023
	19-MAD-07	*0.0001*	0.00018	0.0028	*0.00002*	*0.00005*	0.01	*0.000005*	7.9	0.00043	*0.0001*	0.0019	0.097	*0.00005*	0.0022	2.4	0.0062	0.0000051	0.00025
	19-MAD-08	*0.0001*	0.00025	0.0047	*0.00002*	*0.00005*	0.011	0.0000087	17	0.0005	0.00029	0.0025	0.097	*0.00005*	0.0022	4.6	0.065	*0.000005*	0.00044
	19-MAD-09	*0.0001*	0.00023	0.0042	*0.00002*	*0.00005*	0.01	*0.000005*	9.5	0.00054	0.00012	0.0021	0.12	*0.00005*	0.0021	3.2	0.0086	*0.000005*	0.00029
	19-MAD-10	*0.0001*	0.00046	0.0075	*0.00002*	*0.00005*	0.018	*0.000005*	29	0.00031	0.00012	0.0025	0.035	*0.00005*	0.0038	5.2	0.0087	*0.000005*	0.00038
	19-MAD-11	*0.0001*	0.00044	0.0081	*0.00002*	*0.00005*	0.019	*0.000005*	29	0.00028	*0.0001*	0.0025	0.034	*0.00005*	0.0037	5.5	0.0087	*0.000005*	0.00037

Italicized text indicates value below the method detection lim

Area	Sample ID	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	0.002	*0.05*	0.56	0.00005	1.7	*0.00001*	3.4	0.01	*0.5*	*0.00001*	*0.0001*	0.00059	0.000021	*0.0005*	0.0042	0.00049
	19-REF-02	0.002	*0.05*	0.61	0.00005	3.5	*0.00001*	9.5	0.063	0.96	*0.00001*	*0.0001*	0.00057	0.000014	*0.0005*	0.0017	*0.0003*
	19-REF-03	*0.0005*	*0.05*	0.35	0.000054	1.8	*0.00001*	9.9	0.023	1.8	*0.00001*	*0.0001*	*0.0003*	*0.00001*	*0.0005*	*0.001*	*0.0003*
Waste Rock Influenced Area	19-DC-01	0.082	0.18	30	0.0049	2.6	0.032	350	0.35	140	*0.00002*	*0.0002*	*0.0006*	0.0014	0.0022	*0.002*	*0.0004*
	19-DC-02	0.085	0.16	30	0.0048	2.6	0.033	340	0.35	140	*0.00002*	*0.0002*	*0.0006*	0.0015	0.0021	*0.002*	*0.0004*
	19-DC-03	0.073	0.16	26	0.0045	2.5	0.033	290	0.32	120	0.000017	*0.0001*	*0.0003*	0.0014	0.0021	*0.001*	*0.0003*
	19-DC-04	0.0018	*0.05*	17	0.0011	2	*0.00001*	170	0.44	34	0.000034	*0.0001*	*0.0003*	0.00086	0.00074	0.0018	*0.0003*
	19-DC-05	0.0016	*0.05*	16	0.0013	1.9	*0.00001*	160	0.44	33	0.000037	*0.0001*	*0.0003*	0.00087	0.00072	*0.001*	*0.0003*
	19-DC-06	0.004	*0.05*	16	0.0021	2.4	*0.00001*	190	0.63	70	0.000042	*0.0001*	*0.0003*	0.0021	0.00079	*0.001*	*0.0003*
TLA	19-TLA-01	0.0011	*0.05*	3	0.00017	1.6	*0.00001*	26	0.035	9	0.00001	0.0001	0.00088	*0.00005*	*0.0005*	*0.001*	*0.0003*
CPR Access Road	19-DC-02	0.00081	*0.05*	1.6	0.00008	1.8	*0.00001*	13	0.036	3.2	*0.00001*	*0.0001*	0.00062	0.000036	*0.0005*	*0.001*	*0.0003*
	19-DC-03	0.0013	*0.05*	3.4	0.00036	1.9	0.000017	41	0.041	6.6	*0.00001*	*0.0001*	0.00081	0.000027	*0.0005*	0.0014	*0.0003*
Marine Outfall Berm Access Road	19-MOFB-01	0.0011	*0.05*	2.2	0.00005	2.1	*0.00001*	48	0.047	2.8	*0.00001*	*0.0001*	*0.0003*	0.000033	*0.0005*	*0.001*	*0.0003*
	19-MOFB-02	0.00075	*0.05*	1.4	0.00005	1.5	*0.00001*	21	0.03	1.7	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-03	0.00073	*0.05*	1.3	0.00005	1.5	*0.00001*	20	0.029	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-04	0.00074	*0.05*	1.3	0.00005	1.5	*0.00001*	19	0.03	1.5	*0.00001*	*0.0001*	*0.0003*	0.000016	*0.0005*	*0.001*	*0.0003*
	19-MOFB-05	0.00064	*0.05*	1.3	0.00005	1.5	*0.00001*	19	0.03	1.4	*0.00001*	*0.0001*	*0.0003*	0.000015	*0.0005*	*0.001*	*0.0003*
	19-MOFB-06	0.0007	*0.05*	1.3	0.00005	1.6	*0.00001*	18	0.029	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-07	0.00066	*0.05*	1.3	0.00005	1.5	*0.00001*	18	0.029	1.3	*0.00001*	*0.0001*	*0.0003*	0.00002	*0.0005*	*0.001*	*0.0003*
	19-MOFB-08	0.00075	*0.05*	1.4	0.00005	1.6	*0.00001*	20	0.032	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-09	*0.0005*	*0.05*	1.4	0.00005	0.93	*0.00001*	45	0.041	4.3	*0.00001*	*0.0001*	*0.0003*	0.000023	*0.0005*	*0.001*	*0.0003*
	19-MOFB-10	*0.0005*	*0.05*	1.7	0.00005	1.1	*0.00001*	29	0.031	2.5	*0.00001*	*0.0001*	0.0004	0.00008	*0.0005*	*0.001*	*0.0003*
	19-MOFB-11	0.00057	*0.05*	1.8	0.000084	1.5	*0.00001*	15	0.022	1.7	*0.00001*	*0.0001*	0.00088	0.000063	*0.0005*	*0.001*	*0.0003*
	19-MOFB-12	*0.0005*	*0.05*	0.83	0.0001	0.35	*0.00001*	9.1	0.012	2.2	*0.00001*	*0.0001*	0.00039	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-13	*0.0005*	*0.05*	1.5	0.00011	0.38	*0.00001*	10	0.015	2.1	*0.00001*	*0.0001*	0.00043	0.000024	*0.0005*	*0.001*	*0.0003*
Access Road to Madrid North CWP	19-MAD-01	0.00072	*0.05*	0.76	0.00005	1	*0.00001*	3.3	0.015	*0.5*	*0.00001*	*0.0001*	*0.0003*	*0.00001*	*0.0005*	0.0018	*0.0003*
	19-MAD-02	0.0021	*0.05*	1.1	0.00005	1.6	*0.00001*	4.2	0.012	*0.5*	*0.00001*	*0.0001*	0.00056	0.000021	*0.0005*	0.0036	0.0004
	19-MAD-03	0.0021	*0.05*	1	0.00005	1.4	*0.00001*	2.7	0.0092	*0.5*	*0.00001*	*0.0001*	0.00049	0.000019	*0.0005*	0.0044	0.00037
	19-MAD-04	0.002	*0.05*	1.1	0.00005	1.4	*0.00001*	2.7	0.0088	*0.5*	*0.00001*	*0.0001*	0.00043	0.000019	*0.0005*	0.0044	0.00036
	19-MAD-05	0.0022	*0.05*	1.2	0.00005	1.5	*0.00001*	3.1	0.012	*0.5*	*0.00001*	*0.0001*	0.00043	0.000019	*0.0005*	0.0039	0.00039
	19-MAD-06	0.0022	*0.05*	1.1	0.00005	1.5	*0.00001*	2.7	0.01	*0.5*	*0.00001*	*0.0001*	0.00059	0.000021	*0.0005*	0.0034	0.00045
	19-MAD-07	0.0023	*0.05*	1.1	0.00005	1.5	*0.00001*	2.9	0.011	*0.5*	*0.00001*	*0.0001*	*0.0006*	0.000021	*0.0005*	0.0034	0.00038
	19-MAD-08	0.0027	*0.05*	1.8	0.00005	1.8	*0.00001*	7.1	0.023	*0.5*	*0.00001*	*0.0001*	0.00051	0.00002	*0.0005*	0.022	0.00044
	19-MAD-09	0.0024	*0.05*	1.1	0.00005	1.8	*0.00001*	3.4	0.016	*0.5*	*0.00001*	*0.0001*	0.0009	0.000023	*0.0005*	0.0032	0.00048
	19-MAD-10	0.0017	*0.05*	1.4	0.00005	2.7	*0.00001*	7.1	0.11	1.6	*0.00001*	*0.0001*	0.00033	0.00003	*0.0005*	0.0025	*0.0003*
	19-MAD-11	0.0016	*0.05*	1.4	0.00005	2.8	*0.00001*	7.1	0.11	1.6	*0.00001*	*0.0001*	0.00038	0.000035	*0.0005*	0.0049	*0.0003*

Italicized text indicates value below the method detection lim

Appendix E – 2019 Geochemical Monitoring of Flotation and Detoxified Tailings, Doris Mill

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Jessica Evans; Lisa Barazzuol, SRK	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 23, 2020
Subject:	2019 Geochemical Monitoring of Flotation and Detoxified Tailings, Doris Mill		

1 Introduction

TMAC initiated ore processing at the Doris mill and deposition of flotation tailings in the Doris tailings impoundment area (TIA) in January 2017. In October 2019, TMAC started processing ore from Madrid North (Naartok East Crown Pillar Recovery) at the Doris mill. Ore from the Naartok East Crown Pillar Recovery is blended with Doris ore for processing at a ratio of a maximum 25% Naartok East ore to 75% Doris ore. Placement of detoxified tailings as backfill in stopes of the Doris Mine and geochemical monitoring of tailings commenced in February 2017. In 2019, a total of 573,868 t (dry weight equivalent) of flotation tailings were deposited in the Doris TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine.

The geochemical monitoring program for flotation tailings slurry and detoxified tailings are specified in Schedule I, Tables 1 to 3 of NWB Type “A” Water Licence 2AM-DOH1335 Amendment No. 2 (the “Water Licence”, Nunavut Water Board 2018) and includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids[1] (TL-7A), detoxified tailings supernatant (TL7-B) and seepage from underground backfilled stopes (TL-11). Station TL7-B was added to Water Licence and monitoring commenced in 2019. This memo documents the results of the 2019 geochemical monitoring of flotation and detoxified tailings at TL-5, TL-6, TL-7A, TL-7B and TL-11 and fulfills the reporting requirements outlined in Schedule B, Items 2a i, ii, iii and iv of Water Licence 2AM-DOH1335.

2 Background

In the processing plant, there are two sections: the concentrate lines (CL1 and CL2) and the Concentrate Treatment Plant (CTP). Cyanide is a reagent used exclusively in the CTP to dissolve gold from the solid concentrate to be captured by resin. The concentrate lines (CL) react poorly to the presence of cyanide and so this side must be kept free of cyanide in order for the process to perform well. The final stage of the CTP is cyanide destruction. Cyanide is destroyed using the

[1] Detoxified tailings are referred to as cyanide leach residue in the Water Licence and prior to 2019 was monitored as station TL-7.

INCO SO_2 process. The detoxified slurry is filtered with the solids (TL-7A) placed in a stockpile for co-disposal with backfill underground for permanent storage (TL-11 seepage survey). The solution (TL-7B) is pumped to the tailings thickener where it is combined with the flotation tailings slurry. Samples of TL-5 and TL-6 represent the tailings slurry supernatant and solids, respectively, that is discharged to the TIA. The detoxification circuit is run to produce a total cyanide level of less than one part per million (1 ppm). The solution from the detoxification circuit and final detoxified tailings are routinely analyzed for weak acid dissociable (WAD) and total cyanide species by mill personnel to monitor the performance of the cyanide detoxification circuit. Concentrations of free, WAD and total cyanide in the process plant tailings water discharge (TL-5) are reported monthly to the Nunavut Water Board and cyanate and thiocyanate are reported quarterly. Concentrations of cyanate, thiocyanate and WAD cyanide in the detoxified tailings filtrate (TL-7B) are analyzed monthly.

3 Methods

3.1 Sample Collection and Analysis

3.1.1 Tailings and Process Water

Process Plant Flotation Tailings Slurry Discharge: Solids (TL-6) and Supernatant (TL-5)

Schedule I (Table 3) of the Water Licence specifies weekly sampling of flotation tailings (TL-6) and monthly sampling of the process plant tailings supernatant (TL-5). Samples of the flotation tailings solids (TL-6) and the supernatant solution (TL-5) were collected from the flotation tailings thickener tank. The filtrate from the detox filter press (where detoxified tailings are dewatered) is pumped to the flotation tailings thickener tank prior to discharge to the TIA.

TMAC collects flotation tailings slurry from the tailings thickener tank in a clean 5-gallon bucket. The sample is left in the bucket to allow gravitational settling and separation of the tailings solids from the liquid. After settling, samples of supernatant solution (TL-5) and flotation tailings solids (TL-6) are collected at the frequency outlined above.

The tailings supernatant solution (TL-5) was sampled using a sterile 60 mL syringe and submitted to ALS Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, dissolved and total metals. In total, the 2019 monitoring program included geochemical characterization of 12 monthly samples of tailings process supernatant collected from January to December with a duplicate sample collected in March.

After sampling is completed for the tailings supernatant solution (TL-5), the remaining supernatant is discarded and a clean stainless-steel spoon is used to transfer the solid tailings into a clean plastic Ziploc bag supplied by the laboratory. The bag is then sealed and placed in a fridge until the last weekly sample for the month has been collected. At the end of each month, TMAC combines and homogenizes equal amounts of tailings from each weekly sample to create an approximately 500 g monthly composite sample of flotation tailings solids (TL-6).

In total, the 2019 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample collected in May. Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to Bureau Veritas Laboratory in Burnaby, BC for analysis of:

- Total sulphur – by Leco combustion;
- Sulphate sulphur – by hydrochloric acid leach;
- TIC – carbonate carbon by CO_2 hydrochloric acid leach; and
- Trace element content – by aqua regia digest (nitric and hydrochloric acid) with ICPMS finish.

Detoxified Tailings Solids (TL-7A) and Filtrate (TL-7B)

As a requirement of Water License 2AM-DOH1335 samples of the detoxified tailings produced in the process plant must be submitted for laboratory analysis. Schedule I of the Water Licence identifies the detoxified tailings solids component (TL-7A) and the filtrate liquid component (TL-7B) as compliance monitoring stations.

Schedule I (Table 3) of the Water Licence specifies monthly sampling and analysis of detoxified tailings solids (TL-7A) for TIC, total metals (including sulphur) and moisture content, and for the filtrate (TL-7B) monthly analysis of total metals, WAD cyanide, cyanate and thiocyanate.

In total, the 2019 monitoring program included geochemical characterization of 12 samples of detoxified tailings solids (TL-7A) collected from January to December. One duplicate sample was collected in May. 12 samples of filtrate (TL-7B) from the detoxified tailings were collected from January to December. One duplicate sample was collected in May.

At the end of a detoxification cycle, TMAC collects one discrete sample of detoxified tailings solids (TL-7A) from the discharge compartment of the detoxification circuit filter press. A clean stainless-steel spoon is used to transfer the solid detoxified tailings solids into 125 mL glass sample jars supplied by the laboratory. Samples of the filtrate liquid component are collected from the receiving tank of the detoxification filter press using a 10 foot sampling pole with an open top 1 L poly bottle and then poured into four 500 mL settling bottles to allow gravitational settling and separation of residual tailings solids from the liquid. After settling, the filtrate (TL-7B) is transferred into laboratory supplied sample bottles either using a clean syringe or decanting the supernatant into the sample bottles.

The solids samples are submitted to Bureau Veritas Laboratory for total sulphur by total Leco, sulphate sulphur, TIC and multi-element trace element content by aqua regia digestion followed by ICP finish. ABA methods at Bureau Veritas Laboratory are the same as described for flotation tailings (TL-6). Laboratory data are provided in Attachment B.

The filtrate samples (TL-7B) are submitted to ALS Laboratory for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals. Laboratory data are provided in Attachment B.

3.1.2 Seepage Survey of Underground Backfilled Stopes (TL-11)

Schedule I (Table 3) of the Water Licence specifies bi-annual seepage surveys of underground backfilled stopes with opportunistic sampling of seepage for the analysis of pH, electrical conductivity (EC), trace metals by ICP-MS, alkalinity, acidity, sulphate, total and WAD cyanide, total ammonia, nitrate and nitrite.

TMAC completed underground seepage inspections of backfilled stopes in May and December 2019. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey, i.e. not all backfill could be inspected. Fifteen locations were surveyed in May and sixteen locations were surveyed in December. Inspection of the backfill materials in the stopes showed that detoxified tailings were only visible on Level 4946 and Level 5002 (TL-11B-27MAY19 and TL-11D-27MAY19); detoxified tailings were not visible in the backfill on the other levels where samples were collected.

No flowing seeps were identified in the May survey; however, TMAC collected samples from pools of water (all stagnant unless otherwise noted) at the base of stopes in the following locations:

- Base of the backfill in the East limb on Level 4932, location E433902, N7559742 (TL-11A-27MAY19). There were no obvious signs of seepage flow from the stope at this location.
- Base of the East limb of the South stope on Level 4946, location E433837, N7559620 (TL-11B-27MAY19). There were no signs of flow from the backfill tailings at this location.
- Base of the West limb on the South stope on Level 4964, location E433786, N7559507 (TL-11C-27MAY19).
- Base of the West limb, North stope on Level 5002, location E433744, N7559239 (TL-11D-27MAY19). This pool was near the Doris Central surface vent raise and there were detoxified tailings visible in the backfill at this location.
- Base of a stope in the East limb on Level 4735, location E433903, N7559726 (TL-11E-27MAY19). At the time of sampling from the pool there was water flowing down into the area from the access ramp.
- Pooled water at base of a stope in the East limb on Level 4905, location E433792, N7559314 (TL-11F-27MAY19). There were no signs of flow from the stope at this location. The area had recently been used as a drill bay.

In December, TMAC collected two seepage samples during the underground survey. One sample from the seep flowing from the bottom of the West limb, North stope at Level 120, location E433718, N7558636 (TL-11A-15DEC19). A field blank and duplicate sample were also collected at this location in the December survey. Another sample was also collected from the seep flowing from the toe of the backfill in the West limb, South stope of Level 134, location E433725, N7558381 (TL-11B-15DEC19).

Seepage samples were collected using a syringe and field measurements of pH, EC, ORP and temperature recorded. Seepage flow rates ranged from 0.022 to 0.044 L/s for TL-11A and TL-11B respectively. TMAC submitted samples to ALS in Burnaby, BC for analysis of pH, EC, TSS, TDS, alkalinity, chloride, sulphate, total and WAD cyanide, and dissolved and total metals. The sample for dissolved metals was filtered and preserved at the time of sampling. Laboratory data are provided in Attachment C.

3.2 Data Interpretation

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when ratios are less than 1 and as having an uncertain potential for ARD when ratios are between 1 and 3 (DIAND 1993).

4 Results and Discussion

4.1 Data QA/QC

4.1.1 Tailings Solids Samples (TL-6 and TL-7A)

All solids data for the flotation (TL-6) and detoxified (TL-7A) tailings were reviewed by SRK for QA/QC. Table 4-1 presents the results of the QA/QC checks including comparison of duplicate sample pairs for the flotation (TL-6) and detoxified (TL-7A) (TL6-6MAY19DUP and TL7-5MAY19DUP). Relative percentage differences (RPD) were calculated to assess reproducibility of results. SRK considers all data acceptable.

4.1.2 Detoxified Tailings Filtrate (TL-7B)

All filtrate water quality data from the detoxified tailings (TL-7B) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate sample collected in May (TL-7B_DUP). SRK considers all data acceptable.

4.1.3 Process Plant Tailings Supernatant (TL-5)

All supernatant water quality data from the flotation tailings (TL-5) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate sample collected in March.

One selenium result reported dissolved concentrations that exceeded the total concentrations by greater than +/-20%. This may be attributed to the introduction of metallic contaminant to the dissolved sample during field filtration. SRK considers all data acceptable.

4.1.4 Seepage Survey Samples (TL-11)

All seepage water quality data from the underground stopes (TL-11) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate samples and analysis of the field blank samples collected in May and December (TL11-C-DUP, TL11-A-DUP and TL11_FB).

RPD values for the field duplicates exceed the QA/QC criterion for the following total metals: aluminium, arsenic, chromium, copper, iron, lead, titanium, vanadium and zinc. This may be attributed to disturbed sediments during sampling. All the dissolved metals for the duplicate samples passed the RPD check. All other data passed the QA/QC tests. SRK considers all data acceptable.

Table 4-1: QA/QC Summary for Solid Analysis of Flotation (TL-6) and Detoxified (TL-7A) Tailings

QC Test	SRK QC Criteria	TL-6 Results	TL-7A Results
Rinse pH			
Lab Duplicate	For any samples, +/- 0.5 difference pH unit	N/A	N/A
Field Duplicate	For any samples, +/- 0.5 difference pH unit	N/A	N/A
Standard/Controls	Within tolerance ranges	N/A	N/A
TIC			
Lab Method Blank	<5X detection limit (DL)	(n=13) All passed.	(n=11) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4) All passed.	(n=19) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	N/A	(n=1) All passed.
Standard reference materials	Within +/-20% difference	(n=21) All passed.	(n=21) All passed.
Total S & Sulphate			
Lab Method Blank	<5X detection limit (DL)	(n=12 for Total S, and n=10 for SO_4) All passed.	(n=9 for Total S, n=10 for SO_4) All passed.
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not then (sulphate-total S)/Total S> 20%	(n=11) All passed.	(n= 11) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=0 for Total S, and n=10 for SO_4) All passed.	(n=8 for Total SO_4, n=4 for Total S) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1 for Total SO_4 and n=1 for Total S) All passed.	(n=1 for Total SO_4, n=1 for Total S) All passed.
Standard reference materials	Within +/-20% Difference	(n=24 for Total S and n=21 for Total SO_4) All passed.	(n=22 for Total S, n=20 for SO_4) All passed.
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n= 13) All passed.	(n=10) The S-ICP is higher than the maximum detection limit (samples May to Nov 2019). Sulphur quantified by Leco S method.
Trace Element Content			
Lab Method Blank	<5X Detection Limit	(n=13) All passed.	(n=11) All passed.
Lab Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, ok 10% of metal scan failing.	(n=2) All passed.	(n=2) All passed.
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, ok 10% of metal scan failing.	(n=1) All passed.	(n=1) All passed.
Standard reference materials	Within specified tolerance ranges.	(n=24) All passed.	(n=23) All passed.

Table 4-2: QA/QC Summary for Process Plant Tailings Supernatant from Flotation Tailings (TL-5) and Backfilled Stope Seepage Samples (TL-11)

QC Test	SRK QC Criteria	TL-5 Results	TL-7B	TL-11 Results
Physical Test[1]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for EC, (n=2) for Hardness, (n=2) for pH, (n=2) for TSS and (n=2) for TDS (All passed.)
Method Blank	<2X DL	(n=12) for TSS and (n=9) for EC (All passed.)	(n=0)	(n=4) for TSS and (n=4) for EC and (n=2) for TDS (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Hardness, (n=1) for pH and (n=1) for TSS (All passed.)	(n=1) for pH. (All passed.)	(n=2) for EC, (n=2) for Hardness, (n=2) for pH, (n=2) for TSS and (n=2) for TDS (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=1) for TSS (All passed.)	(n=0)	(n=1) for EC, (n=1) for TDS and (n=1) for pH (All passed.)
Field pH vs. Lab pH	Difference should not be greater than 1 pH unit	(n=11) (All passed.)	(n=0)	(n=8) (All passed.)
Field EC vs Lab EC	For samples > 10X the detection limit (DL), % RPD should be within +/-30%	(n=9) (All passed.)	(n=0)	(n=10) (TL11-A, TL11-B, TL11-C, TL11-E and TL11-F have OR field EC value)
Standard Reference Materials	Within specified tolerance ranges.	(n=9) for EC and (n=10) for pH and (n=11) for TSS (All passed.)	(n=12) for pH. (All passed.)	(n=4) for EC, (n=4) for TSS, (n=2) for TDS and (n=4) for pH (All passed.)
Anions and Nutrients[2]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Alkalinity, Total, (n=2) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) (All passed.)
Method Blank	<2X DL	(n=9) for Total Alkalinity, (n=12) for Ammonia, Total, (n=10) for Cl, (n=12) for Nitrate (as N), (n=12) for Nitrite (as N), (n=12) for Sulphate (SO_4) (All passed.)	(n=12) for Total Ammonia (as N). (All passed.)	(n=4) for Alkalinity, Total, (n=4) for Ammonia, Total, (n=3) for Cl, (n=3) for Nitrate (as N), (n=3) for Nitrite (as N), (n=3) for Sulphate (SO_4), (n=7) for Acidity (as $CaCO_3$) (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Ammonia, Total, (n=1) for Nitrate (as N), (n=1) for Nitrite (as N), (n=1) for Sulphate (SO_4) (All passed.)	(n=1) for Total Ammonia (as N). (All passed.)	(n=2) for Alkalinity, Total, (n=2) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=0)	(n=0)	(n=2) for Alkalinity, Total (as $CaCO_3$) (All passed.)
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=9) (All passed.)	Not possible to calculate with available data (no major ions).	(n=8) (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=9) for Total Alkalinity, (n=11) for Ammonia, Total, (n=9) for Cl, (n=11) for Nitrate (as N), (n=11) for Nitrite (as N), (n=11) for Sulphate (SO_4) (All passed.)	(n=12) for Total Ammonia (as N). (All passed.)	(n=3) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) and (n=2) for Alkalinity, Total (All passed.)
Cyanides and Cyanide Degradation Products[3]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for WAD CN, (n=2) for Total CN, and (n=2) for Cyanide, Free (All passed.)
Method Blank	<2X DL	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free (All passed.)	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free. (All passed.)	(n=3) for WAD CN, (n=3) for Total CN, and (n=5) for Cyanide, Free (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for WAD CN, (n=1) for Total CN, (n=1) for Cyanate, (n=1) for Thiocyanate (SCN) and (n=1) for Cyanide, Free (All passed.)	(n=1) for Cyanate, (n=1) for Thiocyanate, (n=1) for Cyanide, Total, (n=1) for Cyanide, Free and (n=1) for Cyanide, Weak Acid Diss. (All passed.)	(n=2) for WAD CN, (n=2) for Total CN, and (n=2) for Cyanide, Free (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=3) for Thiocyanate (SCN) (All passed.)	(n=5) for Cyanate and (n=2) for Thiocyanate. (All passed.)	(n=0)
Standard Reference Materials	Within specified tolerance ranges.	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free (All passed.)	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free. (All passed.)	(n=3) for WAD CN, (n=3) for Total CN, and (n=4) for Cyanide, Free (All passed.)
Trace Metals by ICP-MS				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Method Blank	<2X DL	(n=8) for Dissolved and (n=10) for Total (All passed.)	(n=12) for Total. (All passed.)	(n=4) for Dissolved and (n=4) for Total (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Total (All passed.)	(n=2) for Total. (All passed.)	(n=2) for Total and (n=2) for Dissolved (TL11-C Dup failed for Total Al, As, Cr, Cu, Fe, Pb, Ti, V and Zn - >30% RPD and >10x DL. The parent sample, TL-11, are <10x DL (L2280421))
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=0)	(n=1) for Total. (All passed.)	(n=1) for Total (All passed.)
Total vs Dissolved Metals	Total Metals>Dissolved metals. Total Metals should be greater than Dissolved Metals, if not the % difference should be within +/-20%. ALS would use 10X DL, Maxxam would use 5X DL	(n=9) (Se failed the criteria - both Total and Dissolved Se are >10x DL (L2361827)	(n=0)	(n=8) (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=7) for Dissolved and (n=9) for Total (All passed.)	(n=12) for Total. (All passed.)	(n=4) for Dissolved and (n=4) for Total (All passed.)
Hg-CVAAS				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Method Blank	<2X DL	(n=12) for Total and (n=8) for Dissolved (All passed.)	(n=0)	(n=5) for Total and (n=3) for Dissolved (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Total (All passed.)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=4) for Dissolved (All passed.)	(n=0)	(n=1) for Dissolved (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=12) for Total and (n=8) for Dissolved (All passed.)	(n=0)	(n=4) for Total and (n=3) for Dissolved (All passed.)

Notes:

1) Conductivity, pH, Hardness (as $CaCO_3$), Total Suspended Solids

2) Total Alkalinity, Total Ammonia, Unionized Ammonia, Cl, NO_3, NO_2, Total N, SO_4

3) WAD CN, Total CN, Cyanate, SCN, Free CN

4.2 Tailings Solids (TL-6 and TL-7A)

4.2.1 Acid Base Accounting

A summary of ABA results for the flotation tailings (TL-6) and detoxified tailings (TL-7A) solids are presented in Table 4-3 and Table 4-4, respectively. Full results are presented in Attachment A and Attachment B.

Historically, tailings samples were analyzed at a different lab (ALS) using different analytical test work methods that resulted in results that were in some cases lower, e.g. TIC or higher, e.g. sulphate. Accordingly, parameters in Table 4-3 and Table 4-4 are presented according to laboratory to account for differences in analytical differences when data sets are not equivalent methods (SRK 2019). The methods used by BV are equivalent to the geochemical test work conducted on metallurgical tailings (SRK 2015).

Table 4-3: Summary of ABA Results for Flotation Tailings (TL-6)

Year	Sampling Date	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
			ALS	BV	ALS	BV		ALS	BV
		%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2019	Jan-19	0.09	--	0.01	--	160	2.2	--	72
	Feb-19	0.21	--	0.01	--	110	6.3	--	18
	Mar-19	0.17	--	0.02	--	130	4.4	--	29
	Apr-19	0.35	--	0.04	--	160	10	--	16
	May-19	0.23	--	0.02	--	110	6.6	--	17
	Jun-19	0.33	--	0.01	--	160	11	--	14
	Jul-19	0.2	--	0.02	--	170	8	--	22
	Aug-19	0.3	--	0.02	--	97	9.4	--	10
	Sep-19	0.19	--	0.02	--	110	5.9	--	18
	Oct-19	0.24	--	0.02	--	130	7.5	--	17
	Nov-19	0.53	--	0.02	--	200	17	--	12
	Dec-19	0.38	--	0.03	--	220.00	12	--	19
Statistical Summary									
2019	P005	0.13	--	0.01	--	100	3.4	--	11
	P050	0.24	--	0.02	--	140	7.7	--	17
	P095	0.45	--	0.04	--	210	14	--	48
	P100	0.5	--	0.04	--	220	17	--	72
	n	12	--	12	--	12	12	--	12
2018	P005	0.05	0.031	0.01	57	77	1.6	36	8.1
	P050	0.1	0.039	0.02	58	97	3.1	37	28
	P095	0.71	0.064	0.048	66	140	22	37	41
	P100	1.4	0.067	0.06	67	140	43	37	42
	n	12	3	9	3	9	12	3	9
2017 (n = 11)	P005	0.05	0.036	--	43	--	1.6	1.7	--
	P050	0.07	0.049	--	63	--	2.2	25	--
	P095	0.86	0.065	--	92	--	27	48	--
	P100	1.0	0.066	--	110	--	33	48	--

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.037_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2019_rev12.xlsx

Notes:

AP calculation is based upon total sulphur

Results from ALS and Bureau Veritas presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Table 4-4: Summary of ABA Results for Detoxified Tailings (TL-7A)

Year	Sampling Date	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
			ALS	BV	ALS	BV		ALS	BV
		%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2019	Jan-19	12	--	0.16	--	160	360	--	0.44
	Feb-19	9.6	--	0.18	--	170	300	--	0.57
	Mar-19	15	--	0.20	--	140	480	--	0.29
	Apr-19	14	--	0.26	--	130	450	--	0.28
	May-19	12	--	0.13	--	120	360	--	0.34
	Jun-19	13	--	0.29	--	140	410	--	0.35
	Jul-19	22	--	0.28	--	98	680	--	0.14
	Aug-19	21	--	0.27	--	64	660	--	0.10
	Sep-19	22	--	0.16	--	110	690	--	0.16
	Oct-19	25	--	0.22	--	120	770	--	0.15
	Nov-19	22	--	0.10	--	140	680	--	0.20
	Dec-19	21	--	0.25	--	130	670	--	0.20
Statistical Summary									
2019	P005	11	--	0.12	--	83	330	--	0.12
	P050	17	--	0.21	--	130	540	--	0.27
	P095	23	--	0.28	--	160	730	--	0.50
	P100	25	--	0.29	--	170	770	--	0.57
	n	12	--	12	--	12	12	--	12
2018	P005	4.6	0.12	0.09	60	76	140	0.22	0.12
	P050	13	0.2	0.2	67	110	420	0.37	0.24
	P095	23	0.3	0.26	82	140	700	0.6	0.34
	P100	23	0.3	0.27	84	140	720	0.64	0.37
	n	13	4	9	4	9	13	4	9
2017 (n = 11)	P005	2.9	0.16	--	51	--	92	0.1	--
	P050	7.9	0.28	--	75	--	250	0.3	--
	P095	17	0.39	--	81	--	530	0.8	--
	P100	19	0.43	--	82	--	610	1.0	--

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.037_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2019_rev12.xlsx

Notes:

AP calculation is based upon total Sulphur

Results from ALS and Bureau Veritas presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Flotation Tailings (TL-6)

Total sulphur in flotation tailings (TL-6) were variable throughout 2019 ranging from a minimum concentration of 0.09% in January to a maximum of 0.53% in November (Table 4-2). The annual median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019 (Figure 4-1).

Sulphate sulphur was uniformly low resulting in levels of total sulphur and sulphide (calculated as the difference between total sulphur and sulphate) at near parity, suggesting that the majority of sulphur is present as sulphide sulphur (Figure 4-2). On this basis, total sulphur was used to calculate acid potential (AP).

TIC content ranged from 97 to 220 kg $CaCO_3$/t (Figure 4-3) and oscillated throughout 2019. Typically, TIC content of the flotation tailings (TL-6) was greater than the detoxified tailings (TL-7A) with the exception of August to October where the TIC content of the two streams was equivalent. All flotation tailings samples were classified as non-PAG (Figure 4-4). The non-PAG classifications are consistent with the ARD classifications of the metallurgical flotation tailings characterized as part of the Type A water licence amendment (SRK 2015).

Detoxified Tailings (TL-7A)

Sulphur trends in detoxified tailings (TL-7A) showed lower sulphur content earlier in the year compared to July onward. Between January and June, sulphur concentrations in detoxified tailings ranged from 9.6 to 15% whereas from July onwards, sulphur ranged from 21 to 25% (Table 4-2). In 2019, sulphur content of operational detoxified tailings is higher than metallurgical detoxified tailings characterized as part of the Type A water licence amendment (SRK 2015).

Sulphate sulphur ranged from 0.1 to 0.29% and possibly represents sulphate that is a by-product of the cyanide detoxification process and is present in the residual moisture in tailings. Total sulphur and sulphide content were at near parity for detoxified tailings as sulphate content was relatively low compared to sulphide (Figure 4-2). Accordingly, total sulphur was used to calculate AP.

TIC content ranged from 64 to 170 kg $CaCO_3$/t (Figure 4-3) and oscillated throughout 2019, with the lowest concentrations reported in July and August. Consistent with the ARD classifications of the metallurgical tailings characterized as part of the Type A water licence amendment (SRK 2015), all detoxified tailings were classified as PAG (Figure 4-4).

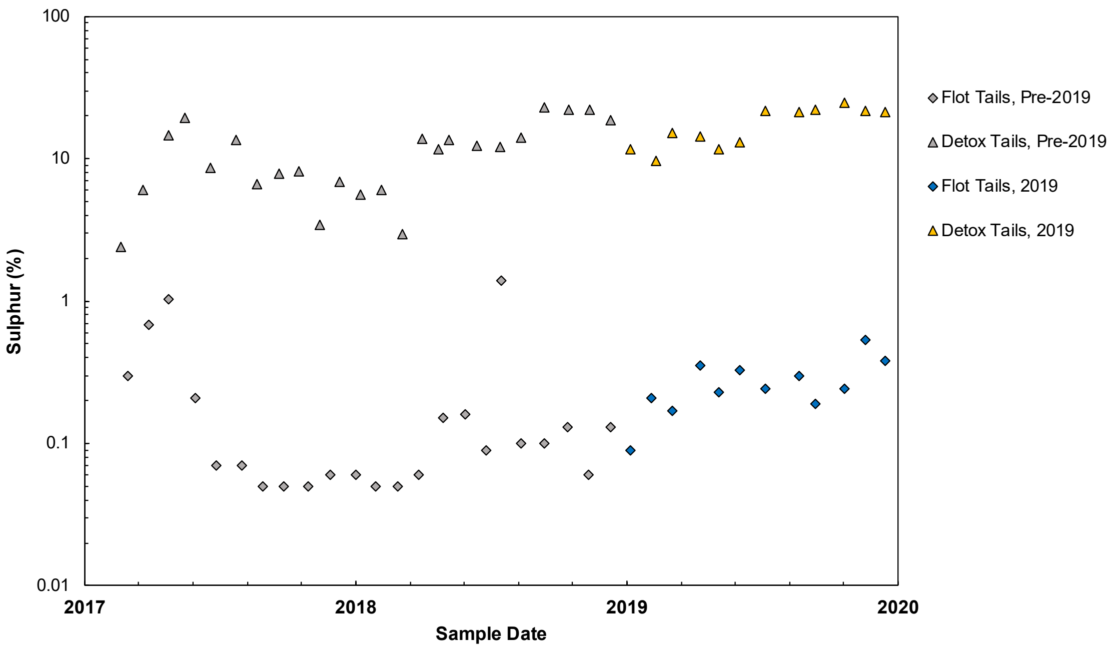

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Figure 4-1: Sulphur Concentrations for Tailings Samples Over Time

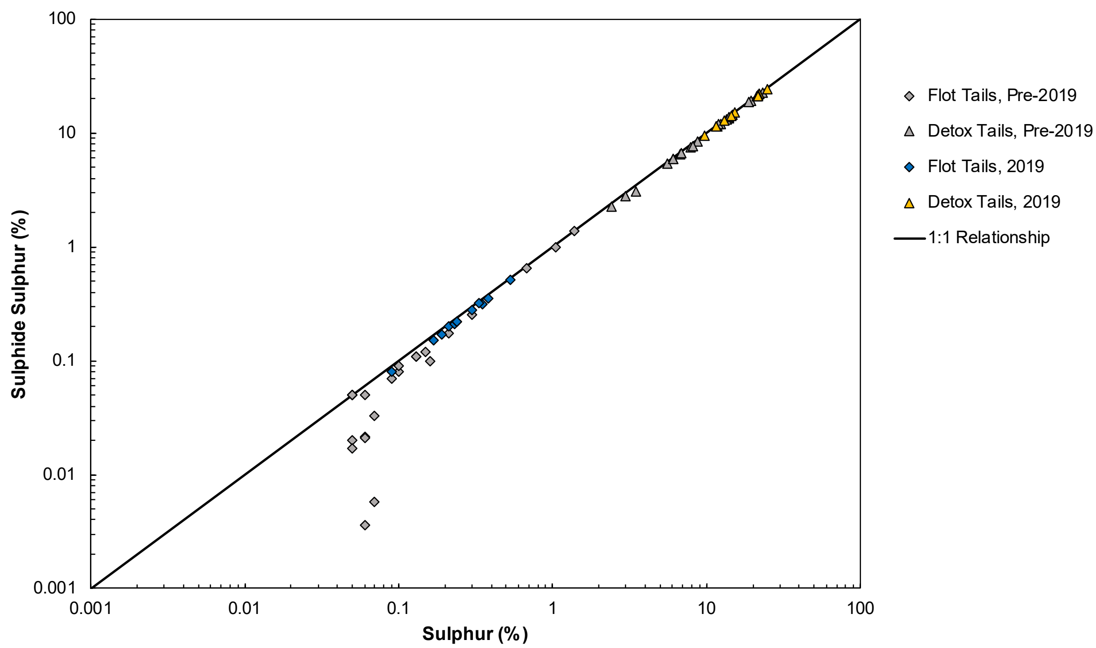

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Figure 4-2: Total Sulphur versus Calculated Sulphide Sulphur

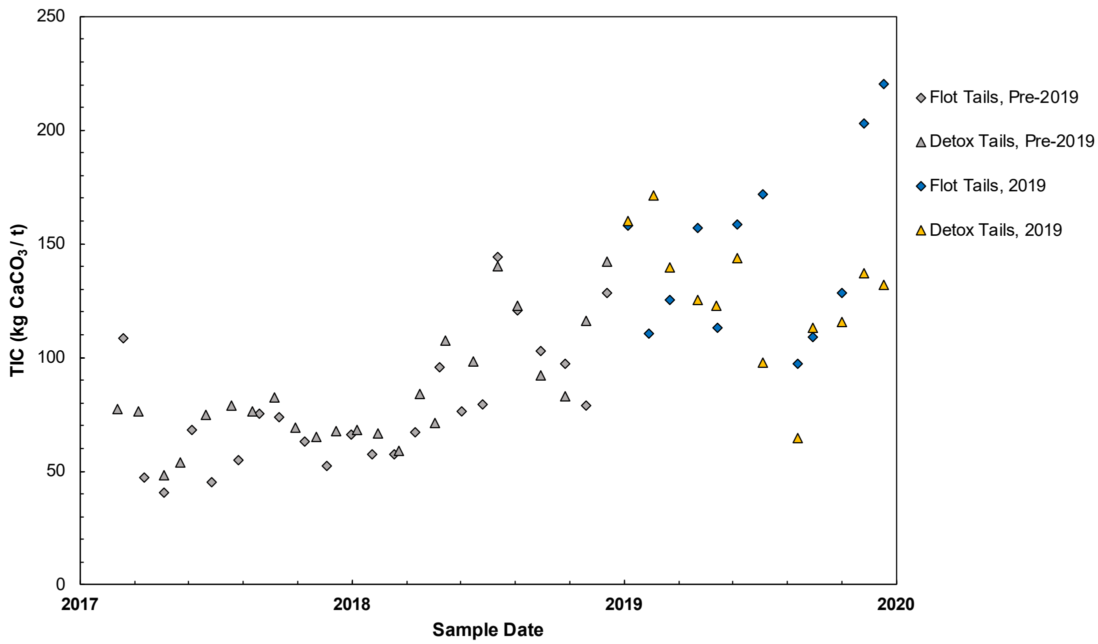

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Figure 4-3: Total Inorganic Carbon (TIC) Concentrations for Tailings Samples Over Time

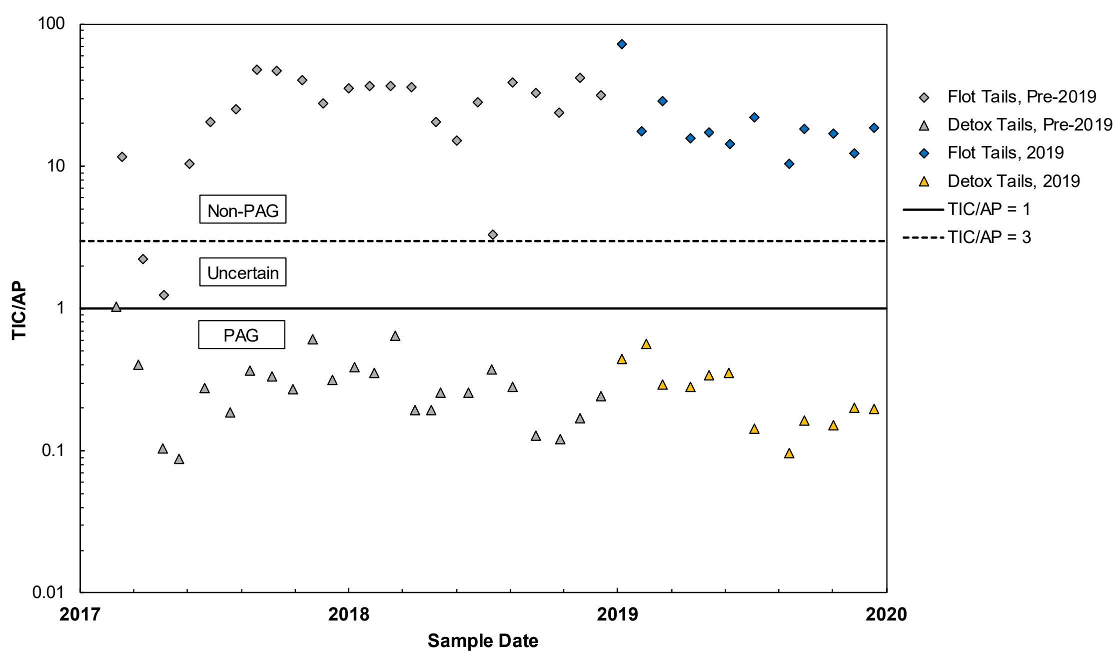

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Figure 4-4: ARD Classifications for Tailings Samples Over Time

4.2.2 Elemental Analysis

Trace element content for flotation (TL-6) and detoxified (TL-7A) tailings are summarized in Table 4-5 and Table 4-6, respectively. Full results are presented in Attachment A and Attachment B.

Results were compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. Selenium and bismuth could not be assessed because the detection limit is equivalent or higher than the screening criteria of 0.5 mg/kg and 0.07 mg/kg, respectively. Only samples with selenium and bismuth concentrations above the level of analytical uncertainty were assessed and are discussed.

Flotation Tailings (TL-6)

The flotation tailings samples (TL-6) reported concentrations below the screening criteria levels for the majority of parameters. Exceptions included:

- April, June, November and December samples contained elevated arsenic. The arsenic content in 2019 ranged from 9 to 170 mg/kg and was within the range of concentrations for historical samples except for April (170 ppm) (Figure 4-5).
- Five samples were elevated in sulphur, with content for enriched samples of 3,100 to 5,300 mg/kg.
- All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg. Gold concentrations ranged from 660 to 3,100 mg/kg.
- Bismuth was elevated in the sample collected in April (9.4 mg/kg).

All other parameters were below the screening criteria indicating no appreciable enrichment.

Detoxified Tailings (TL-7A)

The 2019 detoxified tailings (TL-7A) were elevated for the following parameters relative to the screening criteria:

- All samples were elevated in arsenic (between 23 and 50 times the screening criterion), bismuth (between 17 and 89 times), copper (between 3 and 11 times), selenium (between 12 and 38 times), sulphur (between 27 and 33 times), gold (between 103 and 1,400 times), and silver (between 12 and 46 times).
- More than half of samples were elevated in cadmium (between 1.2 to 3 times higher than the screening criterion), lead (up to 14 times higher) and zinc (between 1.2 and 4 times).
- The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples (Figure 4-6 to Figure 4-11). Arsenic concentrations where slightly higher in 2019 with a median concentration of 15 mg/kg in 2019, compared with 9.2 mg/kg in 2018 (Figure 4-5).

All other parameters, including cobalt (Figure 4-12) were below the screening criteria indicating no appreciable enrichment.

Table 4-5: Summary of Elemental Concentrations for Flotation (TL-6) Tailings

Year	Sampling Date	Ag	As	Au	B	Bi	Cd	Co	Cu	Ni	Pb	S	Se	Zn
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2019	Jan-19	0.2	6.4	***940***	<20	<0.1	<0.1	8.7	26	18	1.5	700	<0.5	31
	Feb-19	0.3	17	***810***	<20	<0.1	0.1	11	93	22	4.0	2000	*<0.5*	43
	Mar-19	0.5	13	***3100***	<20	<0.1	<0.1	12	37	23	3.8	1400	*0.6*	42
	Apr-19	1.0	***170***	***1500***	<20	***9.4***	0.1	12	82	22	44	***3200***	*<0.5*	52
	May-19	0.3	13	***1200***	<20	0.1	0.1	12	70	20	9.8	2100	*<0.5*	55
	Jun-19	0.6	***23***	***2500***	<20	0.1	0.2	17	99	28	11	***3500***	*<0.5*	71
	Jul-19	0.3	16	***1400***	<20	<0.1	0.2	14	99	22	7.3	2500	*0.6*	71
	Aug-19	0.3	12	***1900***	<20	0.1	0.3	12	640	18	14	***3100***	*<0.5*	74
	Sep-19	0.3	9	***920***	<20	<0.1	0.1	13	70	20	12	2200	*<0.5*	67
	Oct-19	0.2	11	***660***	<20	0.1	0.1	13	91	22	9.4	2400	*<0.5*	65
	Nov-19	0.9	***55***	***760***	47	0.1	0.7	21	140	53	43	***5300***	*<0.5*	140
	Dec-19	0.4	***53***	***1000***	<20	0.3	0.2	17	90	58	12	***3800***	*<0.5*	60
Summary Statistics														
2019 (n=12)	P005	0.2	7.8	***720***	20	0.1	0.1	10	32	18	2.8	1100	*0.5*	37
	P050	0.3	15	***1100***	20	0.1	0.1	13	90	22	10	2500	*0.5*	63
	P095	0.95	***110***	***2800***	32	***4.4***	0.48	19	360	55	43	***4500***	*0.6*	100
	P100	1	***170***	***3100***	47	***9.4***	0.7	21	640	58	44	***5300***	*0.6*	140
2018	P005	0.1	6.2	***280***	20	0.1	0.073	8.7	25	16	4.8	910	0.2	30
	P050	0.23	9.2	***530***	20	0.1	0.1	11	39	21	11	1200	0.5	45
	P095	***1.6***	***39***	***7600***	49	0.2	0.4	30	180	36	47	***7200***	0.5	110
	P100	***2.9***	***67***	***12000***	***68***	0.2	0.4	44	300	50	***70***	***14000***	0.5	150
	n	12	12	9	12	12	12	12	12	12	12	12	12	12
2017 (n = 11)	P005	0.18	6.6	--	7.3	0.2	0.063	10	22	18	4.2	1000	0.2	47
	P050	0.28	8.3	--	14	0.2	0.11	13	27	22	6.3	1100	0.2	61
	P095	***1.4***	***47***	--	34	0.2	0.24	32	140	42	15	1400	0.51	130
	P100	***2.1***	***83***	--	41	0.2	0.26	48	200	55	22	1500	0.82	130
10 X Basalt Average		***1.1***	***20***	***40***	***50***	***0.07***	***2.2***	***480***	***870***	***1300***	***60***	***3000***	***0.5***	***1050***

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.037_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2019_rev12.xlsx

Notes:

Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997).

Bismuth was not assessed because the detection limit was greater than the screening criteria.

Table 4-6: Summary of Elemental Concentrations for Detoxified Tailings (TL-7A)

Year	Sampling Date	Ag	As	Au	B	Bi	Cd	Co	Cu	Ni	Pb	S	Se	Zn
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2019	Jan-19	**13**	**490**	**13000**	20	**1.3**	0.6	230	**4600**	180	49	**100000**	**7.3**	240
	Feb-19	**14**	**460**	**6800**	20	**1.2**	1.0	230	**4500**	210	**270**	**82000**	**6.0**	520
	Mar-19	**20**	**670**	**7300**	20	**2.2**	1.2	290	**5100**	260	**130**	**100000**	**9.9**	520
	Apr-19	**51**	**810**	**56000**	20	**4.6**	**3.5**	280	**9400**	240	**500**	**100000**	**10**	**1700**
	May-19	**18**	**500**	**16000**	20	**2.7**	**4.0**	200	**4000**	160	**370**	**100000**	**9**	**1600**
	Jun-19	**25**	**600**	**17000**	20	**2.6**	**3.4**	220	**5500**	200	**360**	**100000**	**9.7**	**1700**
	Jul-19	**15**	**660**	**17000**	20	**5.1**	**7.1**	300	**5800**	200	**850**	**100000**	**16**	**3900**
	Aug-19	**16**	**450**	**20000**	20	**5.3**	**6.1**	280	**8800**	190	**780**	**100000**	**19**	**2900**
	Sep-19	**18**	**580**	**11000**	20	**4.8**	**5.3**	350	**6300**	220	**450**	**100000**	**15**	**2100**
	Oct-19	**17**	**570**	**17000**	20	**3.9**	**3.5**	310	**9200**	220	**390**	**100000**	**16**	**1700**
	Nov-19	**15**	**1000**	**6600**	24	**3.2**	**2.7**	290	**4600**	320	**260**	**100000**	**14**	**1300**
	Dec-19	**17**	**1000**	**4100**	20	**6.2**	**3.5**	210	**2900**	350	**180**	**100000**	**13**	**1100**
Summary Statistics														
2019 (n=12)	P005	**14**	**450**	**5500**	20	**1.3**	0.8	200	**3500**	170	**96**	**92000**	**6.7**	400
	P050	**17**	**590**	**14000**	20	**3.6**	**3.5**	280	**5300**	210	**370**	**100000**	**12**	**1700**
	P095	**37**	**1000**	**36000**	22	**5.7**	**6.6**	330	**9300**	330	**810**	**100000**	**17**	**3400**
	P100	**51**	**1000**	**56000**	24	**6.2**	**7.1**	350	**9400**	350	**850**	**100000**	**19**	**3900**
2018	P005	**8.9**	**240**	**7100**	<20	**1.8**	1.8	140	**4000**	120	**180**	**71000**	**5.8**	800
	P050	**17**	**490**	**15000**	<20	**3.2**	**3.2**	260	**5700**	230	**410**	**>100000**	**10**	**1400**
	P095	**42**	**840**	**25000**	47	**6.9**	**6.9**	410	**10000**	370	**610**	**130000**	**18**	**3100**
	P100	**65**	**860**	**26000**	47	**7.5**	**7.5**	430	**10000**	420	**610**	**170000**	**18**	**3400**
	n	13	13	9	13	13	13	13	13	13	13	13	13	13
2017 (n = 11)	P005	**6.5**	**260**		8.3	**1.9**	1.9	150	**2900**	130	**180**	**82000**	**4.7**	850
	P050	**21**	**410**		13	**5.7**	**5.7**	280	**5400**	220	**380**	**>100000**	**8.2**	**2800**
	P095	**50**	**710**		24	**12**	**12**	460	**16000**	320	**1100**	**210000**	**17**	**5100**
	P100	**51**	**730**		24	**13**	**13**	**510**	**20000**	350	**1500**	**230000**	**18**	**6100**
10 X Basalt Average		***1.1***	***20***	***40***	***50***	***0.07***	***2.2***	***480***	***870***	***1300***	***60***	***3000***	***0.5***	***1050***

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Notes:

Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997).

Summary statistics assume values which are reported as below minimum or above maximum detection limits are equal to that limit.

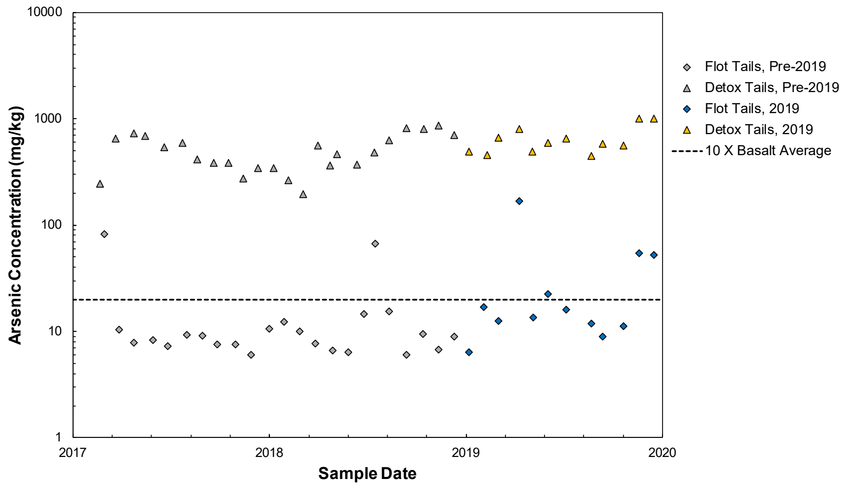

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Figure 4-5: Arsenic Concentrations in Tailings Samples

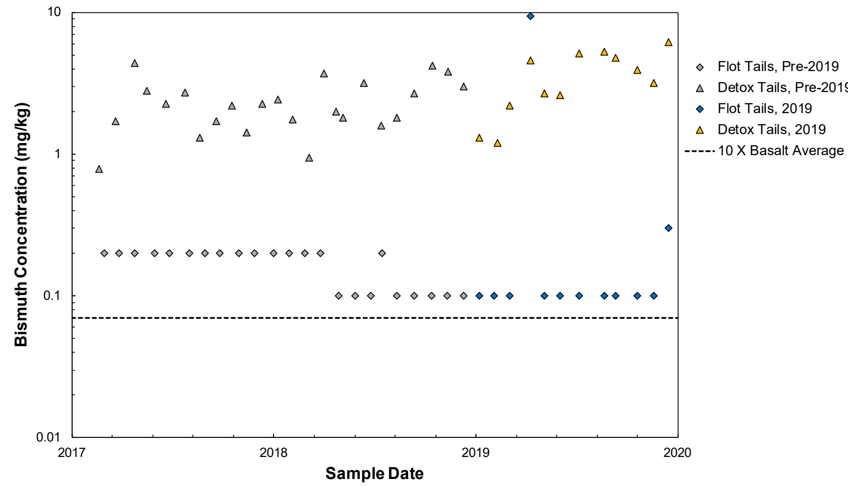

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Figure 4-6: Bismuth Concentrations in Tailings Samples

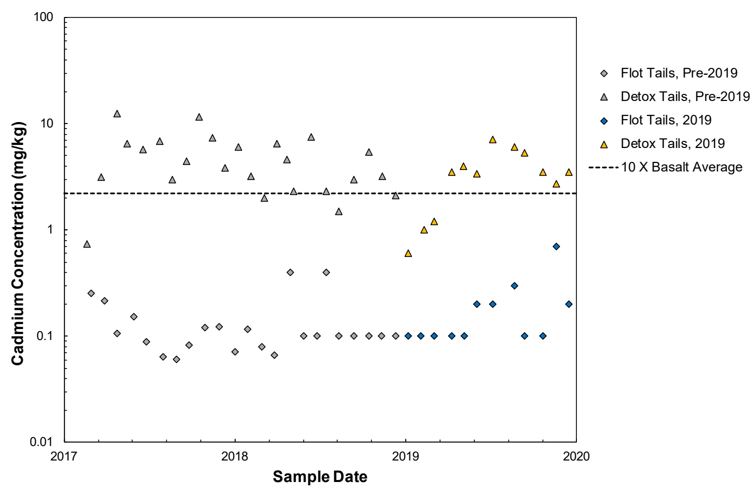

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Figure 4-7: Cadmium Concentrations in Tailings Samples

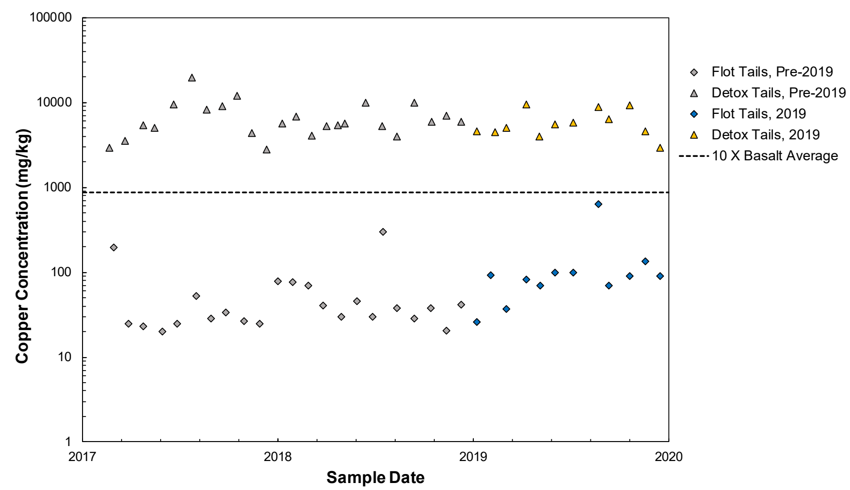

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Figure 4-8: Copper Concentrations in Tailings Samples

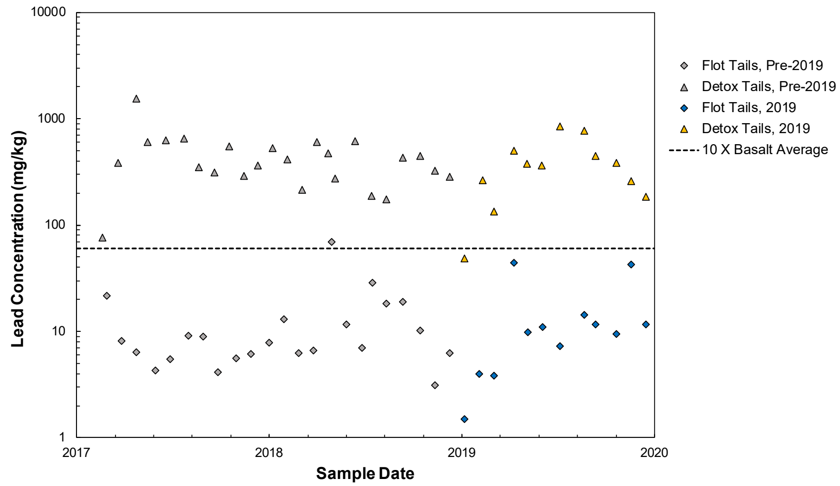

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Figure 4-9: Lead Concentrations in Tailings Samples

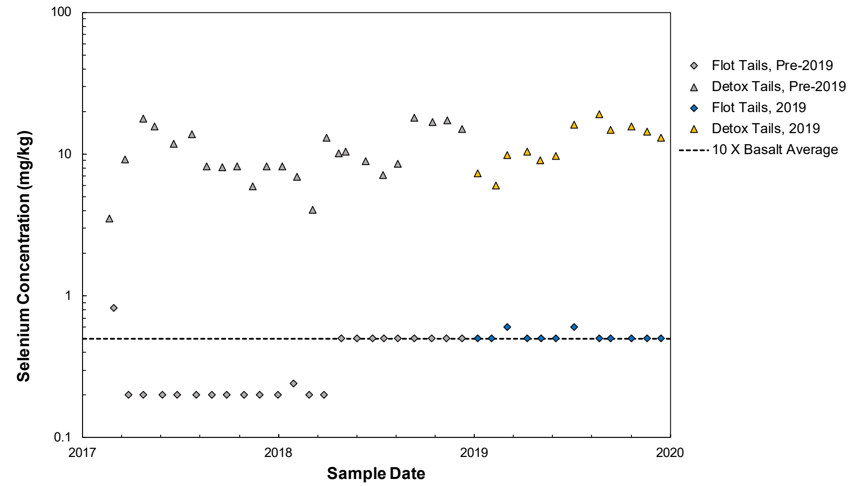

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Figure 4-10: Selenium Concentrations in Tailings Samples

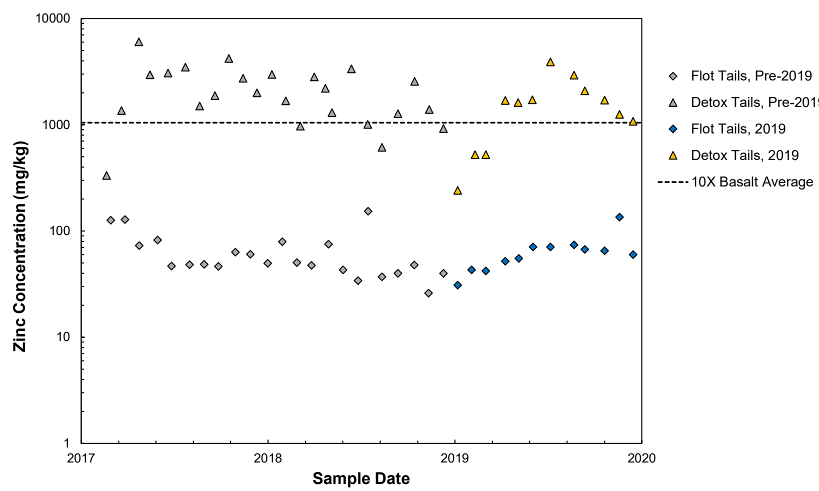

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Figure 4-11: Zinc Concentrations in Tailings Samples

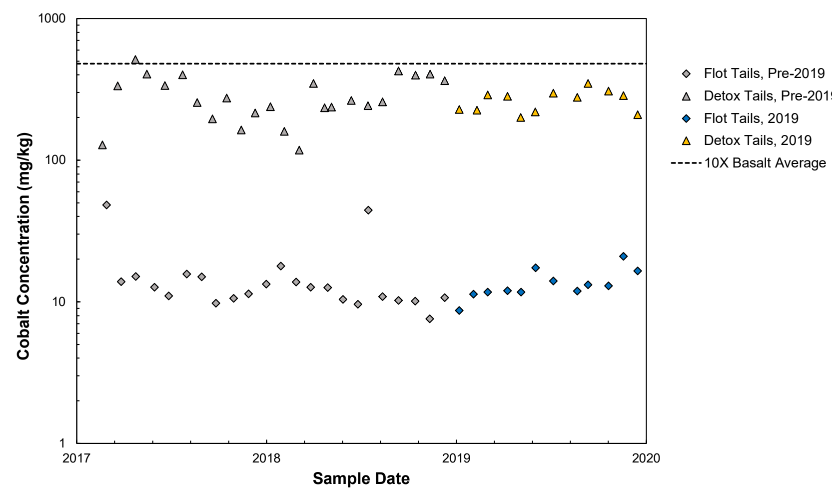

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Figure 4-12: Cobalt Concentrations in Tailings Samples

4.3 Detoxified Tailings Filtrate (TL-7B)

A summary of the detoxified tailings filtrate (TL-7B) analysis is presented in Table 4-7 and Figure 4-13 to Figure 4-22 below. Full results are presented in Attachment C. Cyanide detoxified tailings slurry are squeezed in a filter press to separate the detoxified tailings supernatant from solids (TL-7A). The detoxified tailings supernatant is combined with the flotation tailings slurry in the thickener tank (TL-5). The detoxified tailings supernatant is approximately 7% of the volume of TL-5 and is managed within the TIA. TL-7B represents the chemistry of the residual moisture within the detoxified tailings, which ranges from 18 to 24%. Total metals were analyzed for TL-7B as per the Water Licence. The detoxified tailings filtrate (TL-7B) monitoring data are summarized as follows:

- pH conditions were slightly alkaline with values of between 8.5 to 8.8.
- Sulphate was a significant anion with concentrations ranging between 12,000 mg/L to 28,000 mg/L. The most significant cation was sodium (5,700 to 13,000 mg/L), which is a milling reagent.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate, cyanate and ammonia are produced as by-products of the cyanide detoxification process. Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L.
- Milling of the sulphide rich ore results in high concentrations of total metals, including arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L) and silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Table 4-7: Summary of 2019 Detoxified Tailings Filtrate (TL-7B) Analyses

Parameters	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Moisture content*	%	18	21	22	23	21	26	19	19	20	23	54	21
pH	s.u.	8.6	8.6	8.5	8.5	8.5	8.7	8.7	8.7	8.7	8.7	8.8	8.8
NH_3	mg/L as N	220	190	220	200	180	220	220	230	240	260	270	290
Cyanate	mg/L	310	420	520	510	310	570	620	520	420	670	620	10
Thiocyanate	mg/L	320	150	20	18	12	310	19	200	370	200	180	490
Total CN	mg/L	2.1	0.8	1.5	1	1.8	0.51	0.55	0.38	1.8	1.2	1.2	0.95
WAD CN	mg/L	0.26	0.063	0.11	0.18	0.11	0.48	0.31	0.15	0.34	0.11	0.24	0.42
Free CN	mg/L	*0.005*	*0.005*	*0.005*	*0.01*	0.0051	0.0055	0.008	*0.005*	0.015	*0.01*	*0.005*	*0.019*
Al_T	mg/L	0.84	*0.15*	0.44	0.65	0.44	0.29	0.36	0.18	0.61	0.4	0.32	0.53
Sb_T	mg/L	0.013	0.0059	0.019	0.0088	0.012	0.018	0.022	0.045	0.019	0.026	0.035	0.028
As_T	mg/L	0.17	0.022	0.12	0.061	0.059	0.11	0.04	0.045	0.06	0.057	0.14	0.1
Ba_T	mg/L	0.035	0.054	0.058	0.048	0.071	0.053	0.072	0.056	0.086	0.058	0.053	0.049
Be_T	mg/L	*0.005*	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Bi_T	mg/L	--	*0.0025*	*0.001*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*
B_T	mg/L	1	1.1	1.2	1	0.89	1.2	1.1	0.91	1.4	1.3	0.95	1.7
Cd_T	mg/L	*0.00025*	*0.00025*	*0.0001*	*0.00025*	*0.00025*	*0.00025*	0.00029	*0.00025*	*0.00025*	0.00059	0.00025	0.00025
Ca_T	mg/L	36	56	48	74	72	41	42	40	43	45	39	32
Cs_T	mg/L	--	*0.0005*	*0.0002*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*
Cr_T	mg/L	*0.0064*	*0.005*	0.0051	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.01*	*0.018*
Co_T	mg/L	0.15	0.049	0.075	0.048	0.035	0.13	0.045	0.096	0.066	0.051	0.028	0.23
Cu_T	mg/L	10	5.2	8.5	7.2	6	9.4	6.5	8.5	11	20	9.4	3.3
Fe_T	mg/L	*13*	*0.5*	3.1	5.7	2.3	1.7	2.8	0.67	4.1	4.4	5	4.9
Pb_T	mg/L	0.0067	0.0063	0.0031	0.015	0.0085	0.0033	0.0079	0.0053	0.0067	0.024	0.0071	0.012
Li_T	mg/L	*0.05*	*0.05*	0.039	*0.05*	0.059	0.055	0.072	0.055	0.075	0.059	0.06	0.086
Mg_T	mg/L	45	41	47	50	56	50	44	34	45	46	43	76
Mn_T	mg/L	0.25	0.2	0.21	0.35	0.41	0.13	0.24	0.26	0.24	0.33	0.21	0.21
Mo_T	mg/L	0.065	0.024	0.037	0.04	0.053	0.066	0.13	0.12	0.23	0.27	0.11	0.12
Ni_T	mg/L	*0.052*	*0.025*	0.028	0.031	*0.025*	*0.025*	*0.025*	0.14	*0.025*	0.041	0.031	0.025
P_T	mg/L	--	*2.5*	*1*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*
K_T	mg/L	67	47	64	48	68	69	66	30	79	57	55	81
Rb_T	mg/L	--	*0.01*	*0.004*	*0.01*	*0.01*	*0.01*	*0.01*	0.011	*0.01*	0.013	0.01	0.01
Se_T	mg/L	0.007	0.0053	0.0099	0.015	0.007	0.0083	0.013	0.027	0.012	0.051	0.032	0.0094
Si_T	mg/L	--	*5*	3.8	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
Ag_T	mg/L	0.04	0.0033	0.0084	0.0079	0.0039	0.0078	0.0052	0.0051	0.0099	0.017	0.0092	0.018
Na_T	mg/L	10000	5700	9700	7300	8900	11000	9800	10000	13000	11000	8700	11000
Sr_T	mg/L	--	0.46	0.49	0.68	0.72	0.47	0.54	0.56	0.69	0.45	0.53	0.51
S_T	mg/L	--	3900	6900	4700	5900	7300	6500	8100	9200	8000	5600	7500
Te_T	mg/L	--	*0.01*	*0.004*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Tl_T	mg/L	*0.0005*	*0.0005*	*0.0002*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*
Th_T	mg/L	--	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Sn_T	mg/L	*0.005*	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Ti_T	mg/L	*0.015*	*0.015*	*0.006*	*0.017*	*0.03*	*0.015*	*0.015*	*0.015*	0.02	*0.015*	*0.015*	*0.015*
W_T	mg/L	--	0.017	0.048	0.028	0.035	0.062	0.053	0.12	0.096	0.22	0.11	0.089
U_T	mg/L	*0.0013*	*0.0005*	0.00041	0.00066	*0.0005*	0.0011	*0.0005*	0.00064	0.00053	0.00072	0.0005	0.00062
V_T	mg/L	*0.025*	*0.025*	*0.01*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Zn_T	mg/L	*0.15*	*0.15*	*0.06*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*
Zr_T	mg/L	--	*0.003*	0.0044	*0.003*	*0.003*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*

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Notes:

Blue italics = Value less than laboratory detection limit. Detection limit shown.

-- = Data not available.

Metal(loid) concentrations are reported as 'Totals'

* Moisture content of TL-7A

4.4 Process Plant Tailings Water Discharge (TL-5)

Between January and December 2019, 12 samples of process plant tailings water discharge (TL-5) were collected. Figures depicting time series of constituent concentrations and loads from the process plant tailings water discharge (TL-5) to the TIA are presented in Attachment D. Prior to 2019, total metals were determined at TL-5 as per the Water Licence; in 2019 dissolved metals were also analyzed. Both totals and dissolved metals are presented in subsequent figures. The geochemistry of the 2019 process plant tailings discharge (TL-5) is summarized as follows:

- The pH of TL-5 ranged from 8.0 to 8.4 s.u for all months except August which had an anomalous low of 6.2 s.u. compared to other months (Figure 4-13). Field pH measurements of 6.1 s.u. confirmed the anomalously value of pH.
- Sulphate loadings increased slightly in 2019 (Figure 4-14).
- Notably, trends in aluminum and zinc loadings decreased in 2019, this difference may be due to change from total to dissolved metals (where total metals analysis also includes measurements due to TSS).
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2017 and 2018, including arsenic. Exceptions included antimony, magnesium and molybdenum, all of which exhibited increasing trends in 2019 (Figure 4-18, Figure 4-21 and Figure 4-22). Selenium showed elevated loadings between August and November, relative to other months in 2019 (Figure 4-23). TSS, antimony, copper, cadmium, nickel, manganese, lead, molybdenum, selenium zinc and phosphorous loadings spiked in August 2019. The spike is also reflected in the solids data for flotation tailings for copper (Section 4.2.2).

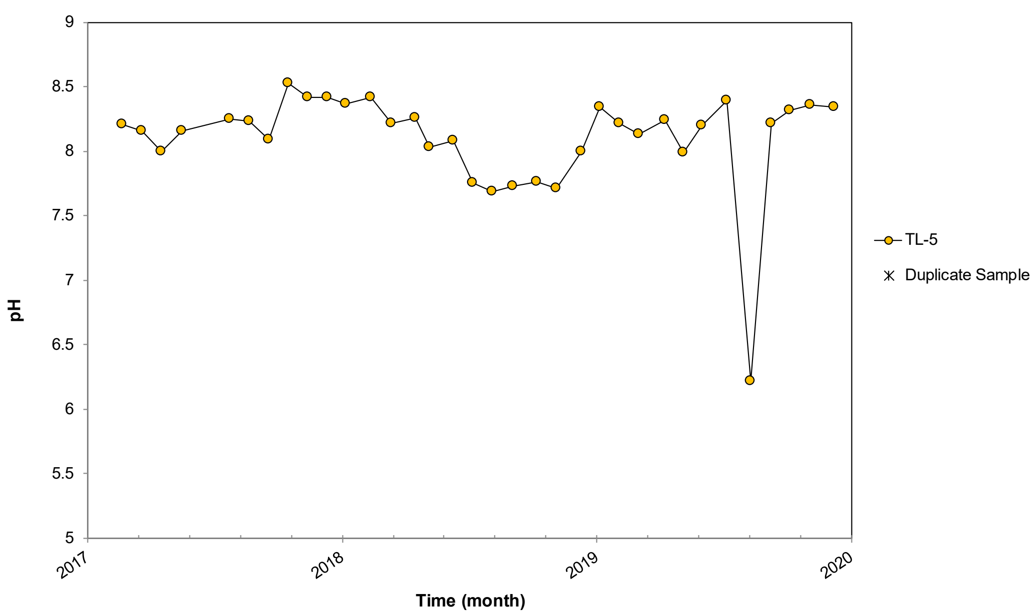

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Figure 4-13: Trends in pH for Process Plant Supernatant Discharge (TL-5)

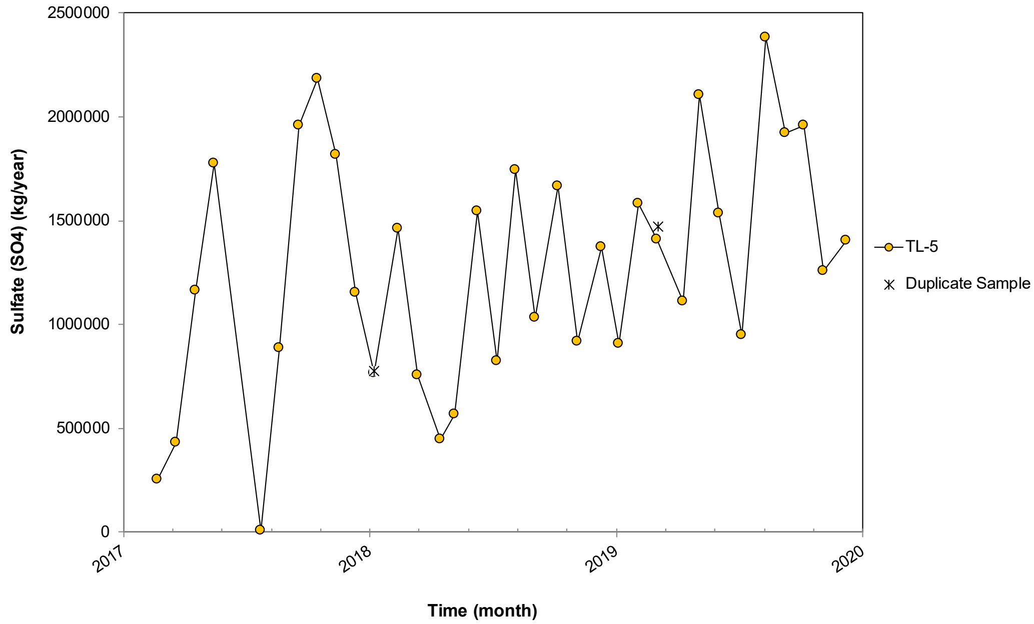

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Figure 4-14: Trends in Sulphate for Process Plant Supernatant Discharge (TL-5)

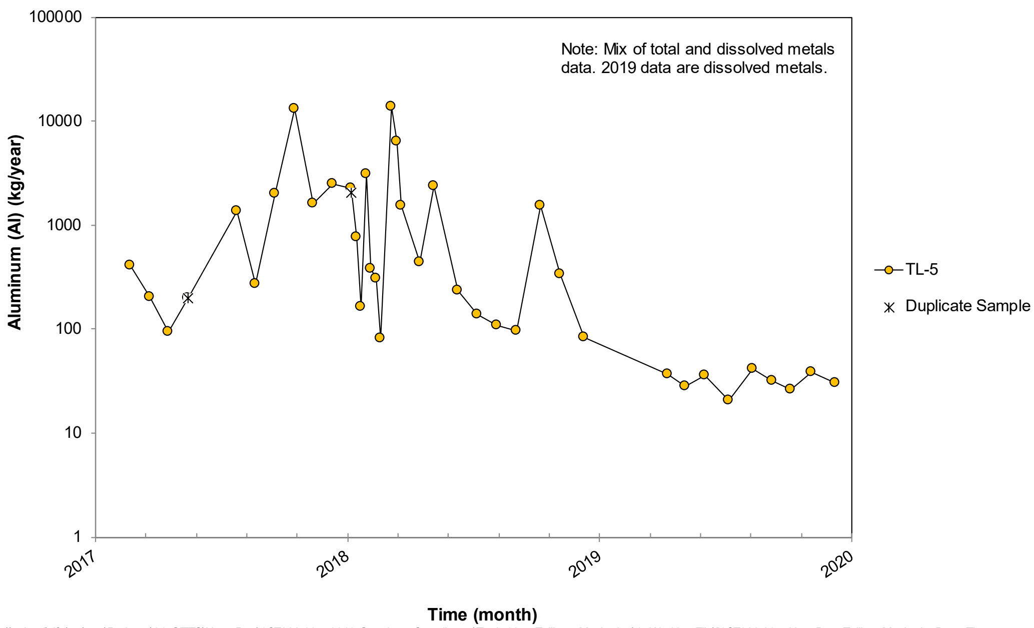

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Figure 4-15: Trends in Aluminum for Process Plant Supernatant Discharge (TL-5)

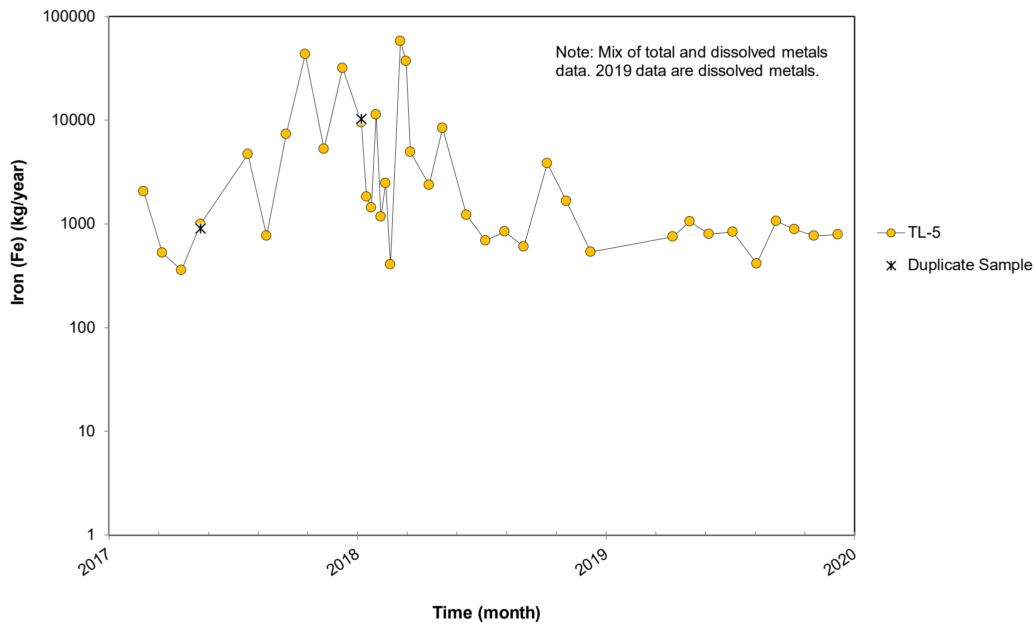

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Figure 4-16: Trends in Iron for Process Plant Supernatant Discharge (TL-5)

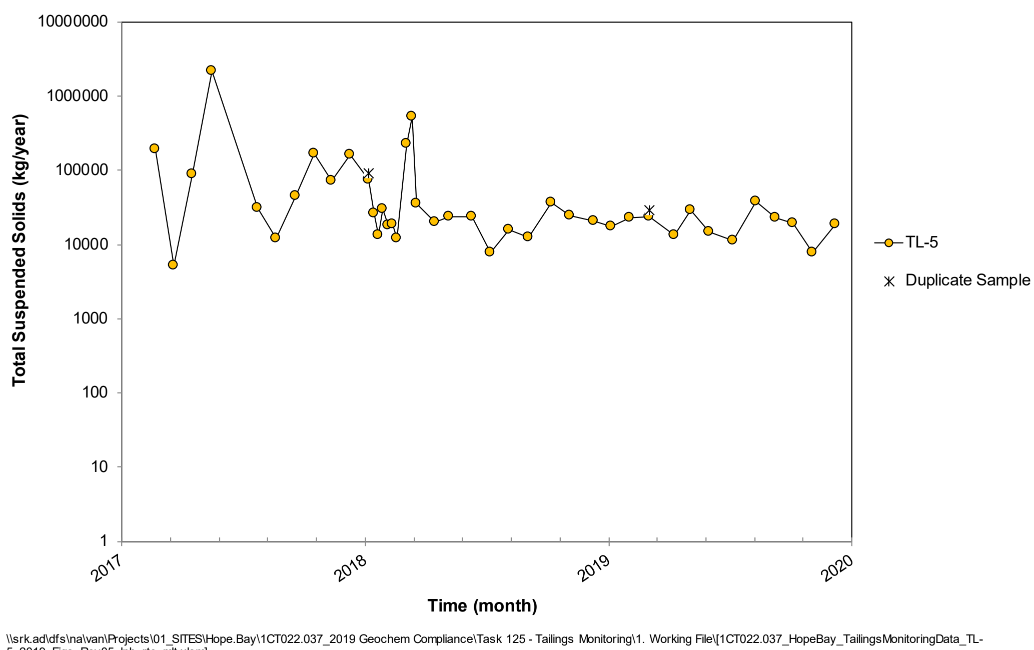

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Figure 4-17: Trends in TSS for Process Plant Supernatant Discharge (TL-5)

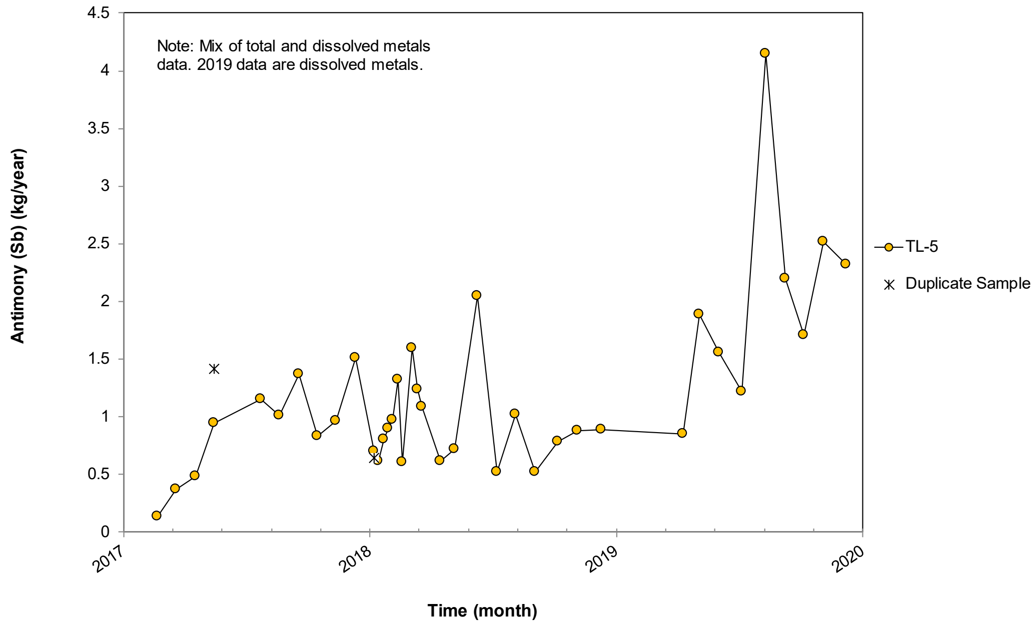

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Figure 4-18: Trends in Antimony for Process Plant Supernatant Discharge (TL-5)

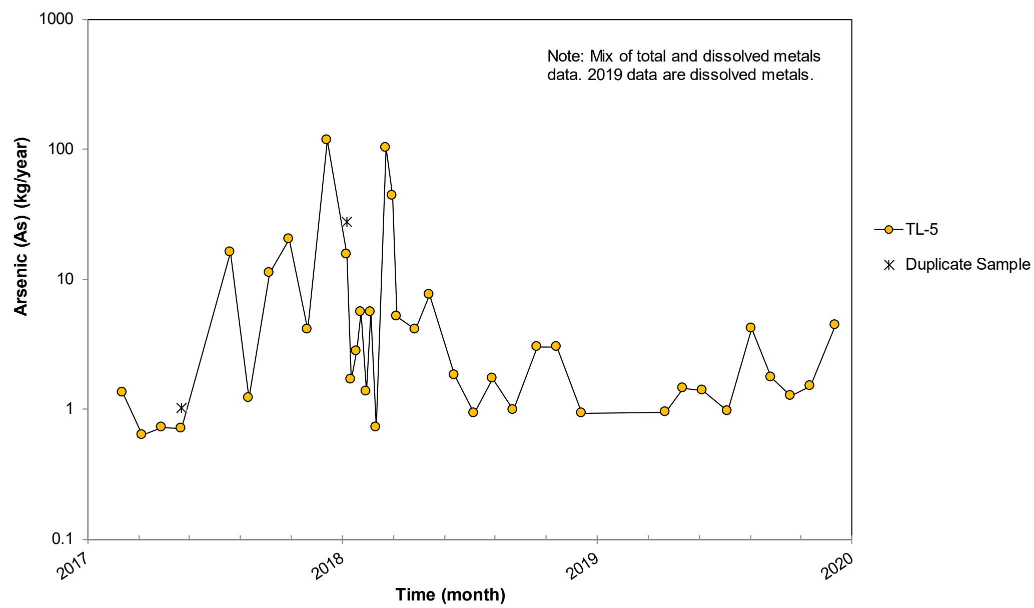

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Figure 4-19: Trends in Arsenic for Process Plant Supernatant Discharge (TL-5)

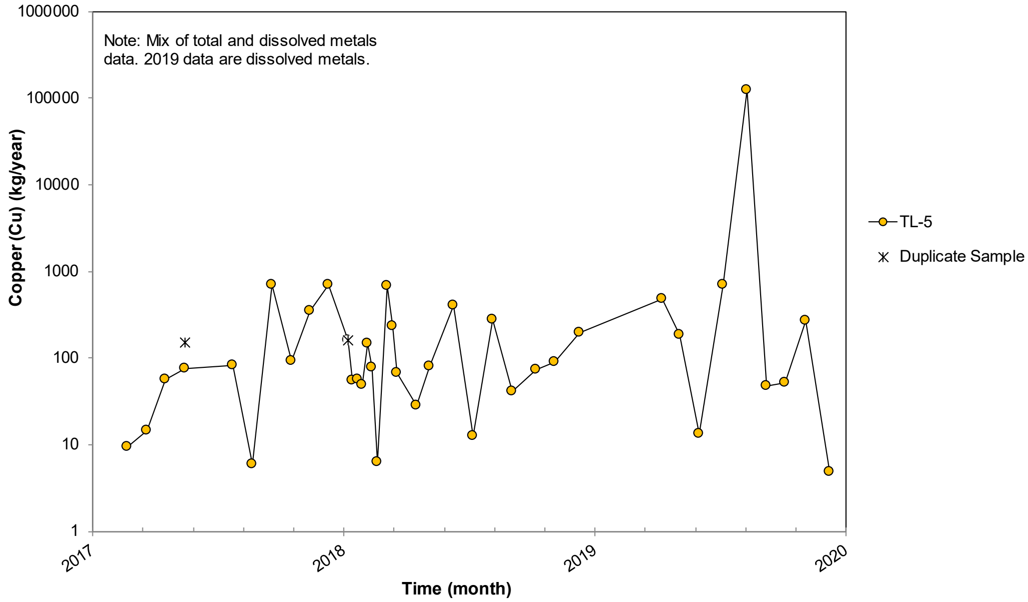

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Figure 4-20: Trends in Copper for Process Plant Supernatant Discharge (TL-5)

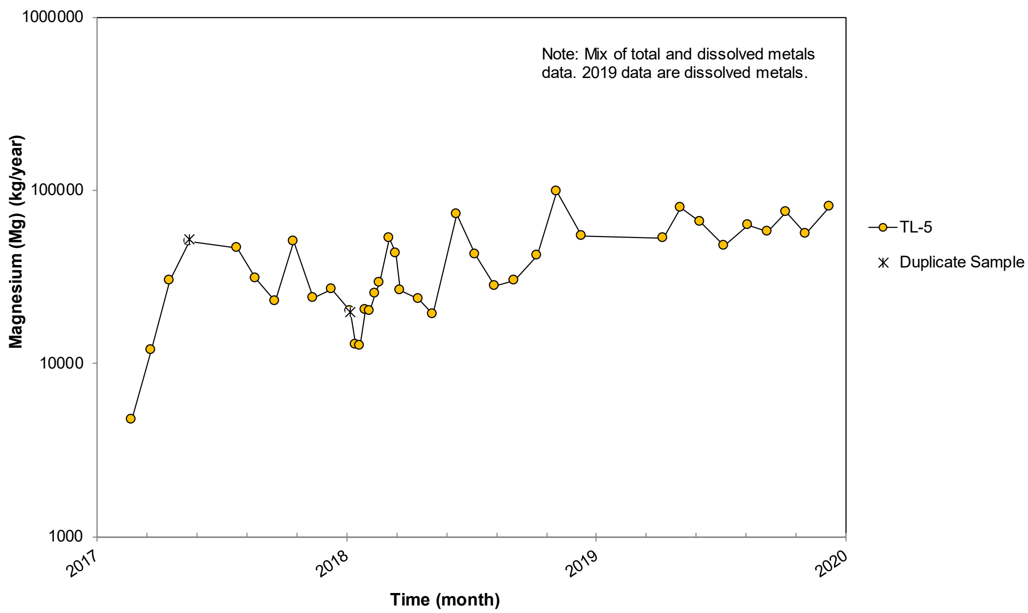

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Figure 4-21: Trends in Magnesium for Process Plant Supernatant Discharge (TL-5)

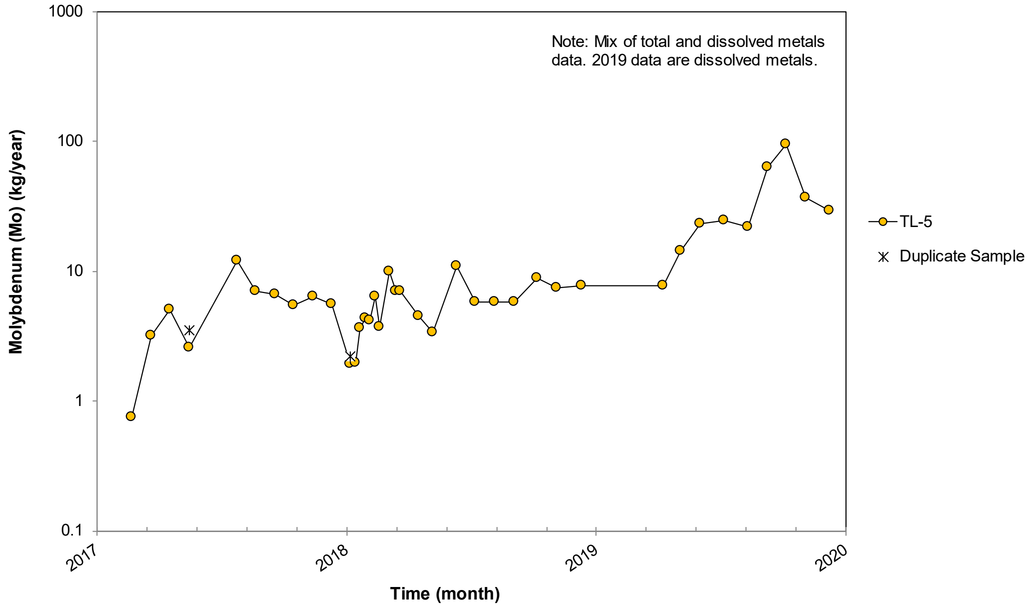

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Figure 4-22: Trends in Molybdenum for Process Plant Supernatant Discharge (TL-5)

4.5 Seepage Monitoring of Backfilled Stopes (TL-11)

Selected water quality analyses of the seepage monitoring samples collected from base of underground stopes are provided in Table 4-8. The results are compared to median and 5th and 95th percentile concentrations reported in the previous TL-11 monitoring surveys (2017 and 2018).

Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. The stopes contained both waste rock and detoxified tailings backfill and is interpreted to be contact water of these material types. In the May survey samples were collected from pools of standing water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. There was no flow observed and accordingly, these samples may not represent contact water chemistry of backfill, particularly for sample TL-11D-27MAY19 which was collected in the vicinity of the surface vent raise.

The chemistry of the two samples collected from seeps on Level 120 and Level 134 in the December survey are interpreted to be contact water of waste rock and tailings backfill based on field observations and is summarized as follows:

- pH is slightly alkaline with both seeps reporting a pH of 8.0.
- The major ion chemistry is presented in Figure 4-23. Major anion chemistry was dominated by chloride (9,000 to 9,300 mg/L) and to a lesser degree sulphate (1,200 to 1,300 mg/L). The major cation chemistry was dominated by sodium (4,500 to 4,300 mg/L) with lesser magnesium (600 to 630 mg/L) followed by calcium (460 to 520 mg/L). Potential sources of

the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).

- Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
- Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015). The exception to this was zinc which was not noted as a parameter of potential concern in the HCT program but report elevated concentrations (0.026 to 0.096 mg/L) in the TL-11 survey.
- The following dissolved parameters were consistently reported at concentrations less than analytical detection limits in all seepage samples from the December survey: aluminium, beryllium, bismuth, chromium, iron, lead, phosphorous, tin, thallium, titanium, vanadium and zirconium.

The chemistry of the underground seepage monitoring samples collected from pooled water at the base of backfilled stopes in May (with the exception of TL-11D-27MAY19) was notably different than the December samples and is summarized as follows:

- pH conditions ranged from 5.8 to 8.0.
- Major ion chemistry is comparable to the samples collected in December (Figure 4-23); however, concentrations were higher, which could be a result of evaporation in the standing pools of water sampled. Major anion chemistry were dominated by chloride (15,000 to 35,000 mg/L) and to a lesser degree sulphate (1,100 to 1,300 mg/L), while major cation chemistry was dominated by sodium (6,700 to 12,000 mg/L), calcium (3,700 to 9,600 mg/L), and to a lesser degree magnesium (860 to 1,800 mg/L).
- Total cyanide concentrations ranged from 0.05 to 0.17 mg/L and free cyanide concentrations were <0.005 to 0.012 mg/L. WAD cyanide concentrations (<0.005 to 0.026 mg/L) were at near parity with free cyanide.
- Levels of ammonia (180 to 350 mg/L) and nitrate (210 to 470 mg/L) were between the 50th to 95th percentile historical concentrations. Levels of nitrite (6.5 to 21 mg/L) were also generally within the range of 50th to 95th percentile concentrations of historical samples, with the exception of sample TL-11B-27MAY19. Sources of these nutrients are degradation of cyanate and thiocyanate in detoxified tailings with a minor contribution from blast residues on waste rock.
- As with the major ions, metals concentrations were higher for May samples as compared to December samples, including cadmium (0.0033 to 0.034 mg/L), copper (0.069 to 0.37 mg/L), nickel (0.11 to 0.35 mg/L), selenium (0.0048 to 0.013 mg/L) and silver (0.0026 to 0.014 mg/L).

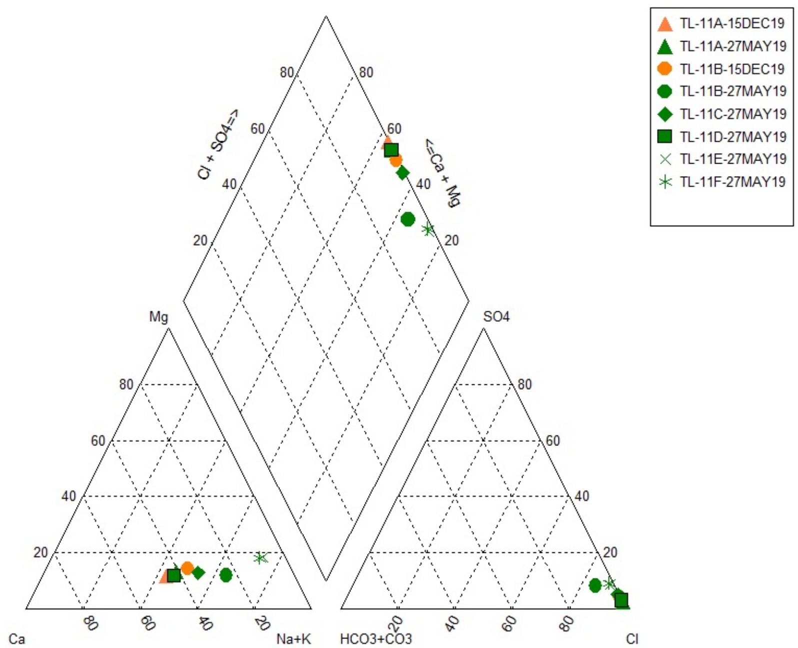

Figure 4-23: Major Ion Chemistry for TL-11 Seepage Water Quality Analysis

The chemistry of TL-11D-27MAY19 was notably different to the chemistry of the other samples collected during the May seepage survey. Field notes recorded for TL-11D-27MAY19 state that the sample was collected in the vicinity of the surface vent raise. This suggests that the seepage sample was potentially diluted by meteoric water, with supporting evidence as follows.:

- TDS was notably lower at 2,600 mg/L compared to between 33,000 to 71,000 mg/L.
- Major anion (chloride and sulphate) and cation (calcium, sodium and magnesium) concentrations were also notably lower than the other May samples by one to two orders of magnitude. However, the major ion signature as shown in Figure 4-23 is consistent with the other samples suggesting dilution from surface meteoric water.
- For cyanide species, concentrations of total (0.052 mg/L), free (0.0061 mg/L) and WAD (0.0069 mg/L) cyanide concentrations were within the range measured in the other seeps.
- Ammonia (29 mg/L) and nitrate (35 mg/L) concentrations were an order of magnitude lower than the other May samples and were also lower than the 5th percentile historical concentrations. In comparison the nitrite concentration (16 mg/L) in the TL-11D-27MAY19 sample was higher than the other May samples and the 95th percentile historical concentrations.
- Generally, concentrations of trace metal in TL-11D-27MAY19 were lower than other May samples. The exception to this is chromium which was elevated (0.015 mg/L) compared to 95th percentile historical concentrations.

Table 4-8: Summary of TL-11 (Backfilled Stopes) Seepage Water Quality Analysis

Parameter	Units	Detection Limit	Historical Statistics (2017-2018)			TL11-A-27MAY19	TL11-B-27MAY19	TL11-C-27MAY19	TL11-D-27MAY19	TL11-E-27MAY19	TL11-F-27MAY19	TL11-A-15DEC19	TL11-B-15DEC19
						Level 4932	Level 4946	Level 4964	Level 5002	Level 4735	Level 4905	Level 120	Level 134
			P05	P50	P95	27-May-2019 10:35	27-May-2019 10:55	27-May-2019 11:20	27-May-2019 11:45	29-May-2019 10:20	29-May-2019 11:00	15-Dec-2019 10:50	15-Dec-2019 11:15
EC	uS/cm	2	93000	100000	100000	80000	84000	58000	3600	50000	68000	25000	27000
pH	pH	0.1	6.7	6.8	6.9	5.8	7.2	7.2	8	7.5	7.2	8	8
TSS	mg/L	3	230	470	32000	13	41	20	15	18	3.5	670	37
TDS	mg/L	10	56000	77000	110000	68000	71000	48000	2600	33000	50000	17000	18000
Total Alkalinity	mg/L as $CaCO_3$	1	41	49	200	2.6	75	73	98	88	62	230	260
NH_3	mg/L	0.005	230	280	390	280	350	220	29	180	310	10	17
Cl	mg/L	0.5	41000	45000	48000	34000	35000	22000	880	15000	27000	9000	9300
NO_3	as N mg/L	0.005	490	520	590	470	430	280	35	210	390	14	16
NO_2	as N mg/L	0.001	1.8	6.7	15	7.2	21	8.5	16	6.5	8.2	0.72	0.6
SO_4	mg/L	0.3	860	890	990	1200	1100	1300	110	1100	1100	1200	1300
Total CN	mg/L	0.005	0.01	0.069	0.85	0.073	0.17	0.074	0.052	0.15	0.051	0.25	0.031
WAD CN	mg/L	0.005	0.005	0.017	0.027	0.011	0.018	*0.005*	0.0069	0.026	0.011	0.01	0.0098
Free CN	mg/L	0.005	0.0054	0.016	0.025	0.0087	0.0051	*0.005*	0.0061	0.012	0.0095	0.01	0.0088
Al_D	mg/L	0.001	0.05	0.1	0.12	*0.05*	*0.05*	*0.05*	0.012	*0.05*	*0.05*	*0.02*	*0.02*
Sb_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.00039	*0.005*	*0.005*	*0.002*	0.0032
As_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.0014	*0.005*	*0.005*	0.0052	*0.002*
Ba_D	mg/L	0.0001	0.26	0.51	0.62	0.26	0.46	0.2	0.022	0.14	0.22	0.031	0.054
B_D	mg/L	0.01	2	2.8	3.5	3.1	3.8	3.1	0.15	3.5	2.7	2.4	2.4
Cd_D	mg/L	0.000005	0.022	0.029	0.041	0.034	0.012	0.0086	0.00001	0.0033	0.01	0.00032	0.00056
Ca_D	mg/L	0.05	12000	15000	18000	9600	9300	5000	140	3700	6700	460	520
Cr_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.015	*0.005*	*0.005*	*0.002*	*0.002*
Co_D	mg/L	0.0001	0.072	0.2	0.31	0.21	0.033	0.089	0.0025	0.026	0.12	0.031	0.057
Cu_D	mg/L	0.0002	0.23	0.55	0.79	0.25	0.25	0.25	0.015	0.069	0.37	0.039	0.1
Fe_D	mg/L	0.01	0.5	0.75	1	*0.5*	*0.5*	*0.5*	0.025	*0.5*	*0.5*	*0.2*	*0.2*
Pb_D	mg/L	0.00005	0.0052	0.13	0.16	0.0068	*0.0025*	*0.0025*	*0.0001*	*0.0025*	*0.0025*	*0.001*	*0.001*
Li_D	mg/L	0.001	0.29	0.37	0.45	0.32	0.21	0.2	0.029	0.13	0.18	0.097	0.092
Mg_D	mg/L	0.1	1100	1400	1700	1500	1800	1200	43	860	1100	630	600
Mn_D	mg/L	0.0001	6.7	8.2	11	10	8.2	7.6	0.06	3.6	7	1.5	1.5
Mo_D	mg/L	0.00005	0.019	0.027	0.046	0.022	0.065	0.029	0.0043	0.021	0.016	0.0062	0.0063
Ni_D	mg/L	0.0005	0.23	0.38	0.48	0.35	0.15	0.18	0.0016	0.11	0.29	0.082	0.12
Se_D	mg/L	0.00005	0.0095	0.014	0.038	0.013	0.0048	0.0097	0.0019	0.005	0.0058	0.0012	0.001
Si_D	mg/L	0.05	2.5	3.9	5	2.9	*2.5*	4.5	4.2	3.2	2.6	3.7	3.6
Na_D	mg/L	0.05	7400	9800	12000	10000	12000	7700	420	6700	8200	4700	4500
S_D	mg/L	0.5	410	510	590	590	560	600	52	500	510	420	450
Tl_D	mg/L	0.00001	0.00071	0.0011	0.0015	0.0009	*0.0005*	*0.0005*	*0.00002*	*0.0005*	*0.0005*	*0.0002*	*0.0002*
Sn_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	*0.0002*	*0.005*	*0.005*	*0.002*	*0.002*
U_D	mg/L	0.00001	0.0025	0.0031	0.0049	0.0031	0.0013	0.0019	0.00023	0.0019	0.0026	0.00028	0.00059
Zn_D	mg/L	0.001	0.32	1.7	3.2	1.3	0.11	0.21	0.0082	1.2	0.42	0.026	0.094

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.027_HopeBay_TailingsMonitoringData_TL-11_2019_rev04.xlsx

Notes:

Blue italics = Value less than laboratory detection limit. Detection limit shown.

-- = Data not available.

Metal(loid) concentrations are reported as 'Dissolved'

5 Summary and Conclusions

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

The results of the 2019 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019.
- TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019) and metallurgical tailings samples (SRK 2015).
- Trace element content was compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. The following parameters showed enrichment, all other parameters were below the screening criteria indicating no appreciable enrichment:
  - April, June, November and December samples contained elevated arsenic (9 to 170 mg/kg) and was within the range of concentrations for historical samples (except April at 170 ppm).
  - Five samples were elevated in sulphur (3,100 to 5,300 mg/kg for enriched samples).
  - All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg (660 to 3,100 mg/kg).
  - Bismuth was elevated in the sample collected in April (9.4 mg/kg).

The results of the 2019 geochemical monitoring program of detoxified tailings solids (TL-7A) is summarized as follows:

- Sulphur concentrations ranged between 9.6 and 25 % in 2019 and were highest between the months of July and December (21 to 25%).
- TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration in 2018, compared to 15 mg/kg in 2019). All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2019 geochemical monitoring program of detoxified tailings filtrate (TL-7B) is summarized as follows:

- pH conditions ranged from 8.5 to 8.8 s.u.
- Concentrations of sulphate (a by-product of milling of sulphide rich ore) ranged from 12,000 mg/L to 28,000 mg/L.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process.
- Milling of the sulphide rich ore results in high concentrations of total metals, including: arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cadmium (<0.00025 to 0.00059 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L), silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Trends in process plant tailings water discharge (TL-5) are summarized as follows:

- pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u.
- Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019.
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018. Exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

The results of the opportunistic seepage sampling from underground backfilled stopes (TL-11) is summarized as follows:

- Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill with the results summarized as follows:
  - pH is slightly alkaline with both seeps reporting a pH of 8.0.
  - Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).

  – Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
  – Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015). The exception to this was zinc, which reported elevated concentrations (0.026 to 0.096 mg/L) in the survey but was not noted as a parameter of potential concern in the HCT program.

- No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

Regards
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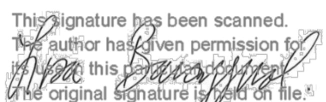
Reviewed by



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6 References

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Attachment A – TL-6 Geochemical Data

Flotation Tailings (TL-6)				ABA									
Sample ID	Station ID	Lab ID	Date Sampled	Moisture	Total Sulfur	HCl Extracted Sulfate	Sulfide Sulfur (by diff.)	CO_2	Inorganic Carbon	$CaCO_3$ Equiv.	AP	NP_{TIC}/AP	
			Units>	%	%	mg/L	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	
TL6-7JAN19	TL-6	B910233	1/7/2019	-	0.09	0.01	0.08	7.0	1.9	158	2.2	72	
TL6-3FEB19	TL-6	B914932	2/3/2019	-	0.21	0.01	0.20	4.9	1.3	110	6.3	18	
TL6-3MAR19	TL-6	B925906	3/3/2019	-	0.17	0.02	0.15	5.5	1.5	125	4.4	29	
TL6-10APR19	TL-6	B929338	4/10/2019	-	0.35	0.04	0.31	6.9	1.9	157	10	16	
TL6-6MAY19	TL-6	B936614	5/6/2019	-	0.23	0.02	0.21	5.0	1.4	113	6.6	17	
TL6-3JUN19	TL-6	B945612	6/3/2019	-	0.33	0.01	0.32	7.0	1.9	158	11	14	
TL6-7JUL19	TL-6	B959350	7/7/2019	-	0.24	0.02	0.22	7.6	2.1	172	7.8	22	
TL6-22AUG19	TL-6	B969604	8/22/2019	-	0.30	0.02	0.28	4.3	1.2	97	9.4	10	
TL6-12SEP19	TL-6	B980380	9/12/2019	-	0.19	0.02	0.17	4.8	1.3	109	5.9	18	
TL6-21OCT19	TL-6	B990946	10/21/2019	-	0.24	0.02	0.22	5.6	1.5	128	7.5	17	
TL6-19NOV19	TL-6	B999581	11/19/2019	-	0.53	0.02	0.51	8.9	2.4	203	16.6	12	
TL6-16DEC19	TL-6	B9A8364	12/16/2019	-	0.38	0.03	0.35	9.7	2.6	220	11.9	19	

Sample ID	Metals															
	Al	Sb	As	Ba	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	La	Pb	Ga	Au
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb
TL6-7JAN19	5400	<0.1	6.4	5.0	<0.1	<20	<0.1	3.6	54	8.7	26	3.7	2	1.5	2	939
TL6-3FEB19	460	0.1	17	5.0	<0.1	<20	0.1	3.1	37	11	93	3.4	1	4.0	2	809
TL6-3MAR19	5200	<0.1	13	7.0	<0.1	<20	<0.1	3.3	51	12	37	3.4	1	3.8	2	3110
TL6-10APR19	5300	5	169	13	9.4	<20	0.1	3.5	60	12	82	4.1	1	44	2	1460
TL6-6MAY19	7300	<0.1	13	52	0.1	<20	0.1	2.6	63	12	70	3.6	2	9.8	3	1200
TL6-3JUN19	7300	0.1	23	17	0.1	<20	0.2	3.9	53	17	99	4.5	2	11	3	2480
TL6-7JUL19	6500	<0.1	16	8.0	<0.1	<20	0.2	3.9	41	14	99	4.5	1	7.3	2	1430
TL6-22AUG19	7400	0.3	12	10	0.1	<20	0.3	2.5	48	12	639	3.6	2	14	4	1850
TL6-12SEP19	10800	0.2	9.0	14	<0.1	<20	0.1	3.1	62	13	70	4.4	2	12	4	919
TL6-21OCT19	9200	0.1	11	14	0.1	<20	0.1	3.1	65	13	91	4.0	1	9.4	3	659
TL6-19NOV19	10500	0.4	55	12	0.1	47	0.7	4.9	73	21	135	5.5	2	43	4	763
TL6-16DEC19	9200	0.4	53	13	0.3	<20	0.2	4.7	114	17	90	5.0	2	12	3	1020

Flotation Tailings (TL-6)				Metals																				
Sample ID	Station ID	Lab ID	Date Sampled	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	S	Te	Tl	Th	Ti	W	U	V	Zn
			Units>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
TL6-7JAN19	TL-6	B910233	1/7/2019	10800	1050	<0.01	0.30	18	290	400	6.3	<0.5	0.2	0.061	18	700	<0.2	<0.1	0.1	30	0.7	<0.1	17	31
TL6-3FEB19	TL-6	B914932	2/3/2019	10000	973	0.02	0.40	22	230	400	6.1	<0.5	0.3	0.057	16	2000	<0.2	<0.1	0.7	80	0.2	<0.1	17	43
TL6-3MAR19	TL-6	B925906	3/3/2019	10700	934	<0.01	0.30	23	270	400	5.8	0.6	0.5	0.069	17	1400	<0.2	<0.1	0.2	80	0.3	<0.1	18	42
TL6-10APR19	TL-6	B929338	4/10/2019	11800	1020	0.23	0.50	22	320	500	6.5	<0.5	1	0.063	18	3200	0.4	<0.1	1.1	80	0.6	<0.1	19	52
TL6-6MAY19	TL-6	B936614	5/6/2019	13000	830	<0.01	0.50	20	310	500	6.1	<0.5	0.3	0.11	18	2100	<0.2	<0.1	0.4	360	0.4	<0.1	26	55
TL6-3JUN19	TL-6	B945612	6/3/2019	13800	1130	<0.01	0.40	28	310	900	7.9	<0.5	0.6	0.082	51	3500	<0.2	<0.1	0.5	220	0.4	<0.1	25	71
TL6-7JUL19	TL-6	B959350	7/7/2019	13000	1230	<0.01	0.40	22	360	400	7.2	0.6	0.3	0.085	20	2500	<0.2	<0.1	0.2	110	0.4	<0.1	20	71
TL6-22AUG19	TL-6	B969604	8/22/2019	12400	791	0.01	0.30	18	390	500	6.3	<0.5	0.3	0.088	15	3100	<0.2	<0.1	0.5	370	0.8	<0.1	26	74
TL6-12SEP19	TL-6	B980380	9/12/2019	15700	950	<0.01	0.80	20	450	800	7.6	<0.5	0.3	0.13	19	2200	<0.2	<0.1	0.6	500	0.8	<0.1	39	67
TL6-21OCT19	TL-6	B990946	10/21/2019	14800	896	<0.01	1.0	22	300	600	6.9	<0.5	0.2	0.11	18	2400	<0.2	<0.1	0.20	400	0.8	<0.1	39	65
TL6-19NOV19	TL-6	B999581	11/19/2019	21200	1370	<0.01	1.1	53	400	900	10	<0.5	0.9	0.15	40	5300	<0.2	<0.1	0.20	300	0.9	<0.1	38	135
TL6-16DEC19	TL-6	B9A8364	12/16/2019	17700	1400	<0.01	0.90	58	450	700	9	<0.5	0.4	0.11	43	3800	<0.2	<0.1	0.2	80	0.7	<0.1	29	60

Attachment B – TL-7A Geochemical Data

Detoxified Tailings (TL-7A)				ABA									Metals															
Sample ID	Station ID	Lab ID	Date Sampled	Moisture	Total Sulfur	HCl Extracted Sulfate	Sulfide Sulfur (by diff.)	CO_2	Inorganic Carbon	$CaCO_3$ Equiv.	AP	NP_{TIC}/AP	Al	Sb	As	Ba	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	La	Pb	Ga	Au
			Units>	%	%	mg/L	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb
TL7-7JAN19	TL-7	B910230	1/7/2019	18	12	0.16	11	7.0	1.9	160	364	0.44	5800	0.5	490	7	1.3	<20	0.6	3.4	80	228	4610	15	1	49	2	12800
TL7-10FEB19	TL-7	B914934	2/10/2019	21	10	0.18	9.5	7.5	2.1	171	301	0.57	6200	0.5	458	8	1.2	<20	1	3.7	61	226	4470	12	1	266	2	6780
TL7-3MAR19	TL-7A	B925908	3/3/2019	22	15	0.2	15	6.1	1.7	140	477	0.29	6500	1.2	665	9	2.2	<20	1.2	3.6	85	289	5060	16	1	134	2	7310
TL7-10APR19	TL-7A	B929340	4/10/2019	23	14	0.26	14	5.5	1.5	125	449	0.28	6800	4.6	808	11	4.6	<20	3.5	3.2	88	283	9440	17	1	504	2	56300
TL7-5MAY19	TL-7A	B936612	5/5/2019	21	12	0.13	11	5.4	1.5	123	362	0.34	7400	1.2	495	20	2.7	<20	4	2.8	69	200	3980	14	2	374	3	16100
TL7-2JUNE19	TL-7A	B945617	6/2/2019	26	13	0.29	13	6.3	1.7	143	409	0.35	8800	0.9	598	10	2.6	<20	3.4	3.7	70	219	5480	16	1	362	3	16500
TL7-7JULY19	TL-7A	B959353	7/7/2019	19	22	0.28	21	4.3	1.2	98	679	0.14	7600	1.5	656	11	5.1	<20	7.1	2.5	67	297	5760	21	1	851	3	17100
TL7-22AUG19	TL-7A	B969606	8/22/2019	19	21	0.27	21	2.8	0.77	64	664	0.10	5200	1.4	451	7	5.3	<20	6.1	1.7	64	278	8780	20	1	776	3	19700
TL7-12SEP19	TL-7A	B980383	9/12/2019	20	22	0.16	22	5.0	1.4	113	690	0.16	6800	1.2	579	10	4.8	<20	5.3	2.5	72	348	6340	23	1	448	3	10500
TL7-21OCT19	TL-7A	B990943	10/21/2019	23	25	0.22	24	5.1	1.4	116	772	0.15	5100	1.1	565	9	3.9	<20	3.5	2.5	66	307	9170	21	1	385	2	16600
TL7-19NOV19	TL-7A	B999582	11/19/2019	54	22	0.1	22	6.0	1.6	137	680	0.20	6100	1	1010	8	3.2	24	2.7	3.5	334	286	4590	21	1	259	2	6620
TL7-16DEC19	TL-7A	B9A8370	12/16/2019	21	21	0.25	21	5.8	1.6	126	671	0.20	8100	1.2	1000	12	6.2	<20	3.5	2.8	359	209	2920	19	1	183	3	4100

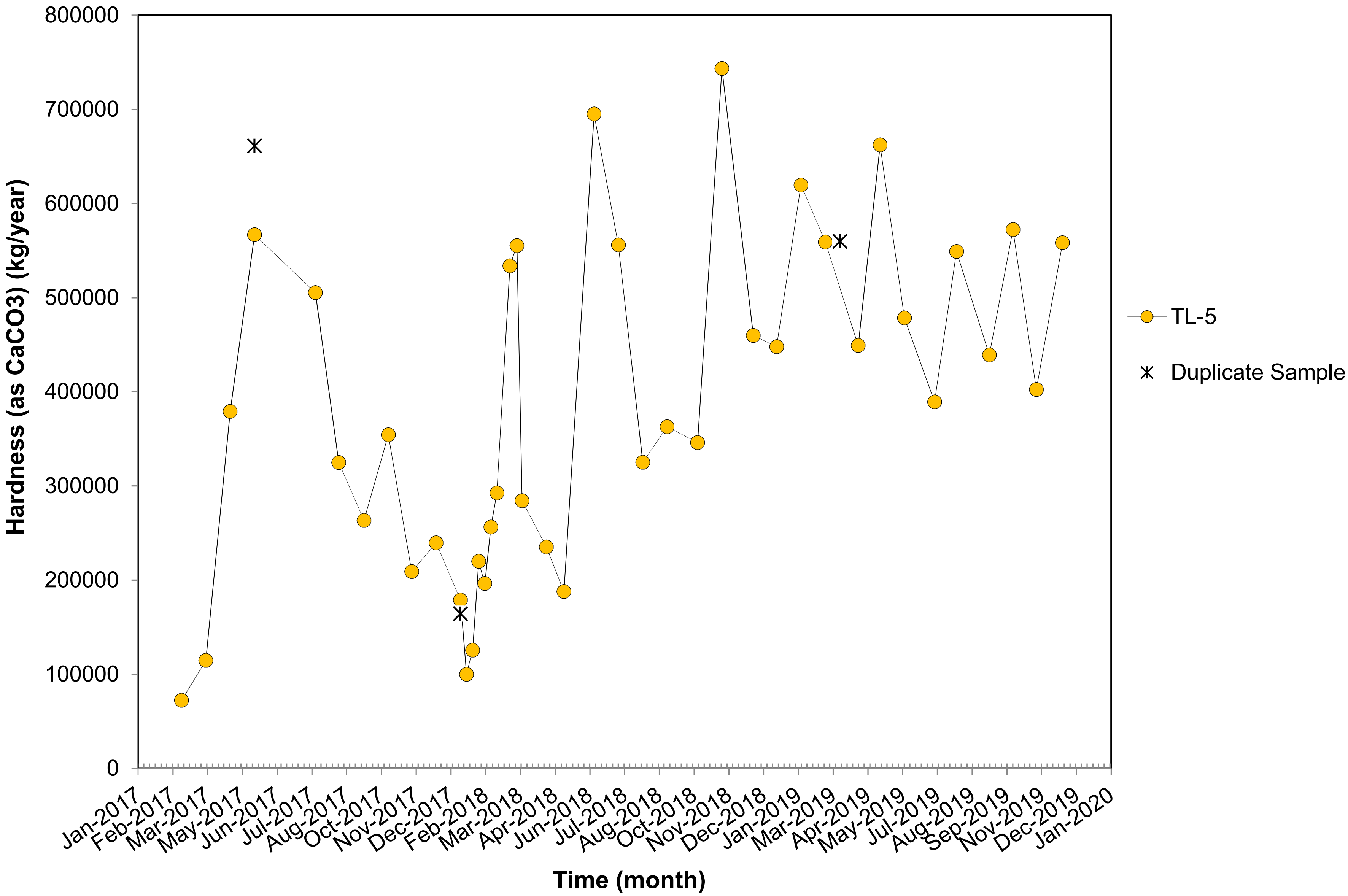
Detoxified Tailings (TL-7A)				Metals																					
Sample ID	Station ID	Lab ID	Date Sampled	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	S	Te	Tl	Th	Ti	W	U	V	Zn
			Units>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
TL7-7JAN19	TL-7	B910230	1/7/2019	11200	1090	0.03	2.2	180	260	500	6.5	7.3	13	0.23	19	>100000	2.5	0.2	0.2	50	2.6	<0.1	19	241
TL7-10FEB19	TL-7	B914934	2/10/2019	11700	1180	0.04	2.4	206	250	500	7.4	6.0	14	0.28	20	82400	2.3	0.3	0.4	60	1	<0.1	21	524
TL7-3MAR19	TL-7A	B925908	3/3/2019	11000	1140	0.04	2.7	257	280	600	6.8	10	20	0.23	23	>100000	3.9	0.4	0.5	80	1.5	<0.1	23	522
TL7-10APR19	TL-7A	B929340	4/10/2019	11400	1030	0.14	2.7	244	240	600	6.3	10	51	0.26	22	>100000	3.7	0.6	0.3	160	2.1	<0.1	26	1700
TL7-5MAY19	TL-7A	B936612	5/5/2019	12100	999	0.08	2.6	164	350	700	6.2	9.0	18	0.25	21	>100000	2.2	0.6	3.2	330	2.8	<0.1	23	1620
TL7-2JUNE19	TL-7A	B945617	6/2/2019	14500	1260	0.07	2.7	199	320	600	8.2	10	25	0.49	26	>100000	4.1	0.4	0.2	150	1.3	<0.1	29	1720
TL7-7JULY19	TL-7A	B959353	7/7/2019	10600	953	0.16	3.4	199	320	600	5.8	16	15	0.29	18	>100000	4.3	0.6	0.6	180	1.7	<0.1	26	3920
TL7-22AUG19	TL-7A	B969606	8/22/2019	8200	541	0.08	3.4	188	250	400	4.1	19	16	0.41	12	>100000	4.5	0.9	0.4	250	3.6	<0.1	19	2940
TL7-12SEP19	TL-7A	B980383	9/12/2019	10800	878	0.08	4.3	215	280	600	5.7	15	18	0.21	19	>100000	5.6	1	0.7	270	3.8	<0.1	27	2090
TL7-21OCT19	TL-7A	B990943	10/21/2019	9200	846	0.06	5.1	219	240	500	4.8	16	17	0.30	20	>100000	4.5	0.6	0.3	160	5.5	<0.1	23	1710
TL7-19NOV19	TL-7A	B999582	11/19/2019	12700	979	0.06	4.3	318	260	600	6.4	14	15	0.25	30	>100000	3.5	0.5	0.1	180	4	<0.1	23	1250
TL7-16DEC19	TL-7A	B9A8370	12/16/2019	14200	1040	0.06	4.6	346	260	700	7.0	13	17	0.29	35	>100000	5.3	0.2	0.2	150	4.2	<0.1	28	1080

Attachment C – TL-7B Geochemical Data

			Aluminum (Al)-Total	Ammonia, Total (as N)	Antimony (Sb)-Total	Arsenic (As)-Total	Barium (Ba)-Total	Beryllium (Be)-Total	Bismuth (Bi)-Total	Boron (B)-Total	Cadmium (Cd)-Total	Calcium (Ca)-Total	Cesium (Cs)-Total	Chromium (Cr)-Total	Cobalt (Co)-Total	Copper (Cu)-Total	Cyanate	Cyanide, Total	Cyanide, Weak Acid Diss	Iron (Fe)-Total	Lead (Pb)-Total	Lithium (Li)-Total	Magnesium (Mg)-Total	Manganese (Mn)-Total	Molybdenum (Mo)-Total	Nickel (Ni)-Total	pH
Sample ID	Lab ID	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH
TL7B	L2231509-1	10-Feb-2019 15:45	<0.15	186	0.006	0.022	0.054	<0.005	<0.0025	1.1	<0.00025	56	<0.0005	<0.005	0.049	5.2	416	0.80	0.063	<0.5	0.0063	<0.05	40.9	0.20	0.024	<0.025	8.6
TL7B	L2239798-1	03-Mar-2019 13:30	0.44	216	0.019	0.12	0.058	<0.002	<0.001	1.2	<0.0001	48	<0.0002	0.0051	0.075	8.5	516	1.5	0.11	3.09	0.0031	0.039	47.1	0.21	0.037	0.028	8.5
TL7B	L2256606-1	10-Apr-2019 14:30	0.65	202	0.0088	0.061	0.048	<0.005	<0.0025	1.0	<0.00025	74	<0.0005	<0.005	0.048	7.2	510	1.0	0.18	5.74	0.015	<0.05	50.3	0.35	0.040	0.031	8.5
TL7B	L2268411-1	05-May-2019 17:45	0.44	175	0.012	0.059	0.071	<0.005	<0.0025	0.89	<0.00025	72	<0.0005	<0.005	0.035	6.0	305	1.8	0.11	2.32	0.0085	0.059	56	0.41	0.053	<0.025	8.5
TL7B	L2285448-1	02-Jun-2019 10:55	0.29	224	0.018	0.11	0.053	<0.005	<0.0025	1.2	<0.00025	41	<0.0005	<0.005	0.13	9.4	570	0.51	0.48	1.68	0.0033	0.055	49.7	0.13	0.066	<0.025	8.7
TL7B	L2307036-1	07-Jul-2019 10:40	0.36	219	0.022	0.040	0.072	<0.005	<0.0025	1.1	0.00029	42	<0.0005	<0.005	0.045	6.5	620	0.55	0.31	2.83	0.0079	0.072	43.9	0.24	0.13	<0.025	8.7
TL7B	L2328804-1	11-Aug-2019 18:50	0.18	229	0.045	0.045	0.056	<0.005	<0.0025	0.91	<0.00025	40	<0.0005	<0.005	0.096	8.5	519	0.38	0.15	0.67	0.0053	0.055	34.4	0.26	0.12	0.139	8.7
TL7B	L2344190-1	08-Sep-2019 16:45	0.61	242	0.019	0.060	0.086	<0.005	<0.0025	1.4	<0.00025	43	<0.0005	<0.005	0.066	11	416	1.8	0.34	4.05	0.0067	0.075	44.9	0.24	0.23	<0.025	8.7
TL7B	L2361805-1	05-Oct-2019 17:05	0.40	259	0.026	0.057	0.058	<0.005	<0.0025	1.3	0.00059	45	<0.0005	<0.005	0.051	19.9	665	1.2	0.11	4.36	0.024	0.059	46.1	0.33	0.27	0.041	8.7
TL7B	L2377266-1	03-Nov-2019 15:30	0.32	270	0.035	0.14	0.053	<0.005	<0.0025	1.0	<0.00025	39	<0.0005	0.0103	0.028	9.4	615	1.2	0.24	5.01	0.0071	0.06	42.9	0.21	0.11	0.031	8.8
TL7B	L2394097-1	08-Dec-2019 15:30	0.53	291	0.028	0.10	0.049	<0.005	<0.0025	1.7	<0.00025	32	<0.0005	0.0181	0.23	3.3	<10	1.0	0.42	4.9	0.012	0.086	75.7	0.21	0.12	<0.025	8.8
TL7B	L2223176-1	21-Jan-2019 10:00	0.84	216	0.013	0.17	0.035	<0.005	-	1.0	<0.00025	36	-	0.0064	0.15	10	311	2.1	0.26	13.2	0.0067	<0.05	45.2	0.25	0.065	0.052	8.6

			Phosphorus (P)-Total	Potassium (K)-Total	Rubidium (Rb)-Total	Selenium (Se)-Total	Silicon (Si)-Total	Silver (Ag)-Total	Sodium (Na)-Total	Strontium (Sr)-Total	Sulfur (S)-Total	Tellurium (Te)-Total	Thallium (Tl)-Total	Thiocyanate (SCN)	Thorium (Th)-Total	Tin (Sn)-Total	Titanium (Ti)-Total	Tungsten (W)-Total	Uranium (U)-Total	Vanadium (V)-Total	Zinc (Zn)-Total	Zirconium (Zr)-Total	Cyanide, Free
Sample ID	Lab ID	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
TL7B	L2231509-1	10-Feb-2019 15:45	<2.5	47	<0.01	0.0053	<5	0.0033	5660	0.46	3890	<0.01	<0.0005	146	<0.005	<0.005	<0.015	0.017	<0.0005	<0.025	<0.15	<0.003	<0.005
TL7B	L2239798-1	03-Mar-2019 13:30	<1	64	<0.004	0.0099	3.8	0.0084	9650	0.49	6860	<0.004	<0.0002	20	<0.002	<0.002	<0.006	0.048	0.00041	<0.01	<0.06	0.0044	<0.005
TL7B	L2256606-1	10-Apr-2019 14:30	<2.5	48	<0.01	0.0151	<5	0.0079	7310	0.68	4710	<0.01	<0.0005	18	<0.005	<0.005	<0.017	0.028	0.00066	<0.025	<0.15	<0.003	<0.01
TL7B	L2268411-1	05-May-2019 17:45	<2.5	68	<0.01	0.007	<5	0.0039	8900	0.72	5920	<0.01	<0.0005	12	<0.005	<0.005	<0.03	0.035	<0.0005	<0.025	<0.15	<0.003	0.0051
TL7B	L2285448-1	02-Jun-2019 10:55	<2.5	69	<0.01	0.0083	<5	0.0078	10600	0.47	7270	<0.01	<0.0005	313	<0.005	<0.005	<0.015	0.062	0.00113	<0.025	<0.15	<0.01	0.0055
TL7B	L2307036-1	07-Jul-2019 10:40	<2.5	66	<0.01	0.0133	<5	0.0052	9840	0.54	6510	<0.01	<0.0005	19	<0.005	<0.005	<0.015	0.053	<0.0005	<0.025	<0.15	<0.01	0.008
TL7B	L2328804-1	11-Aug-2019 18:50	<2.5	30	0.011	0.0274	<5	0.0051	10300	0.56	8130	<0.01	<0.0005	203	<0.005	<0.005	<0.015	0.12	0.00064	<0.025	<0.15	<0.01	<0.005
TL7B	L2344190-1	08-Sep-2019 16:45	<2.5	79	<0.01	0.0121	<5	0.0099	13400	0.69	9200	<0.01	<0.0005	368	<0.005	<0.005	0.02	0.096	0.00053	<0.025	<0.15	<0.01	0.015
TL7B	L2361805-1	05-Oct-2019 17:05	<2.5	57	0.013	0.0508	<5	0.017	11400	0.45	8040	<0.01	<0.0005	196	<0.005	<0.005	<0.015	0.22	0.00072	<0.025	<0.15	<0.01	<0.01
TL7B	L2377266-1	03-Nov-2019 15:30	<2.5	55	<0.01	0.0319	<5	0.0092	8700	0.53	5630	<0.01	<0.0005	184	<0.005	<0.005	<0.015	0.11	<0.0005	<0.025	<0.15	<0.01	<0.005
TL7B	L2394097-1	08-Dec-2019 15:30	<2.5	81	<0.01	0.0094	<5	0.018	10800	0.51	7510	<0.01	<0.0005	493	<0.005	<0.005	<0.015	0.089	0.00062	<0.025	<0.15	<0.01	0.019
TL7B	L2223176-1	21-Jan-2019 10:00	-	67	-	0.007	-	0.040	10200	-	-	-	<0.0005	319	-	<0.005	<0.015	-	0.0013	<0.025	<0.15	-	<0.005

Attachment D – TL-5 Loading Charts



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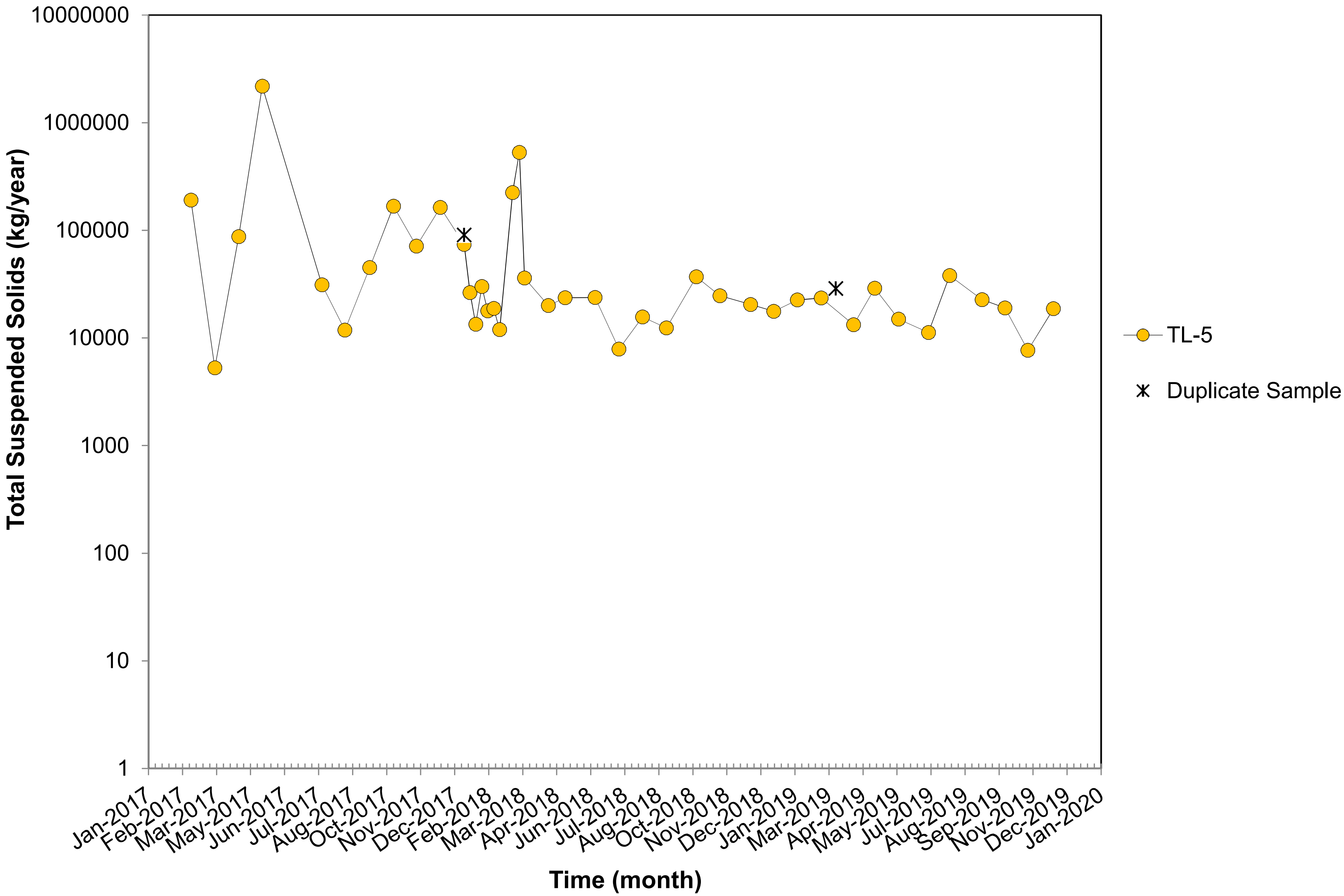

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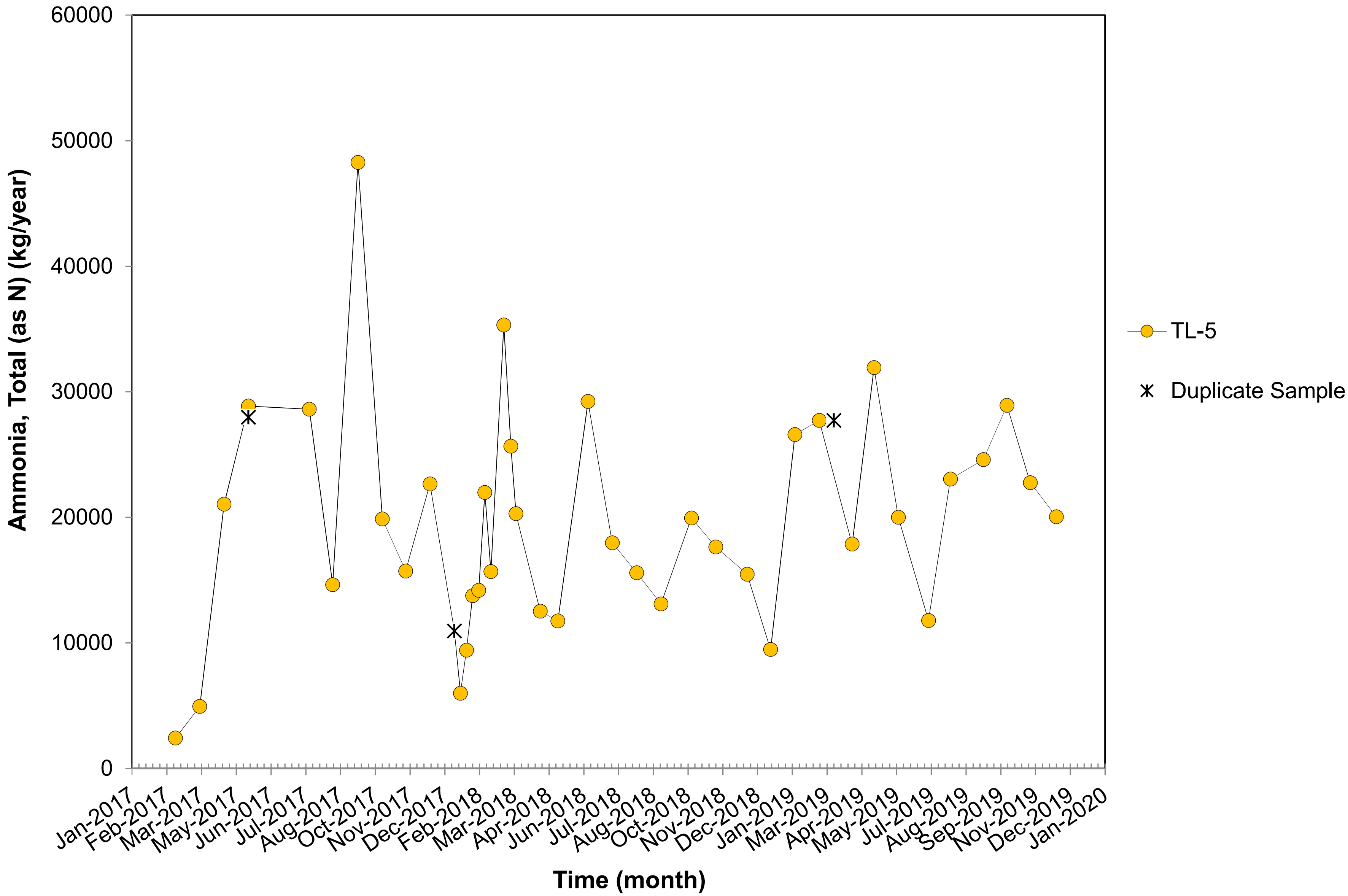

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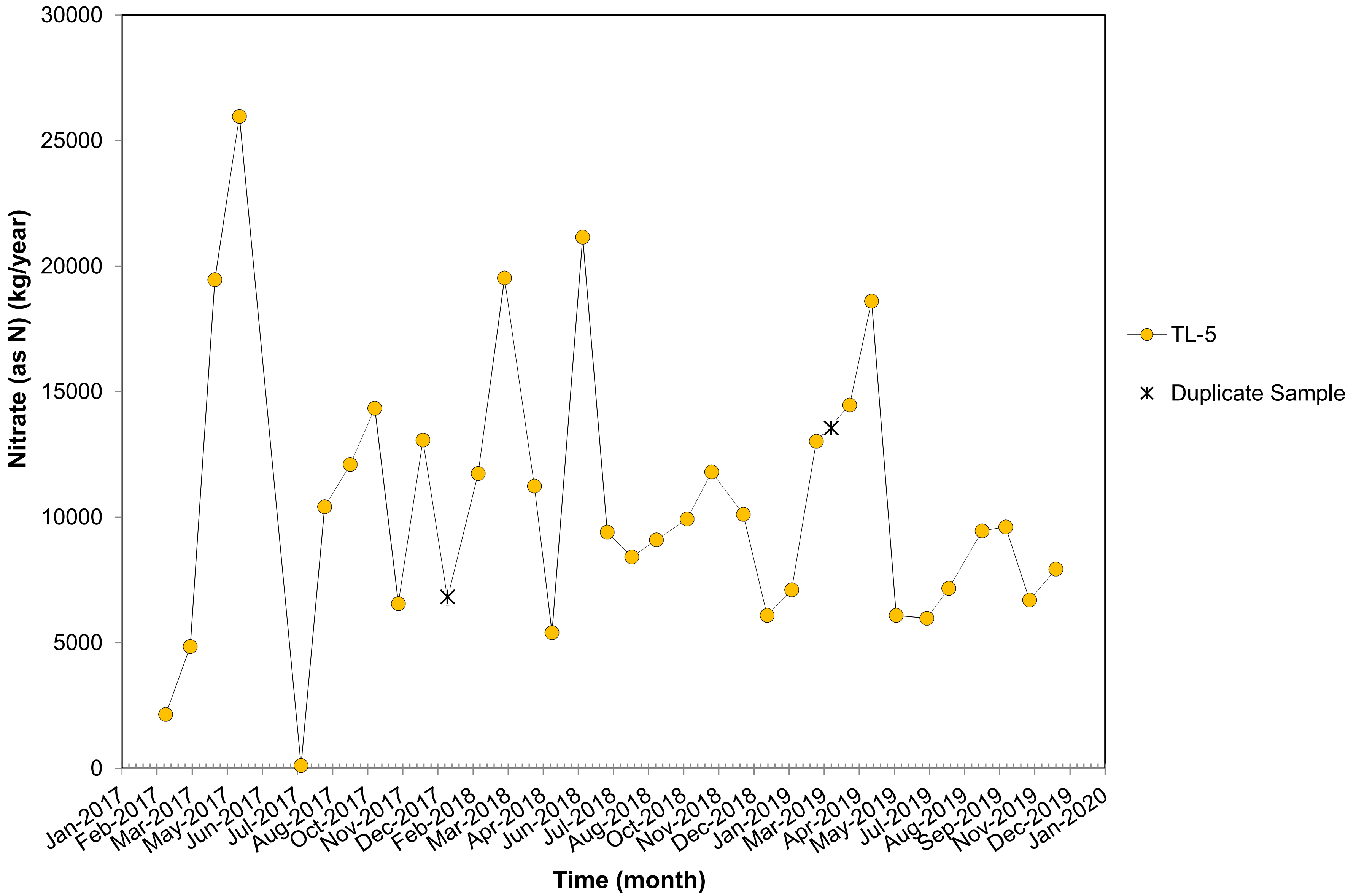

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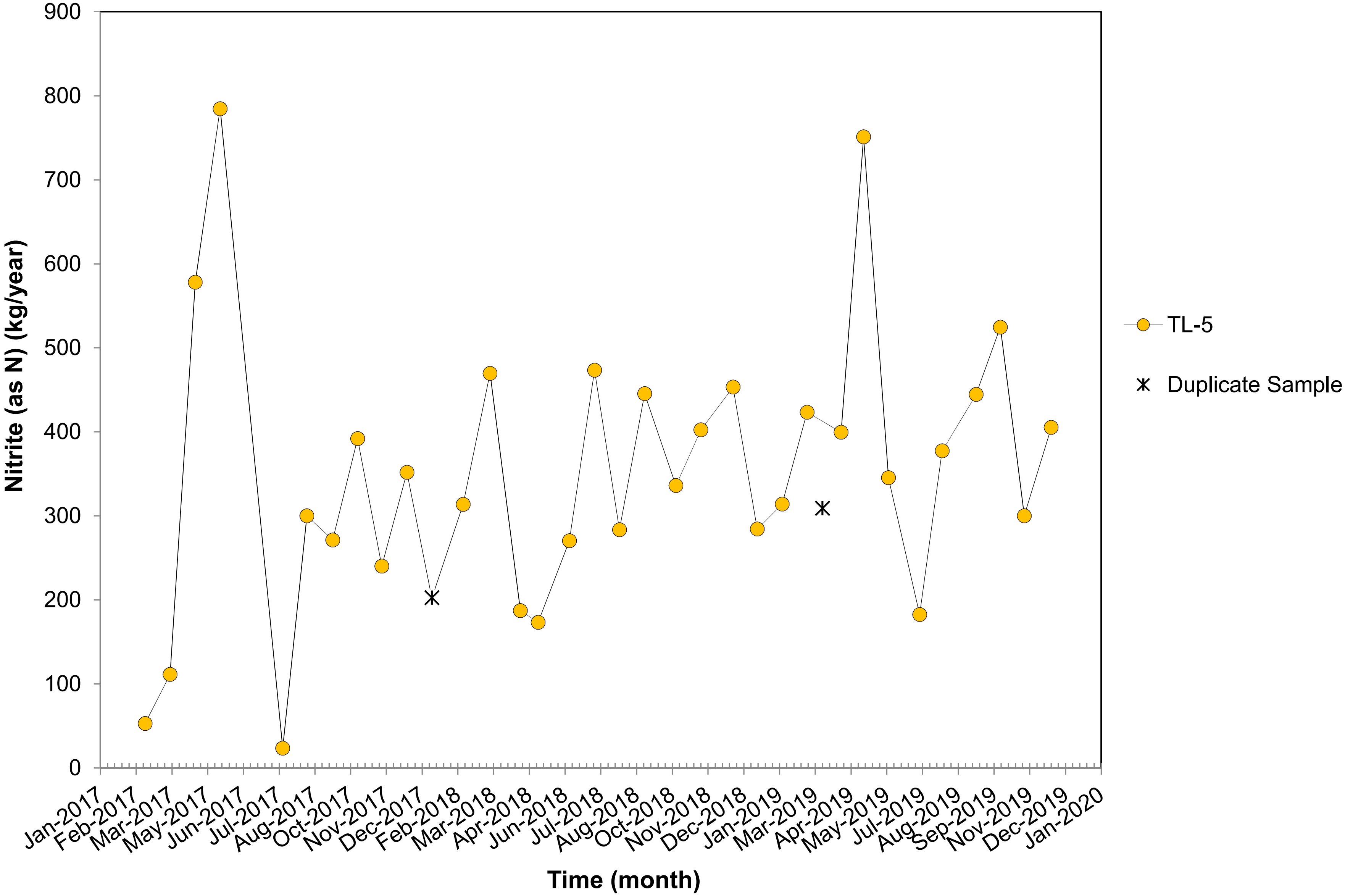

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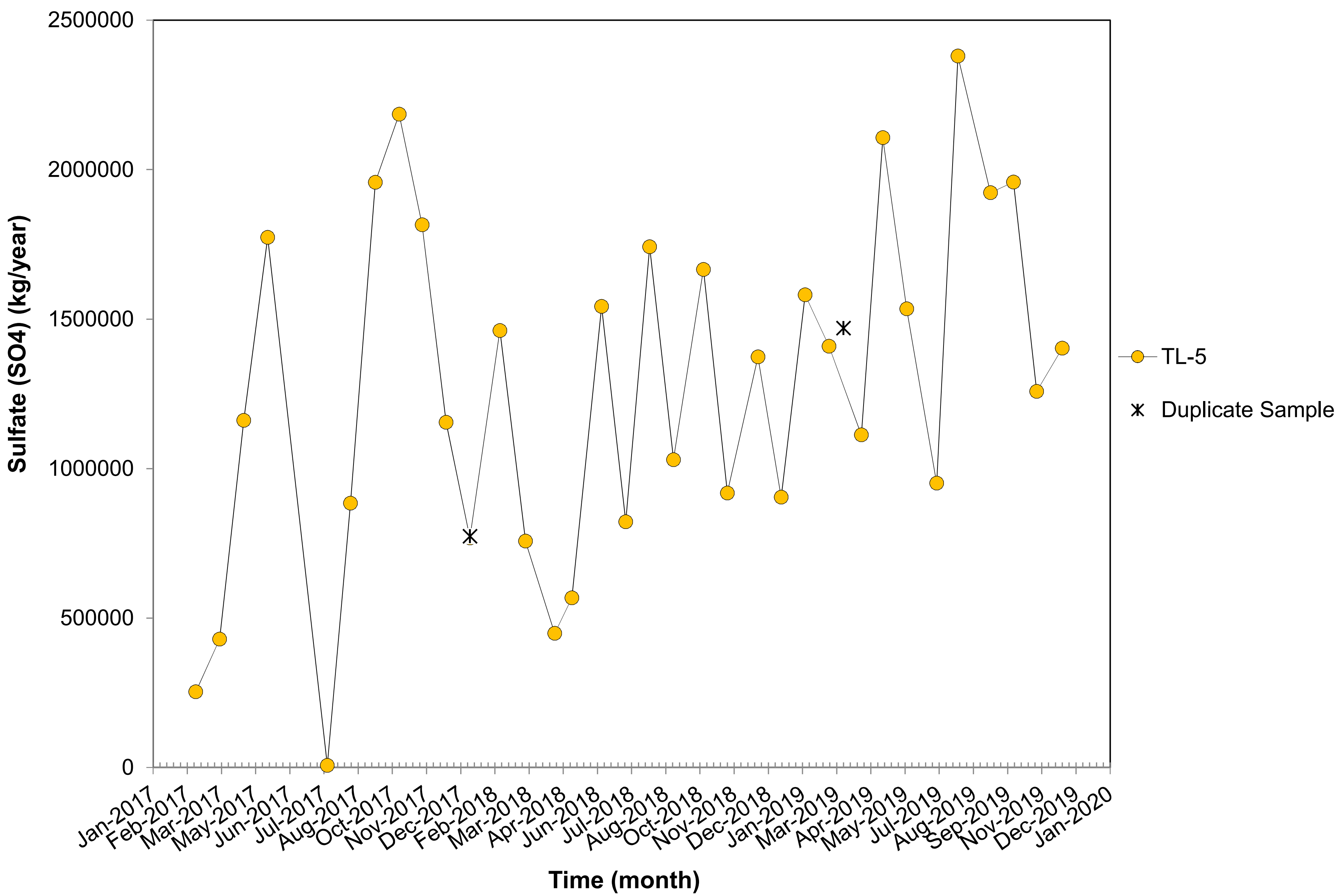

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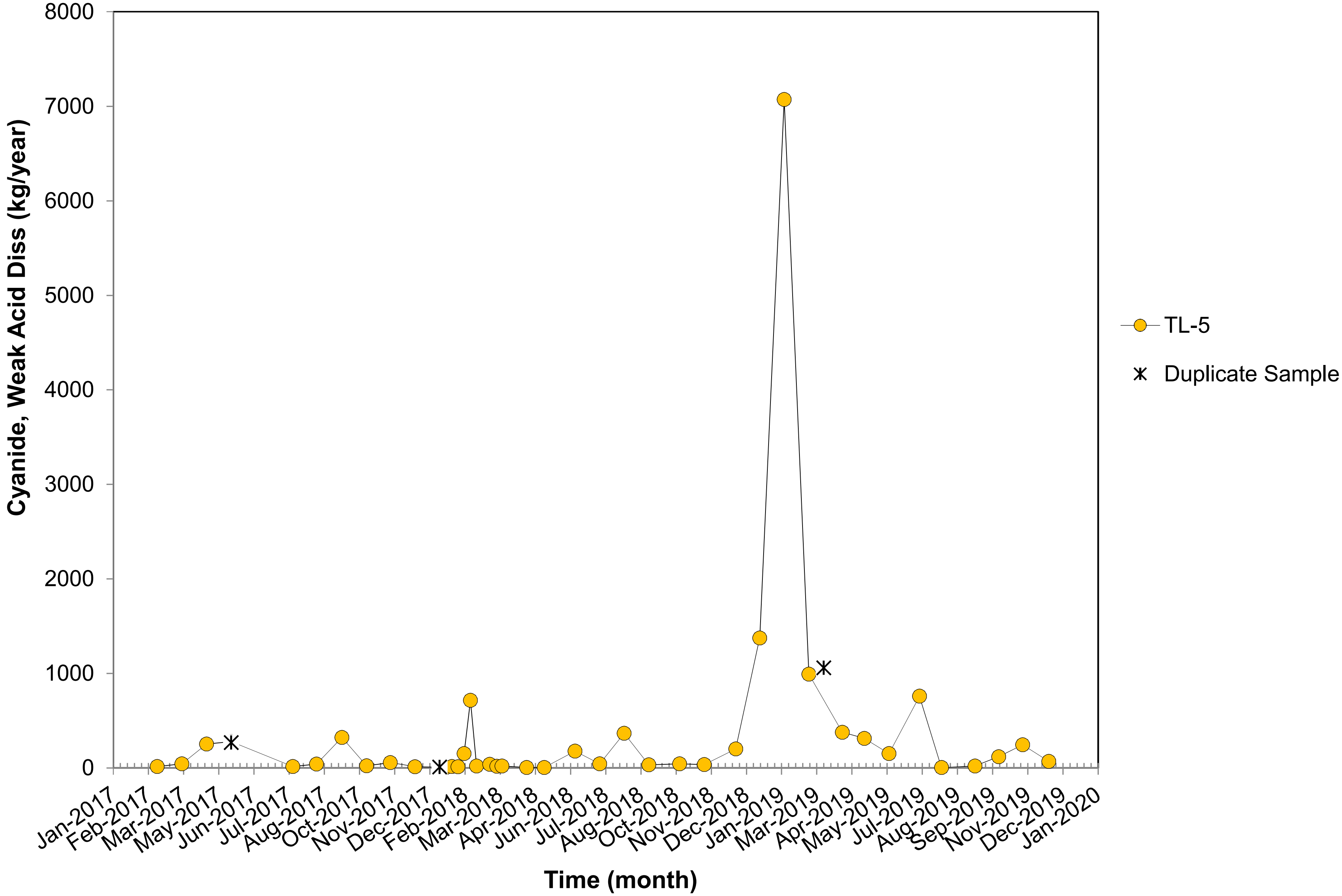

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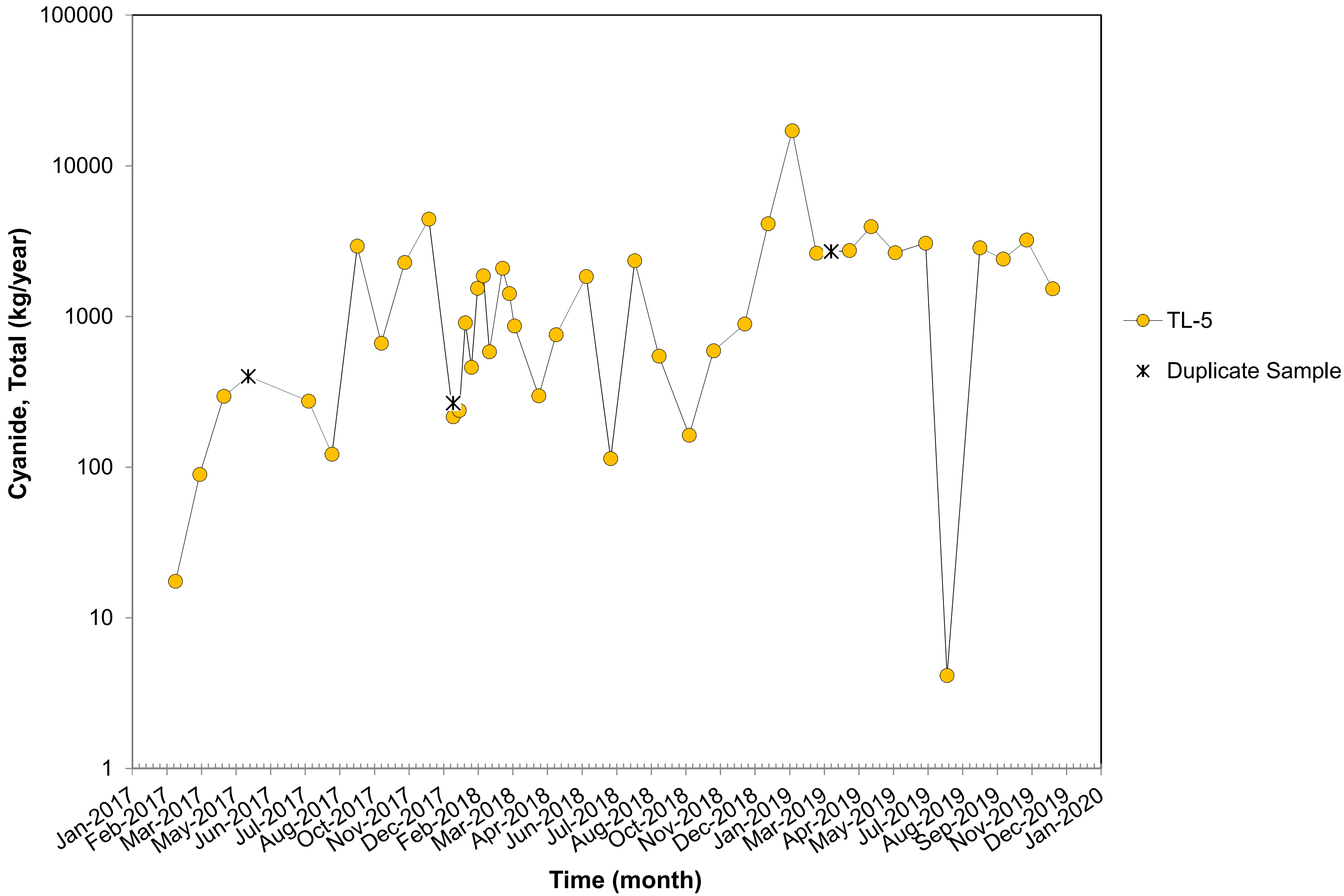

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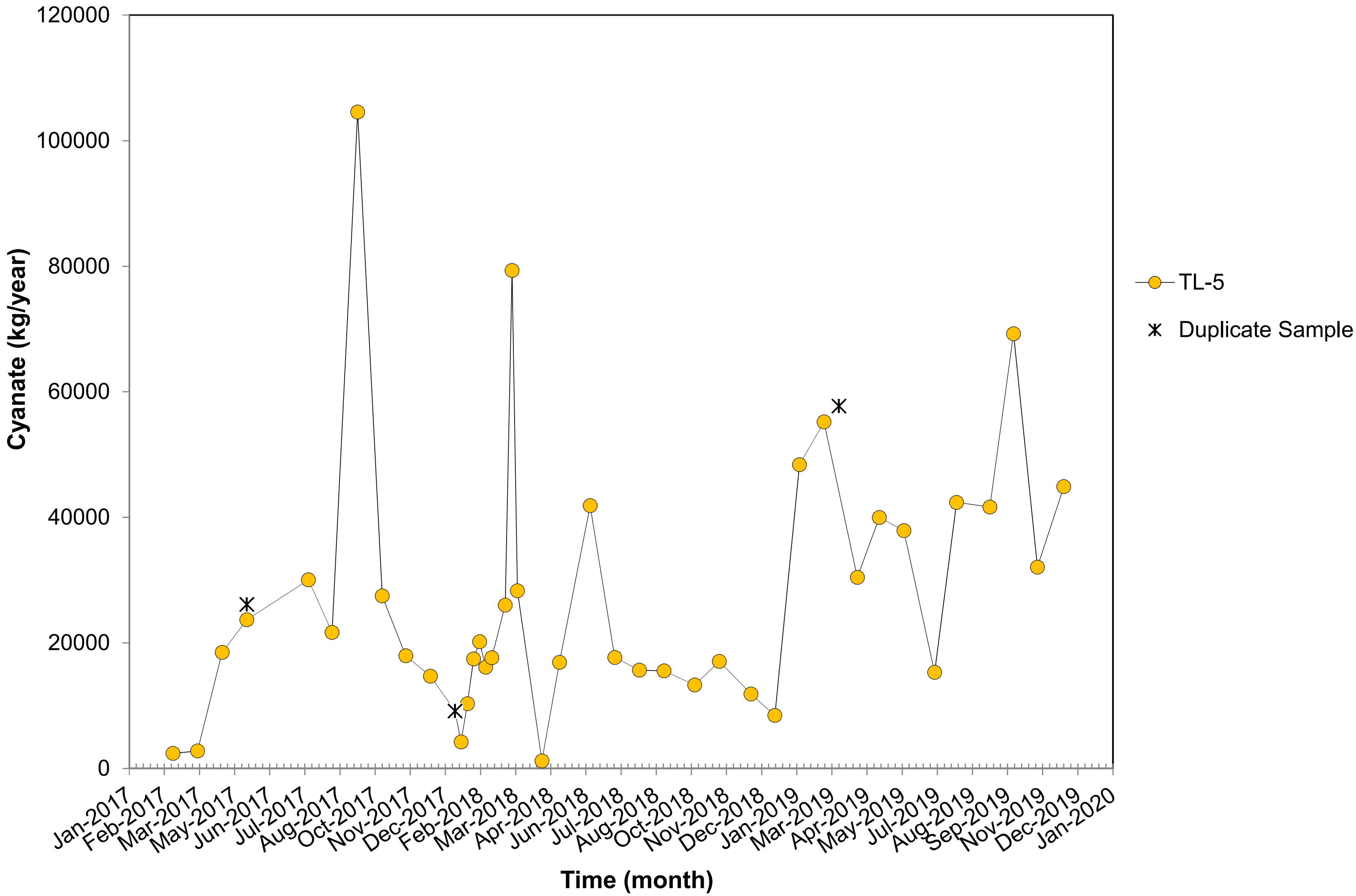

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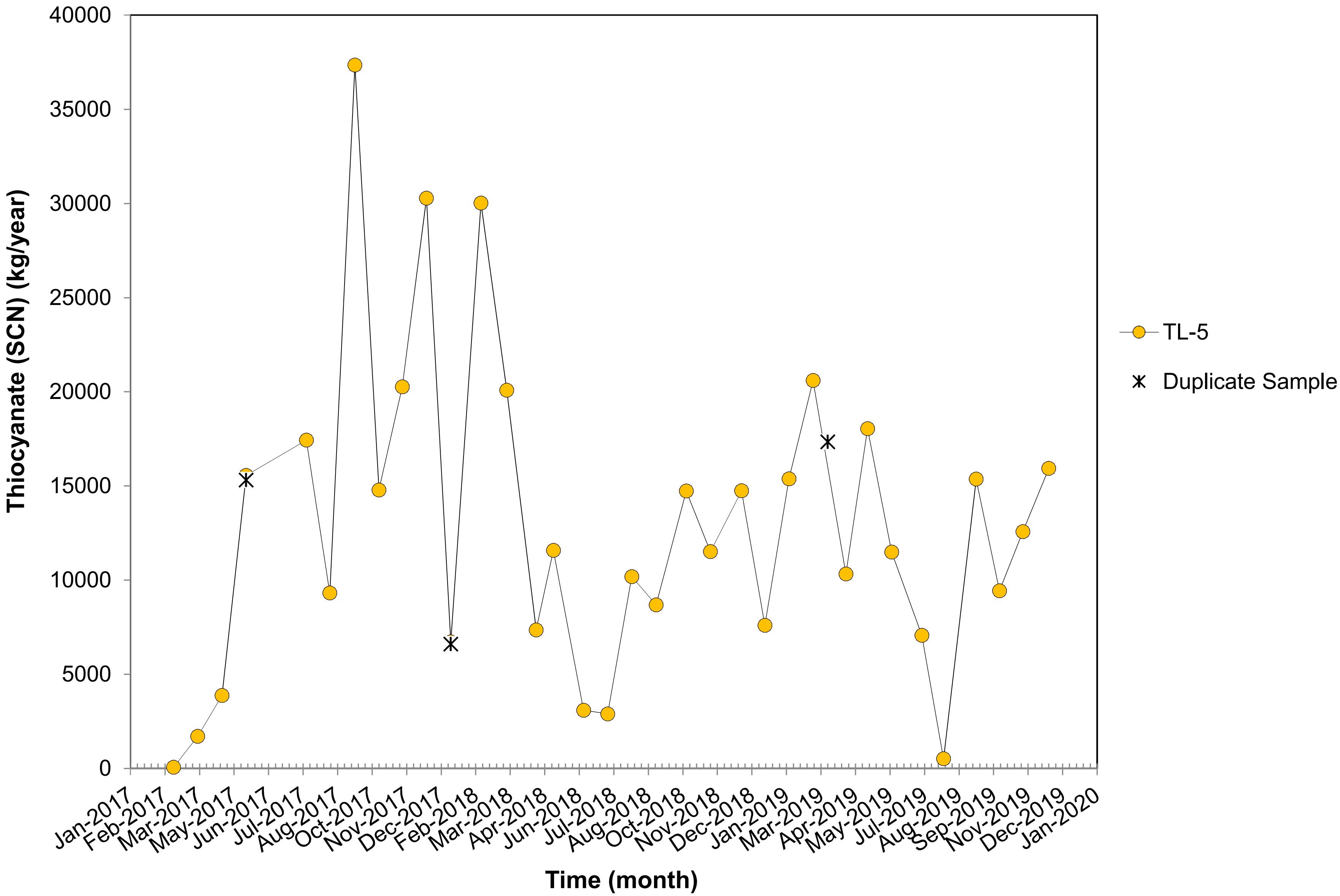

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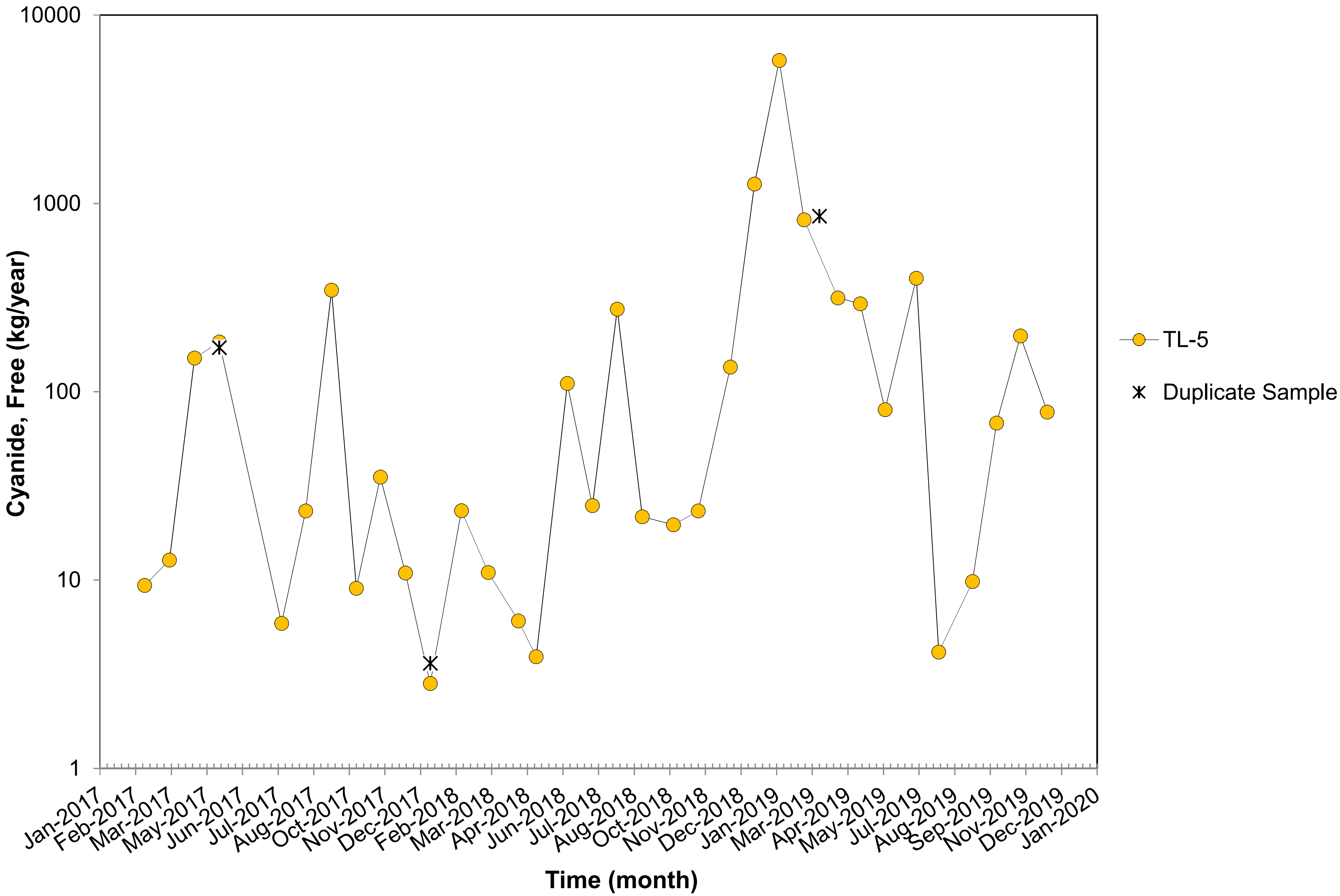

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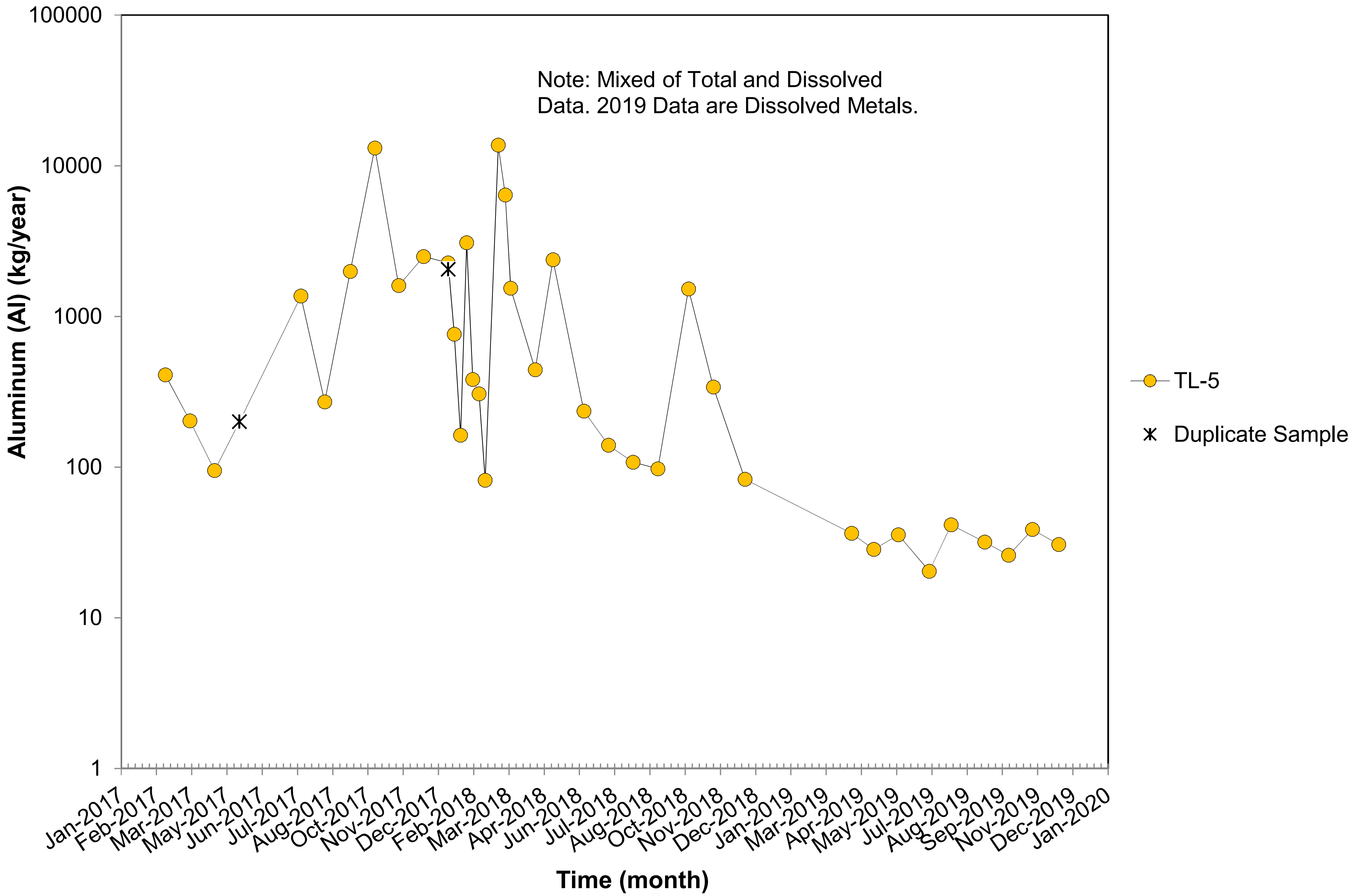

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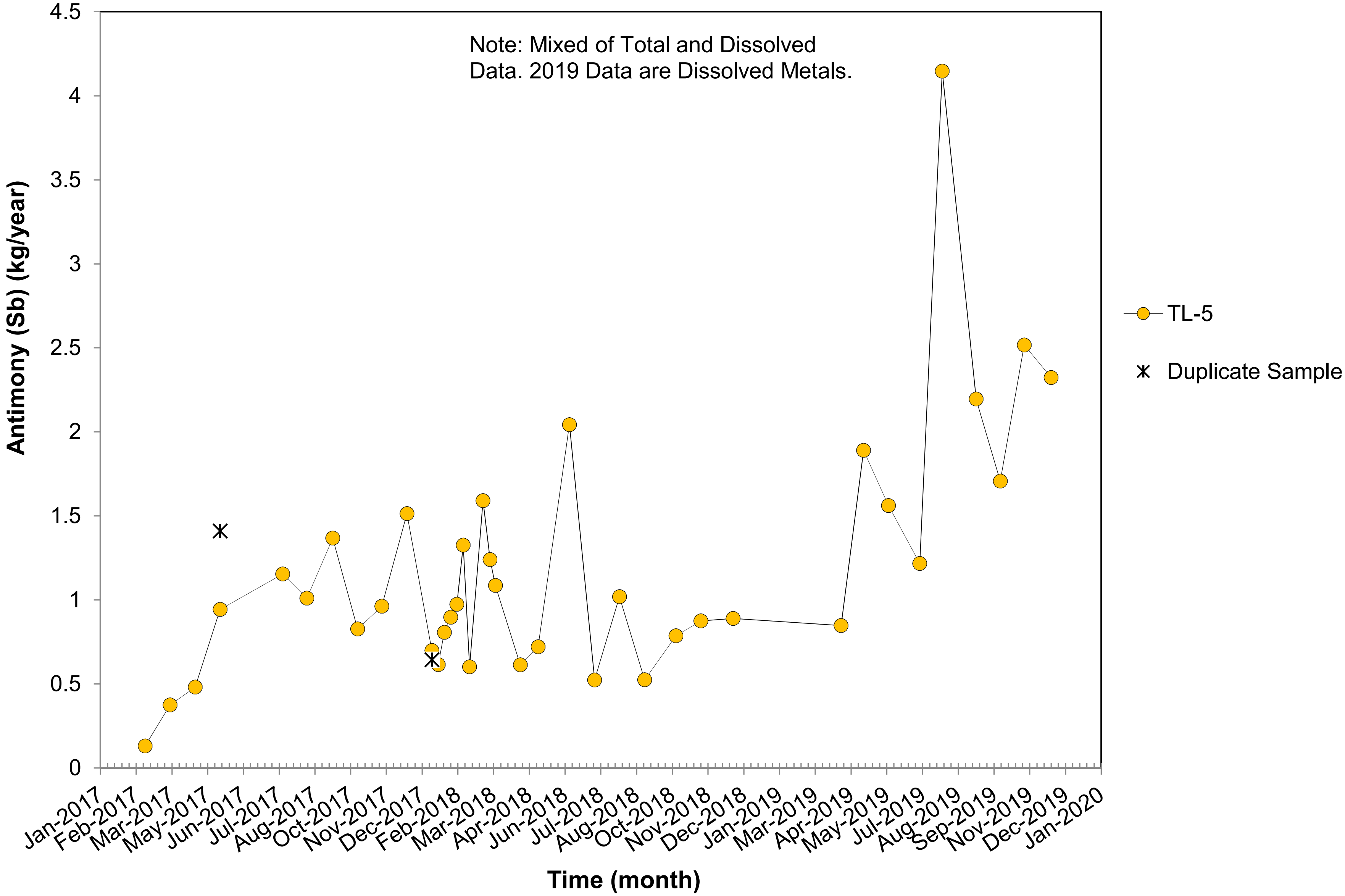

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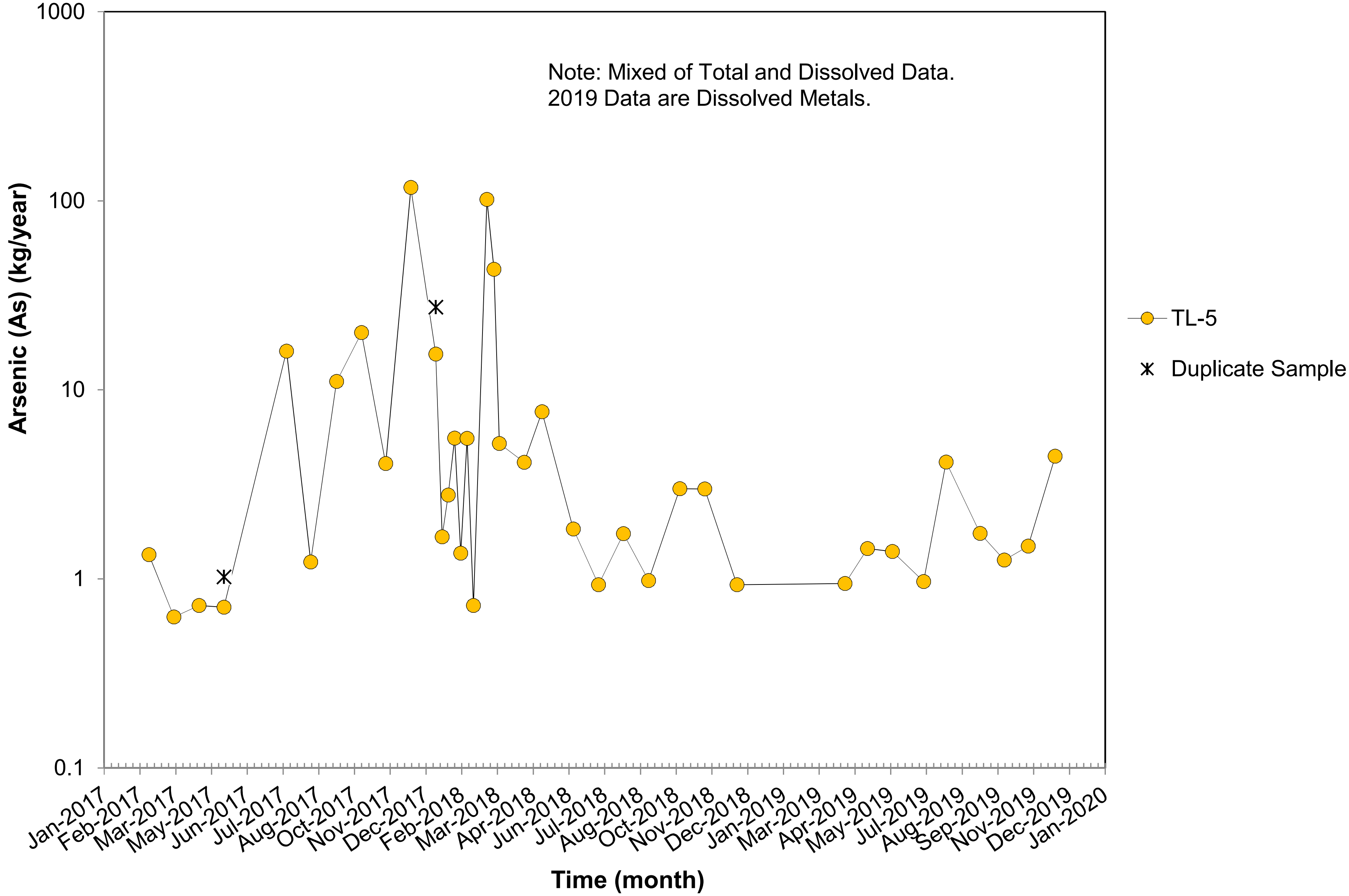

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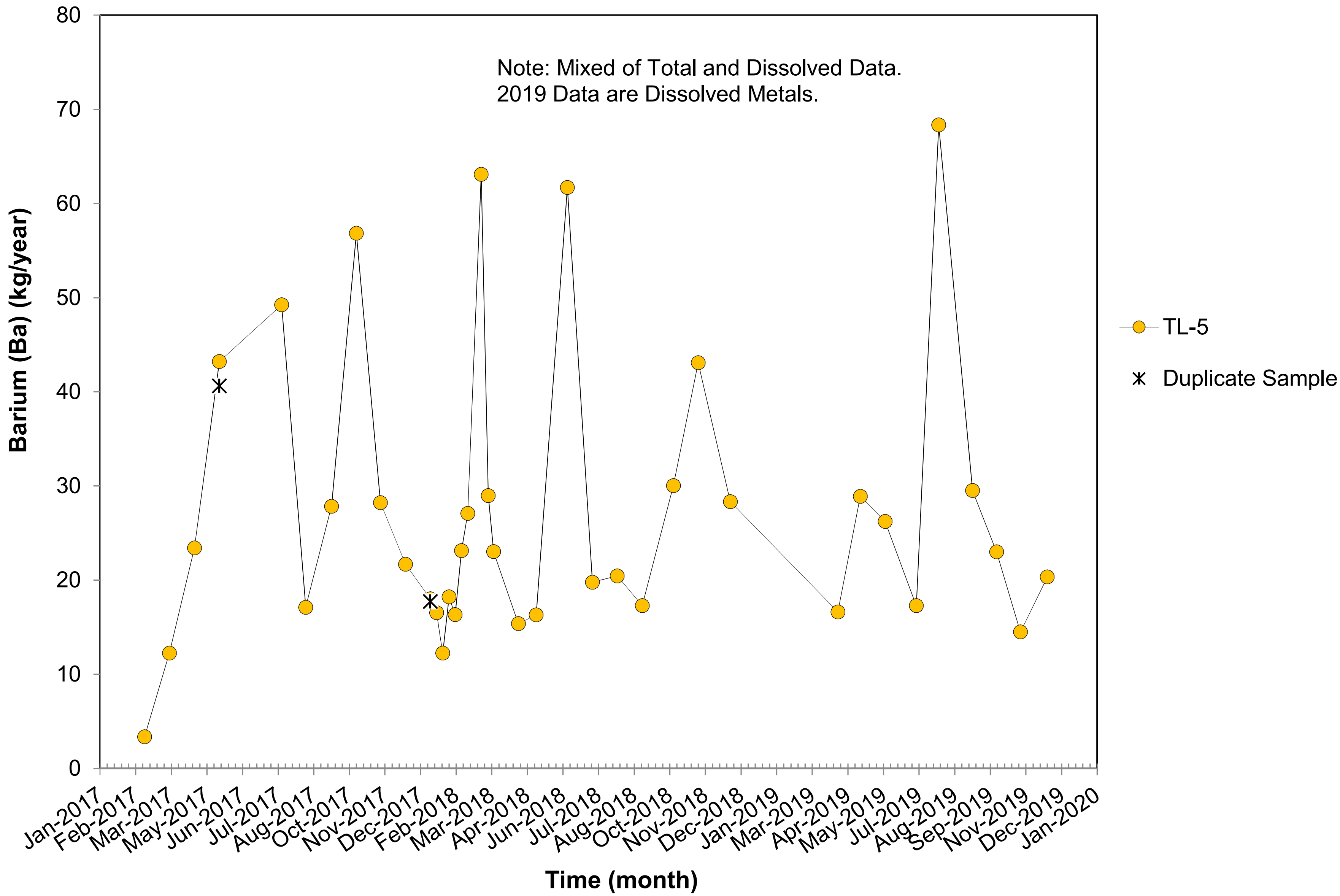

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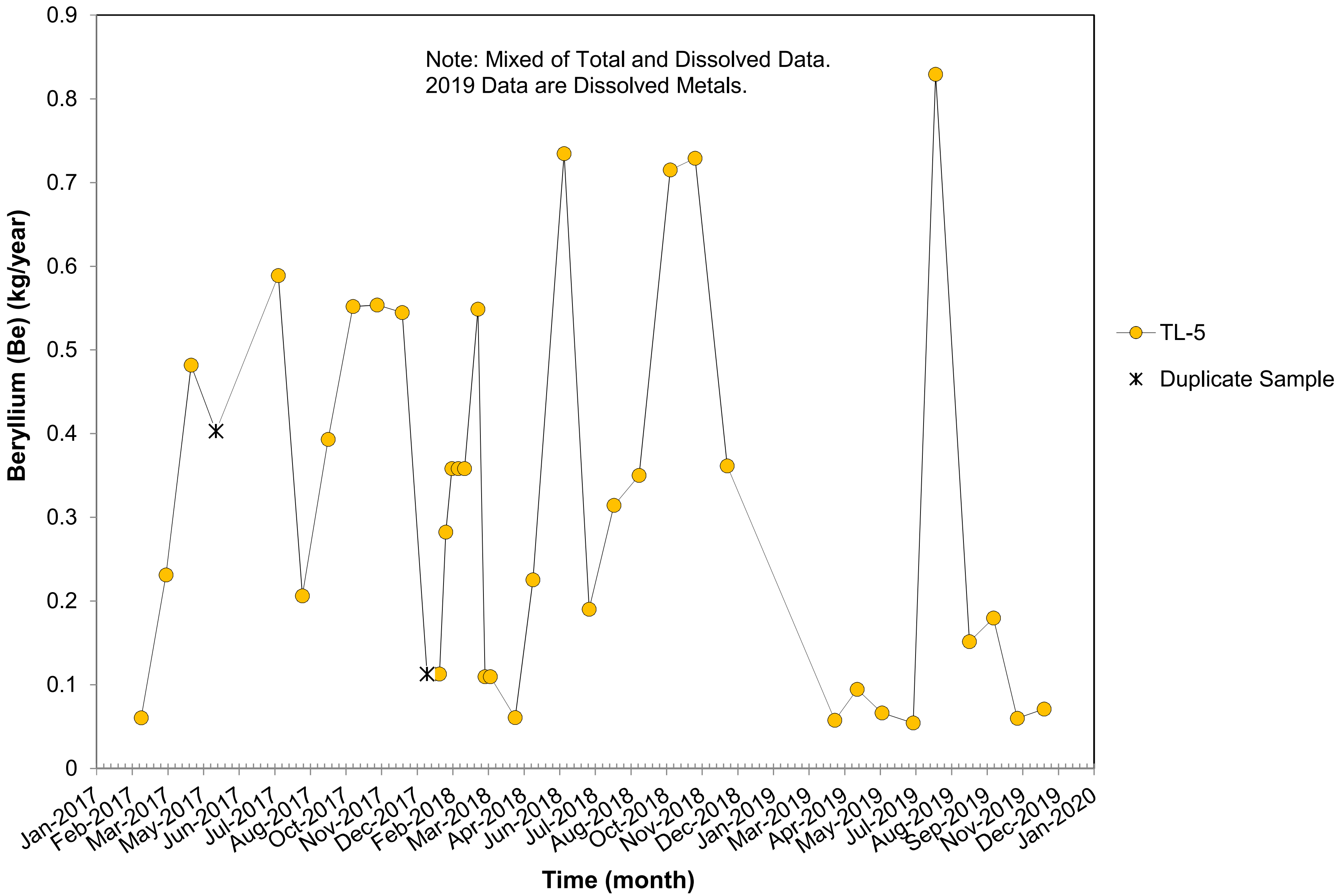

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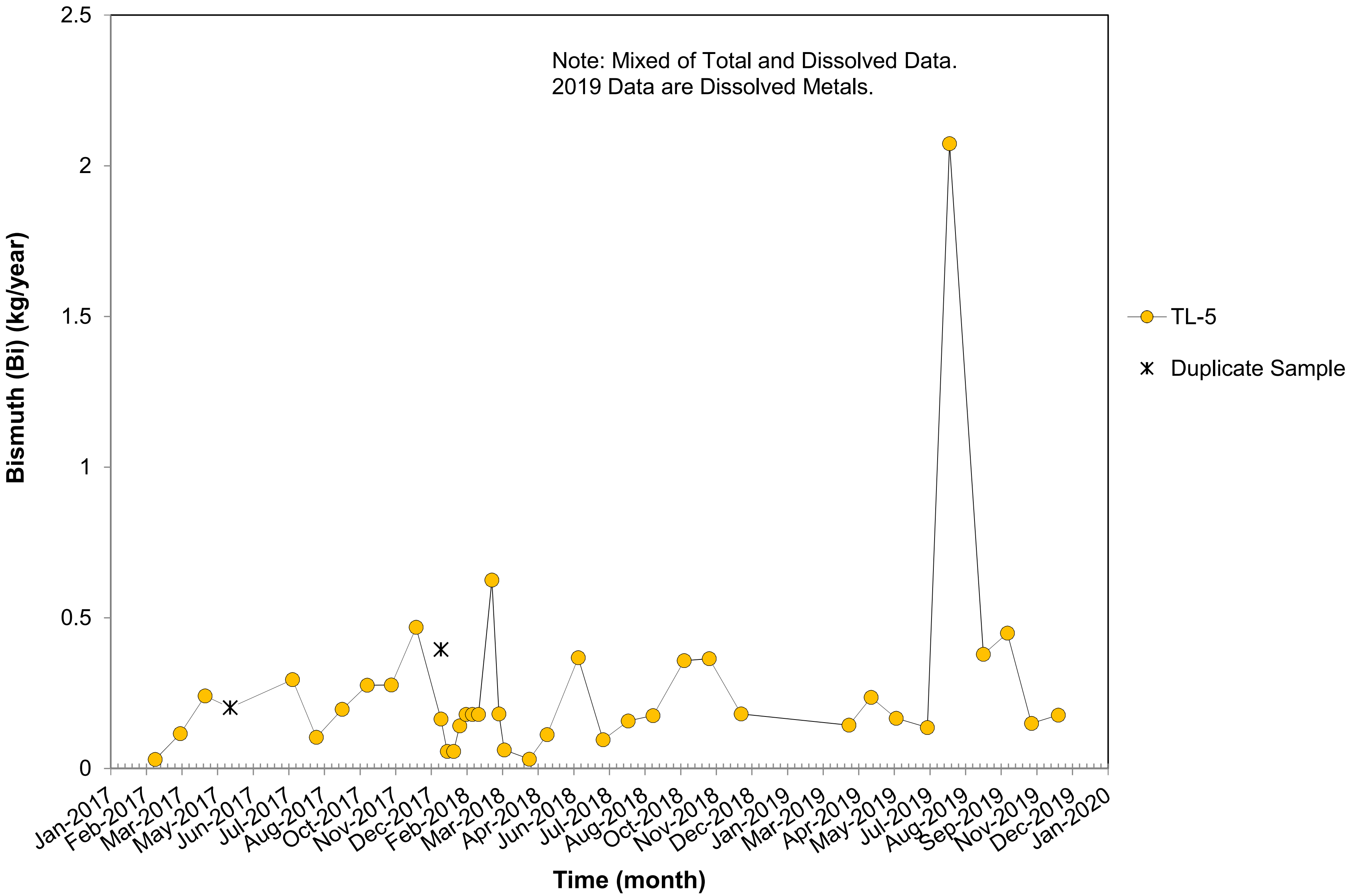

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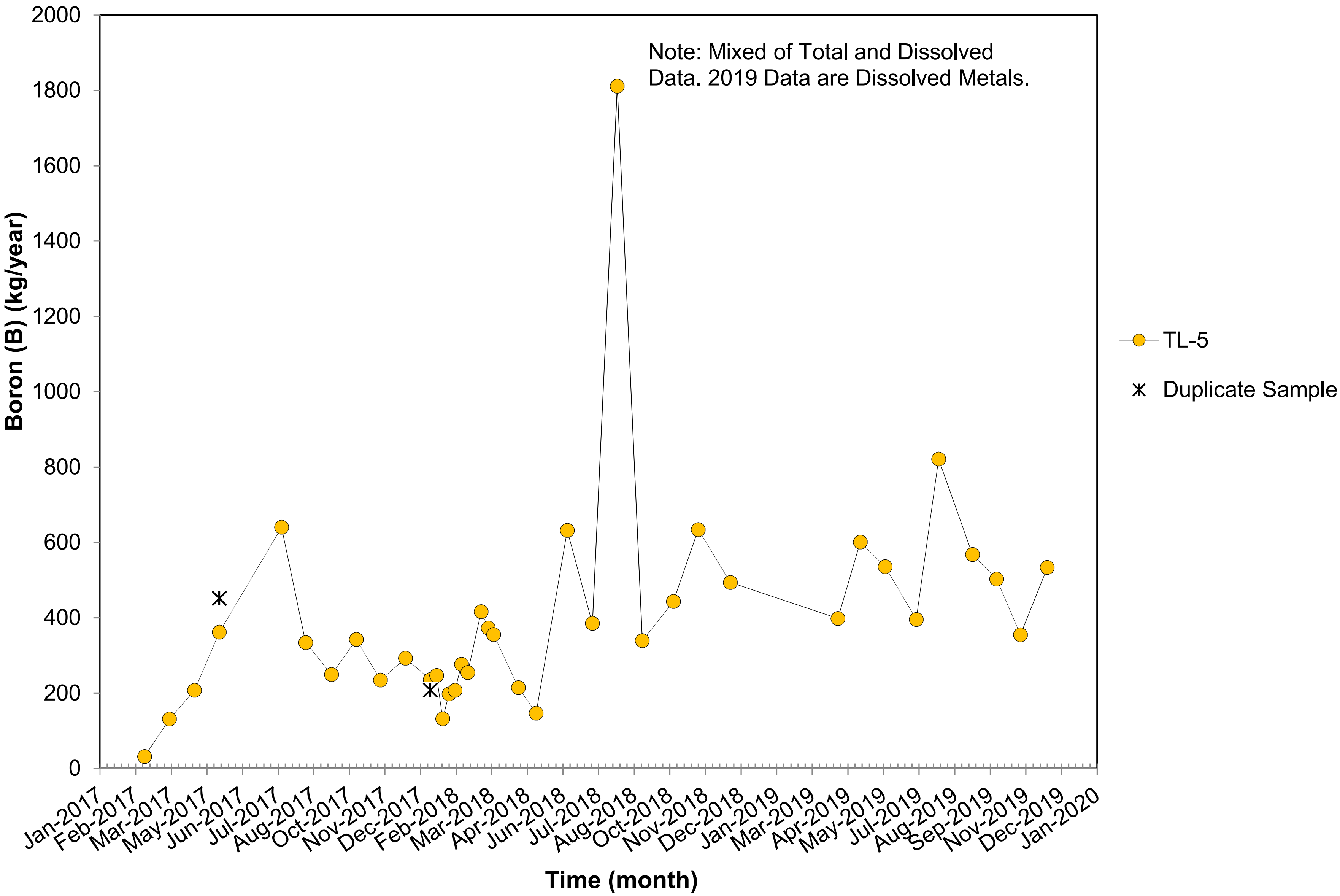

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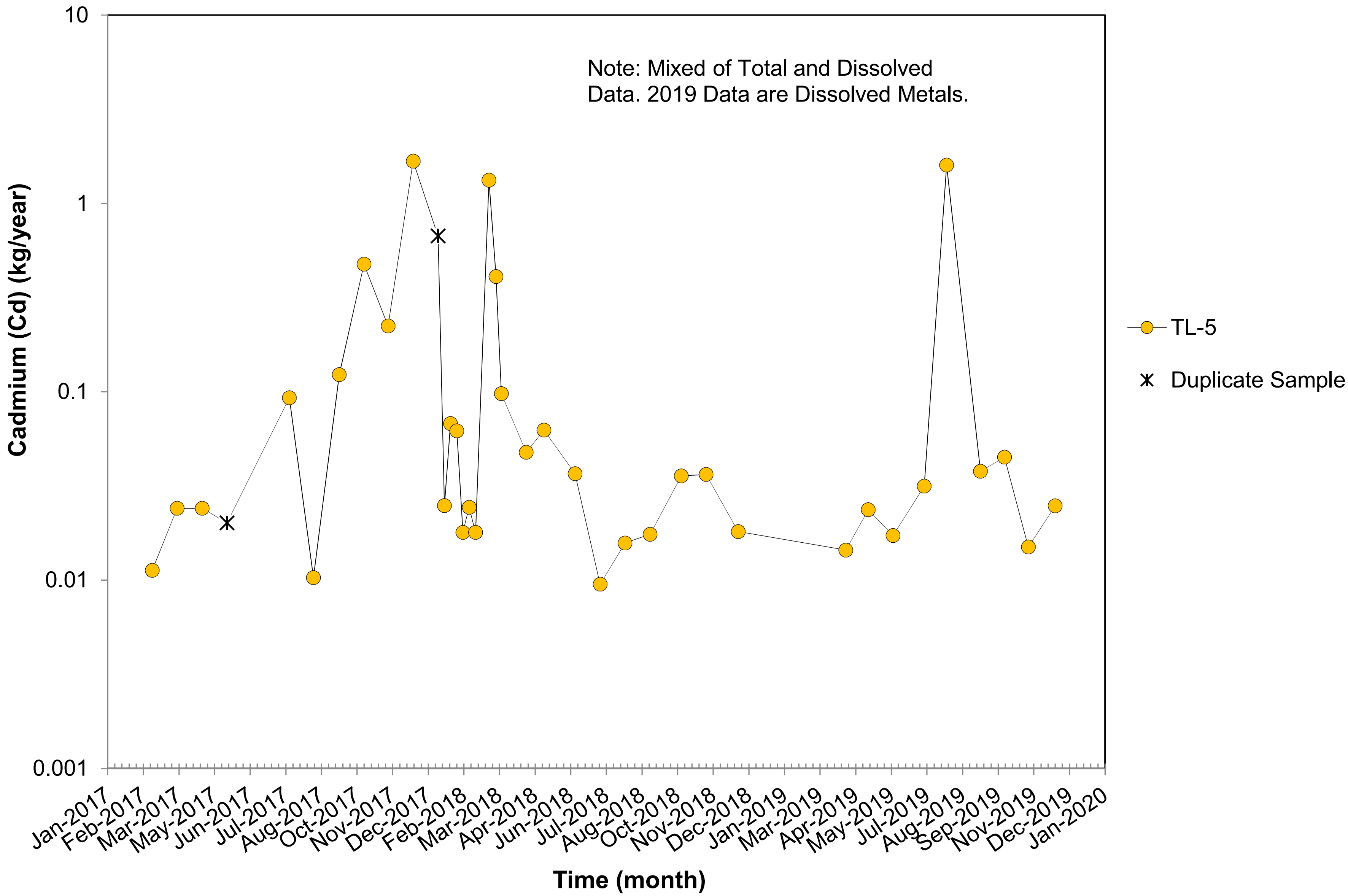

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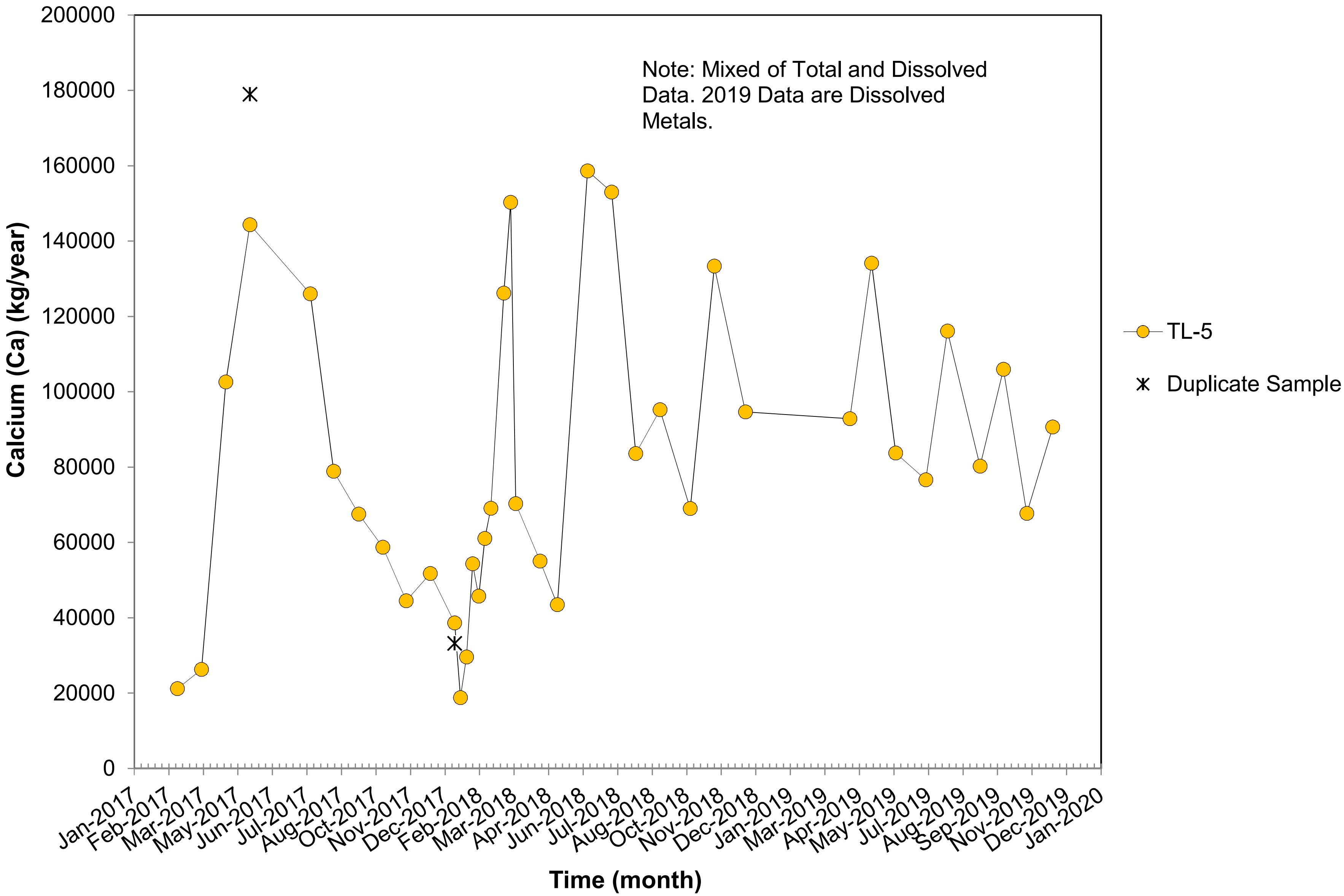

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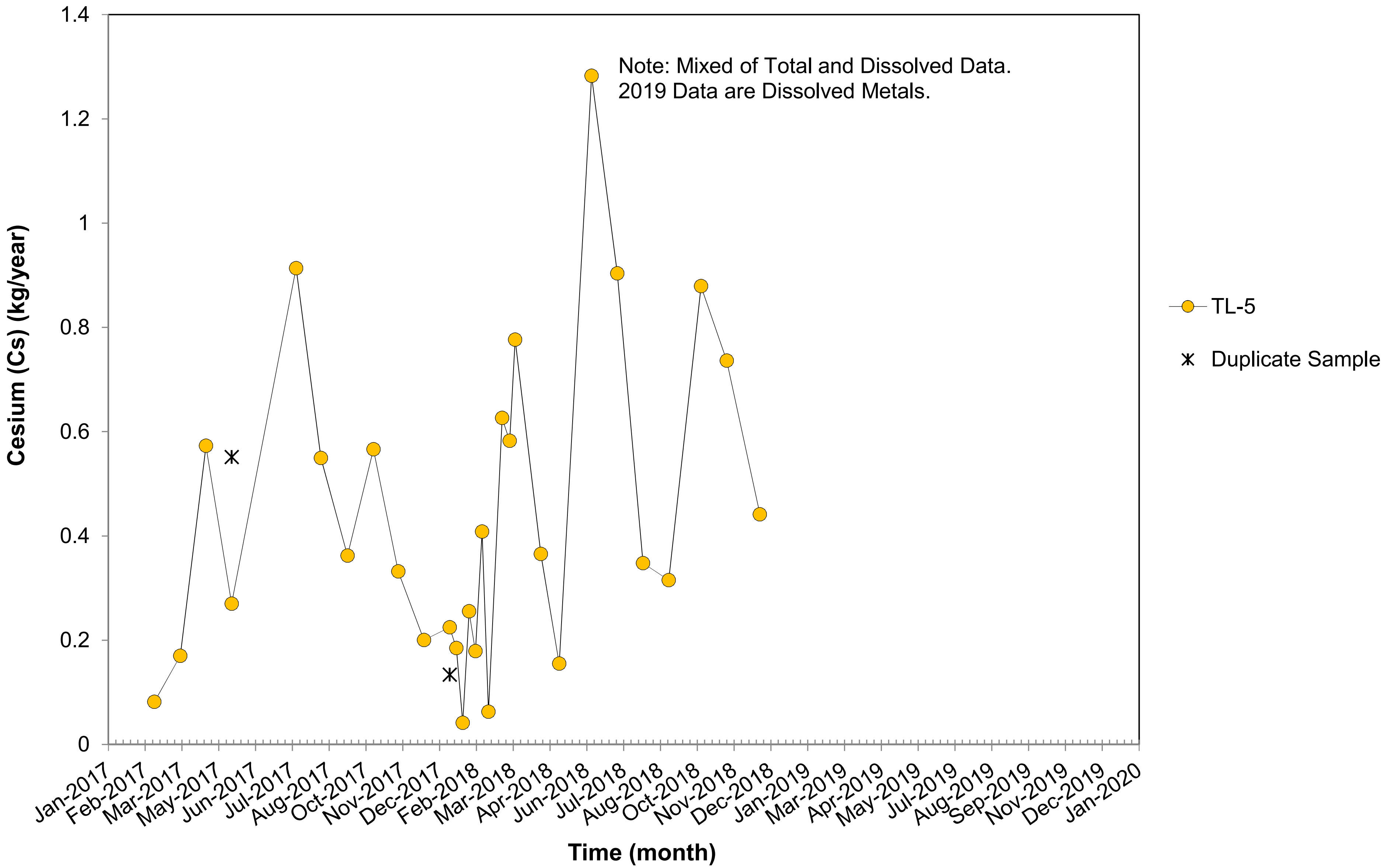

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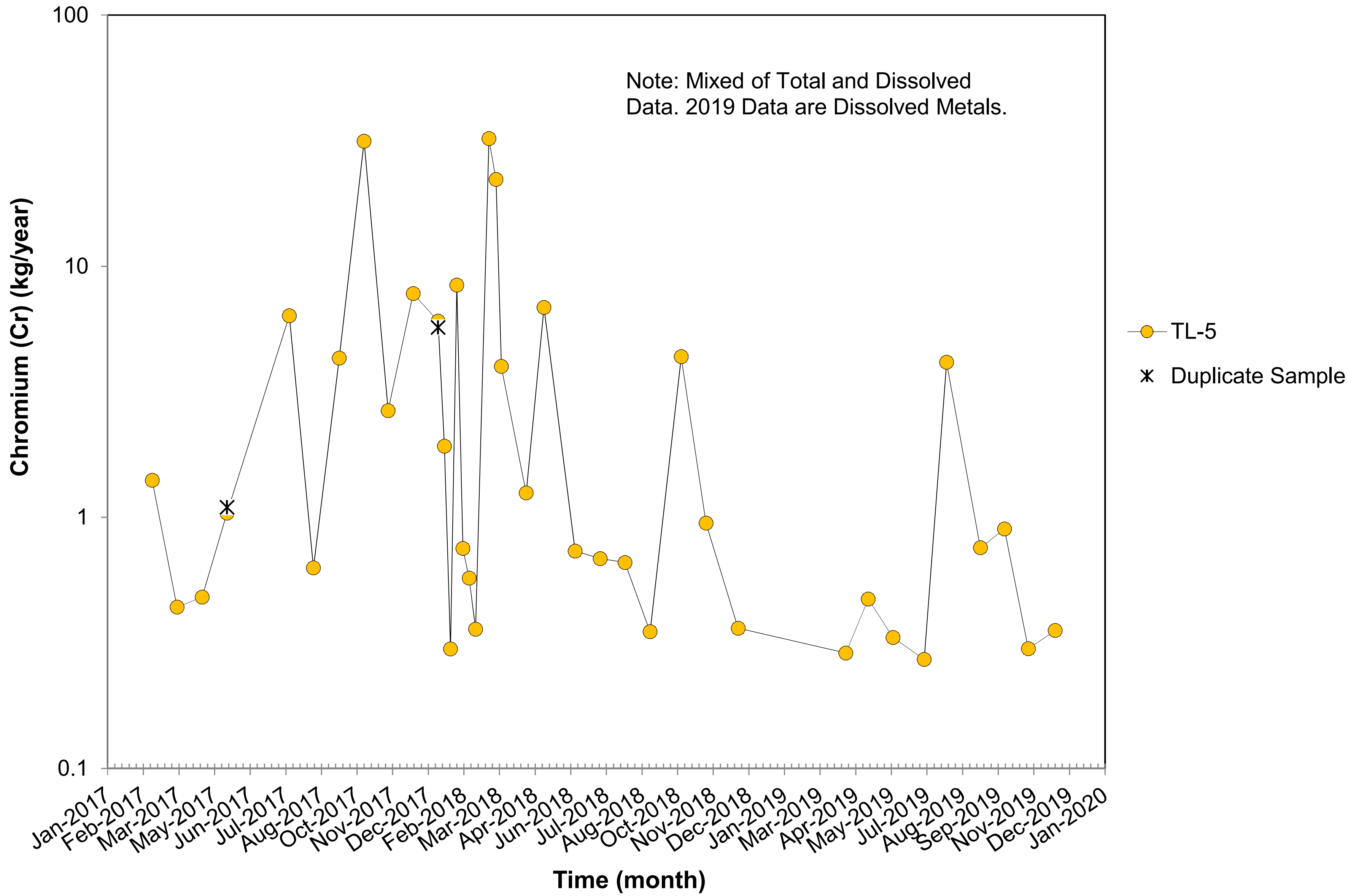

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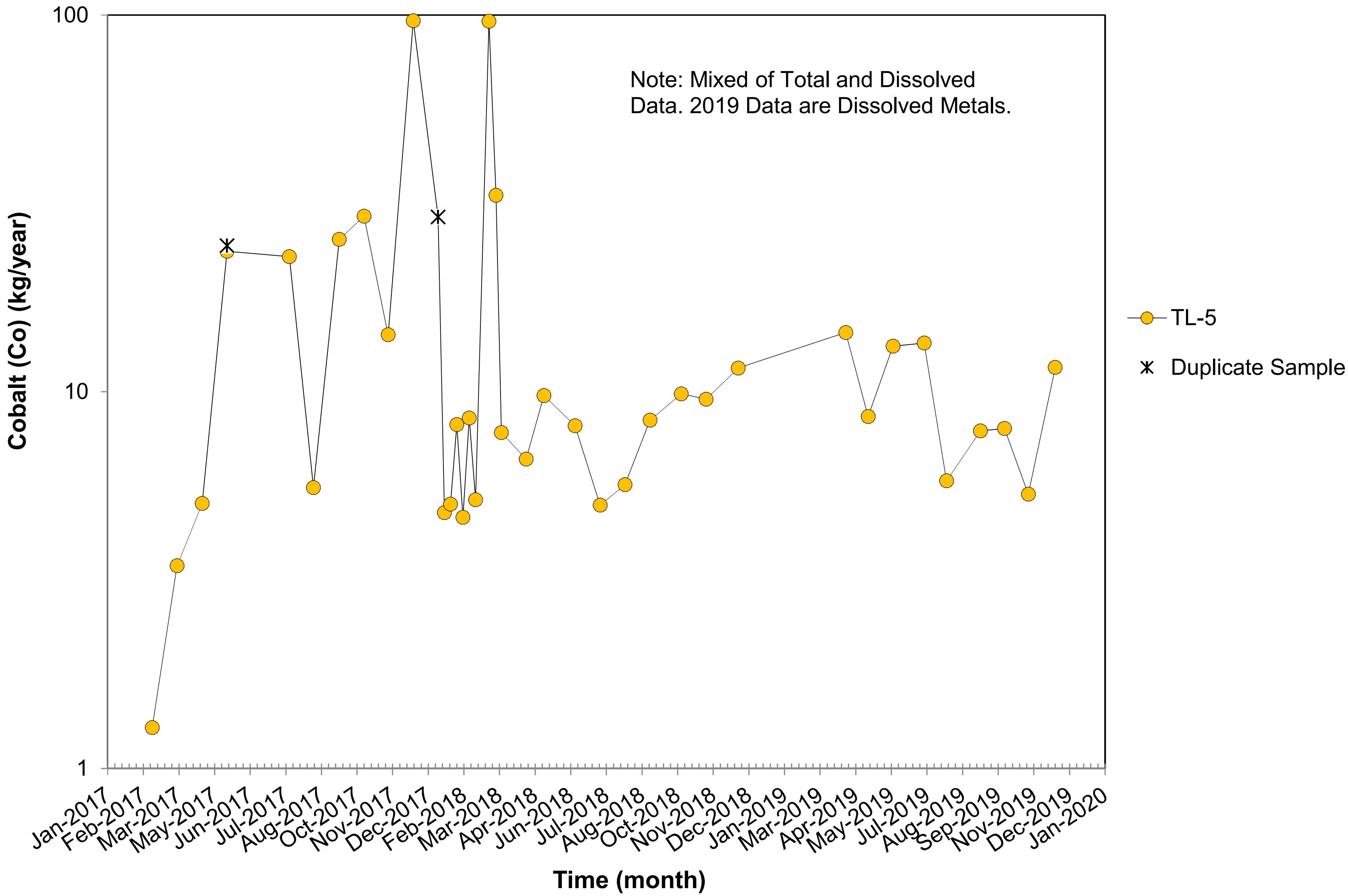

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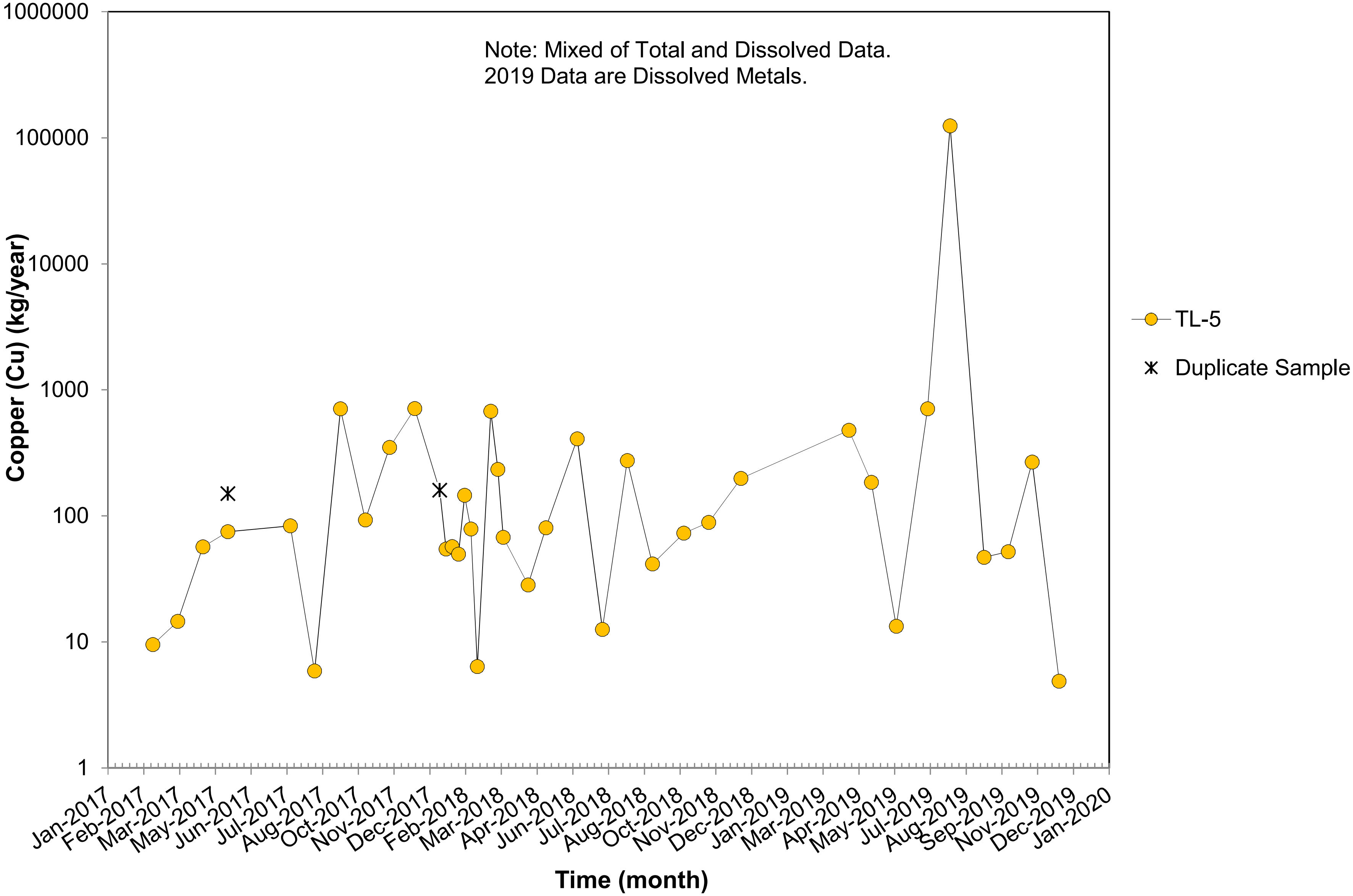

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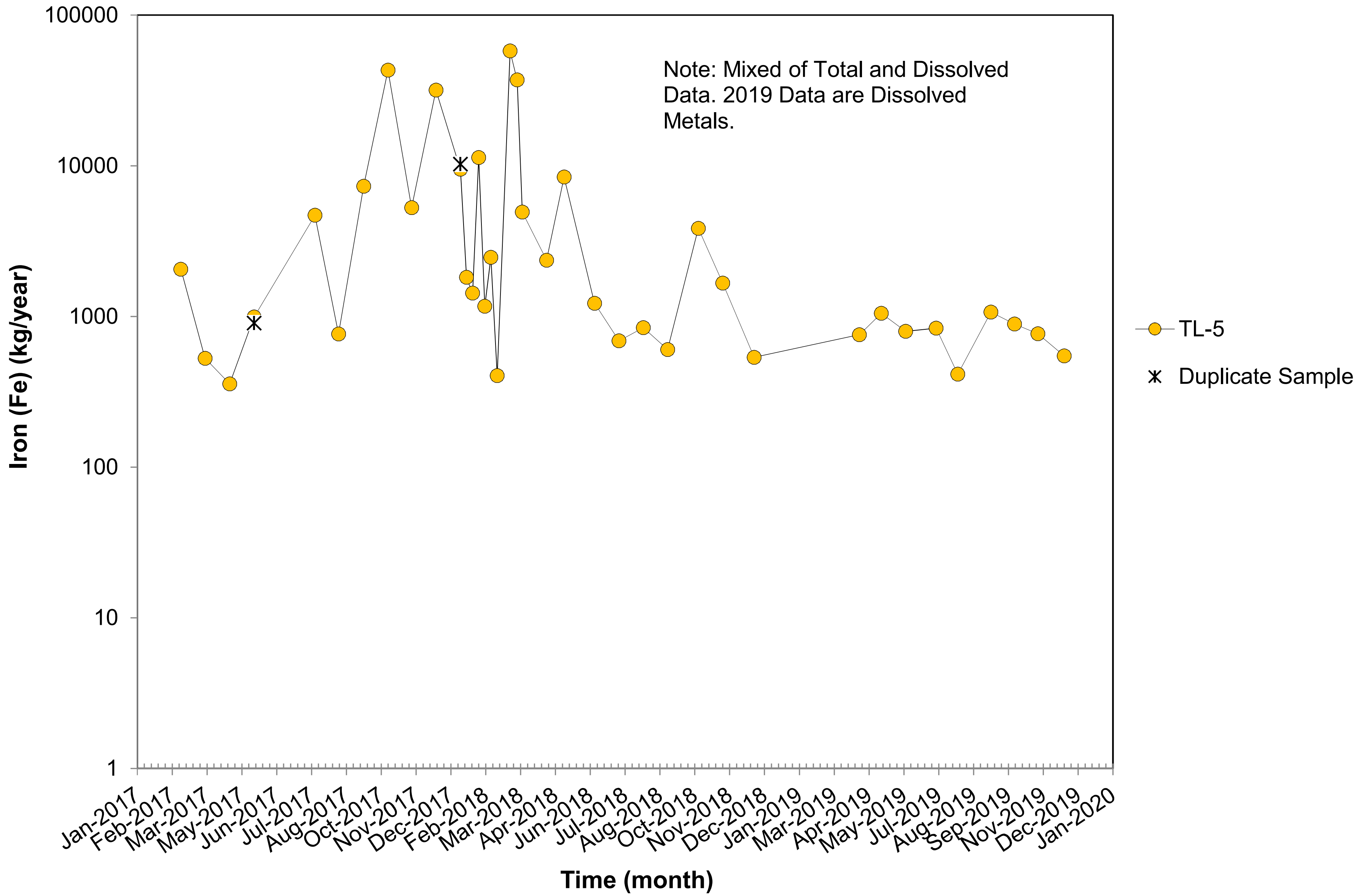

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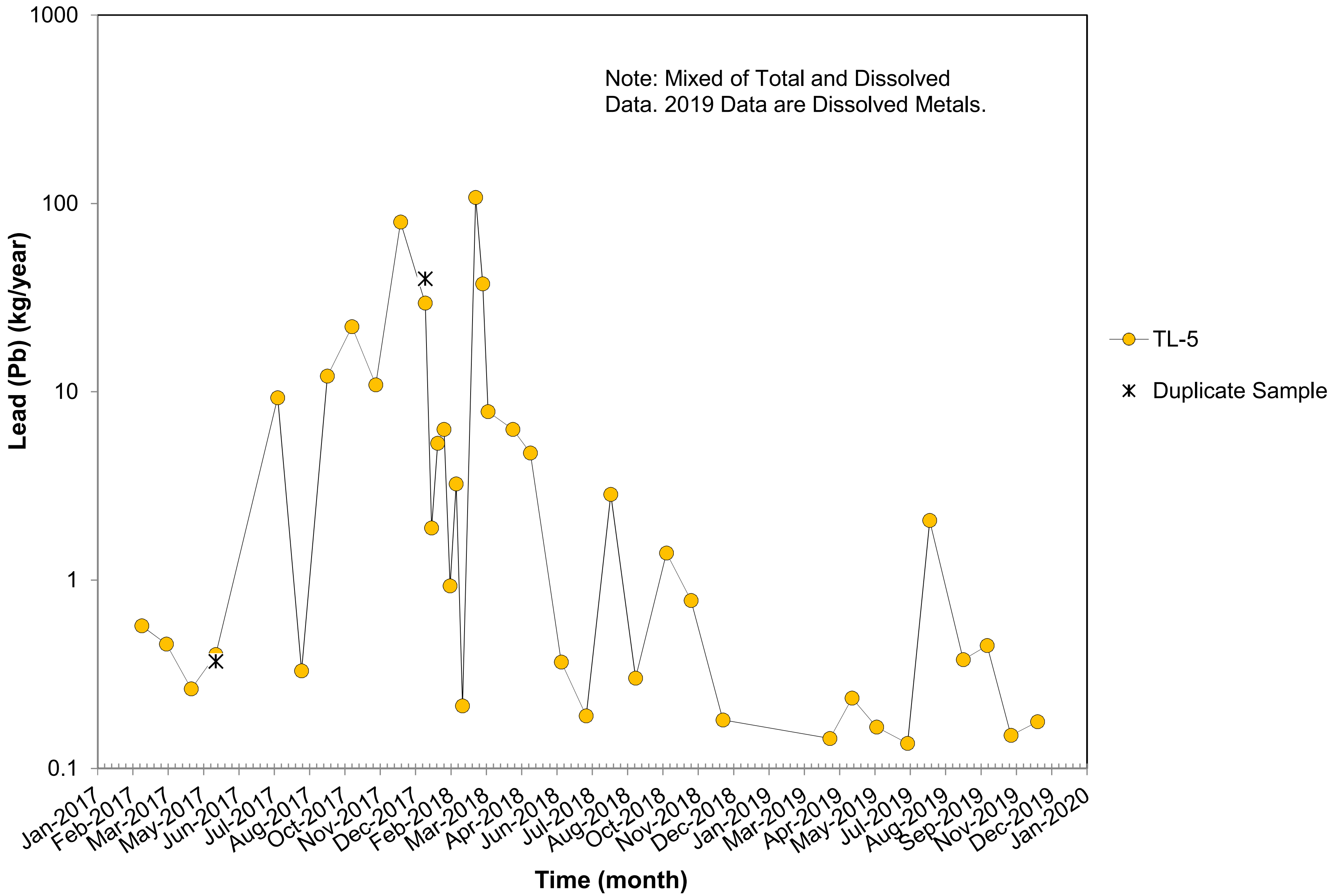

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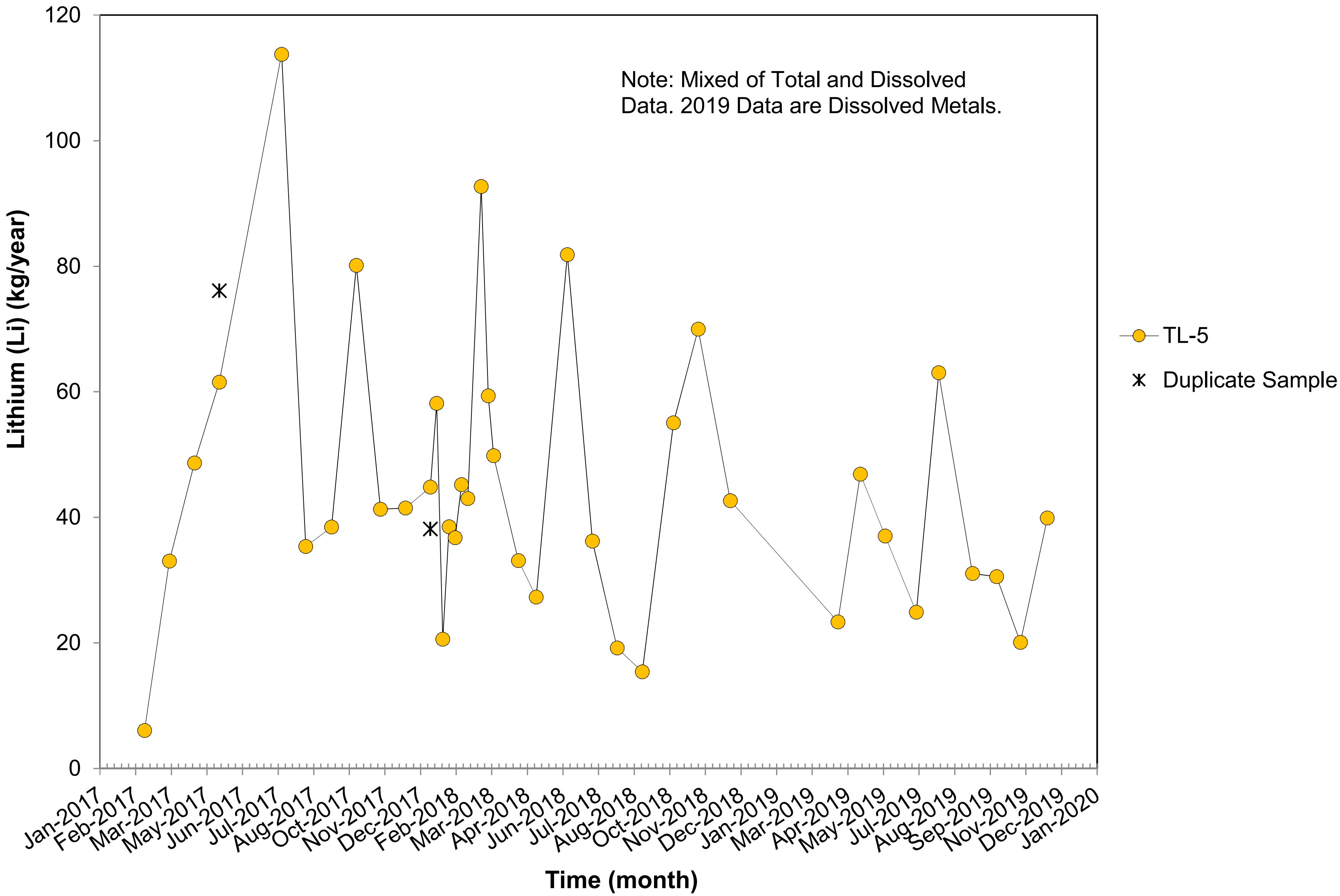

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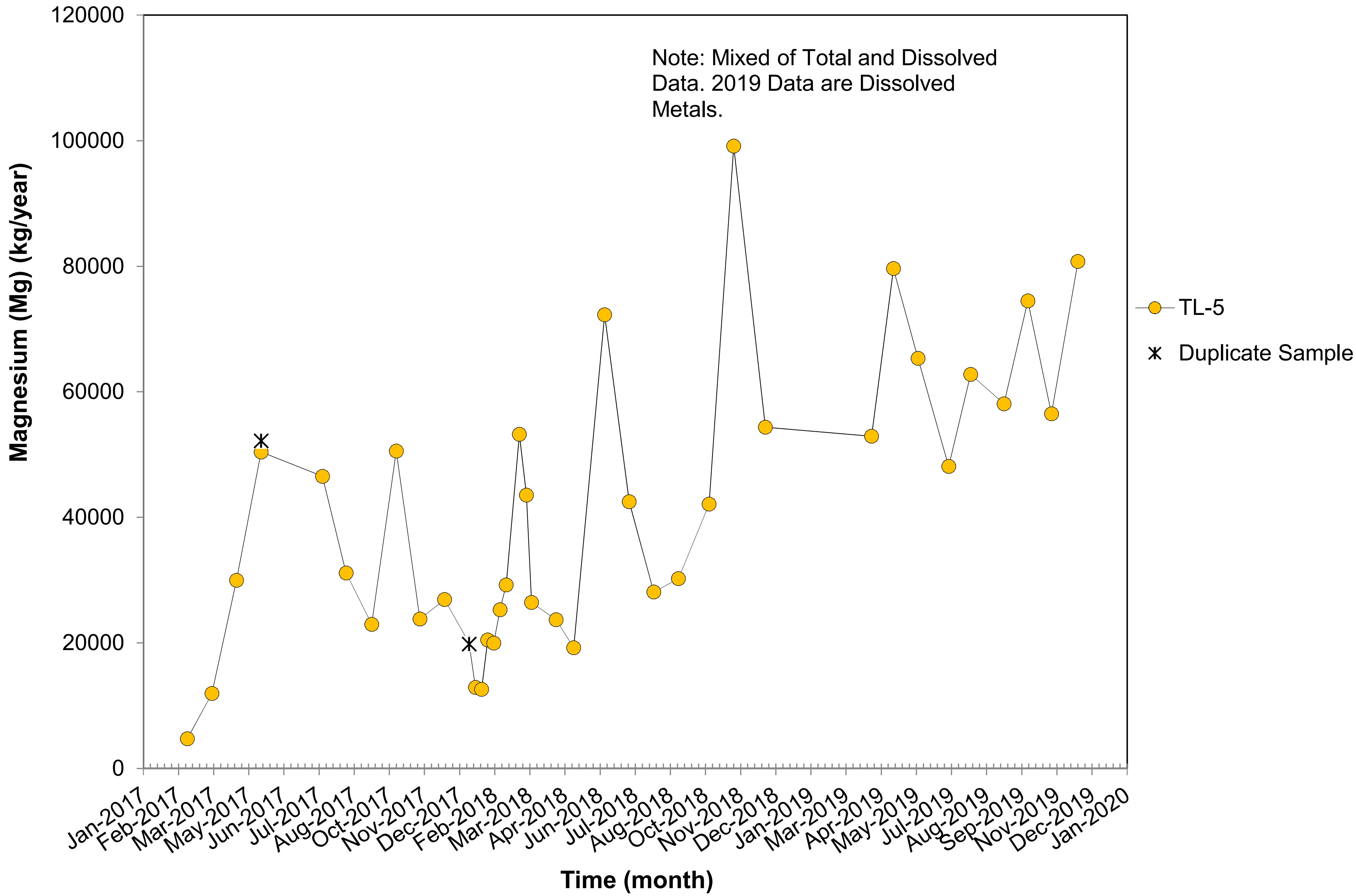

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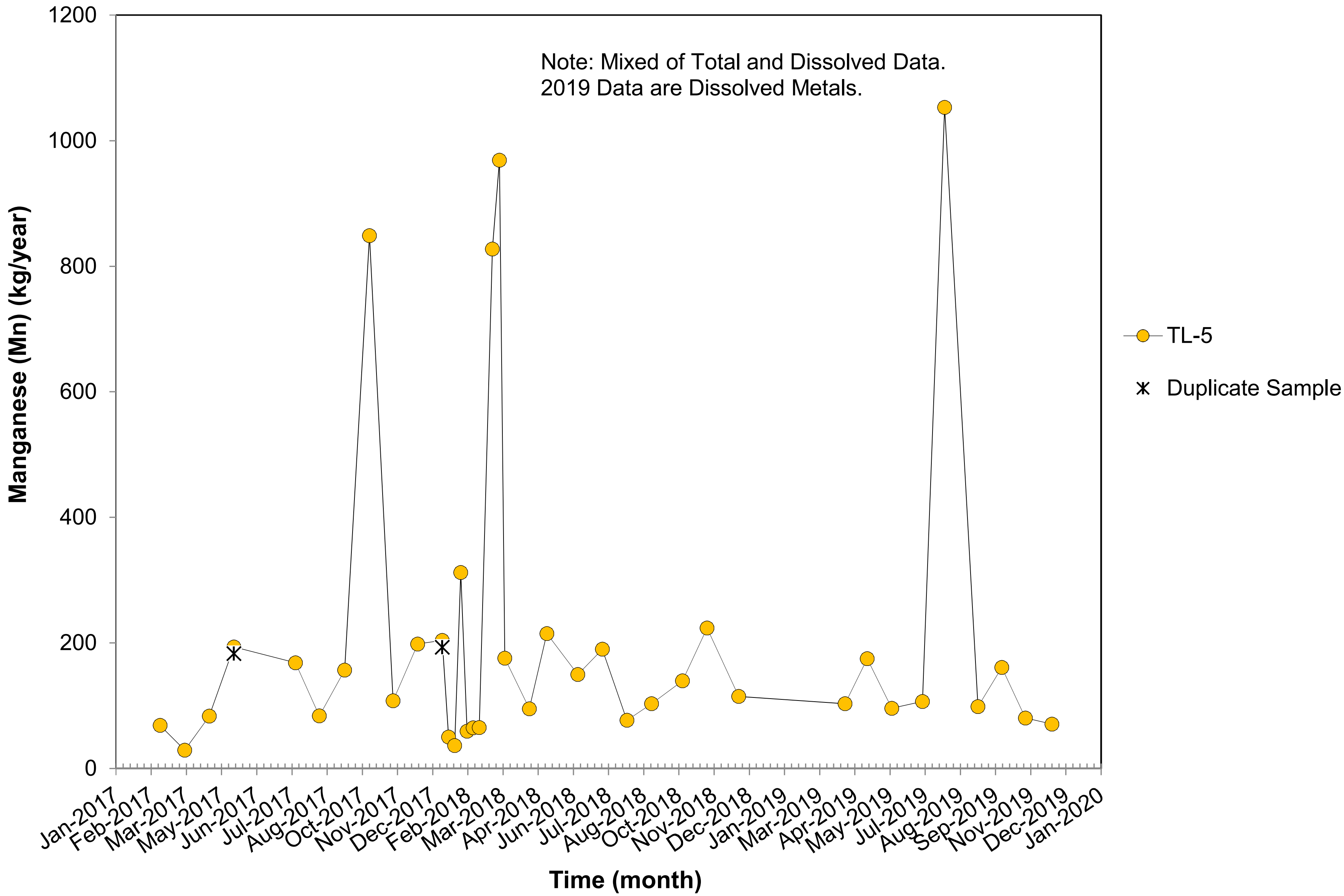

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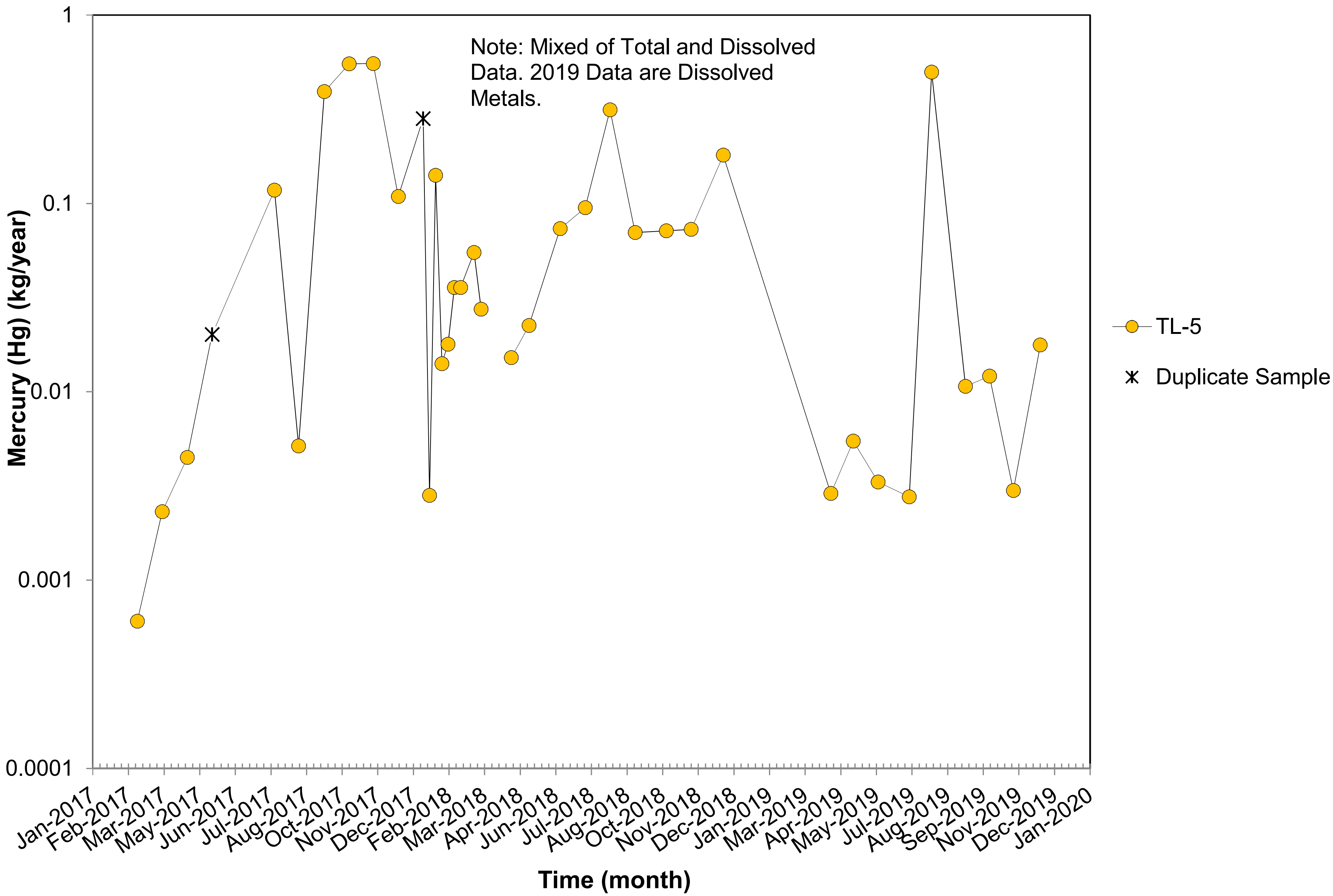

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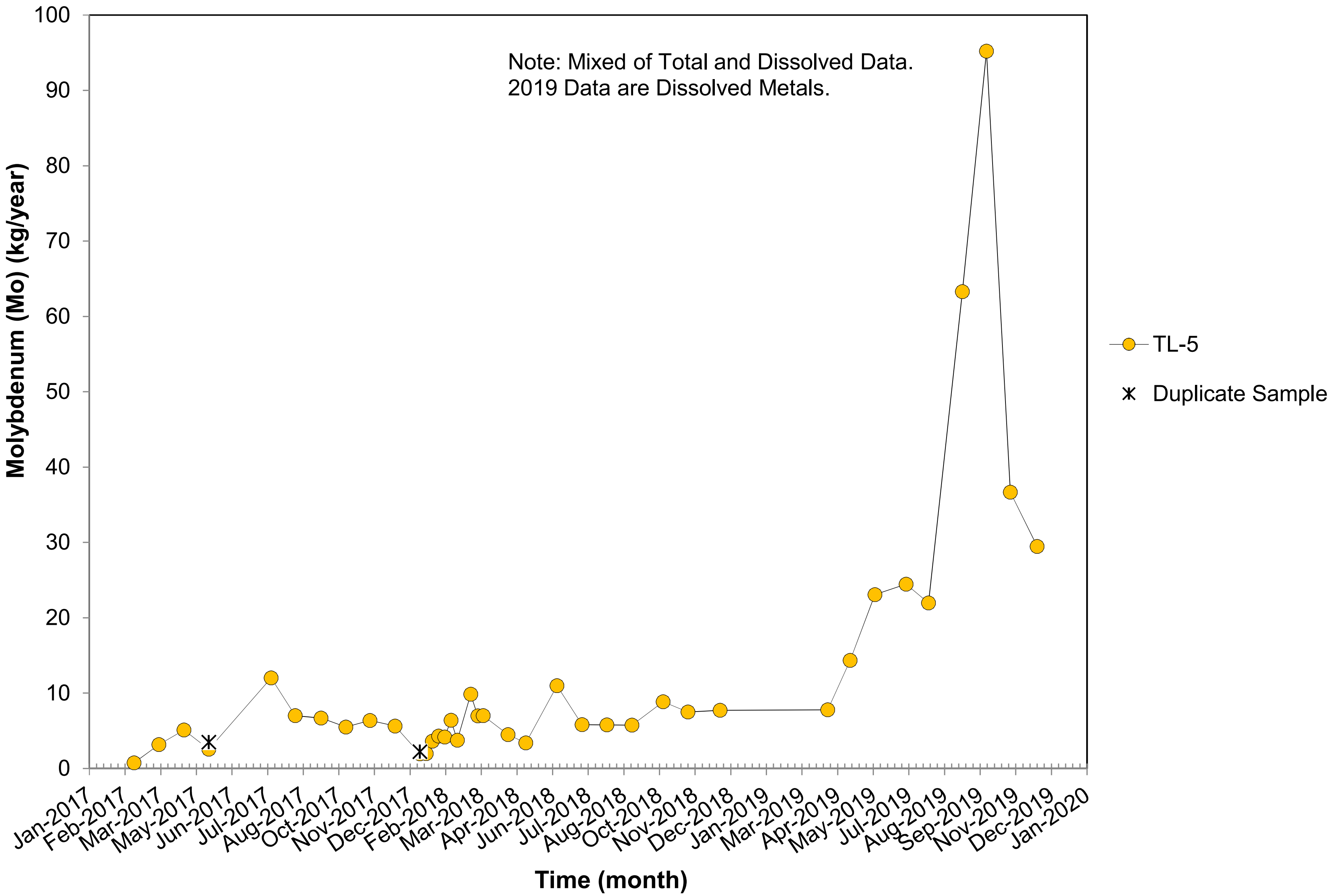

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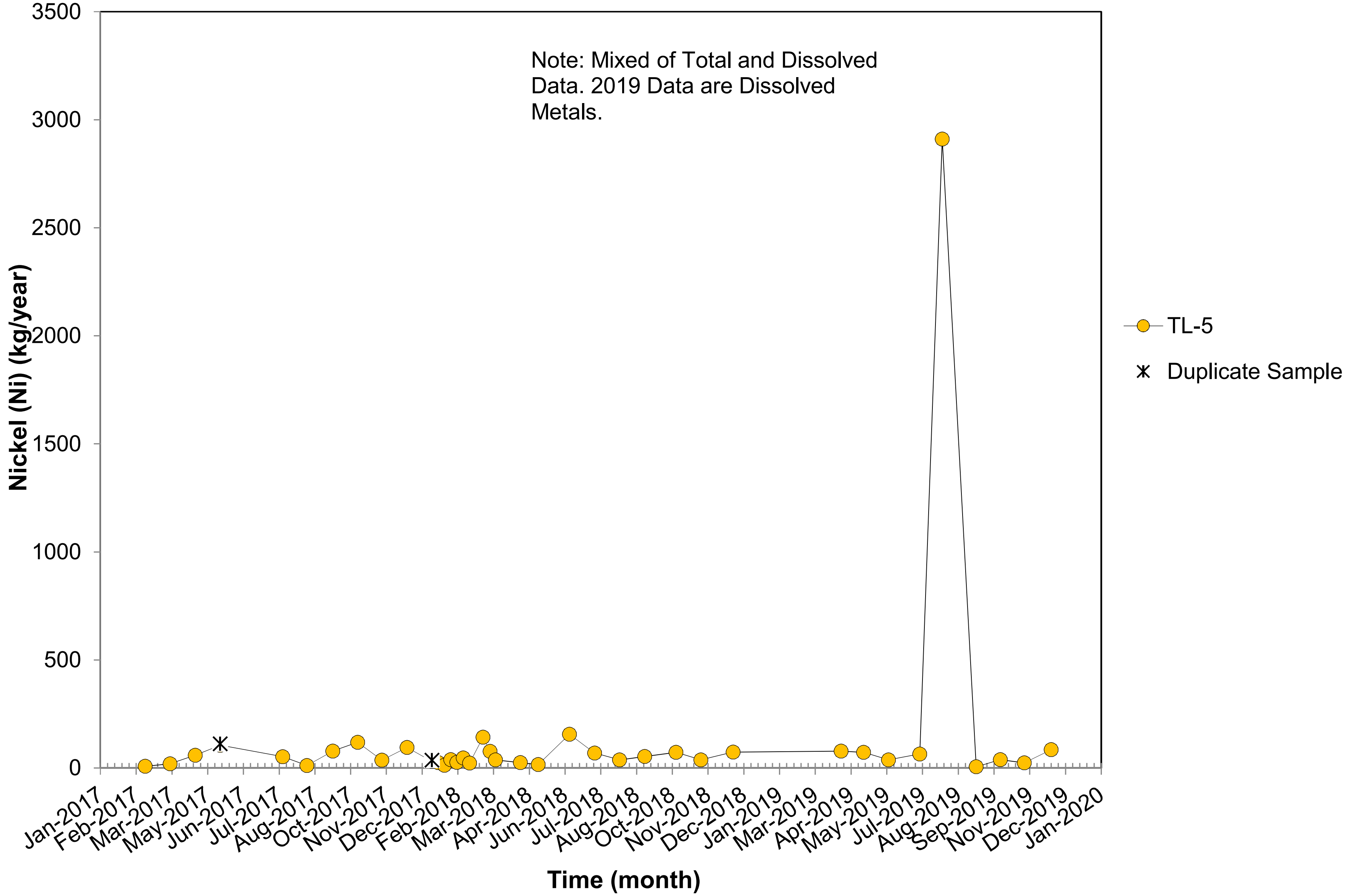

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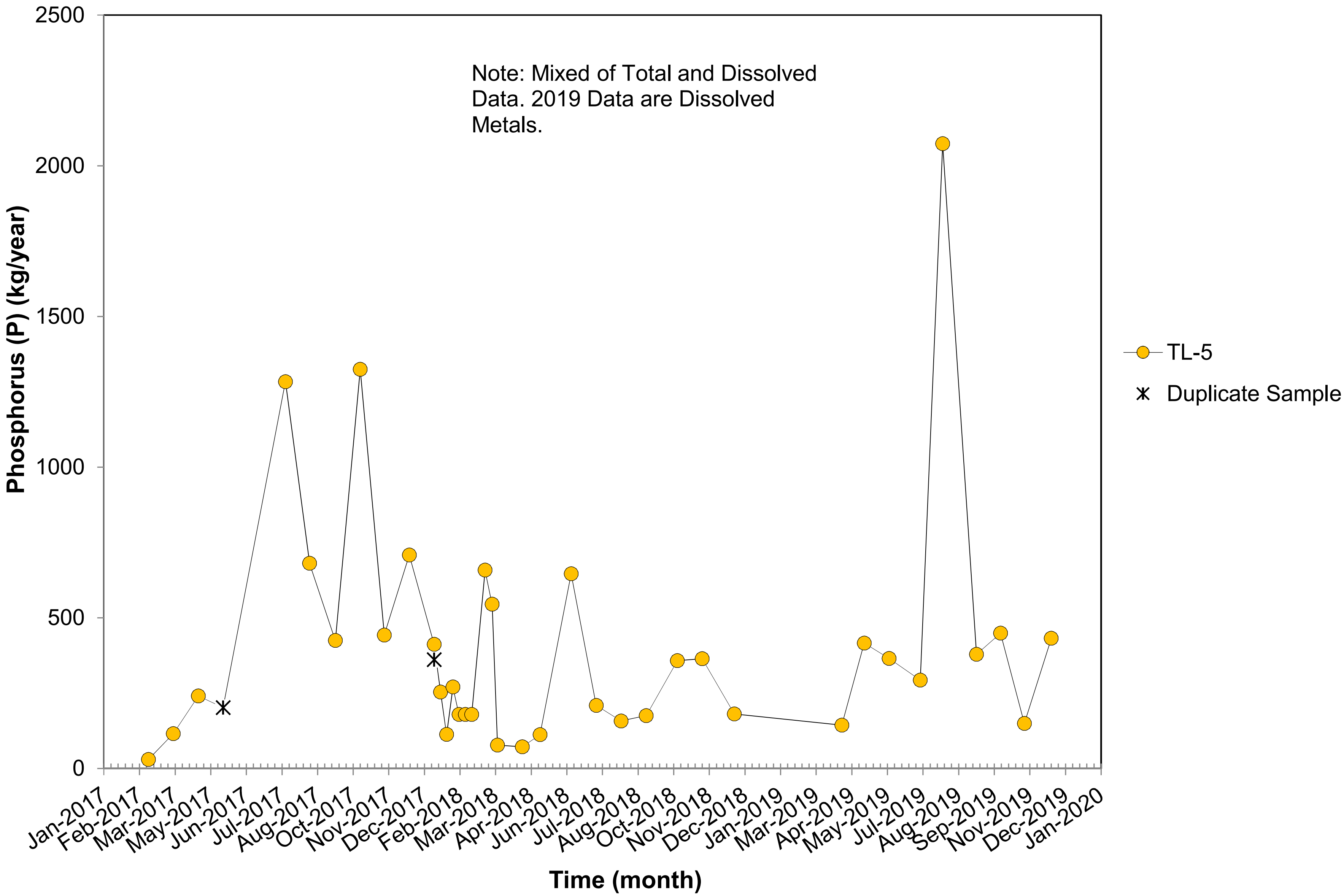

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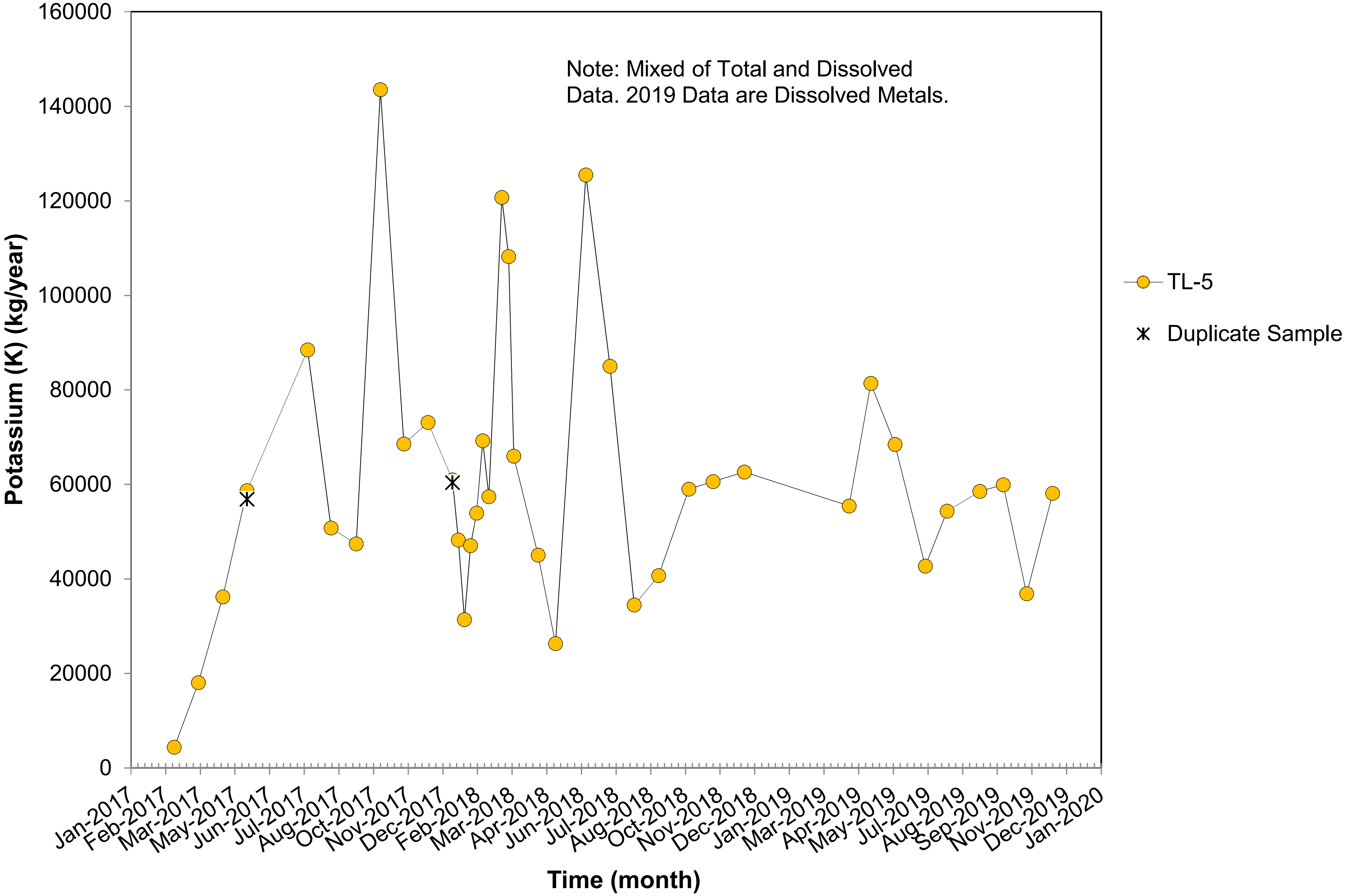

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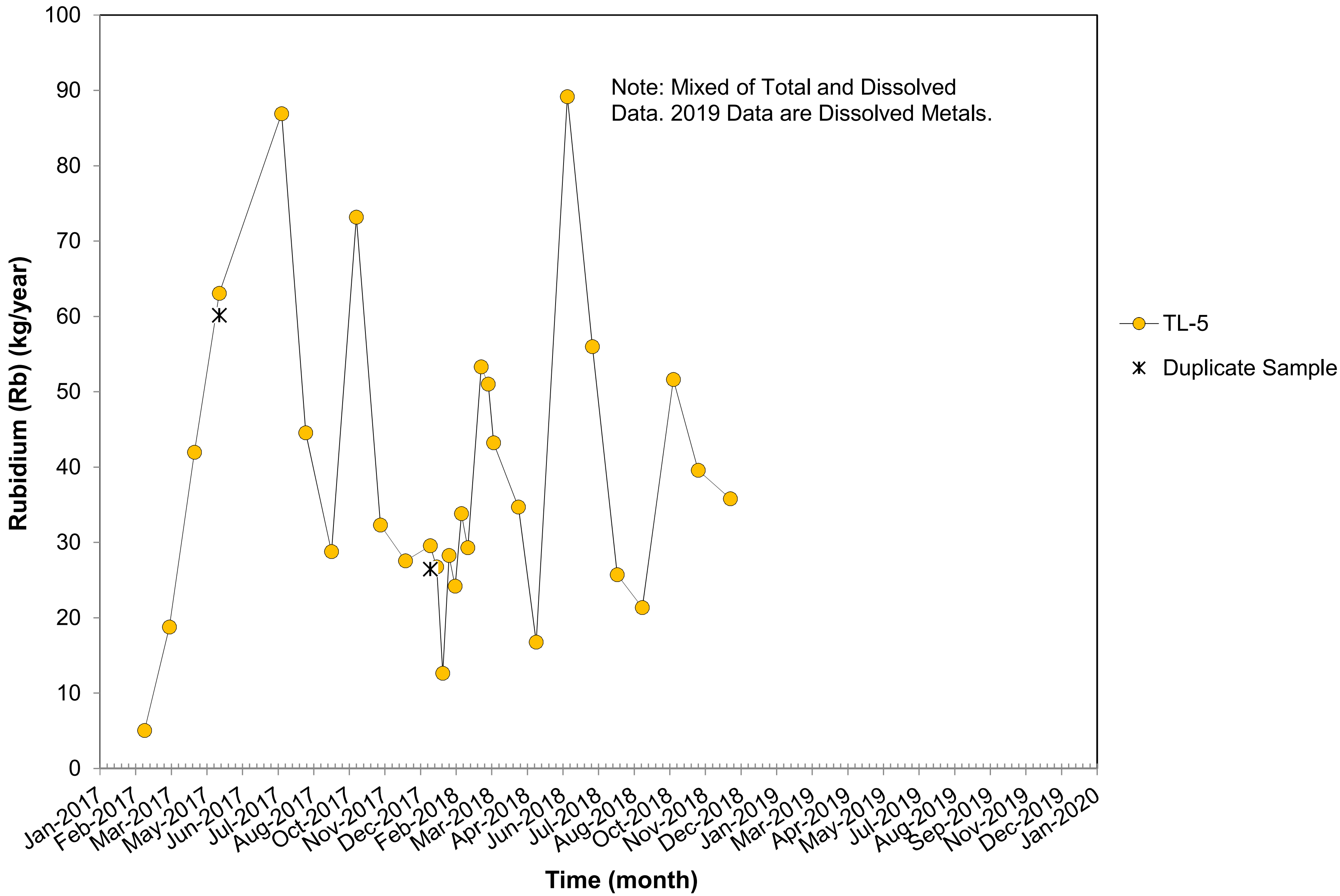

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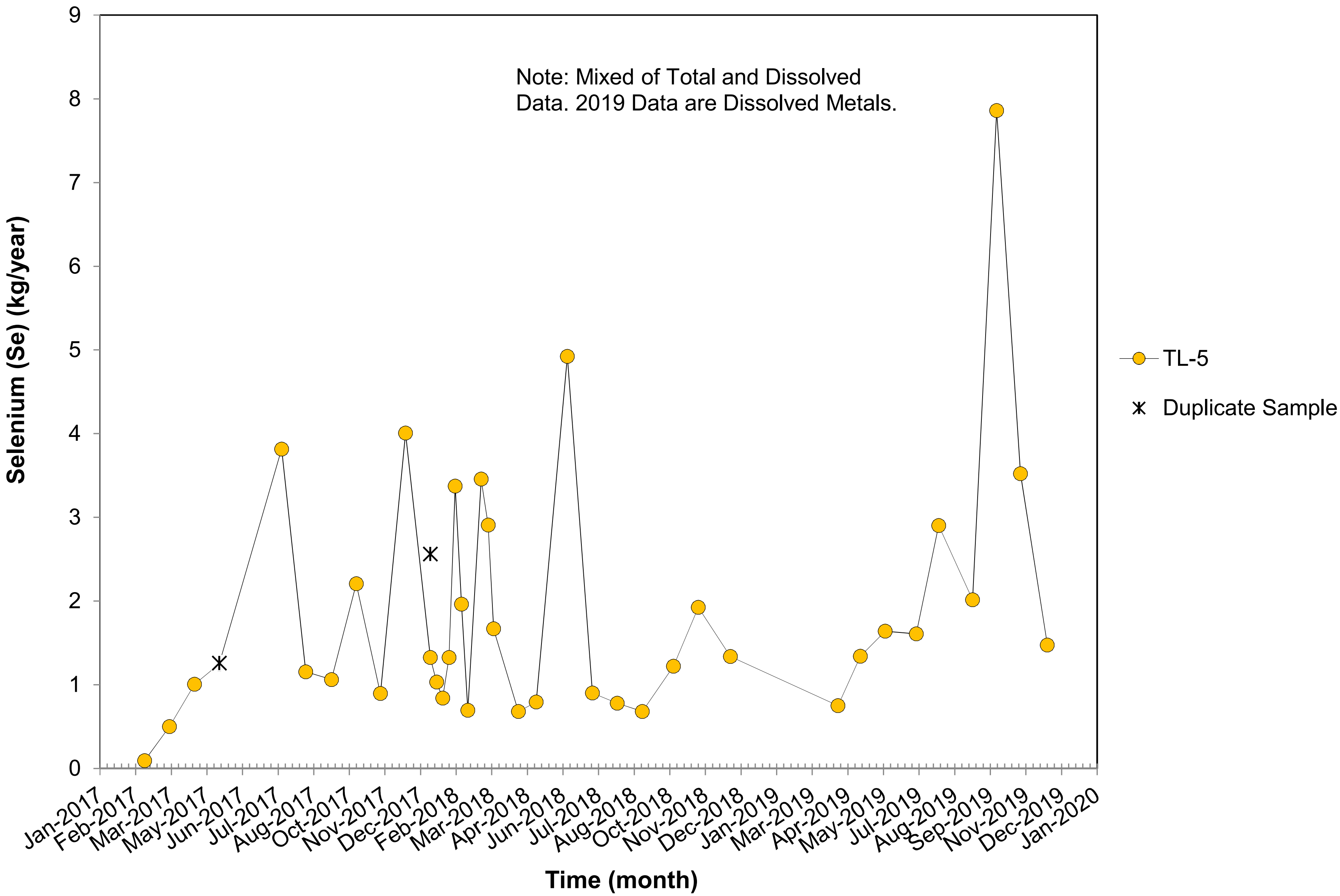

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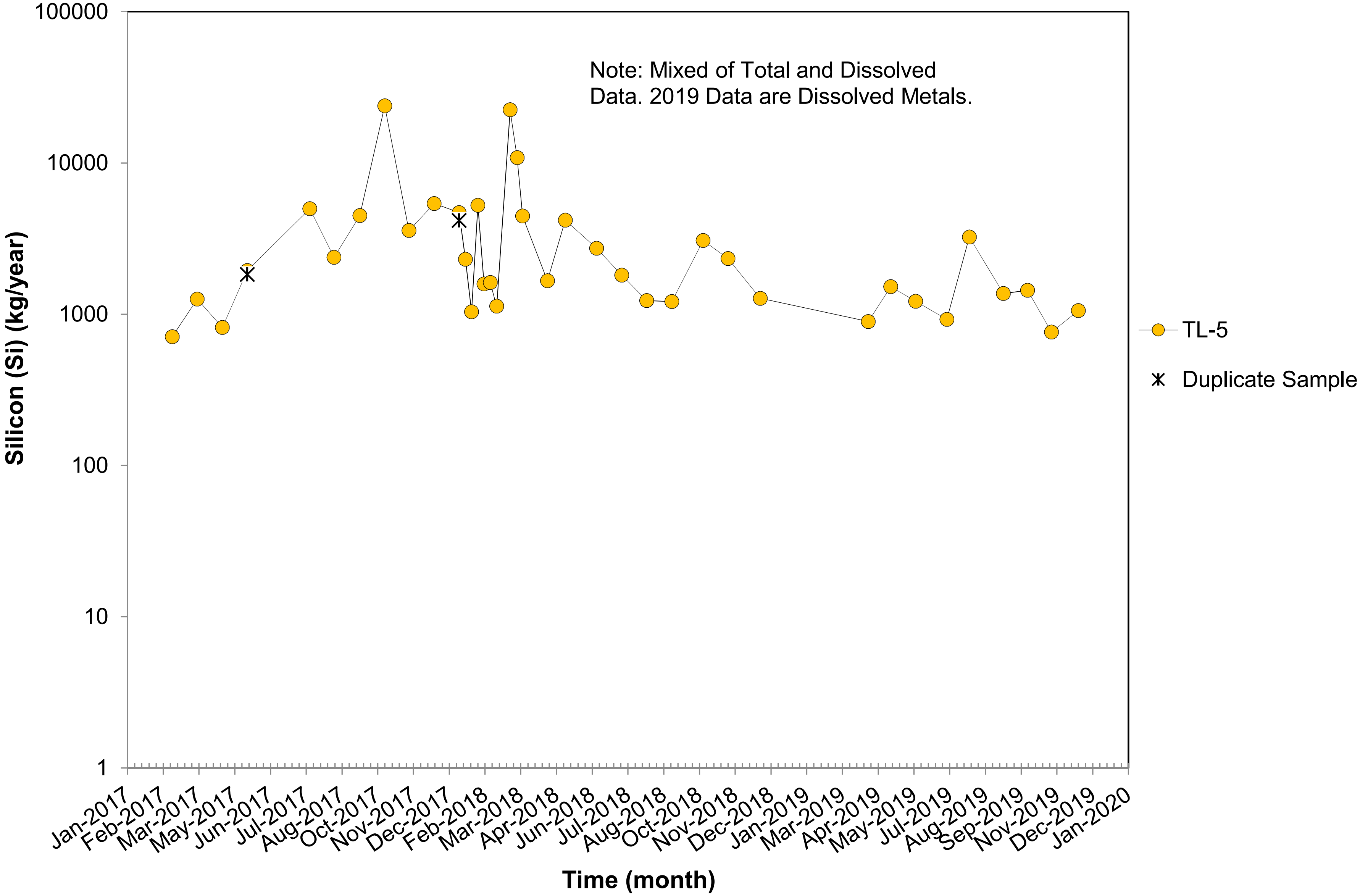

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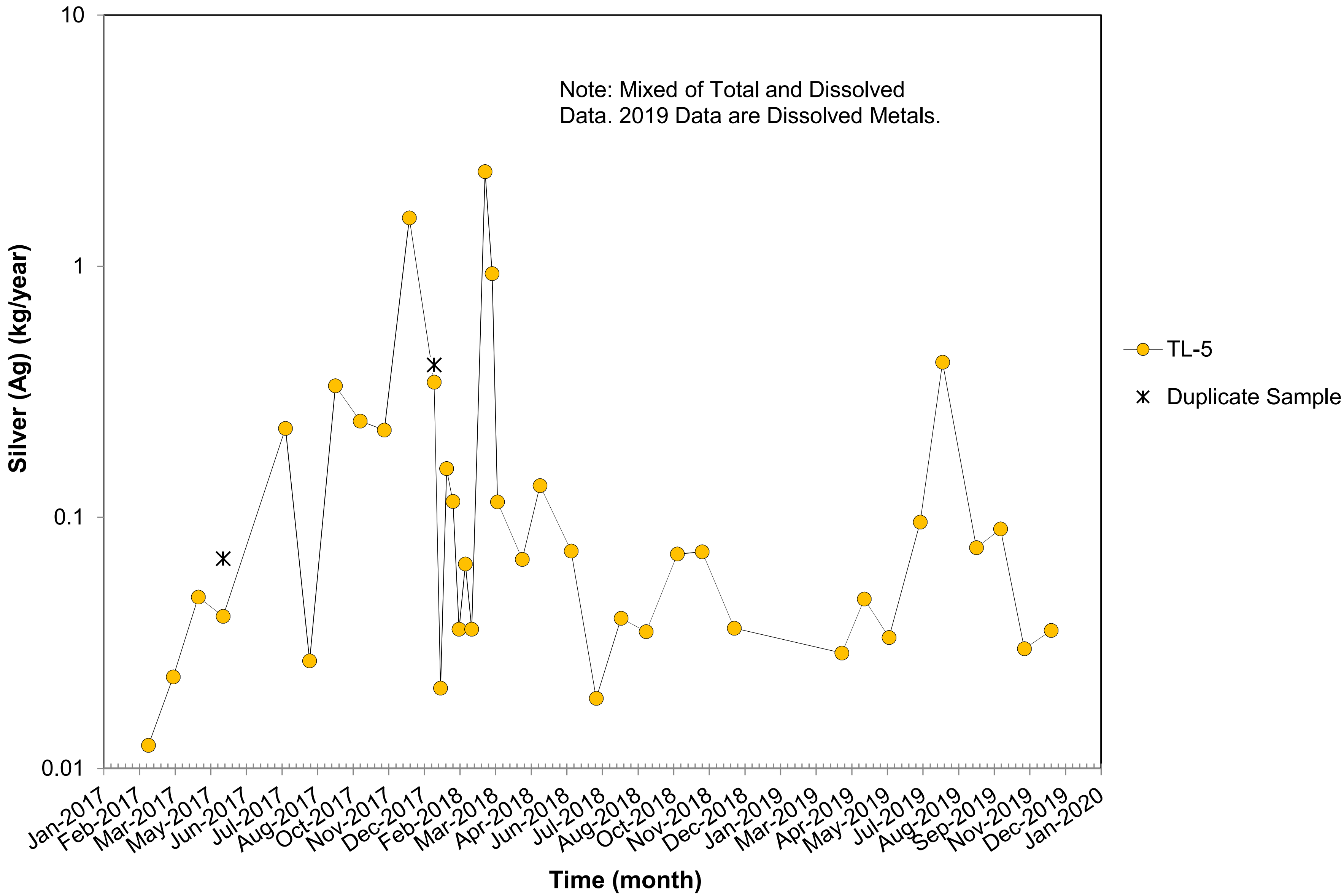

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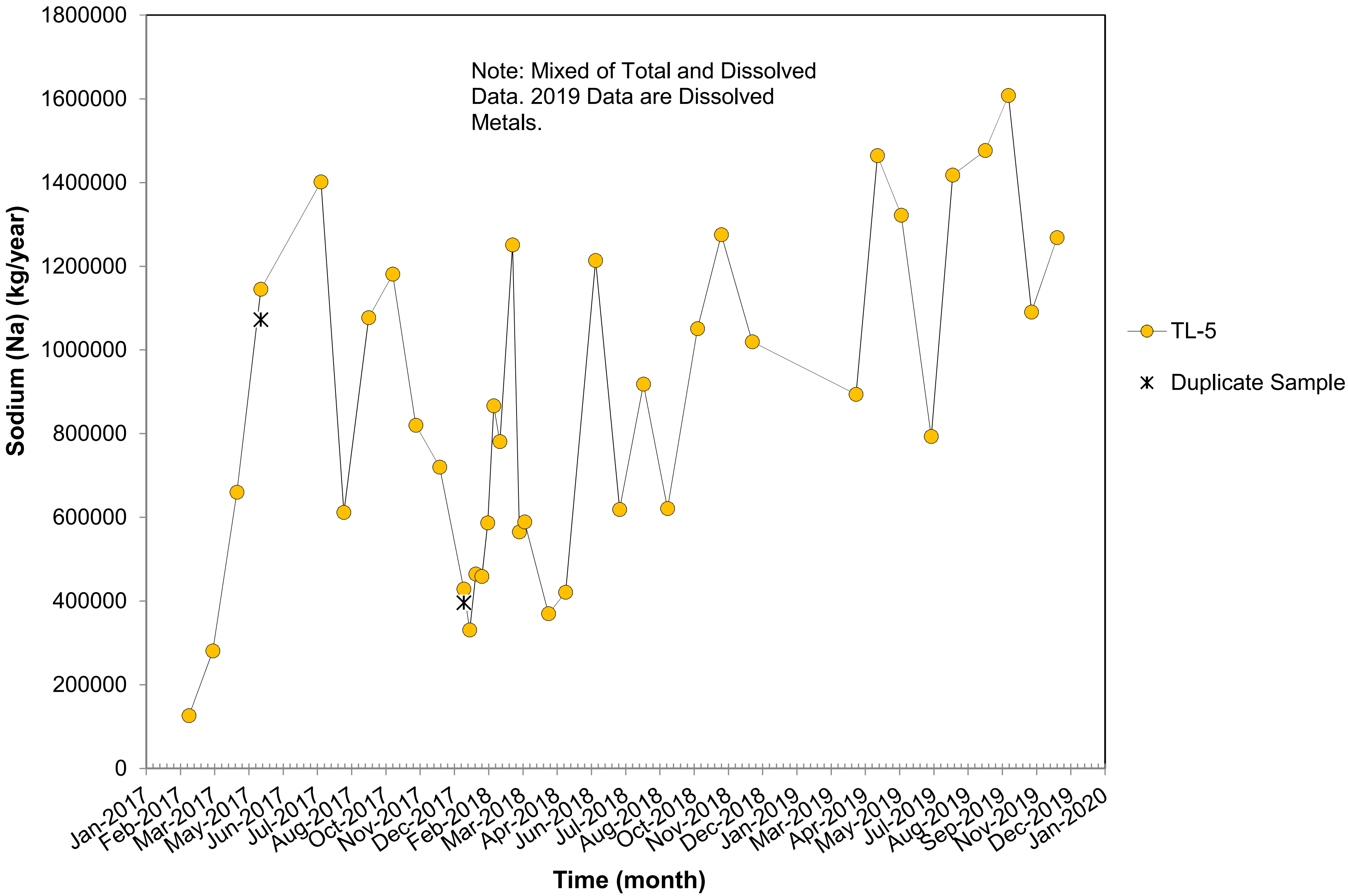

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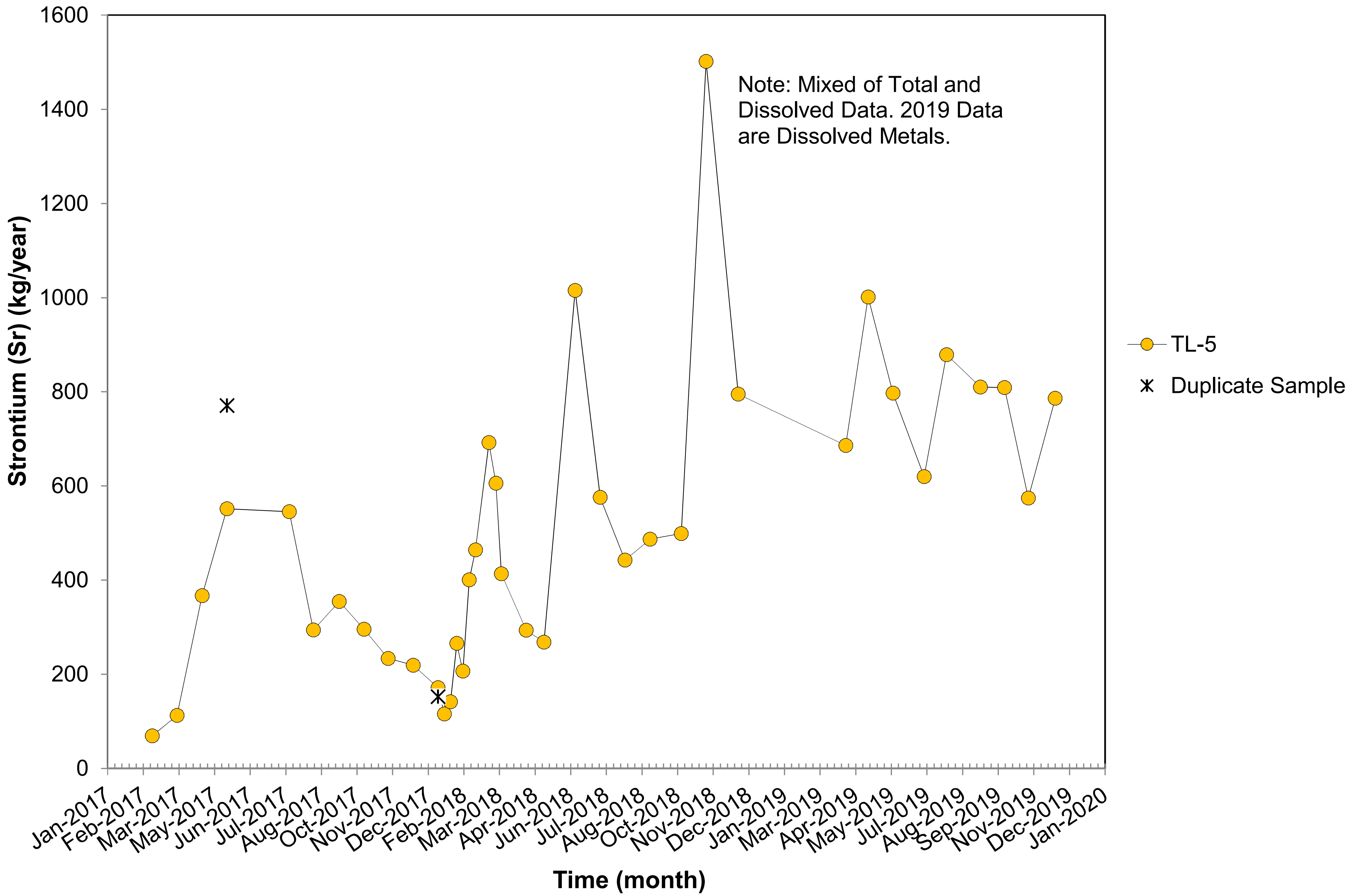

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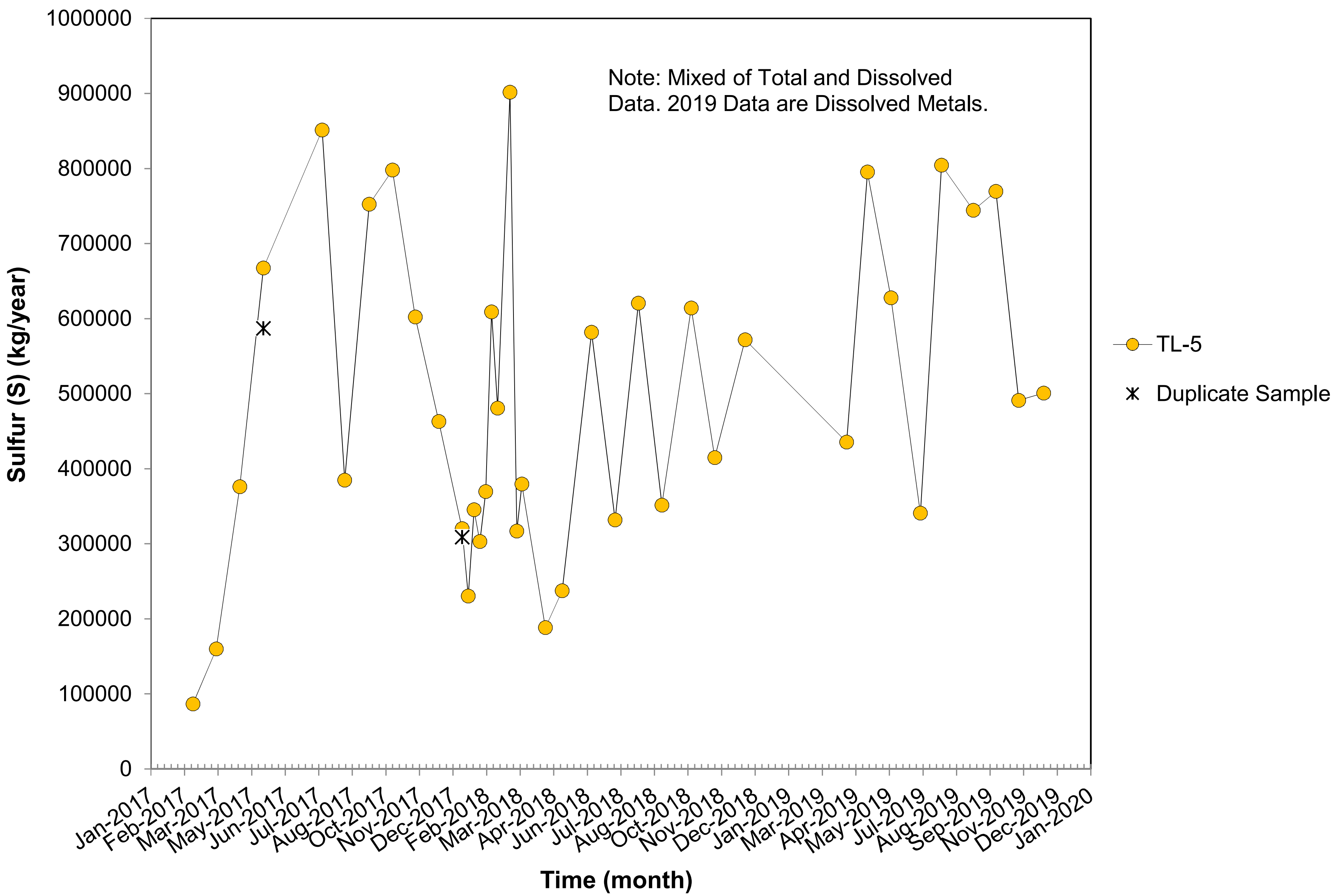

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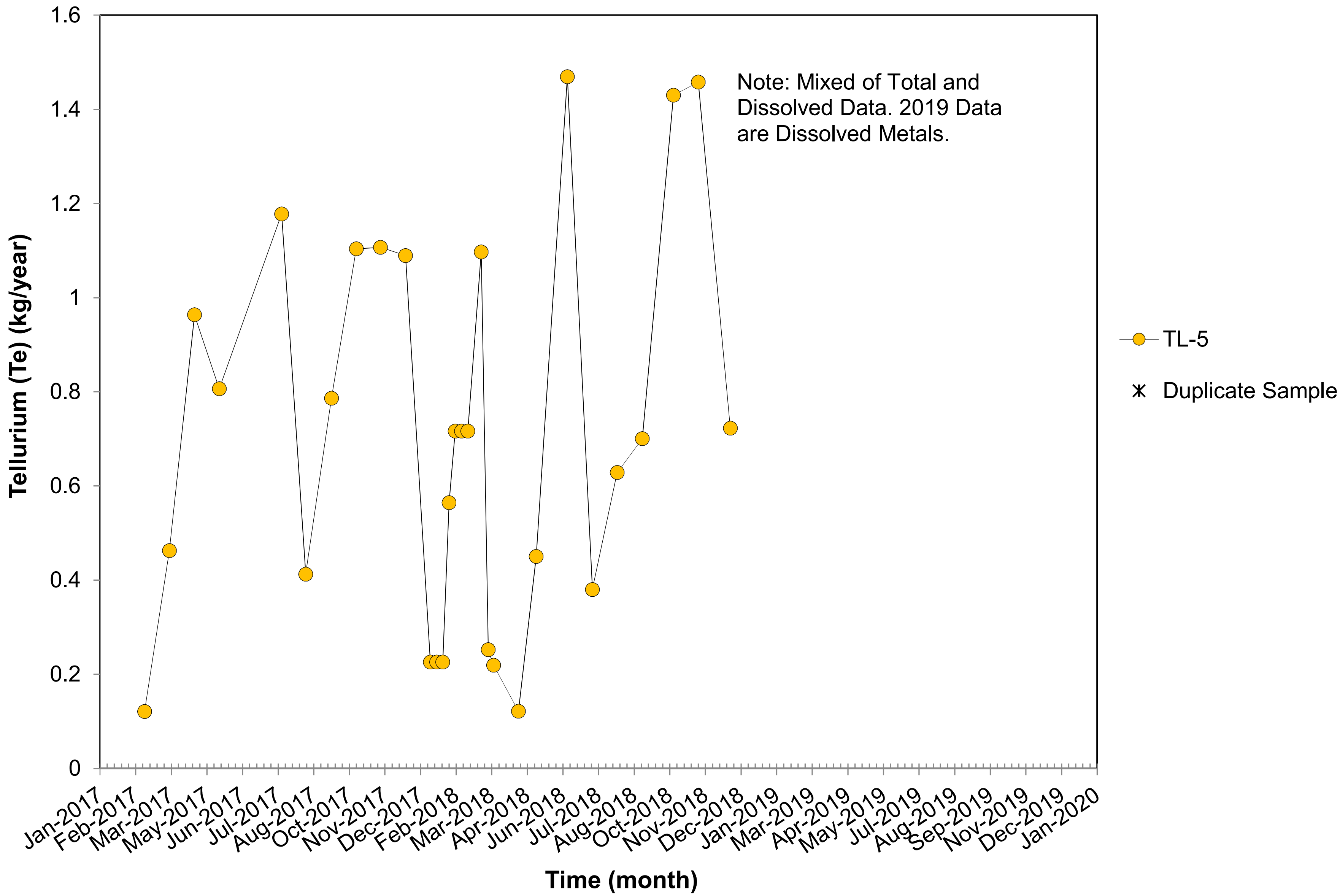

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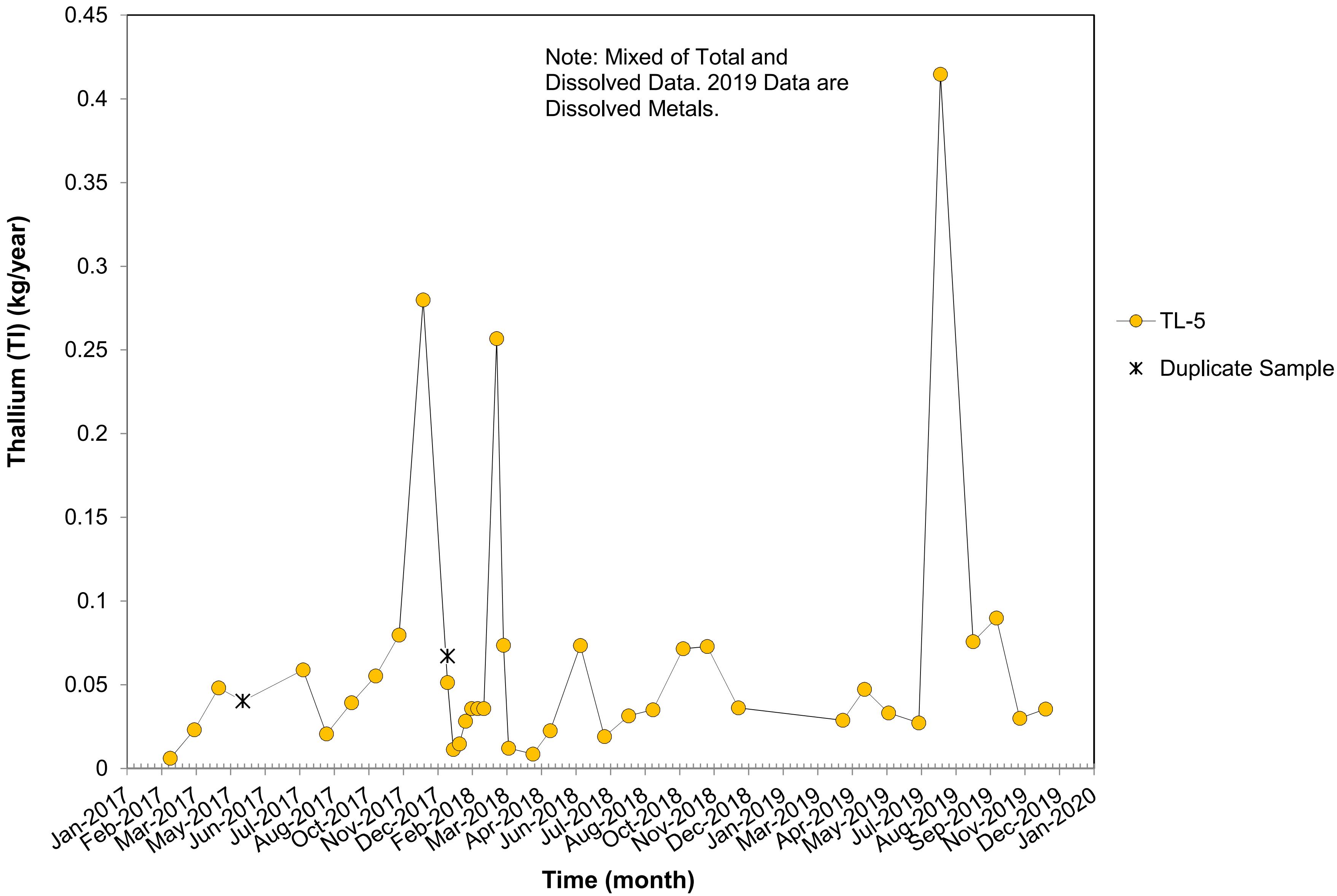

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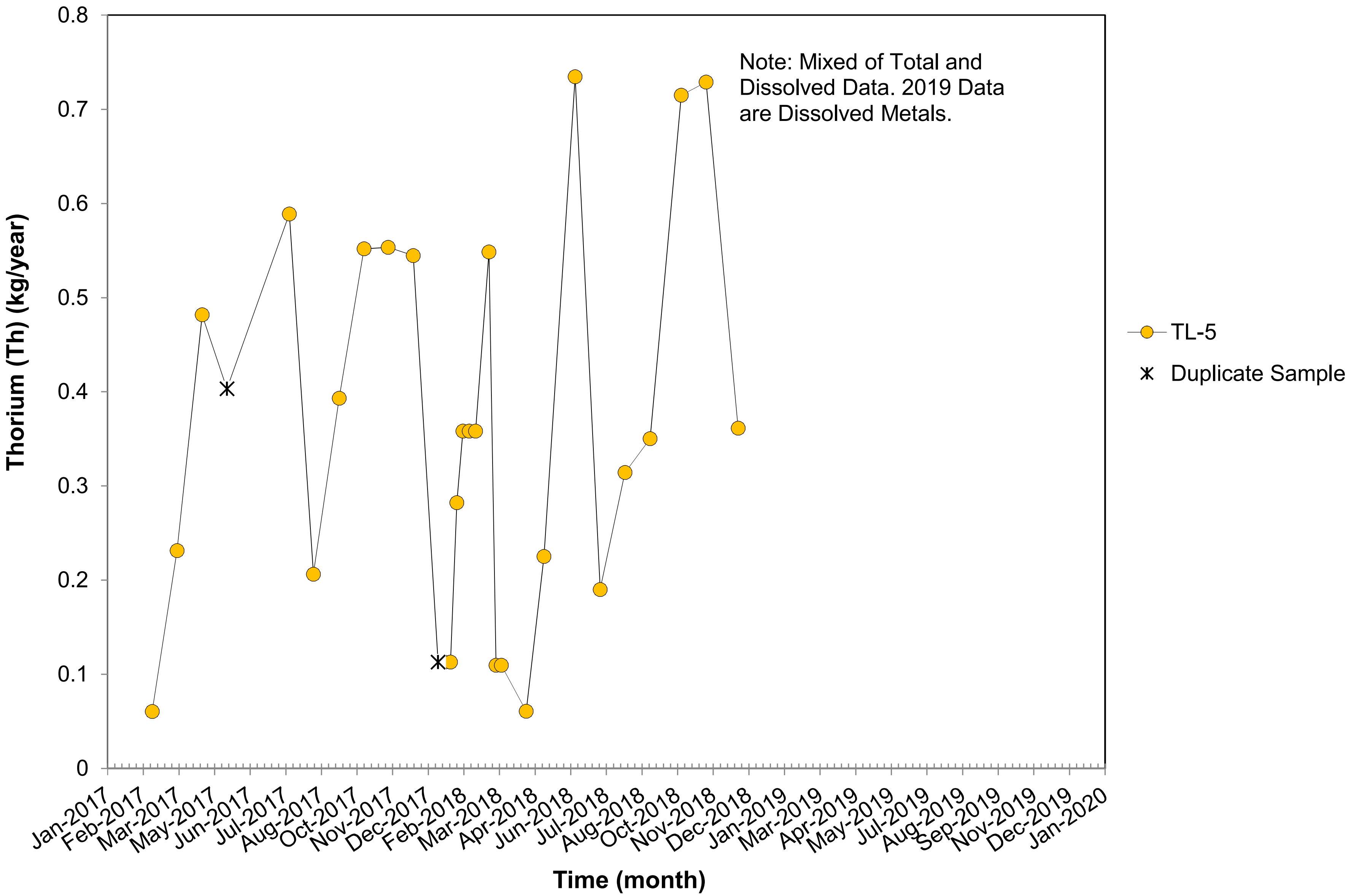

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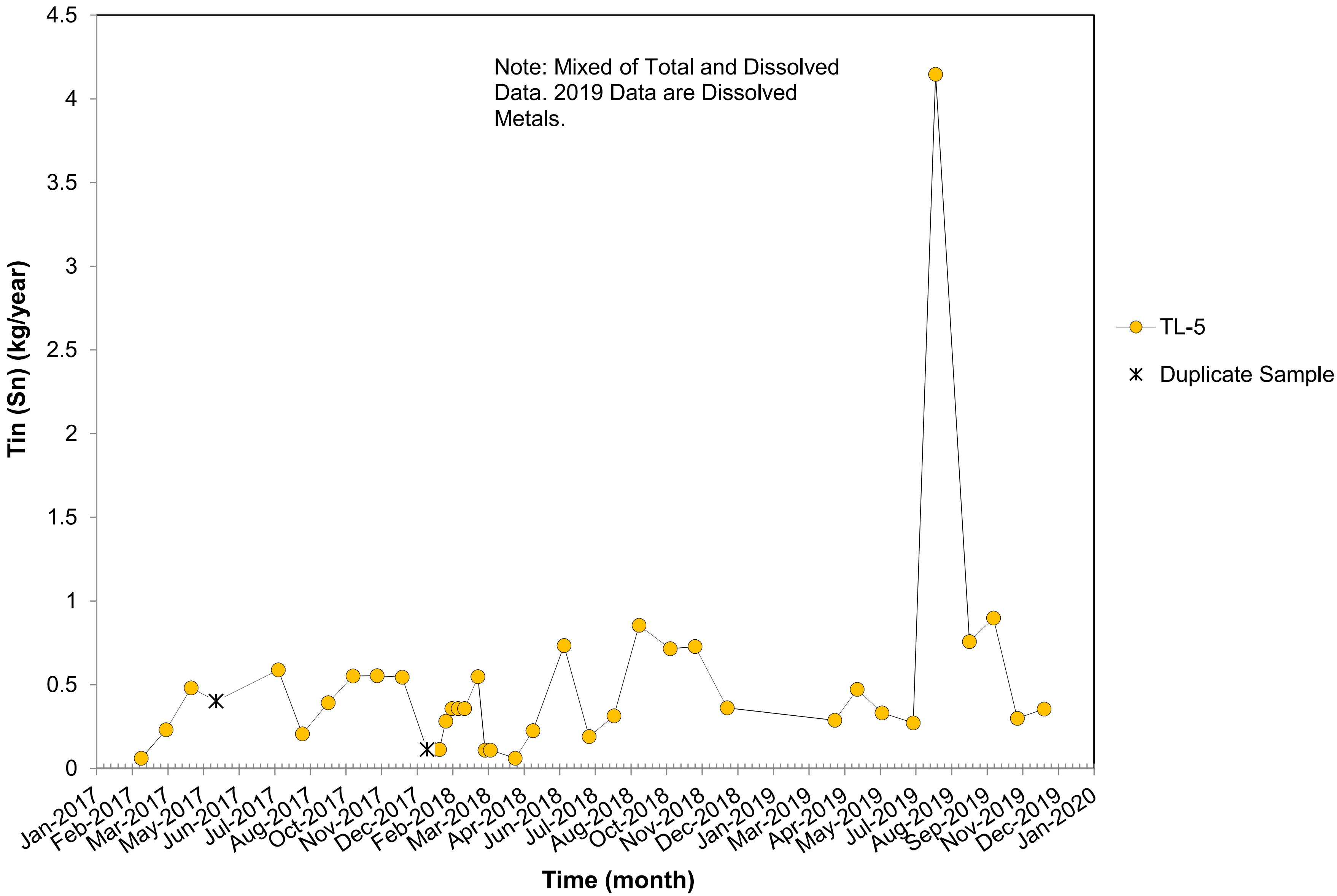

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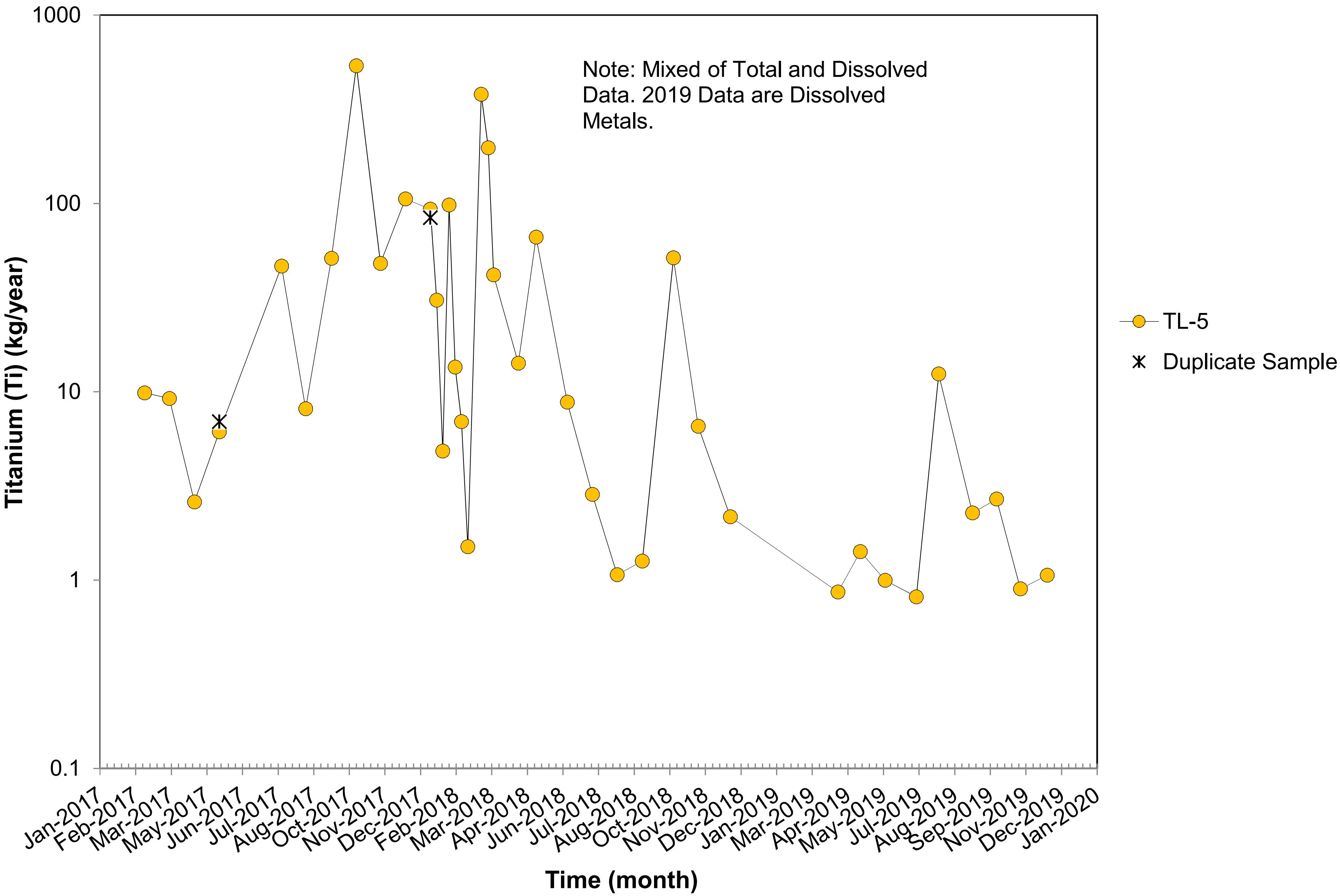

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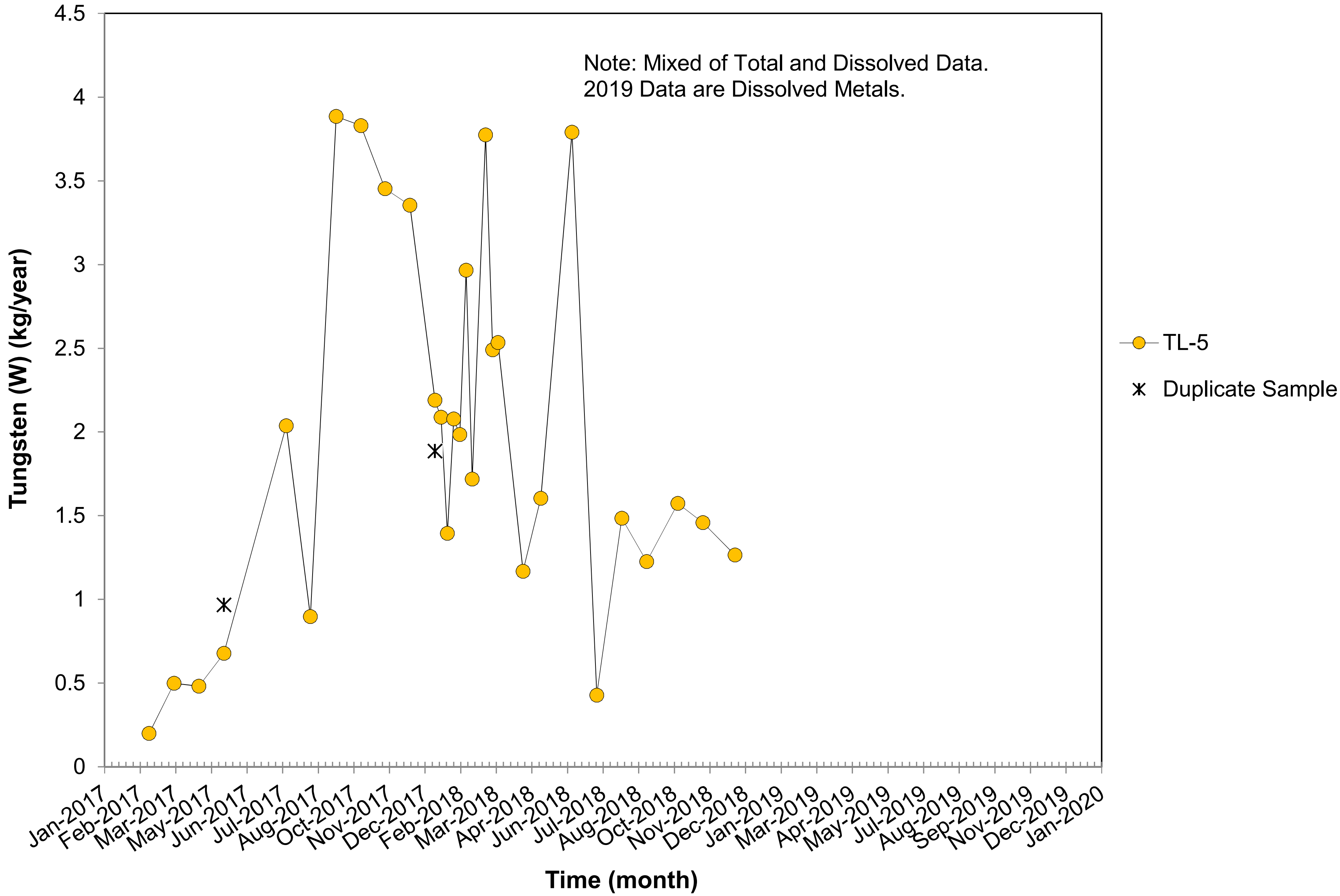

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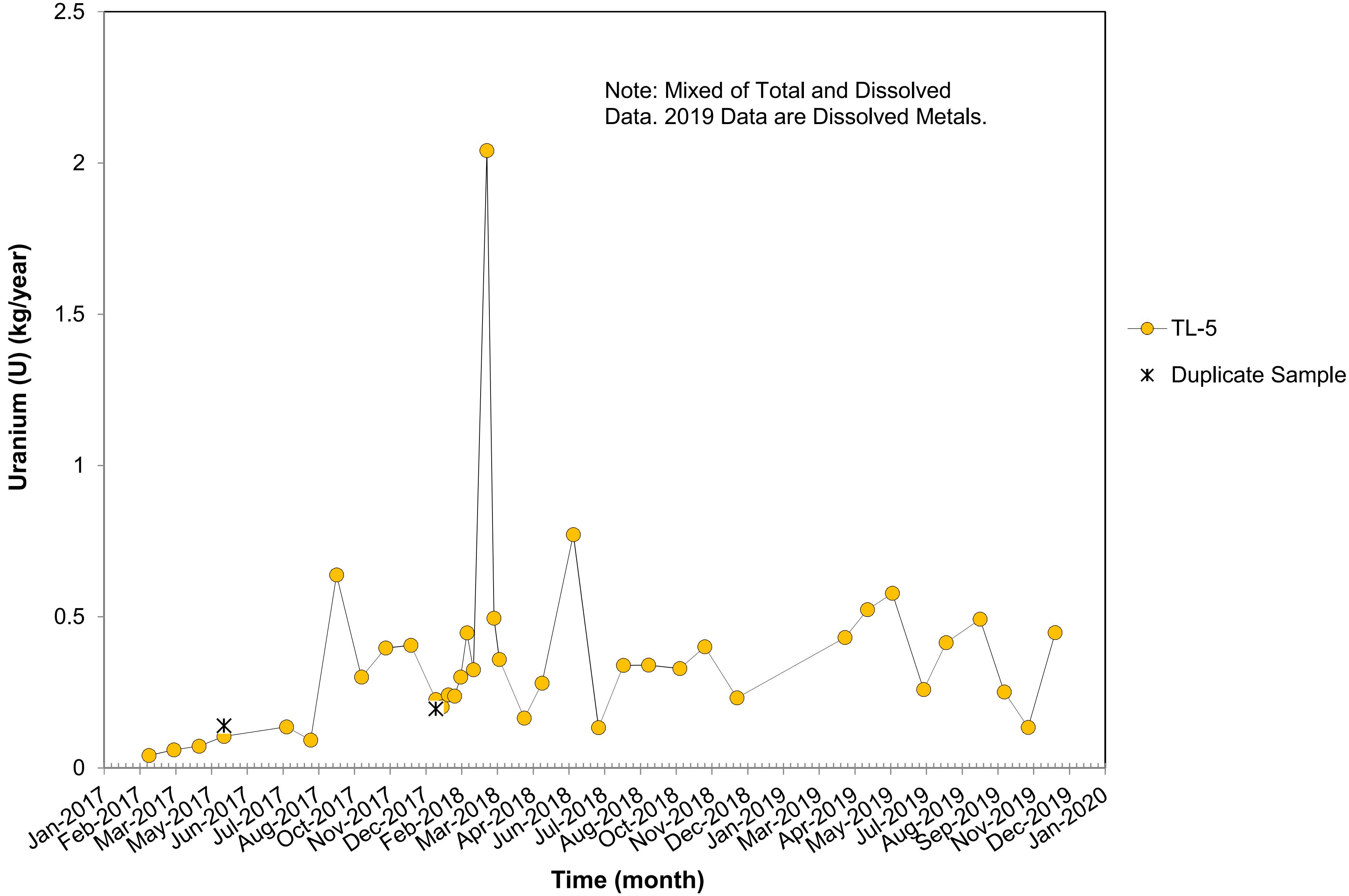

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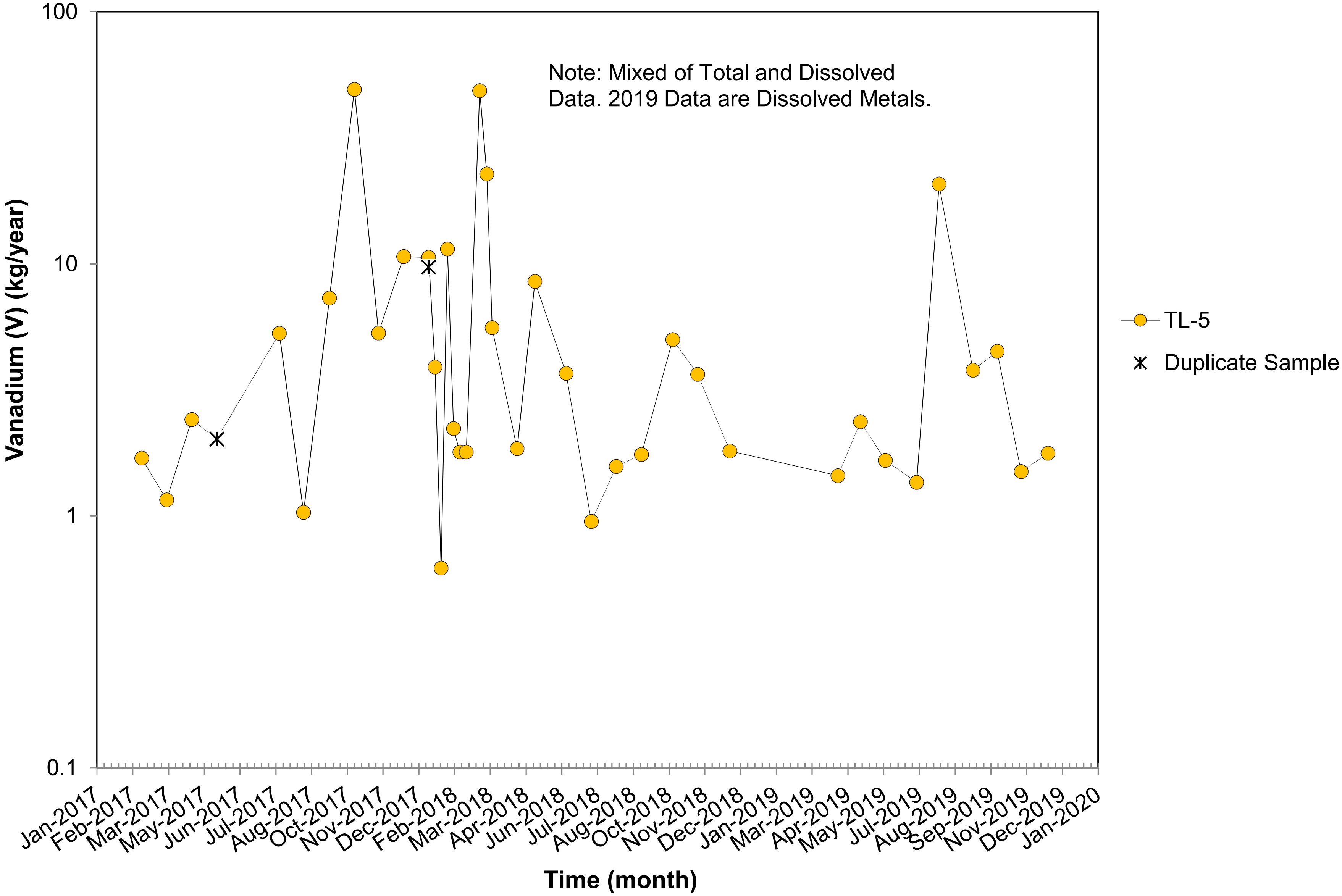

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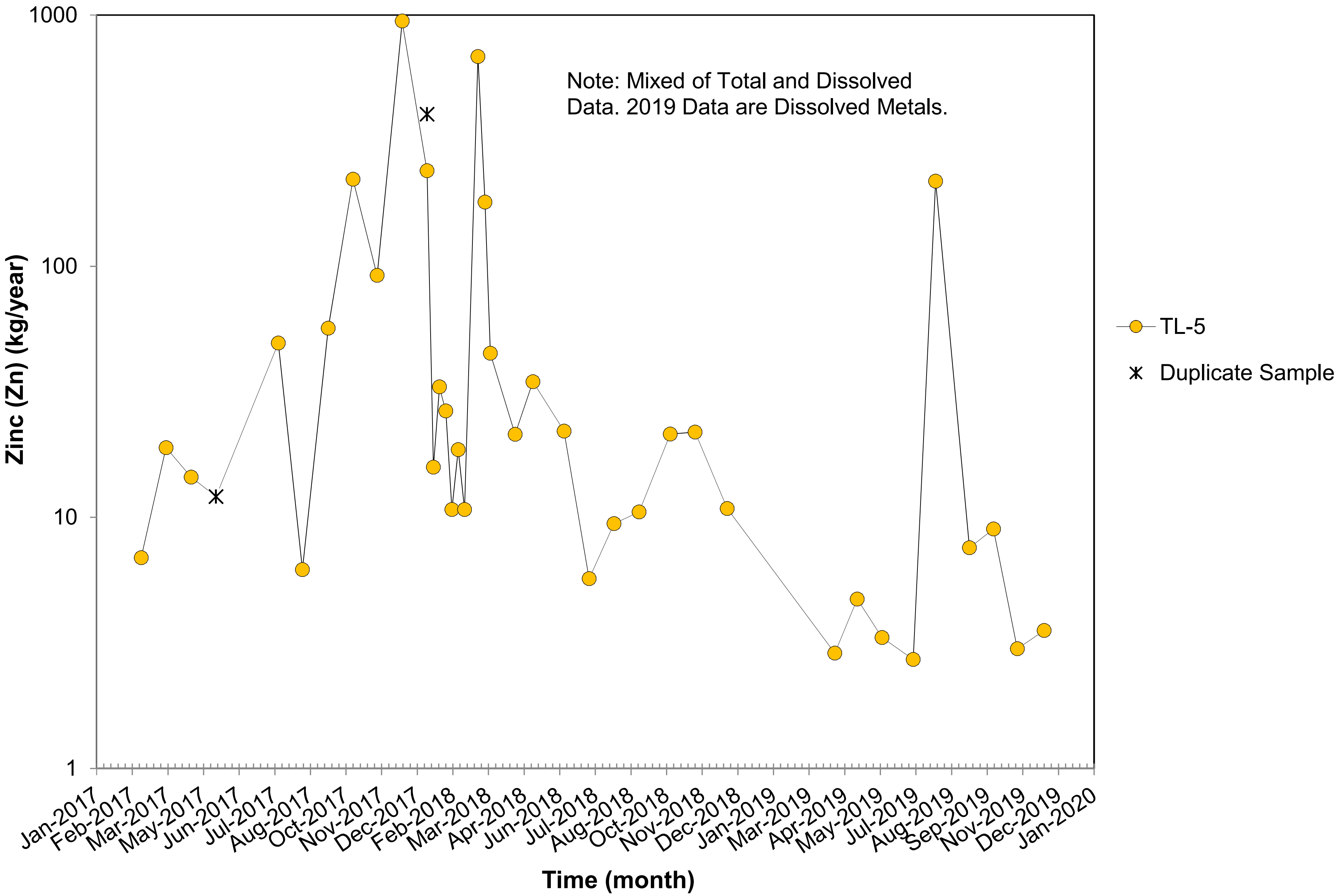

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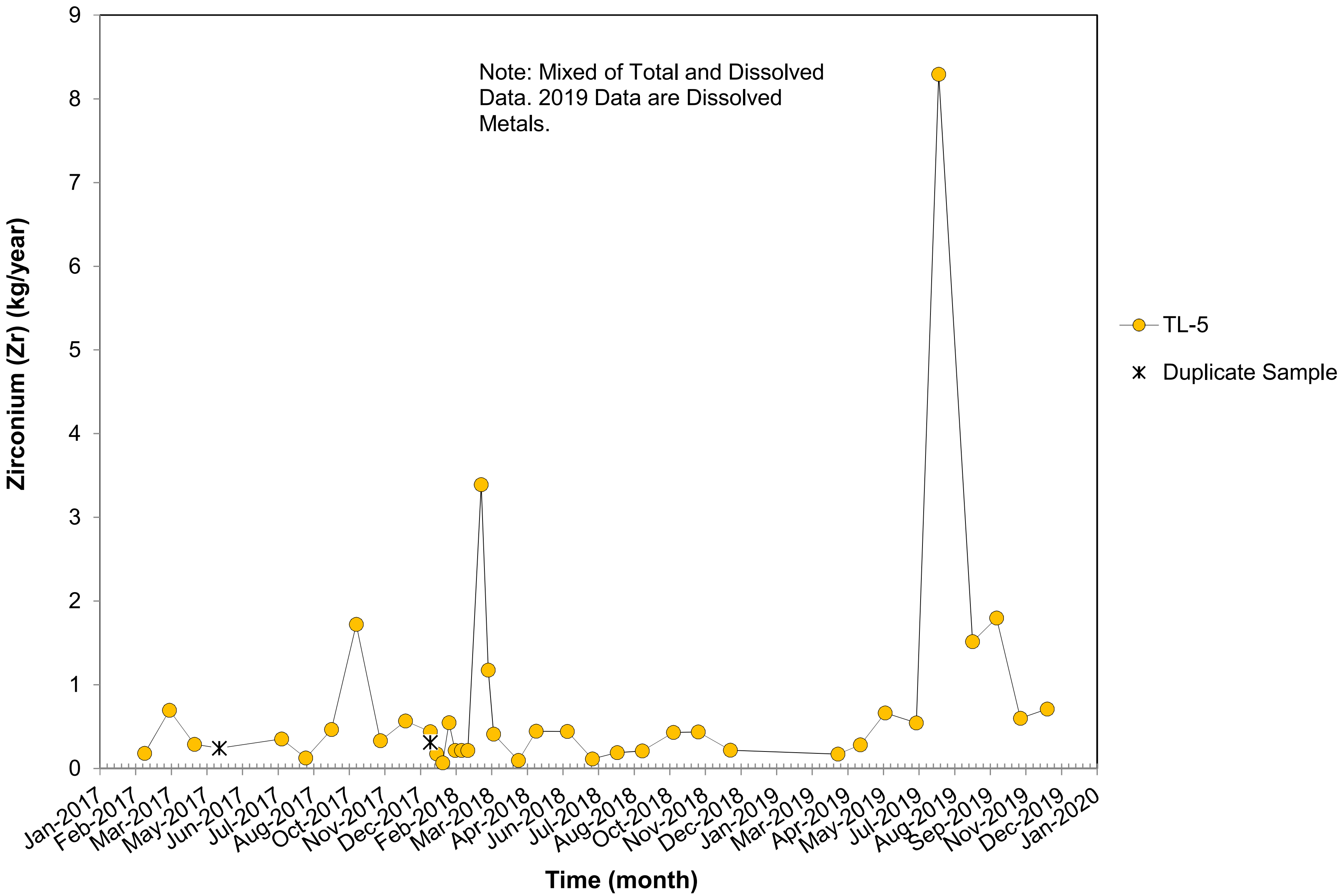

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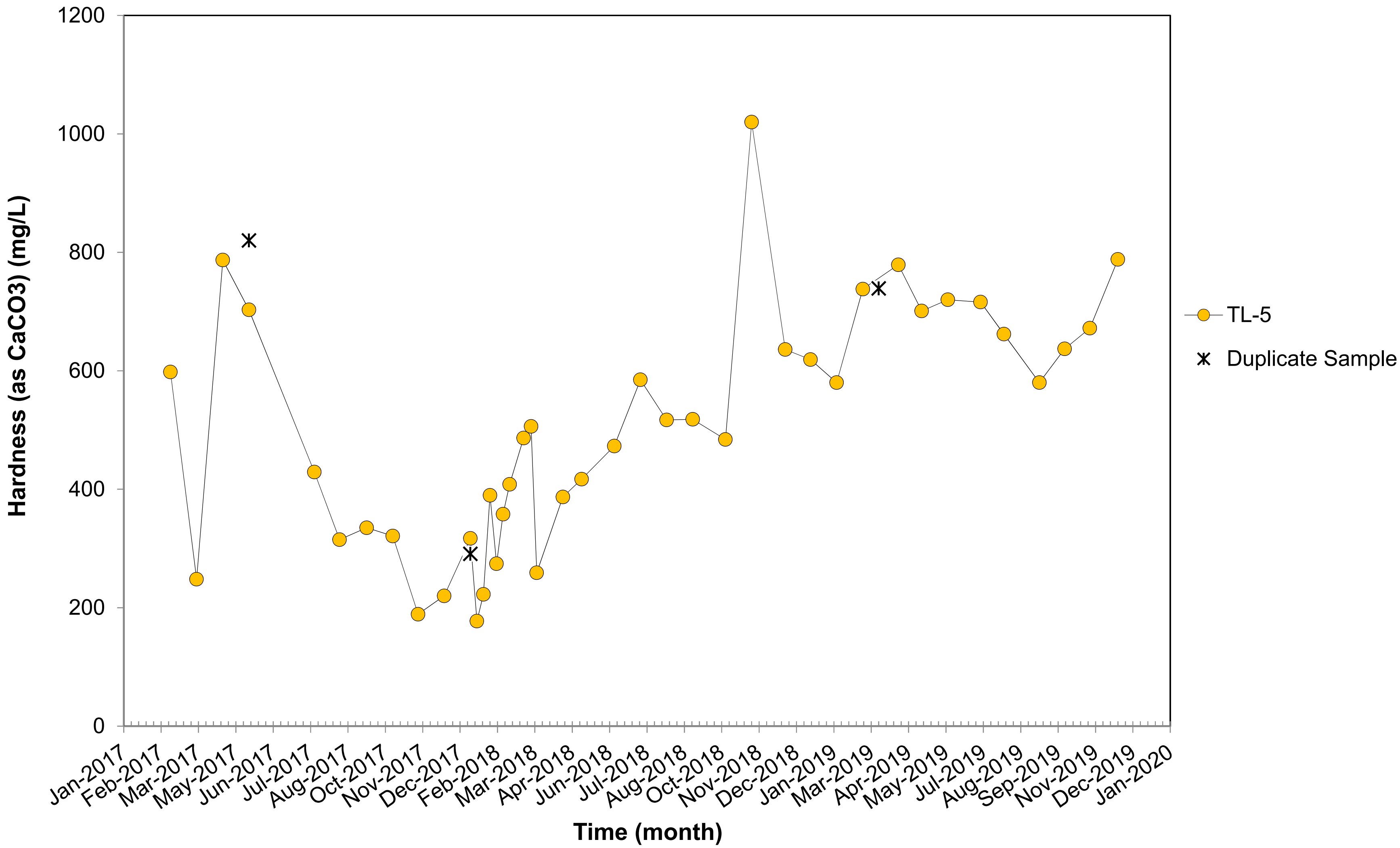

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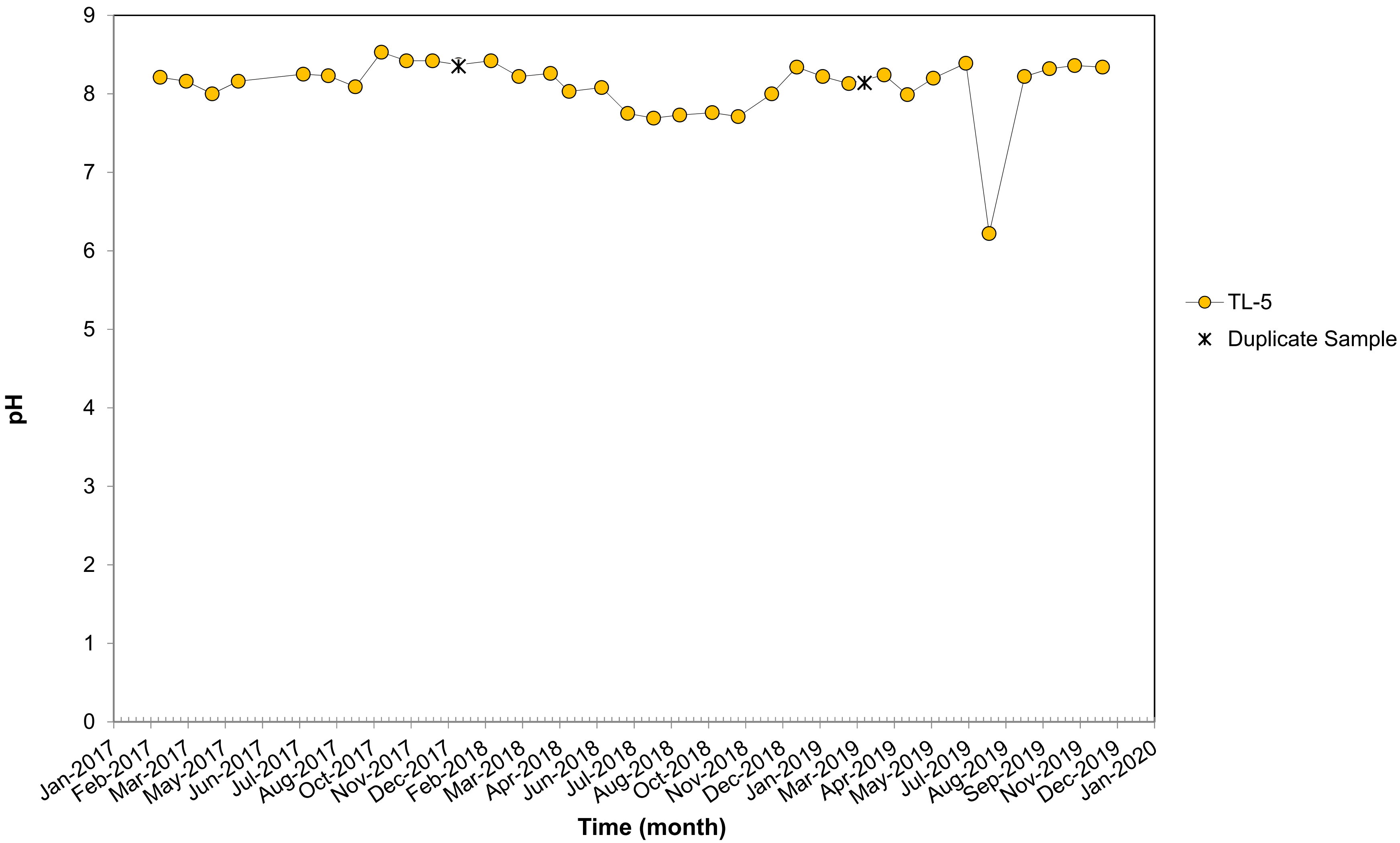

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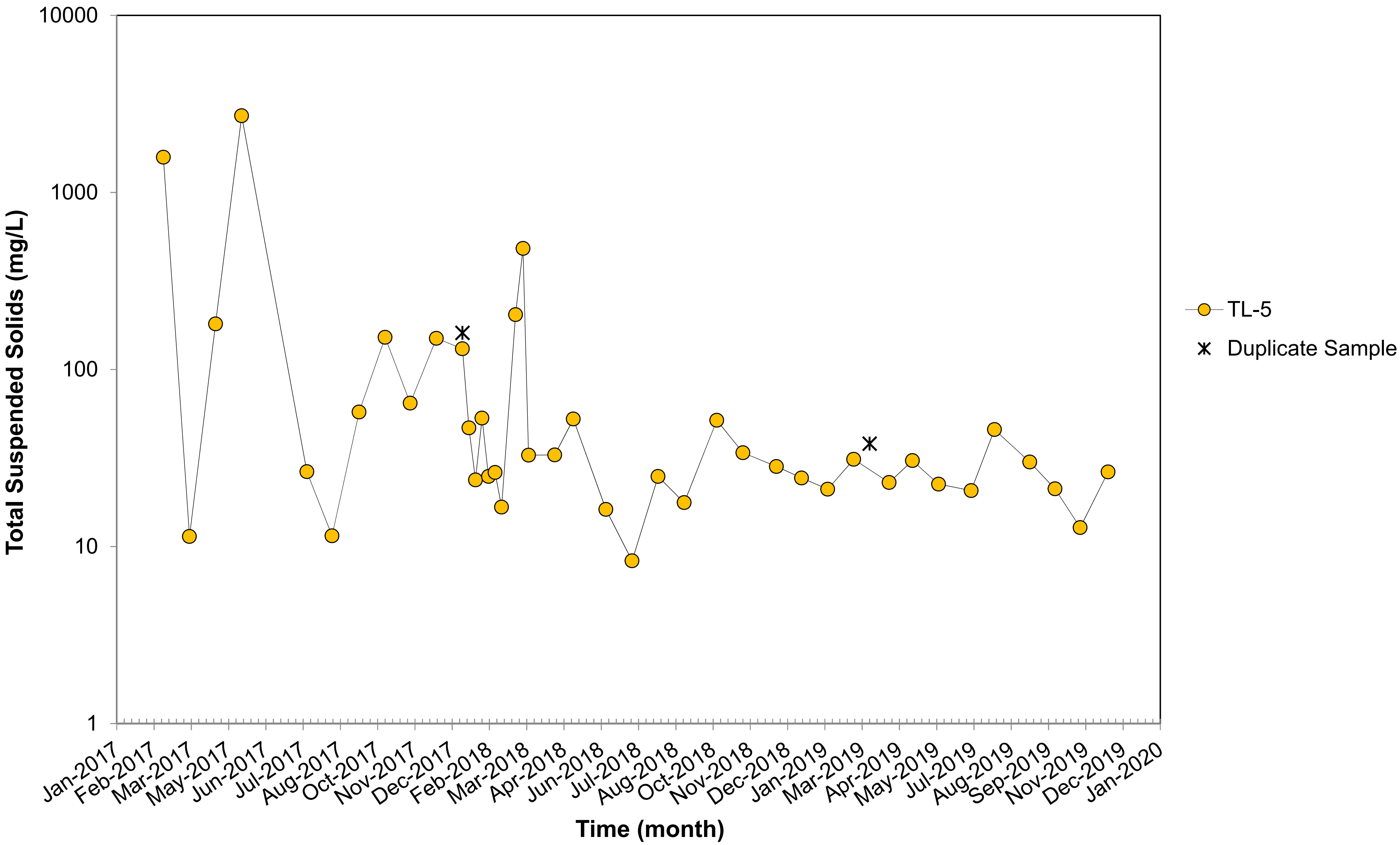

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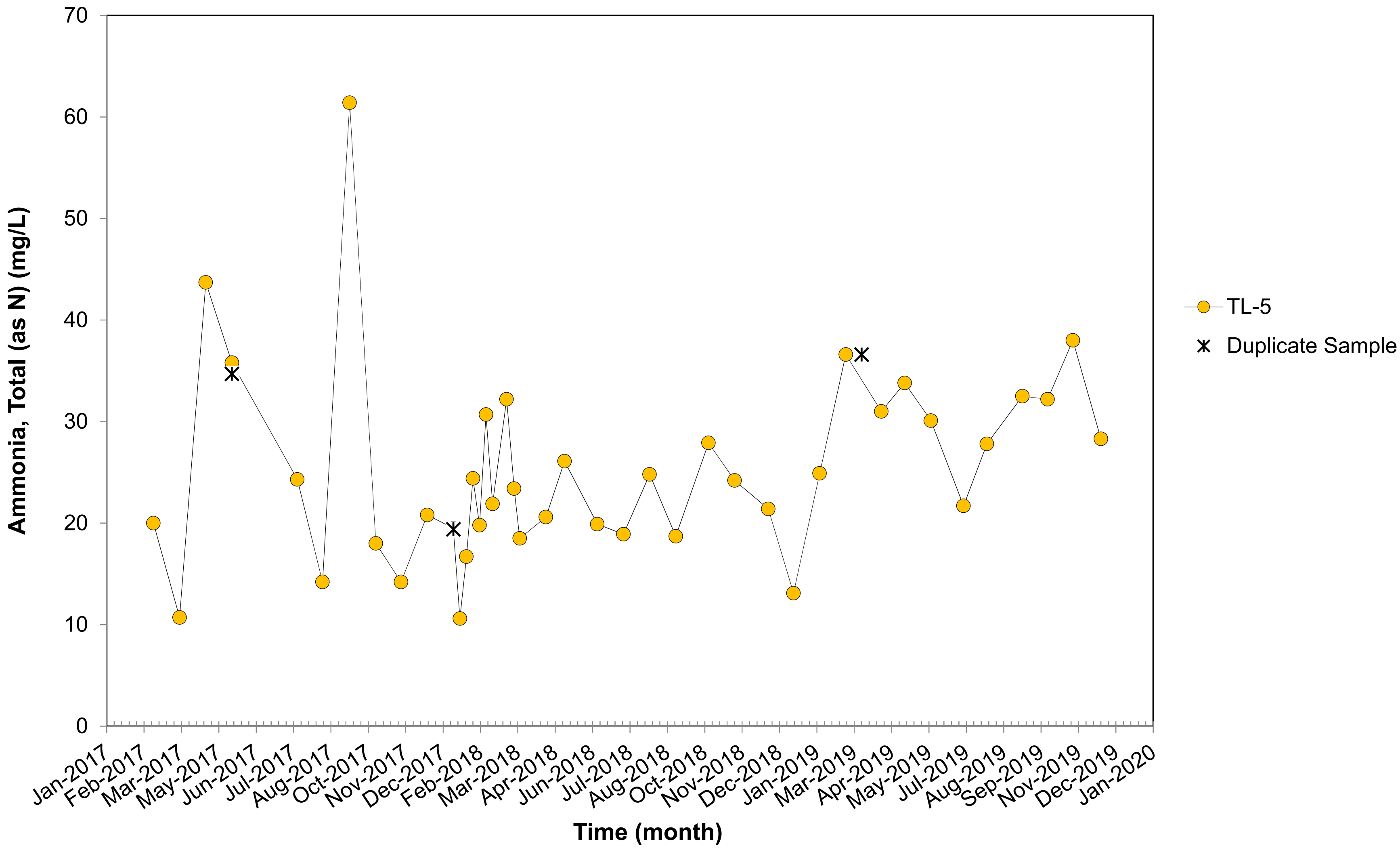

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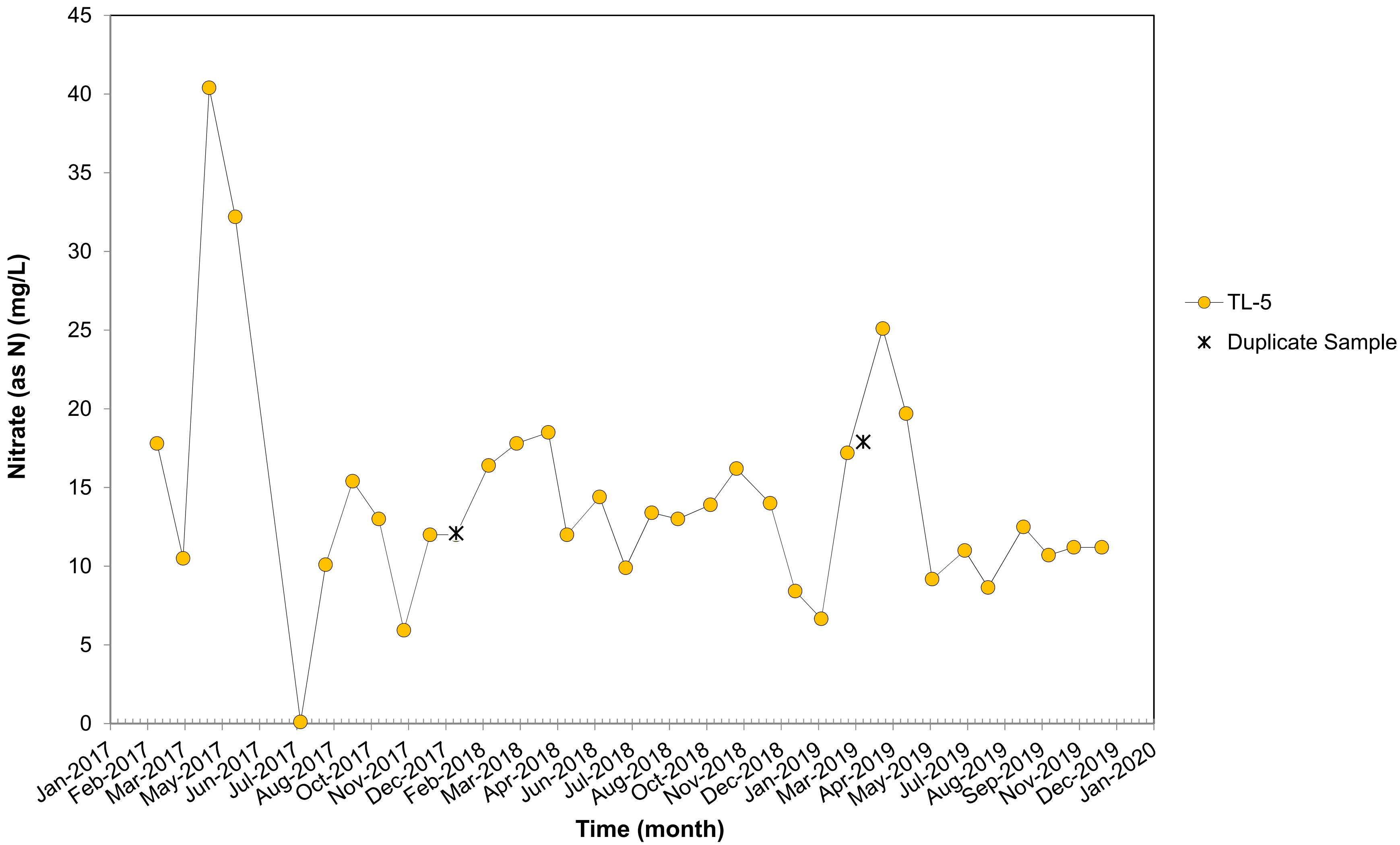

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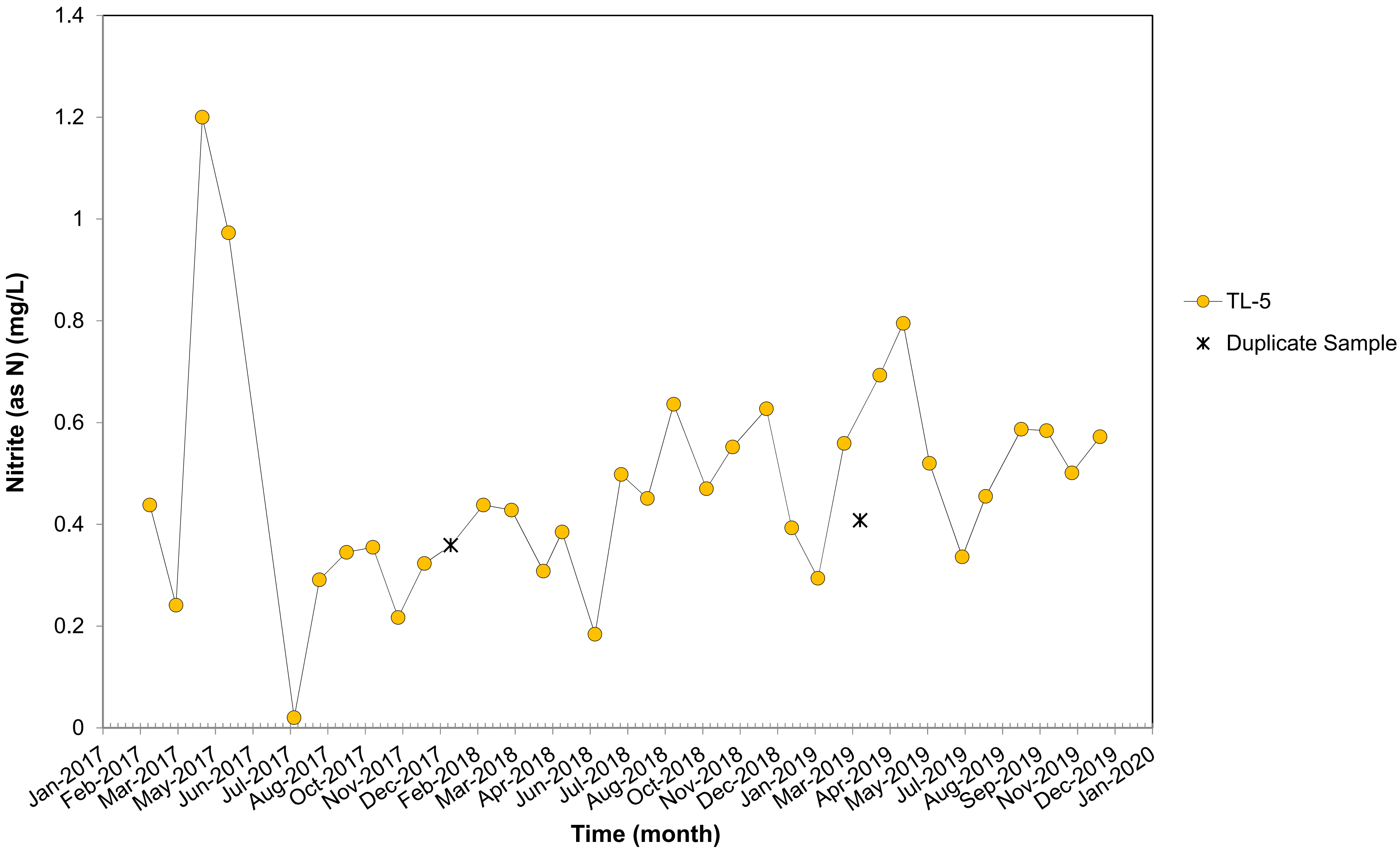

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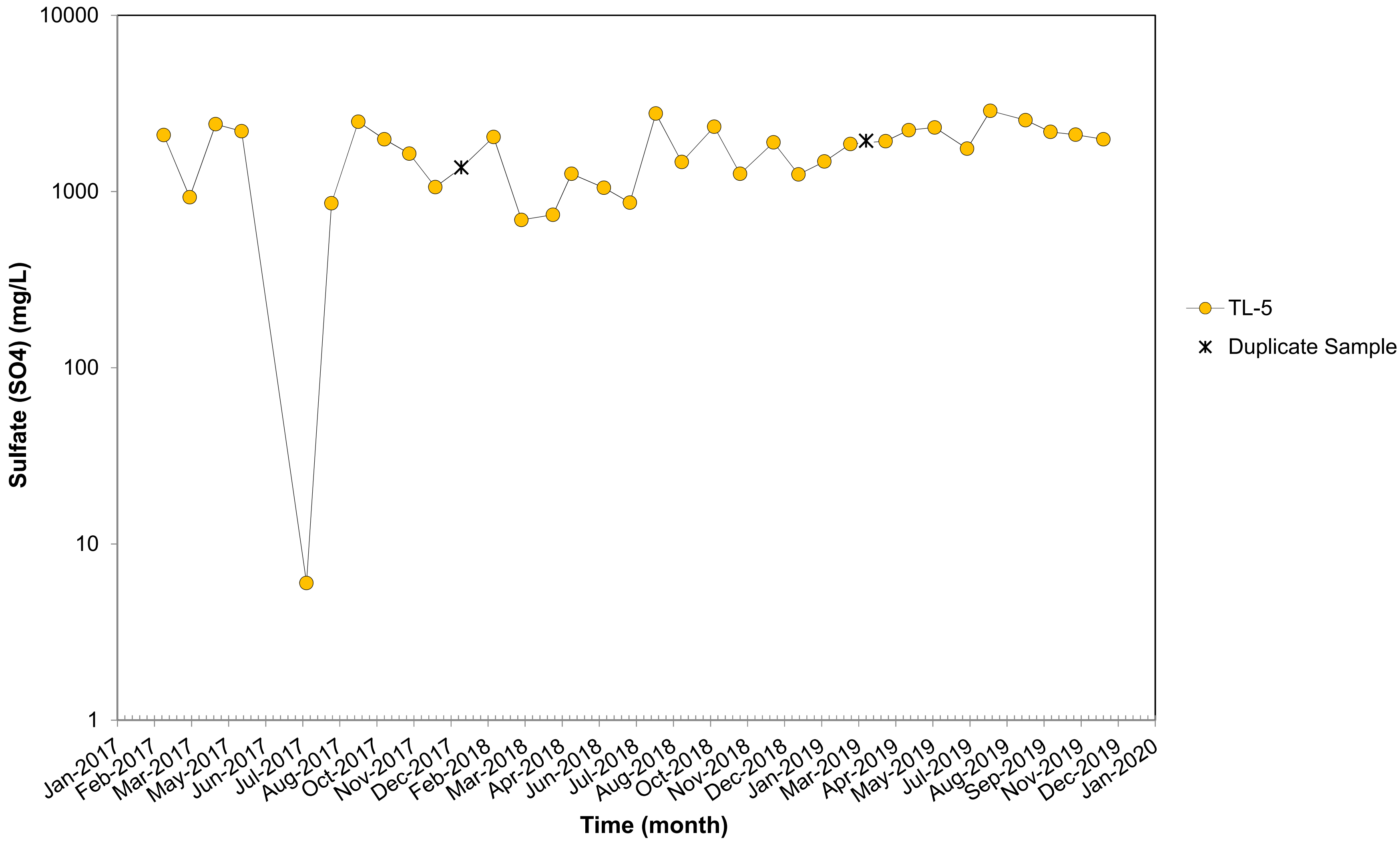

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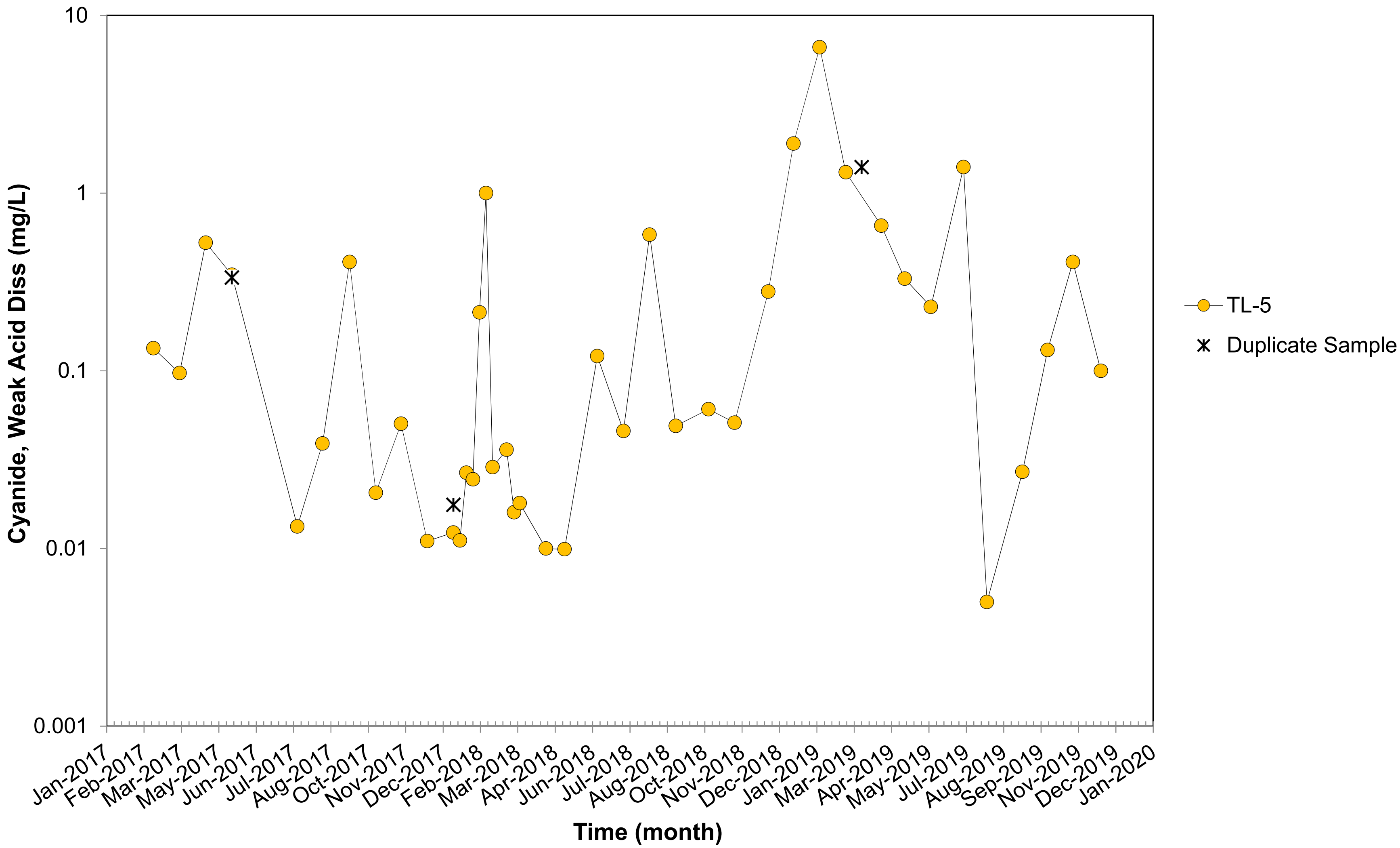

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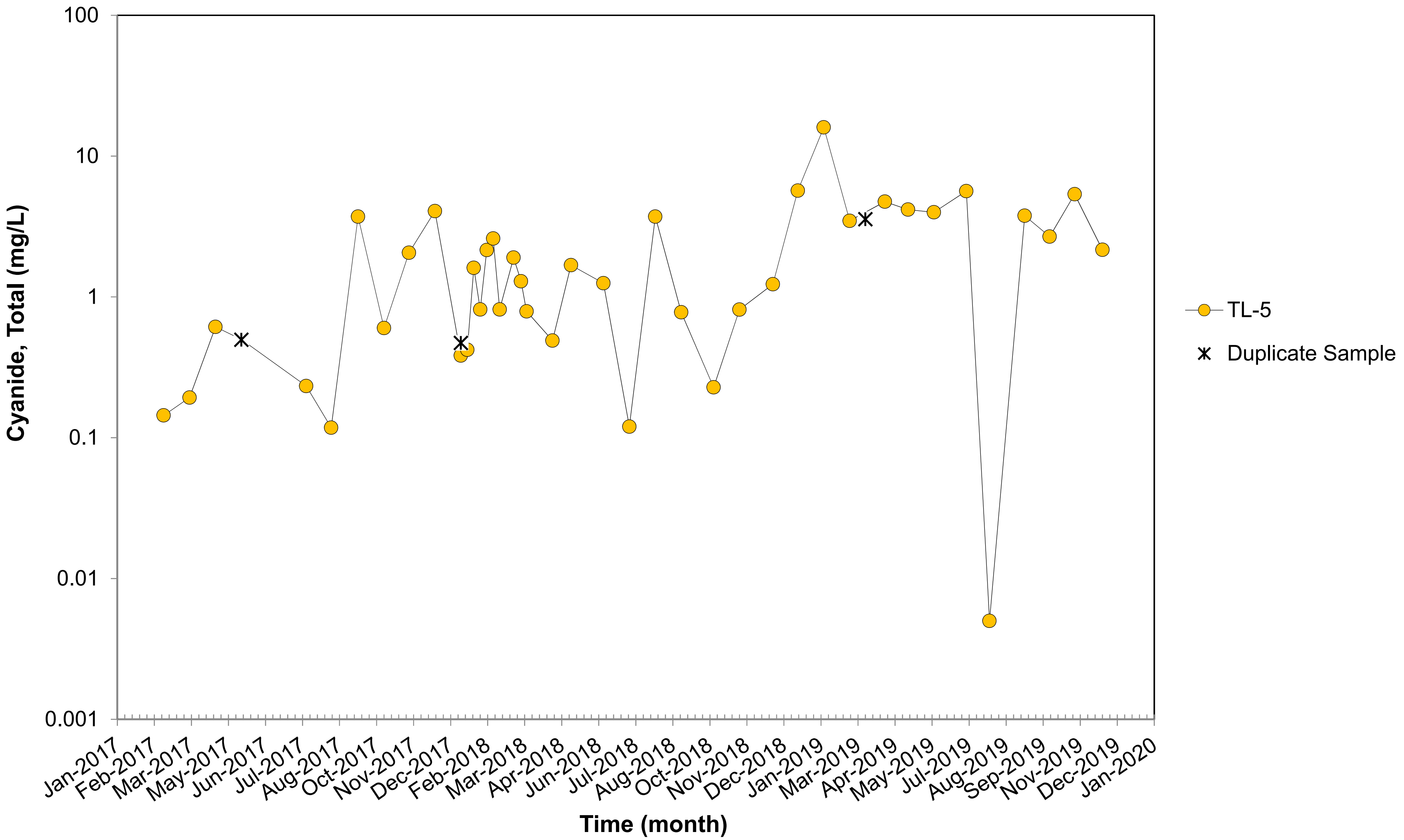

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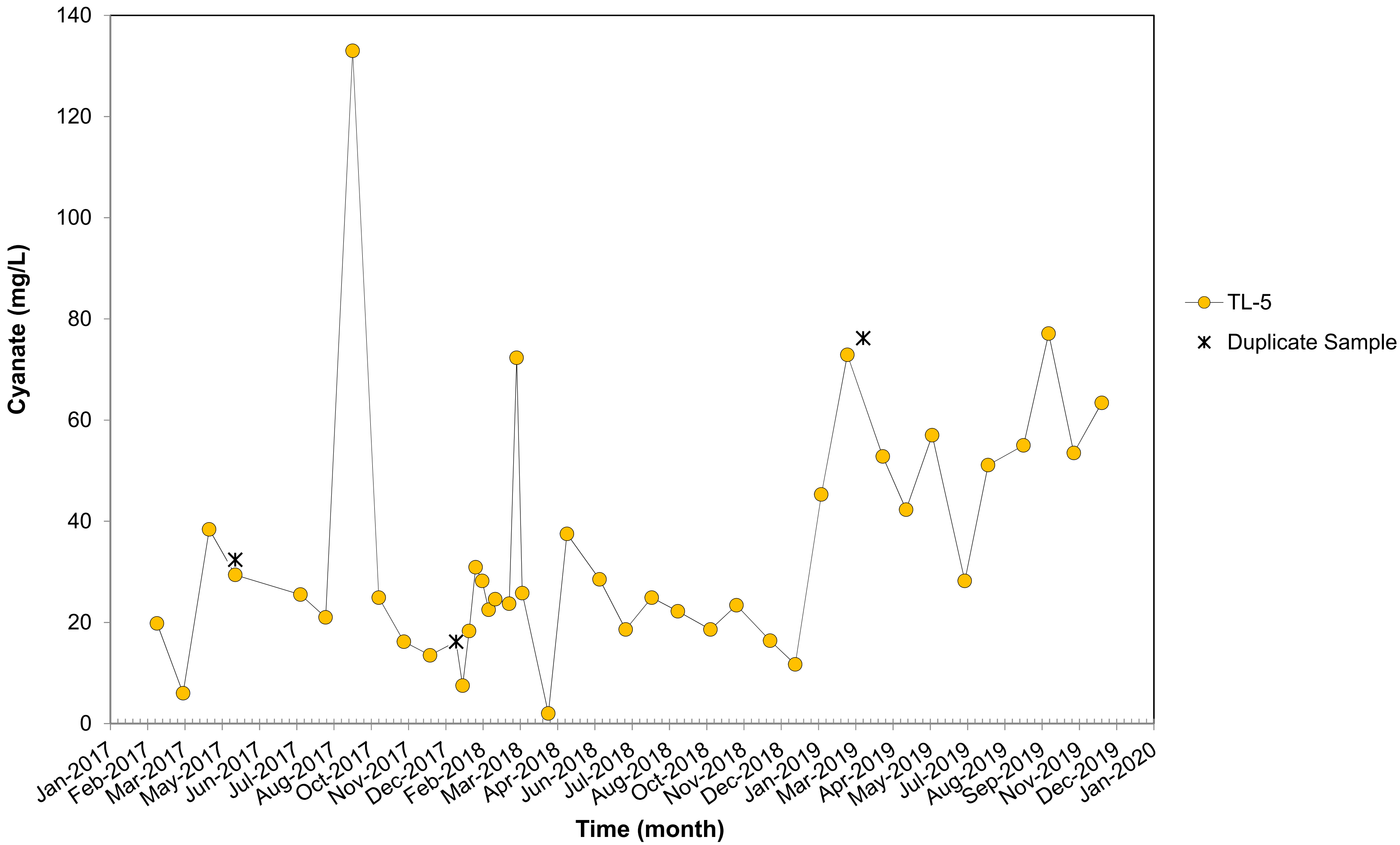

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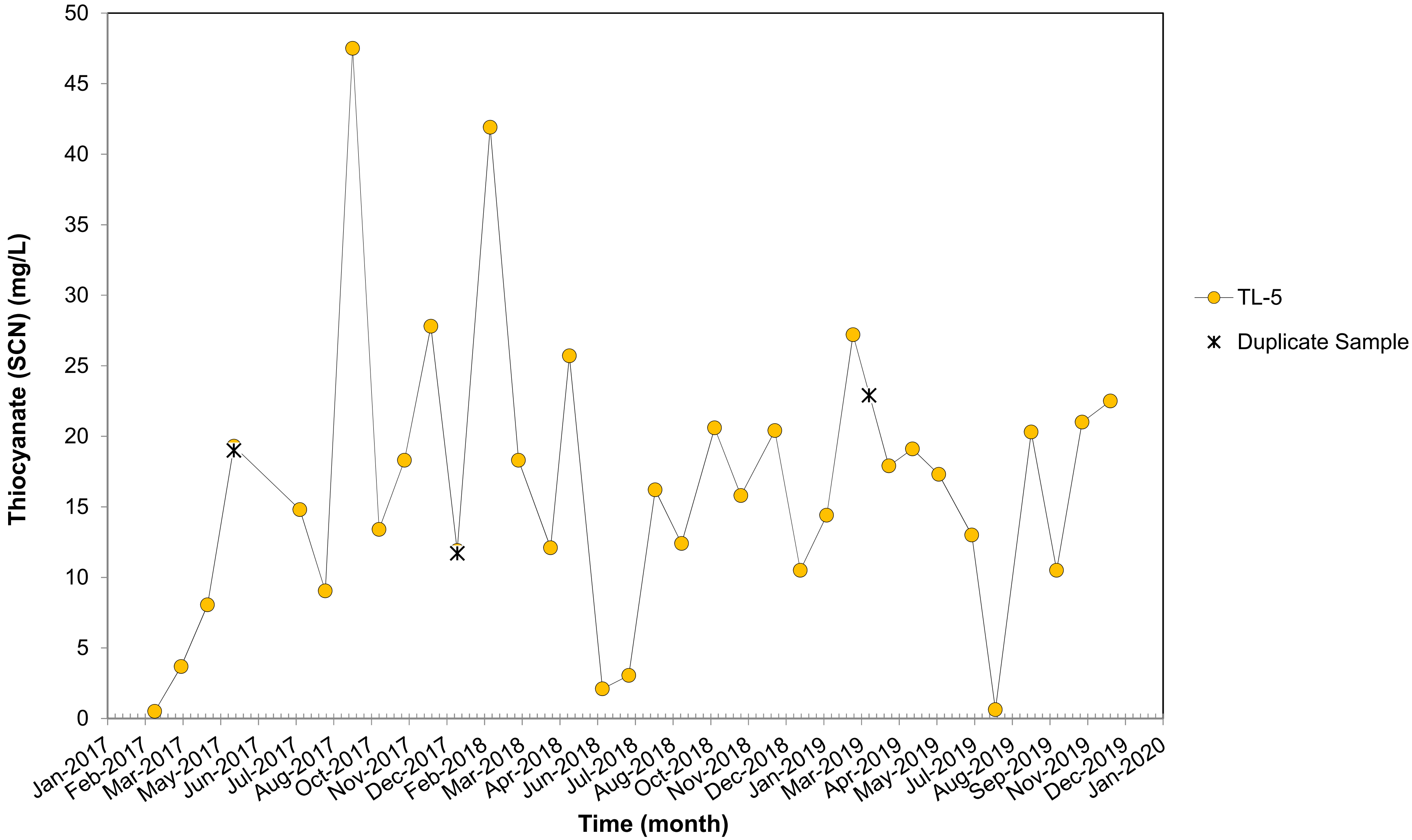

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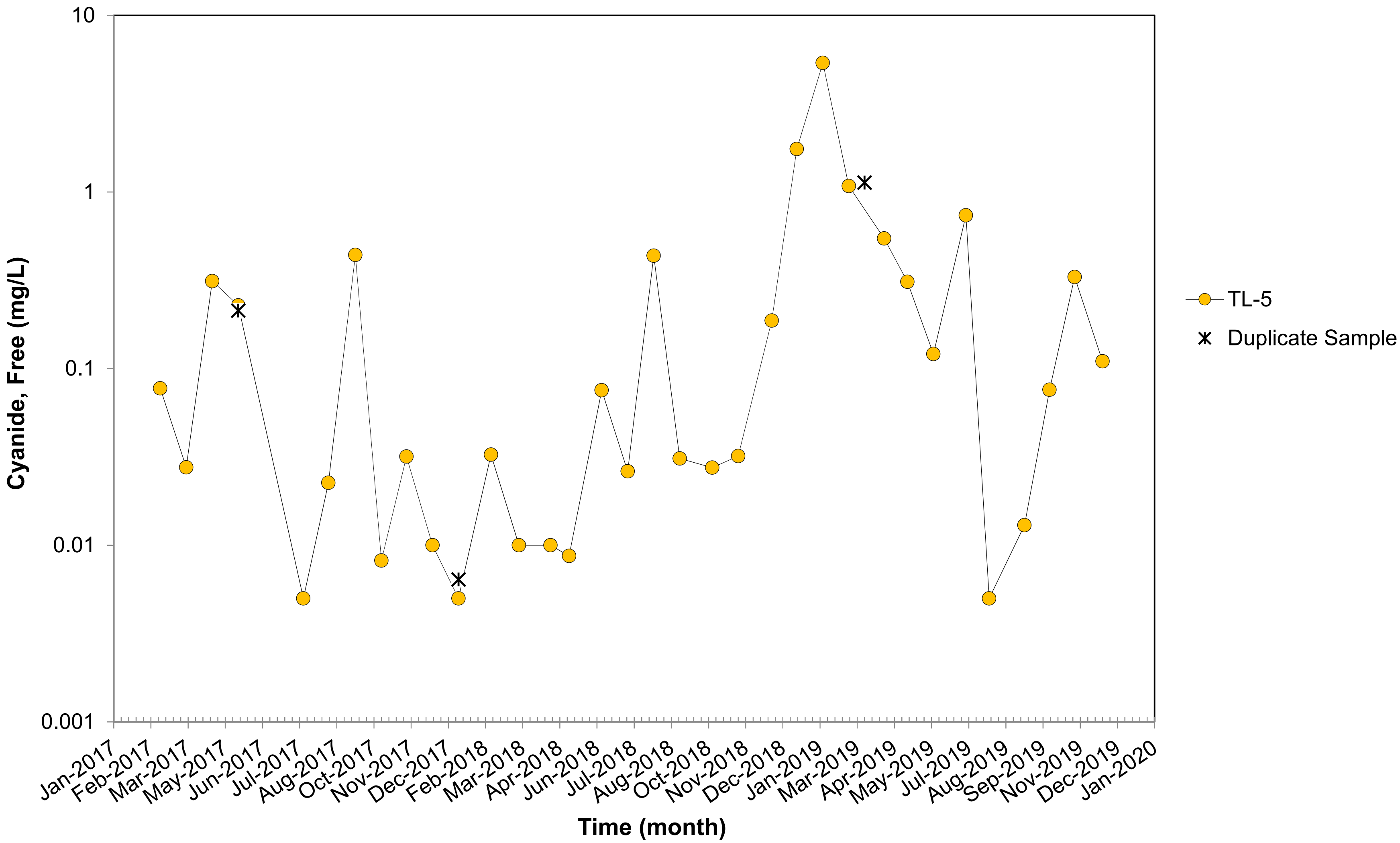

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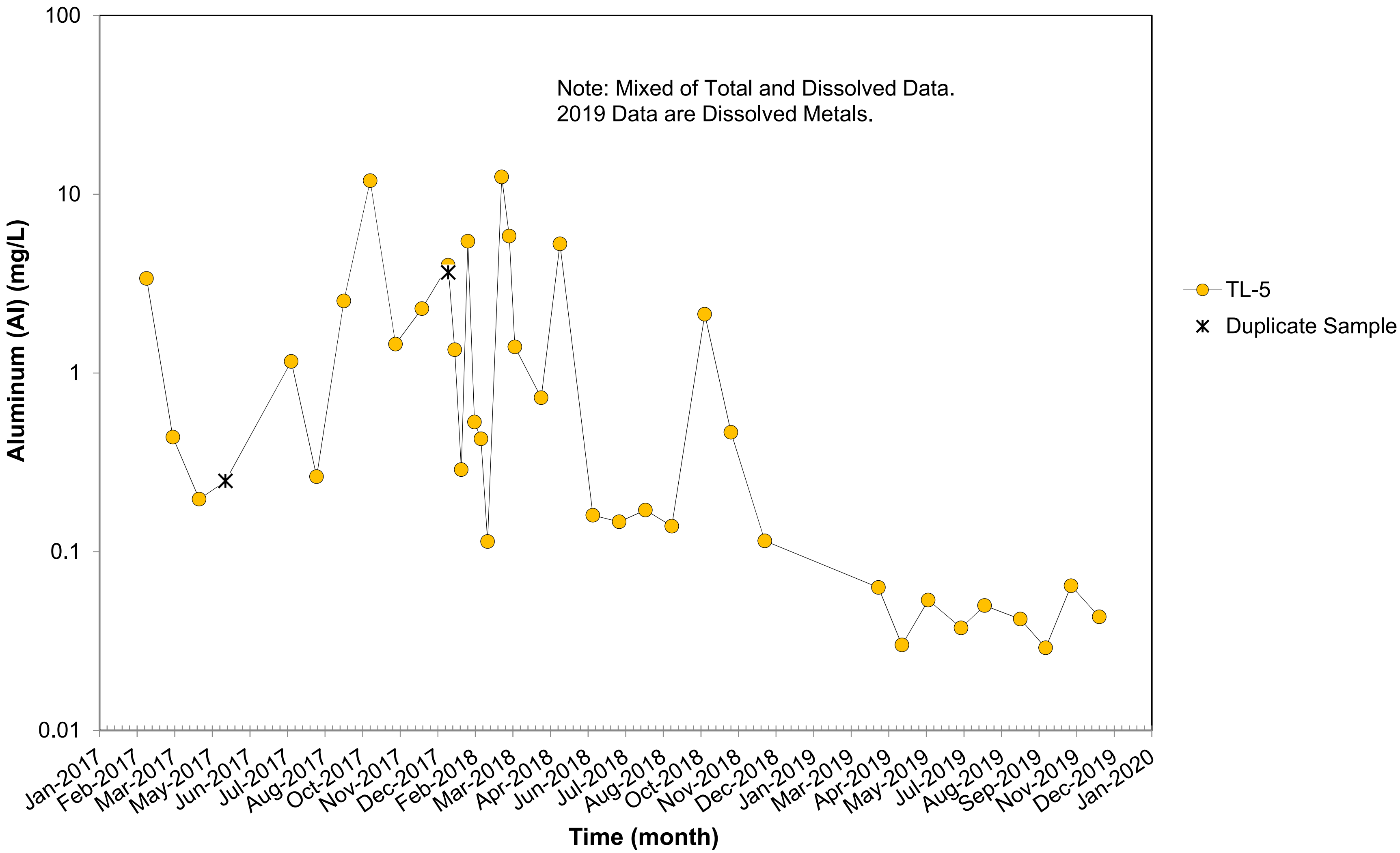

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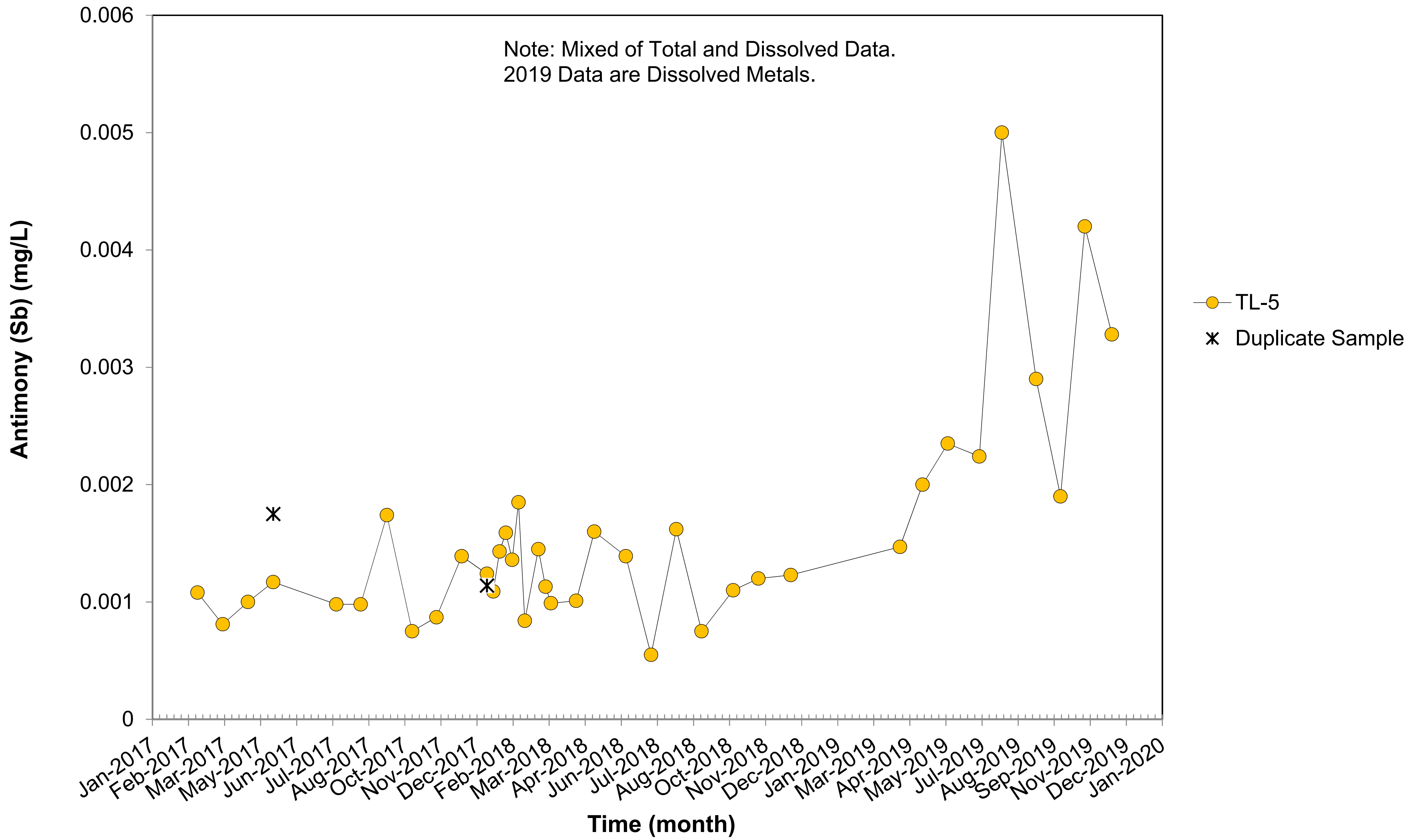

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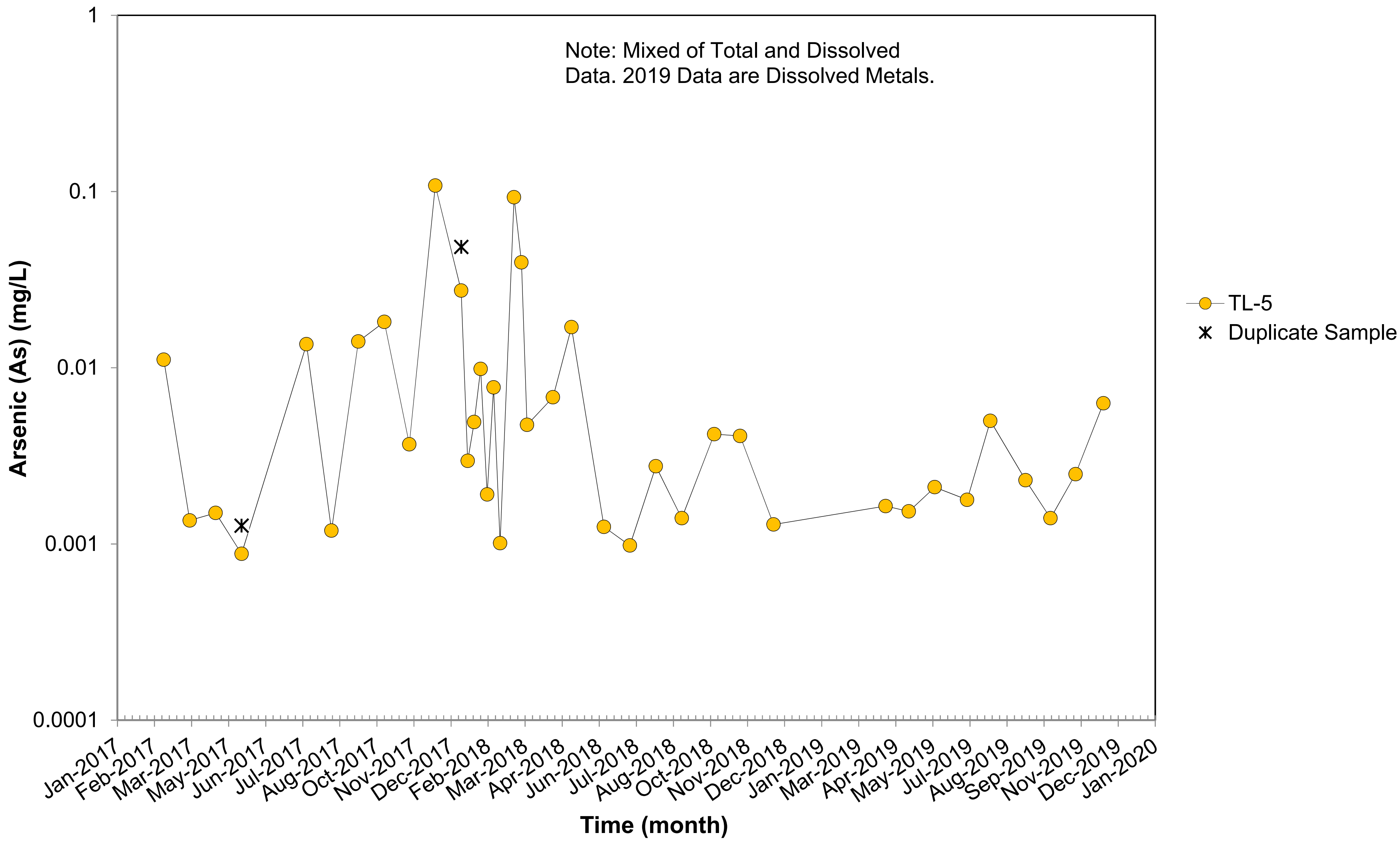

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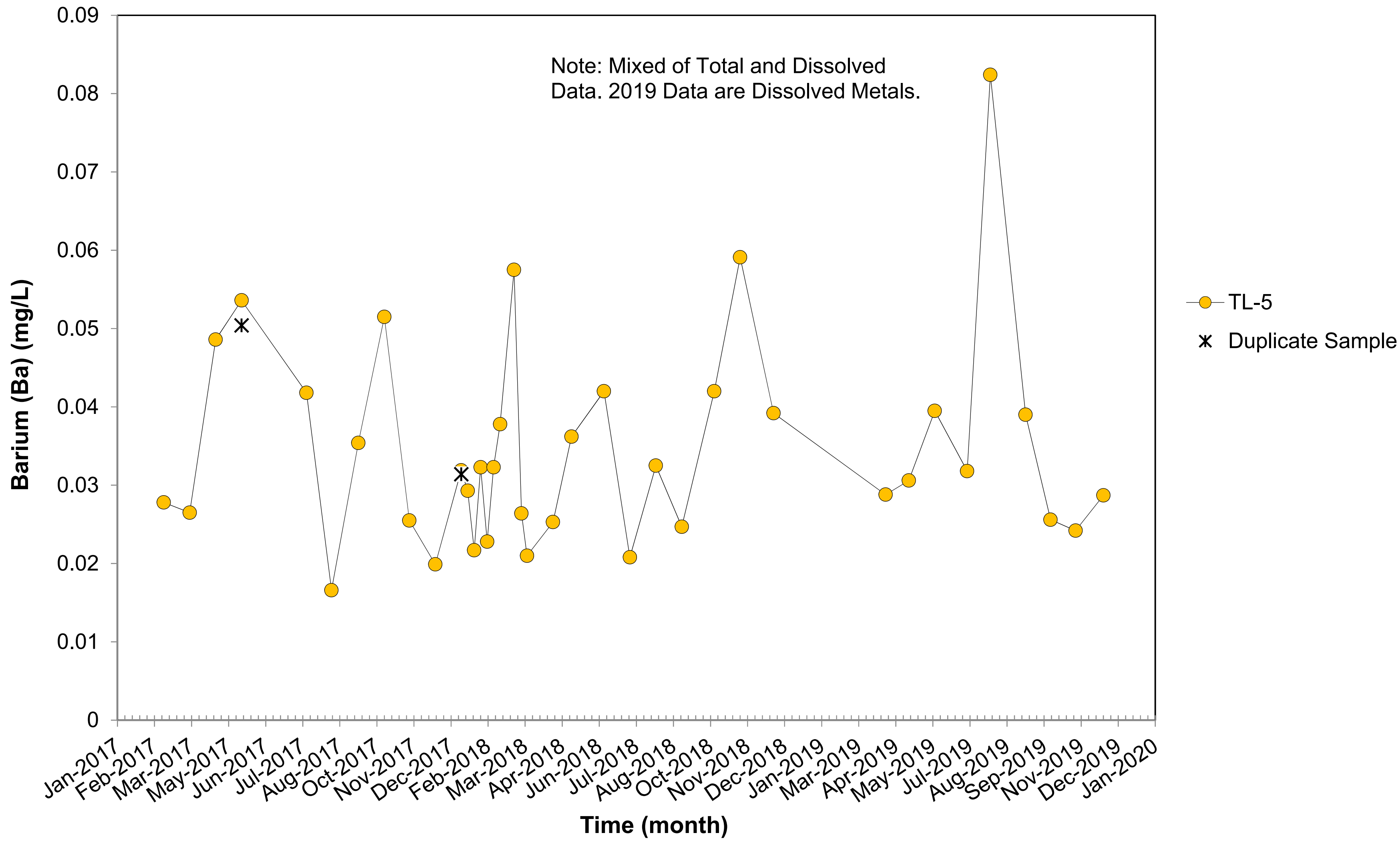

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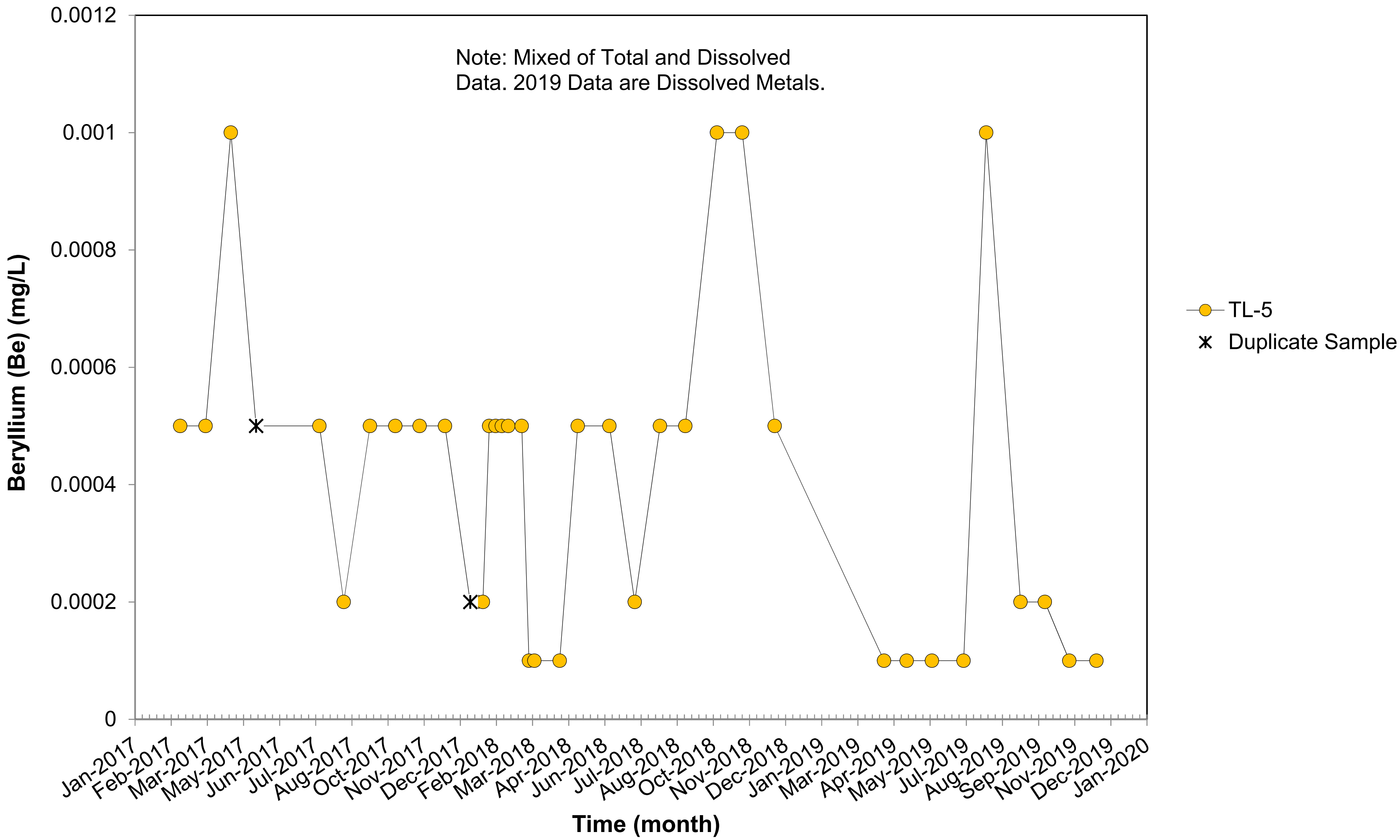

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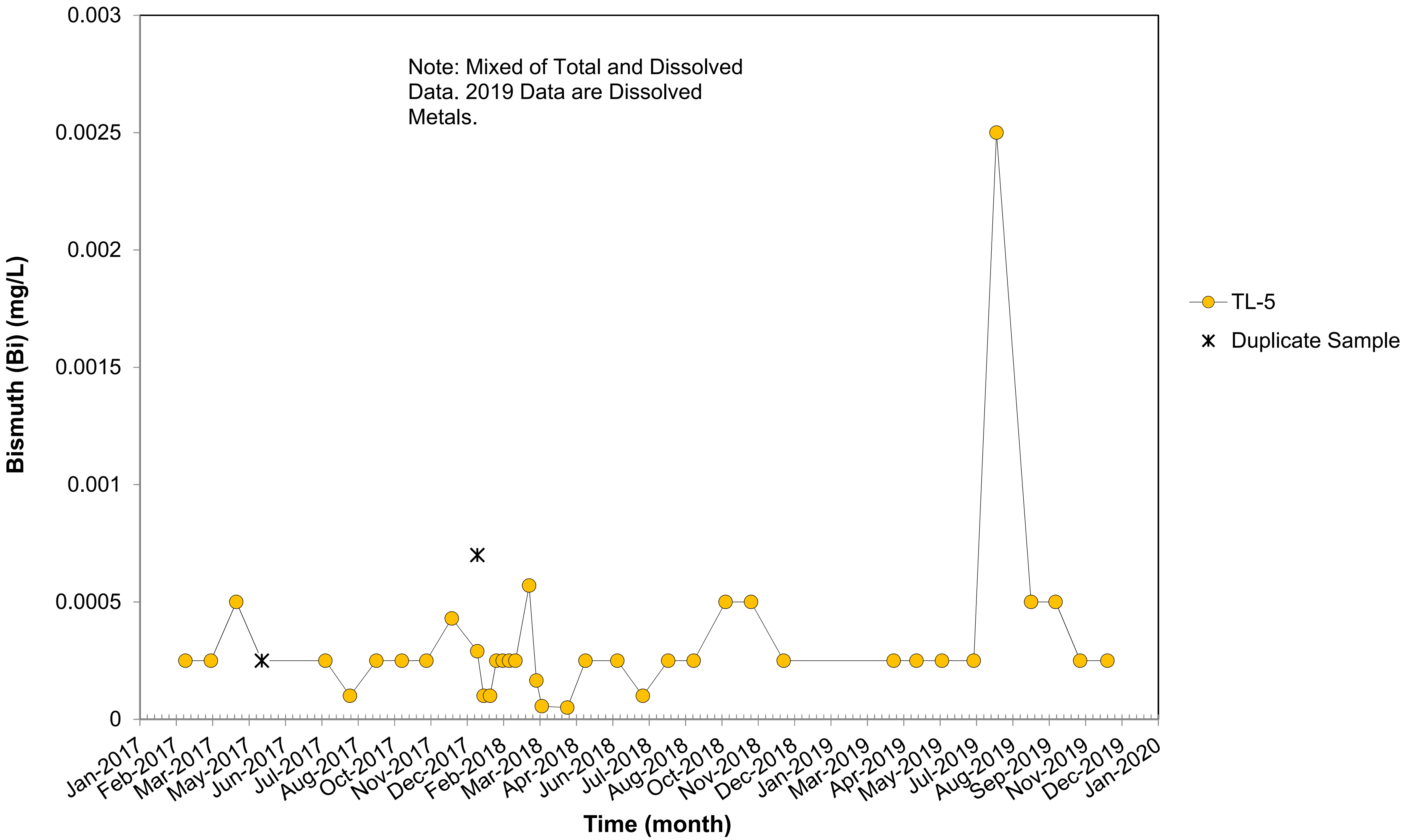

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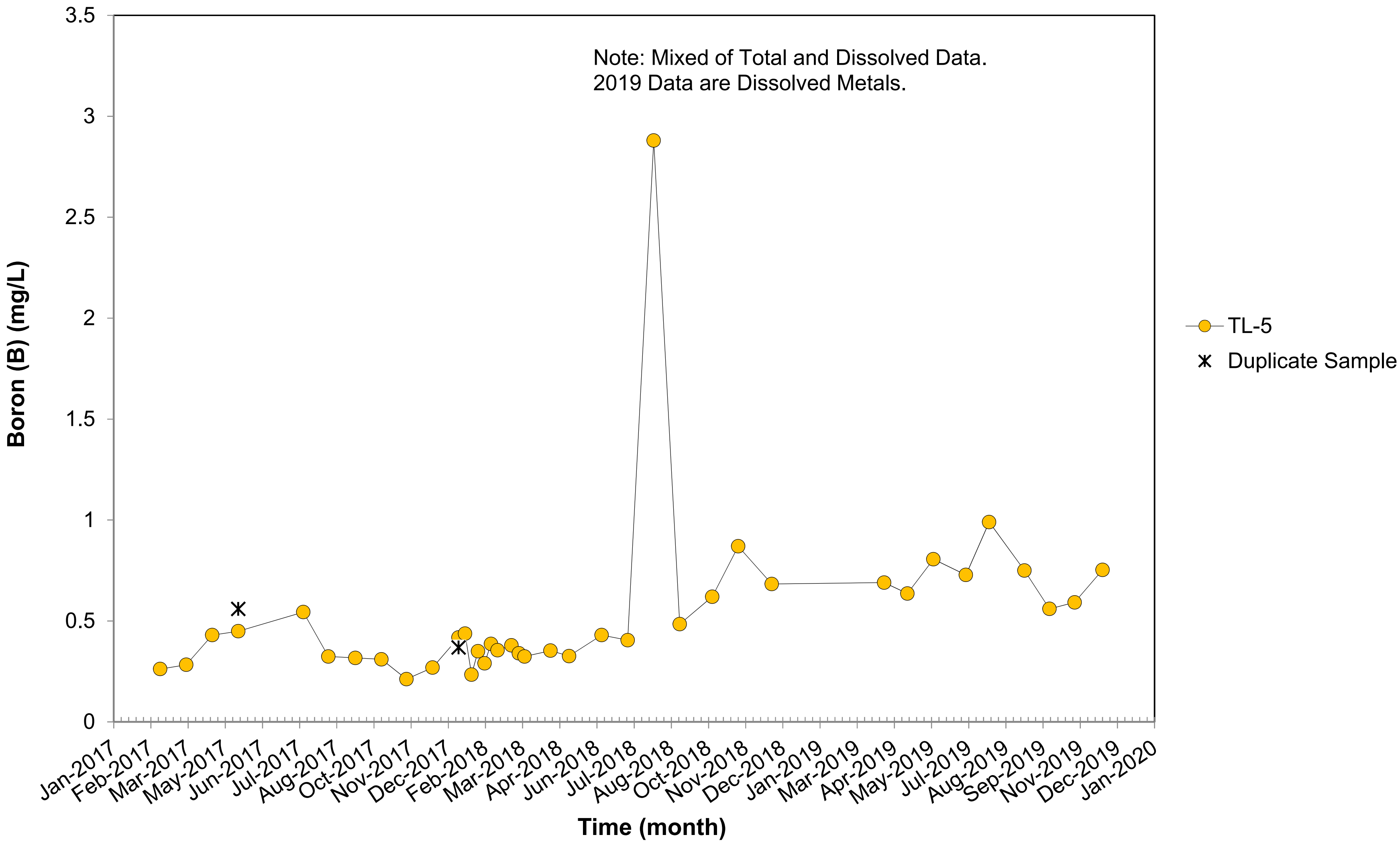

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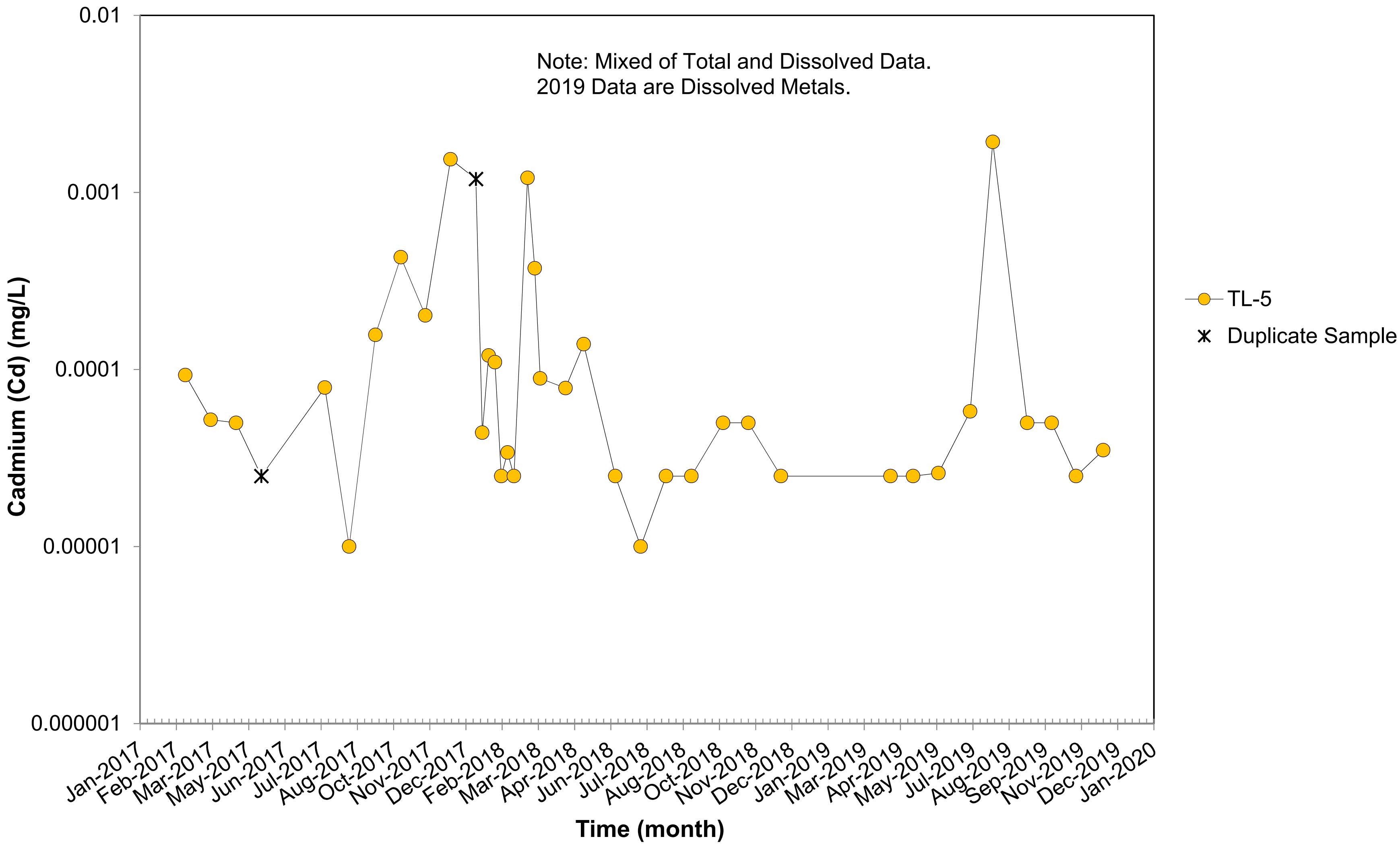

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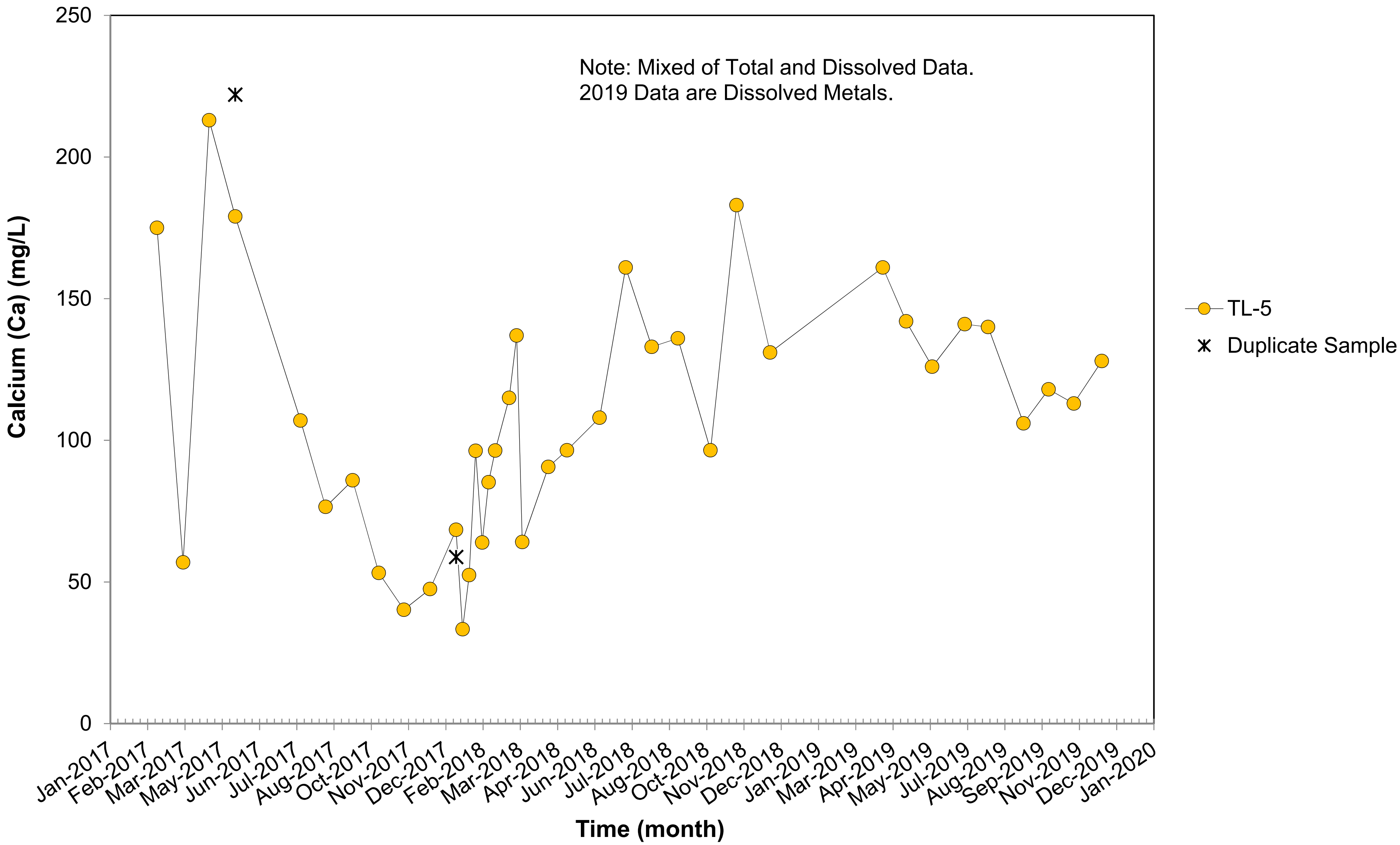

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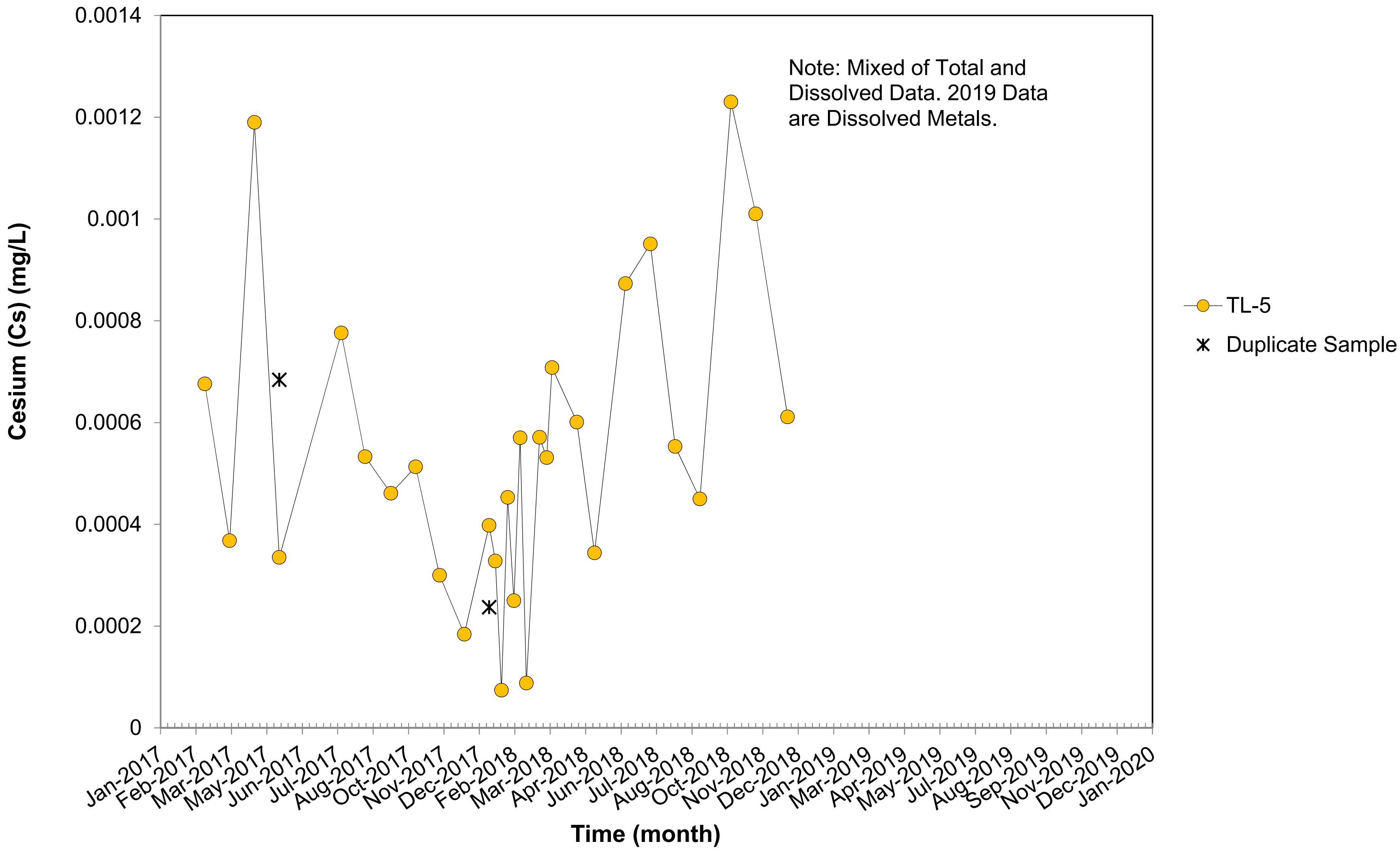

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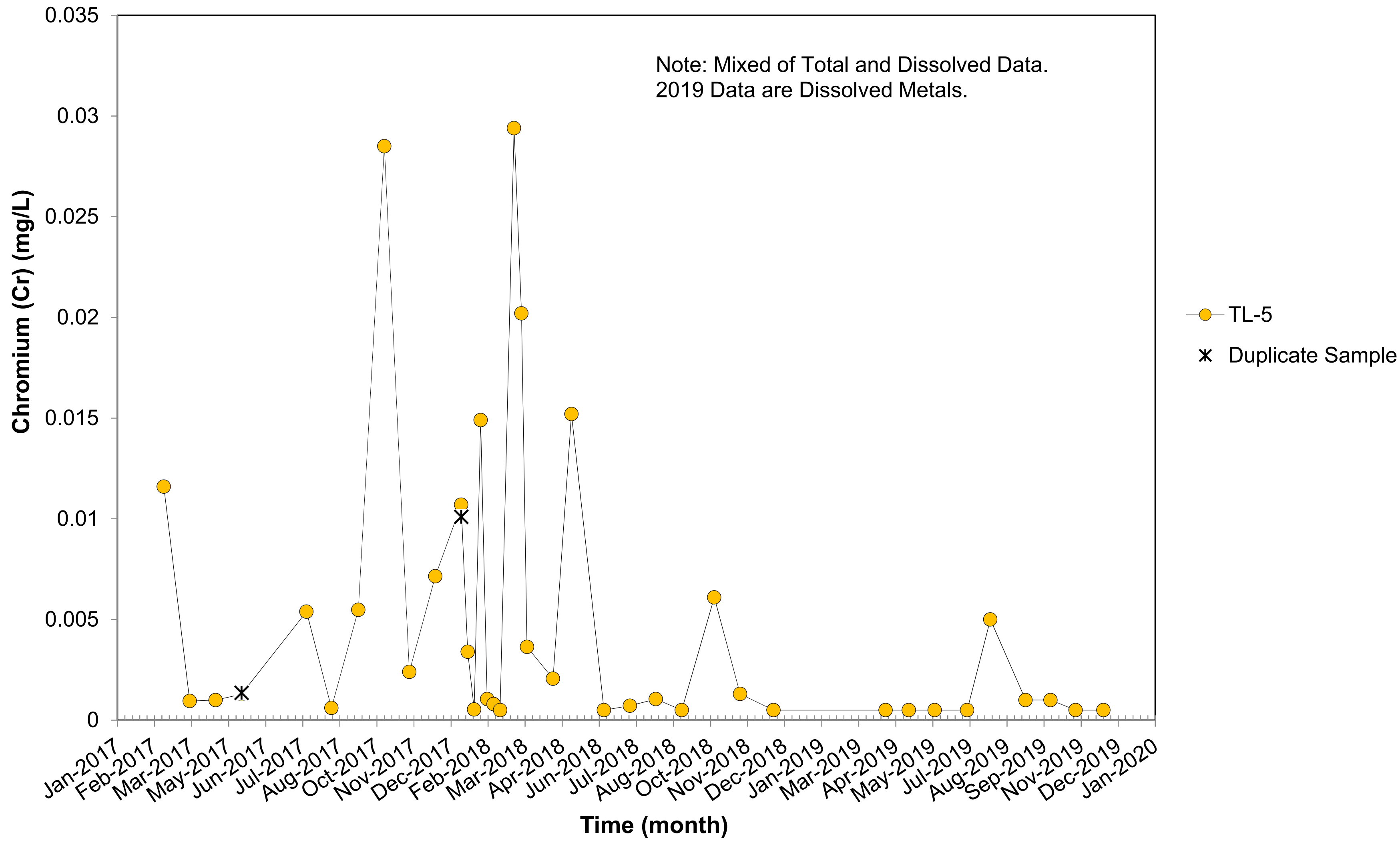

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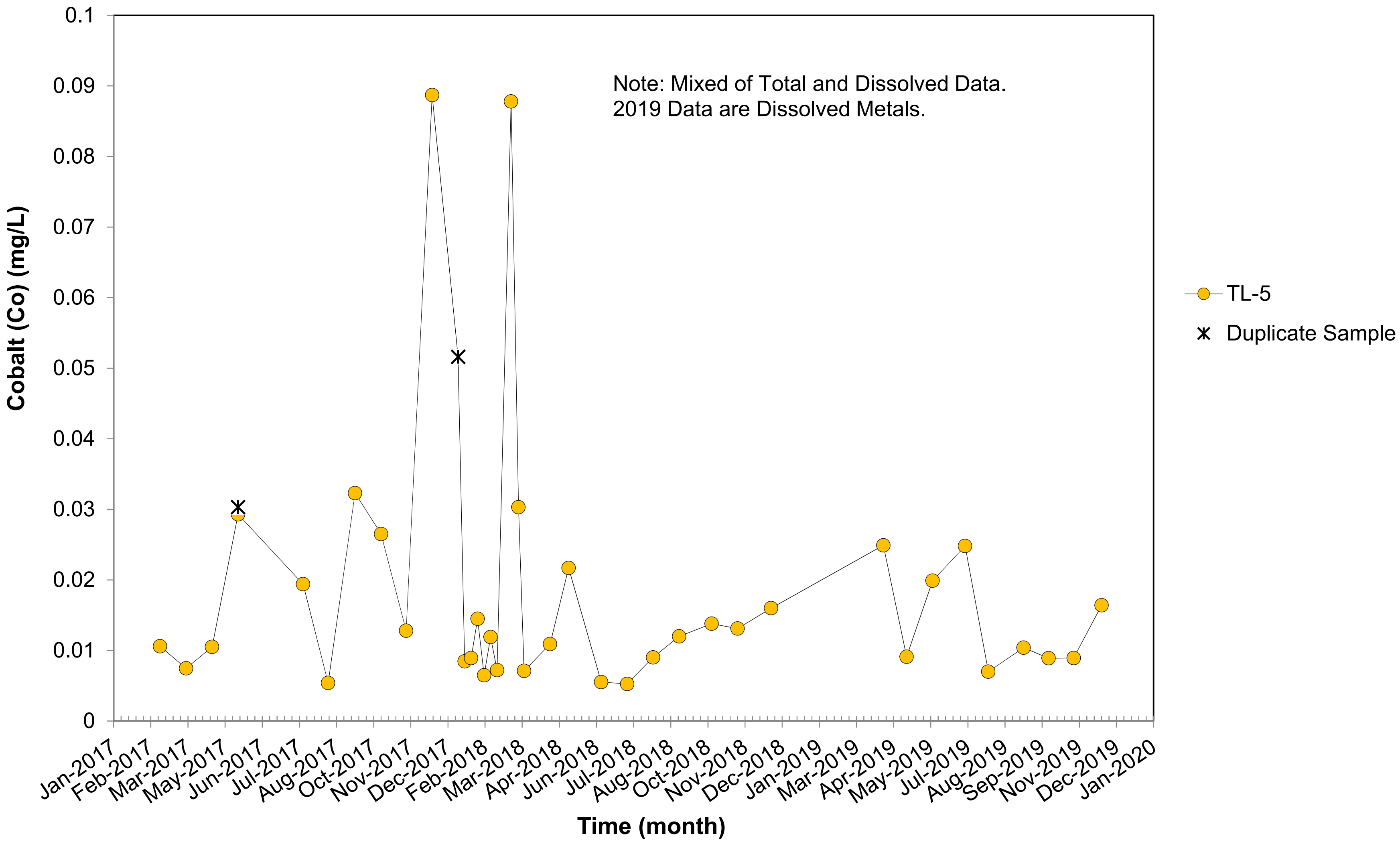

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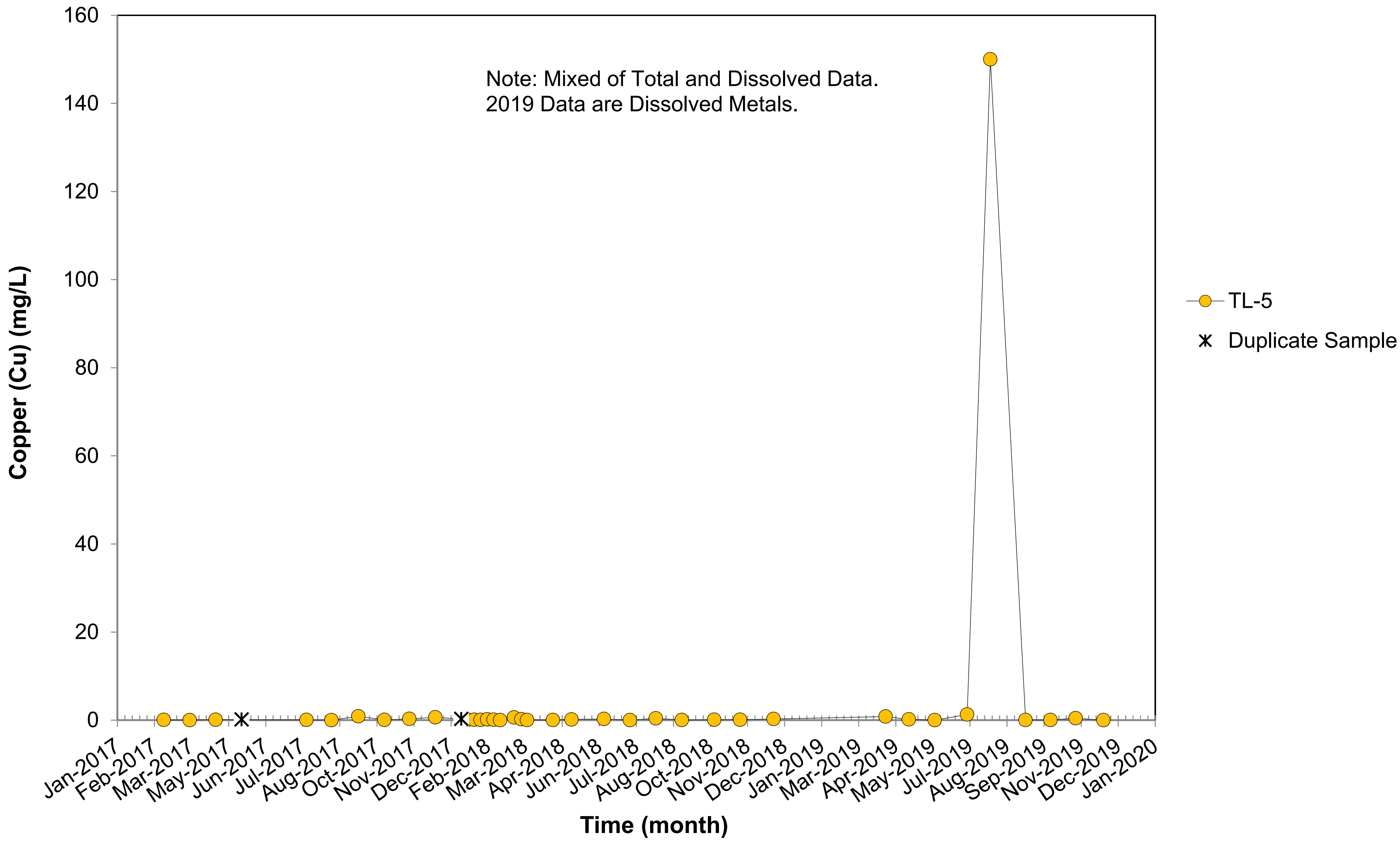

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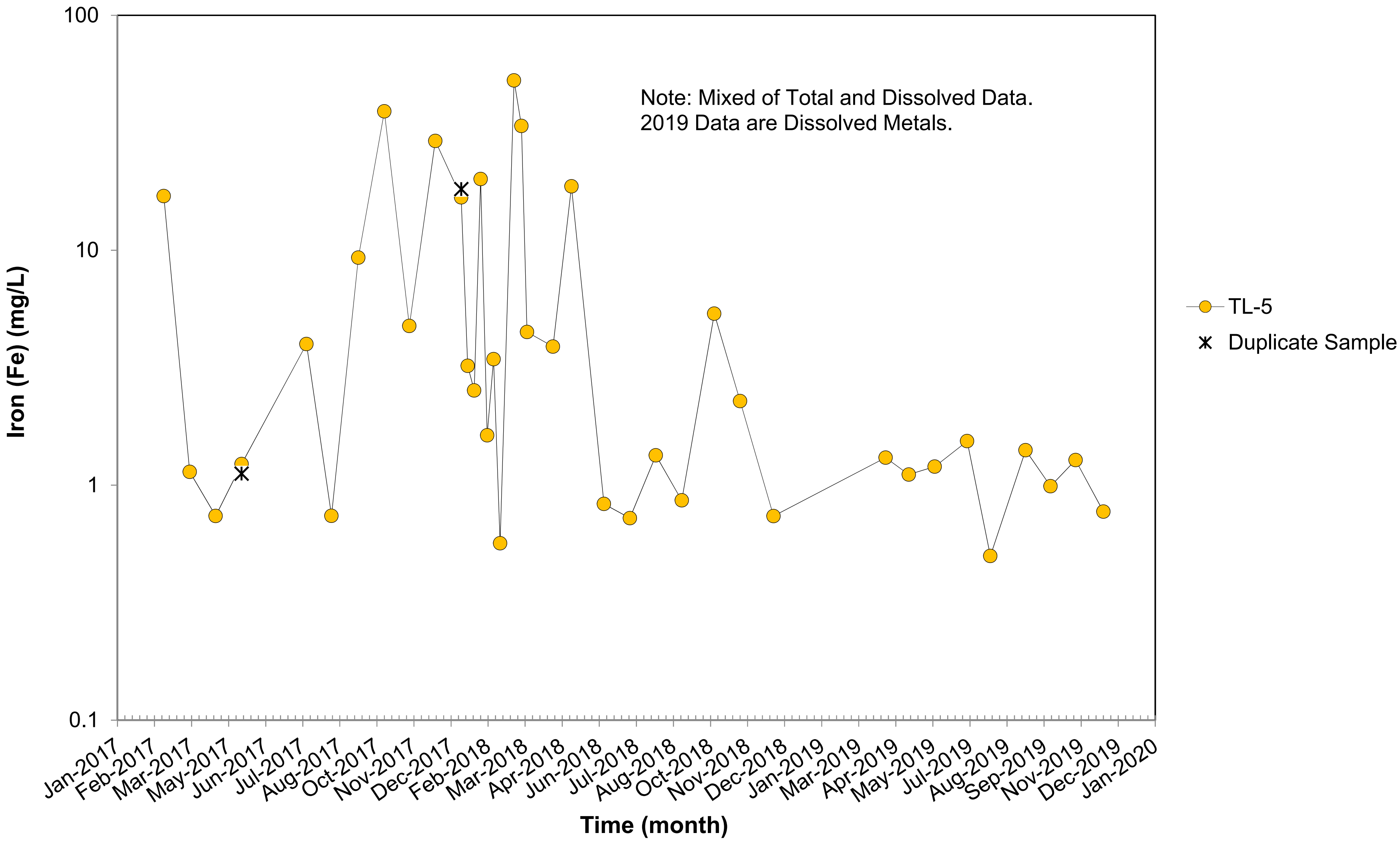

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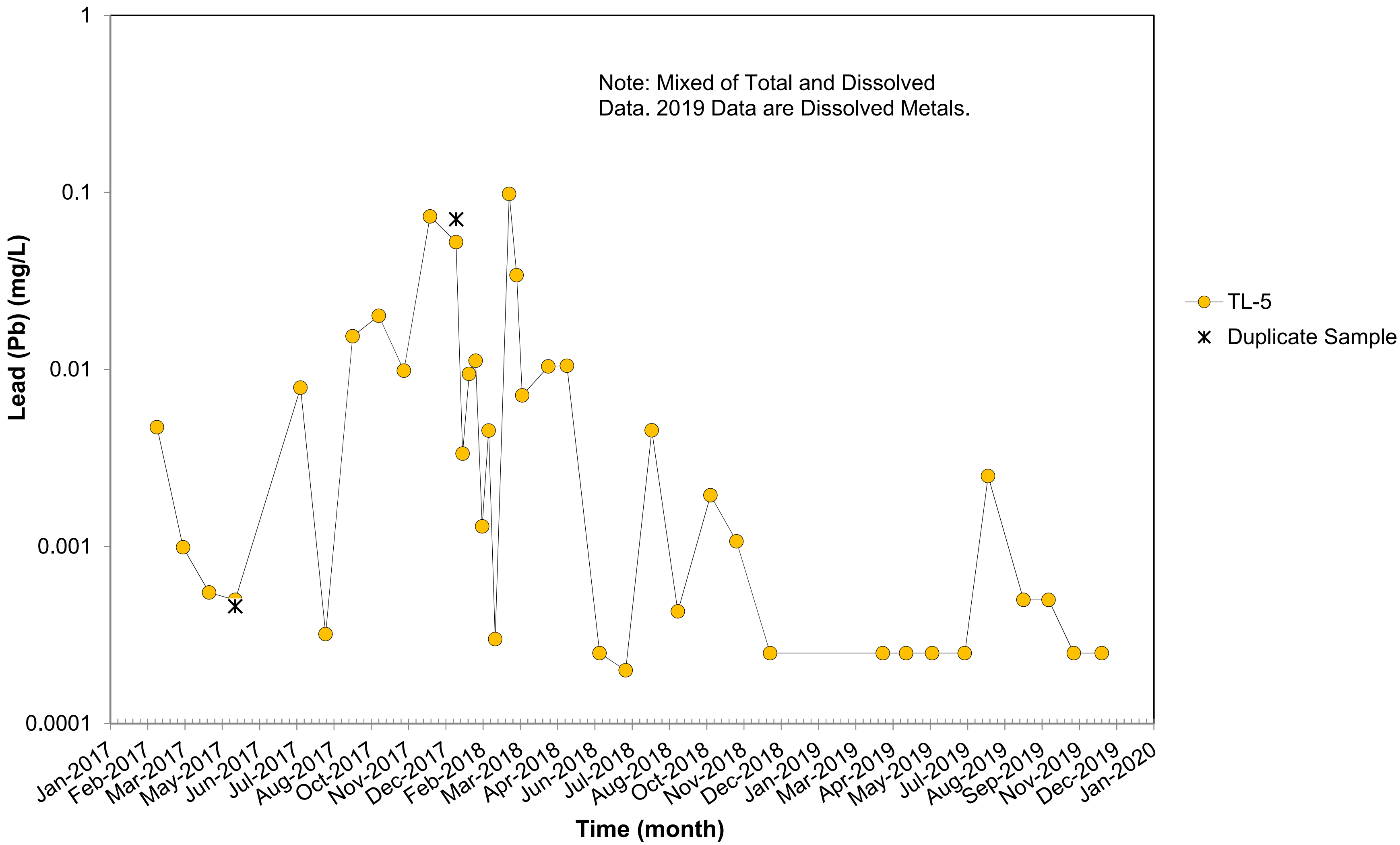

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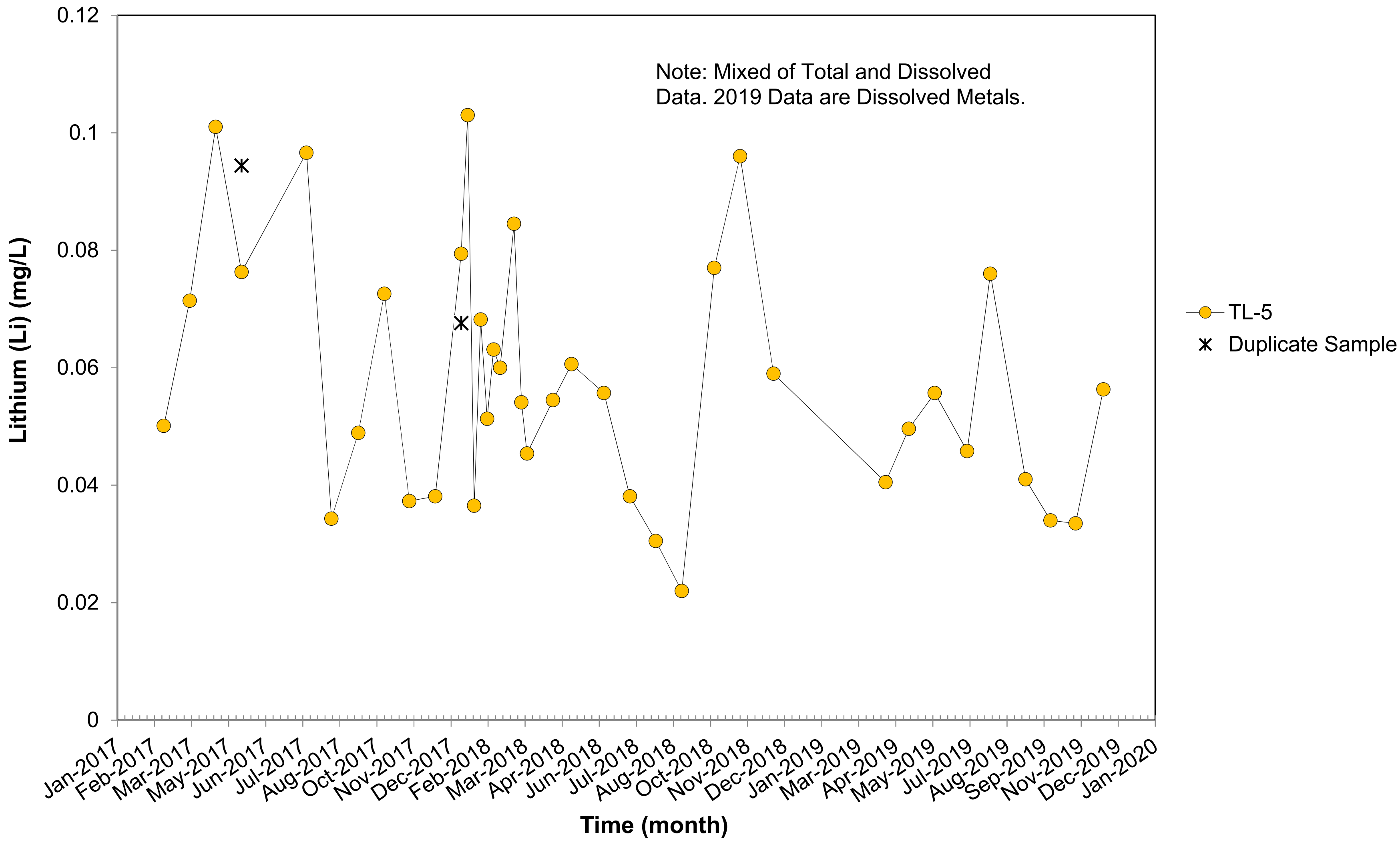

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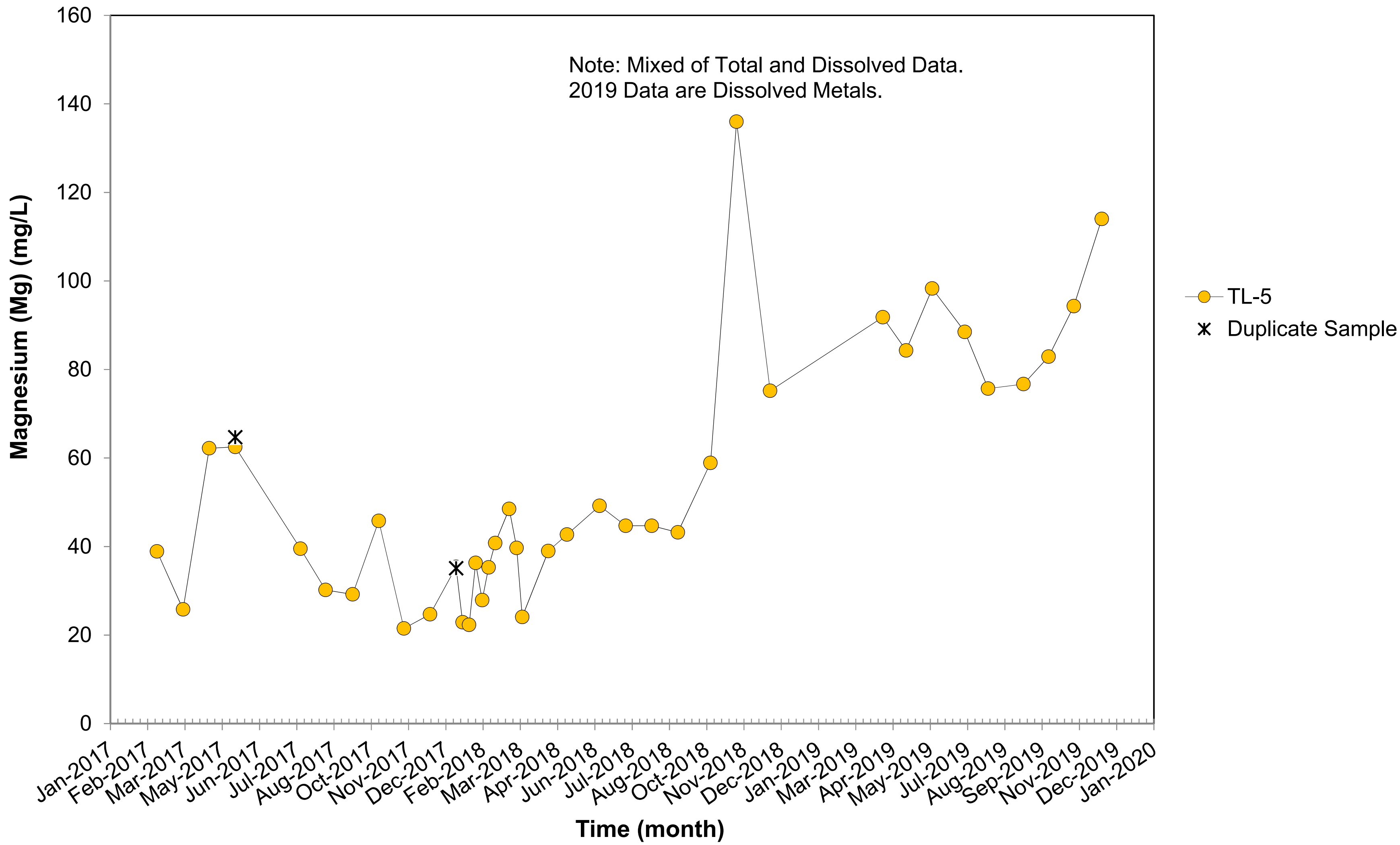

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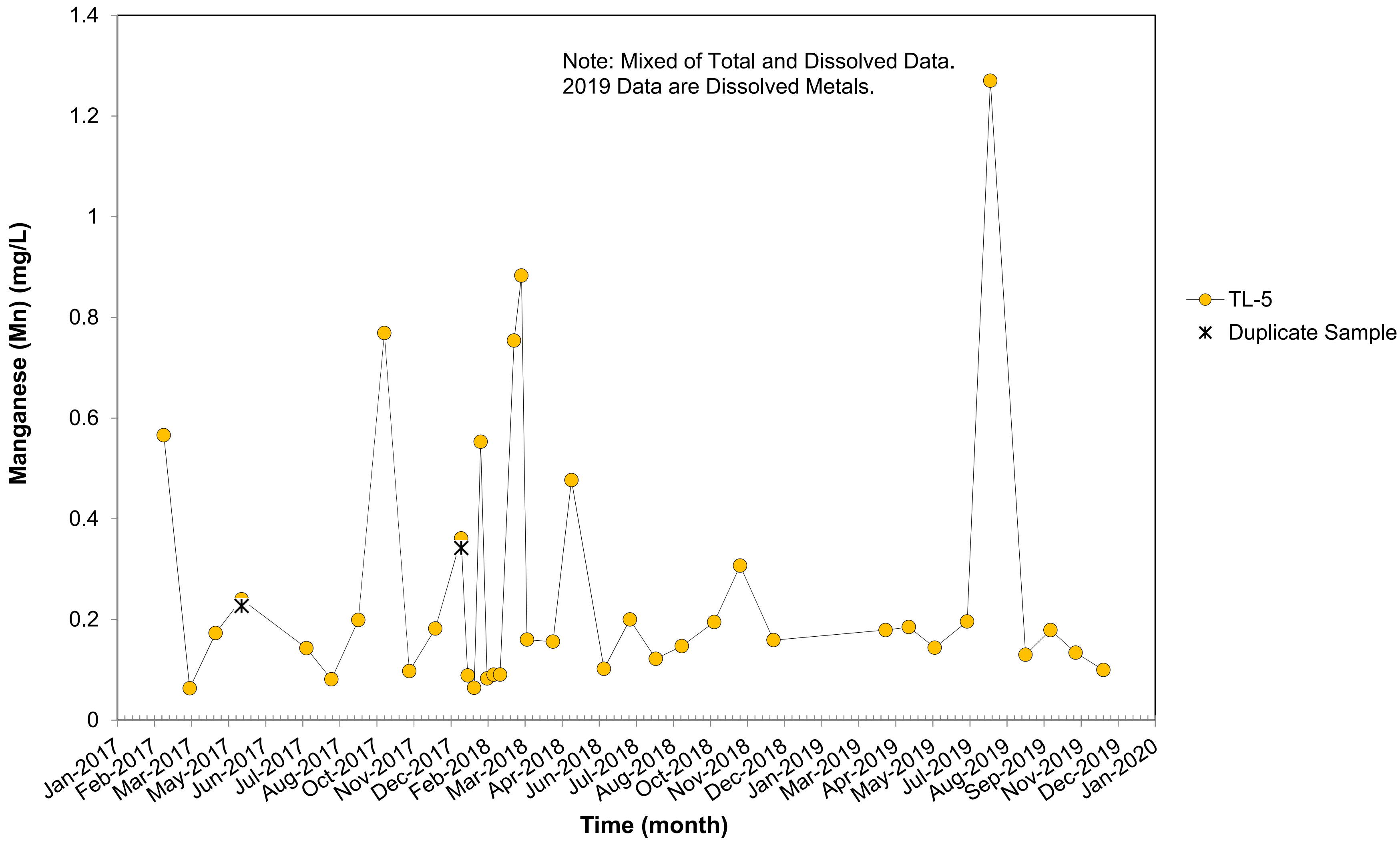

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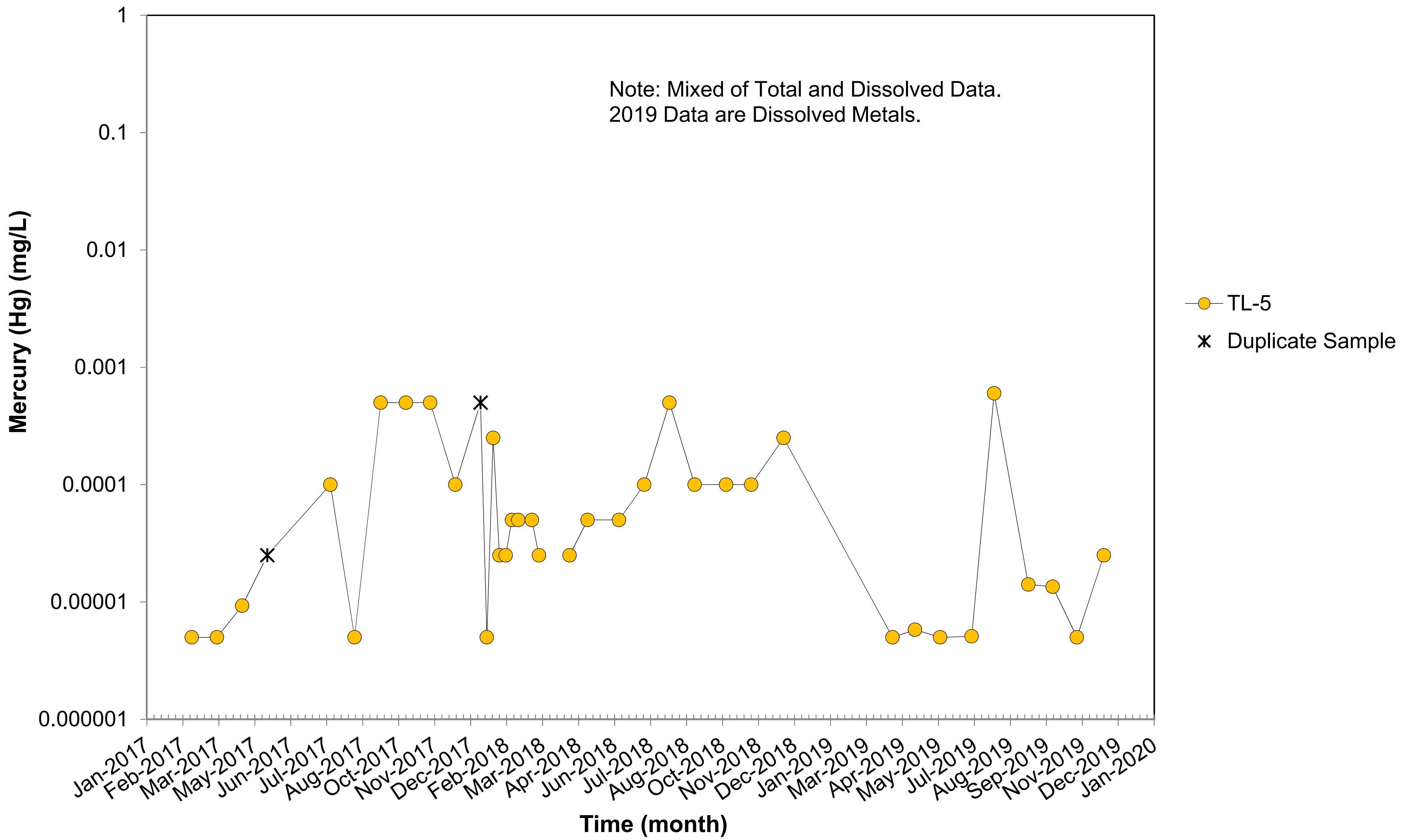

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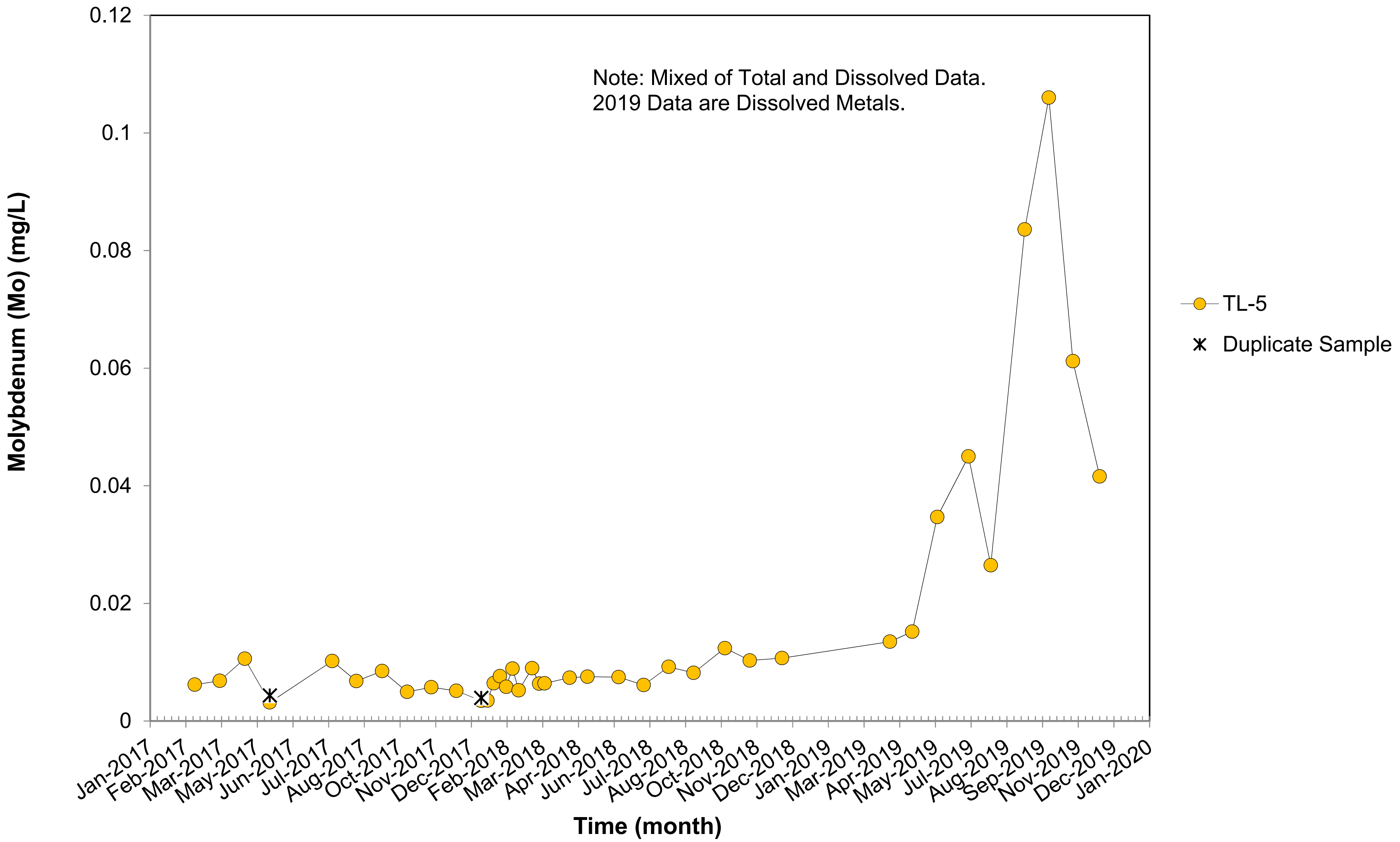

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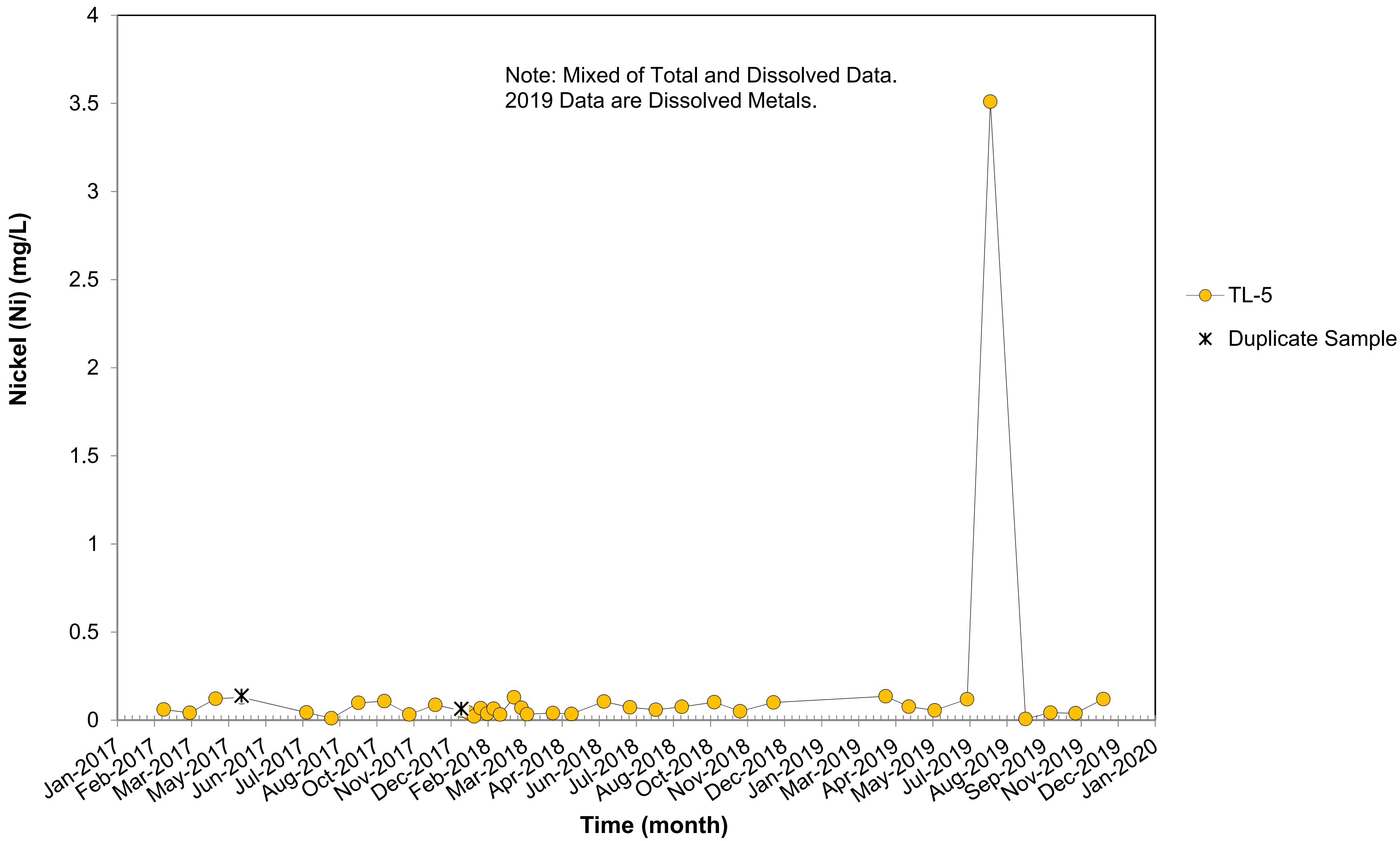

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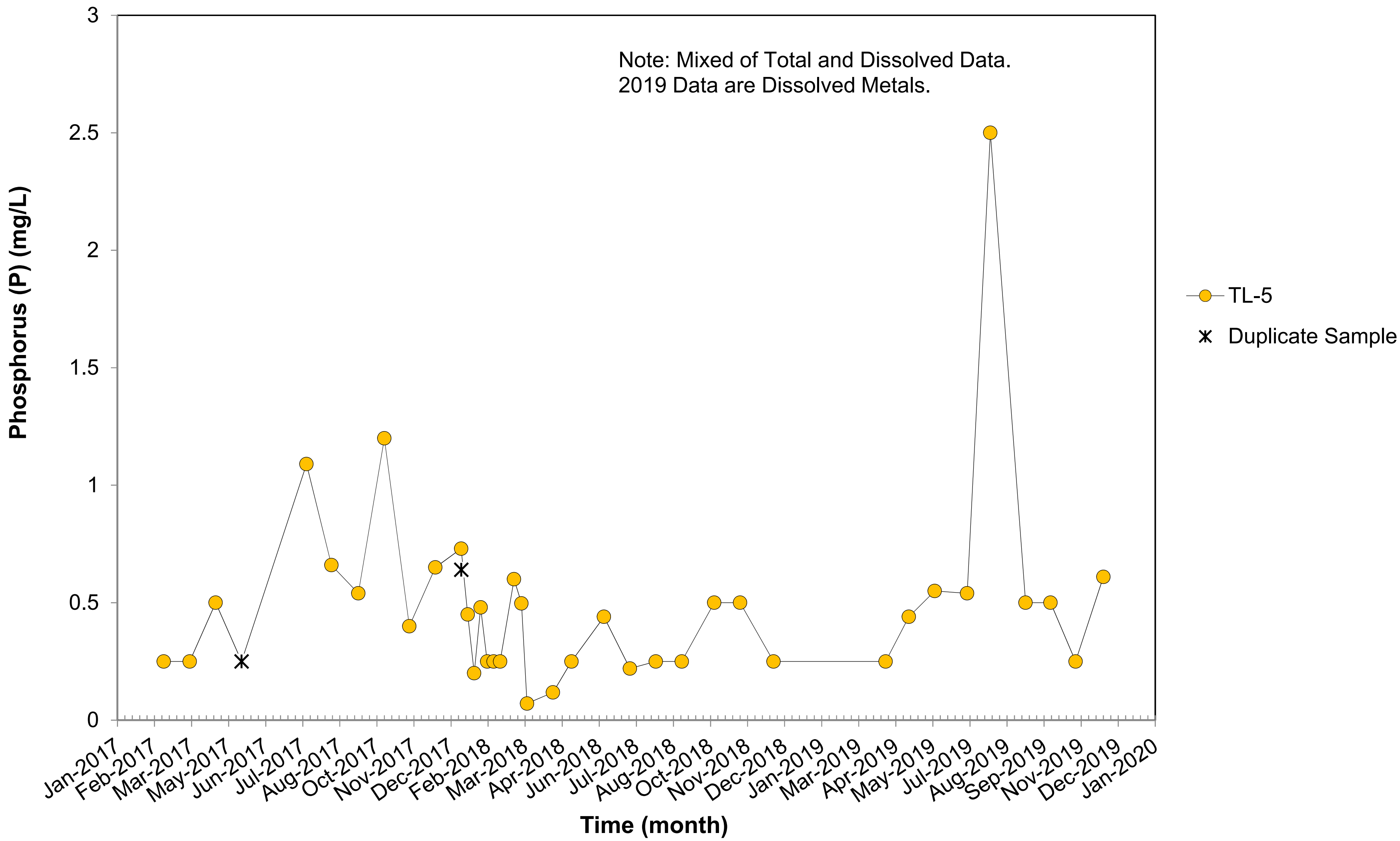

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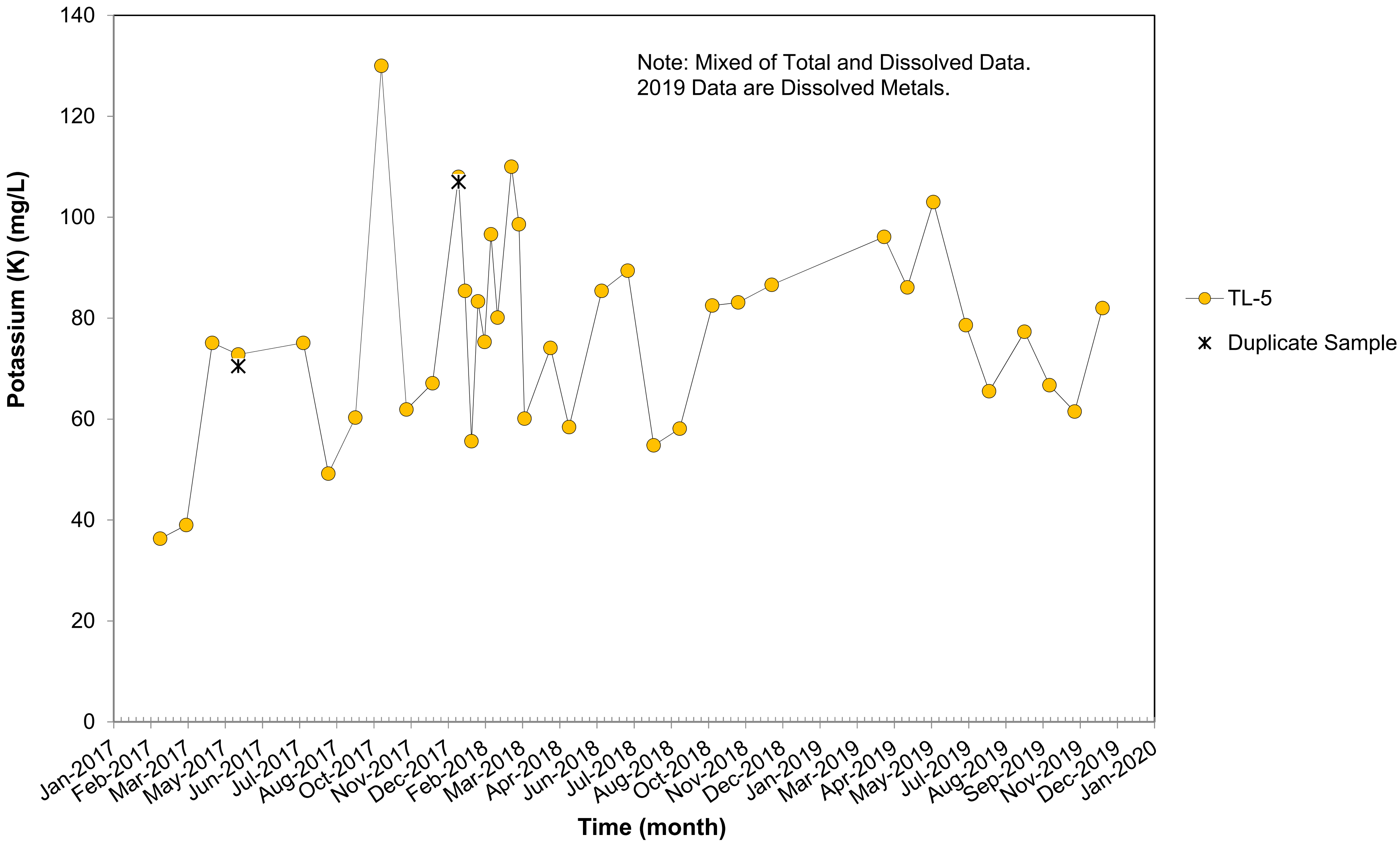

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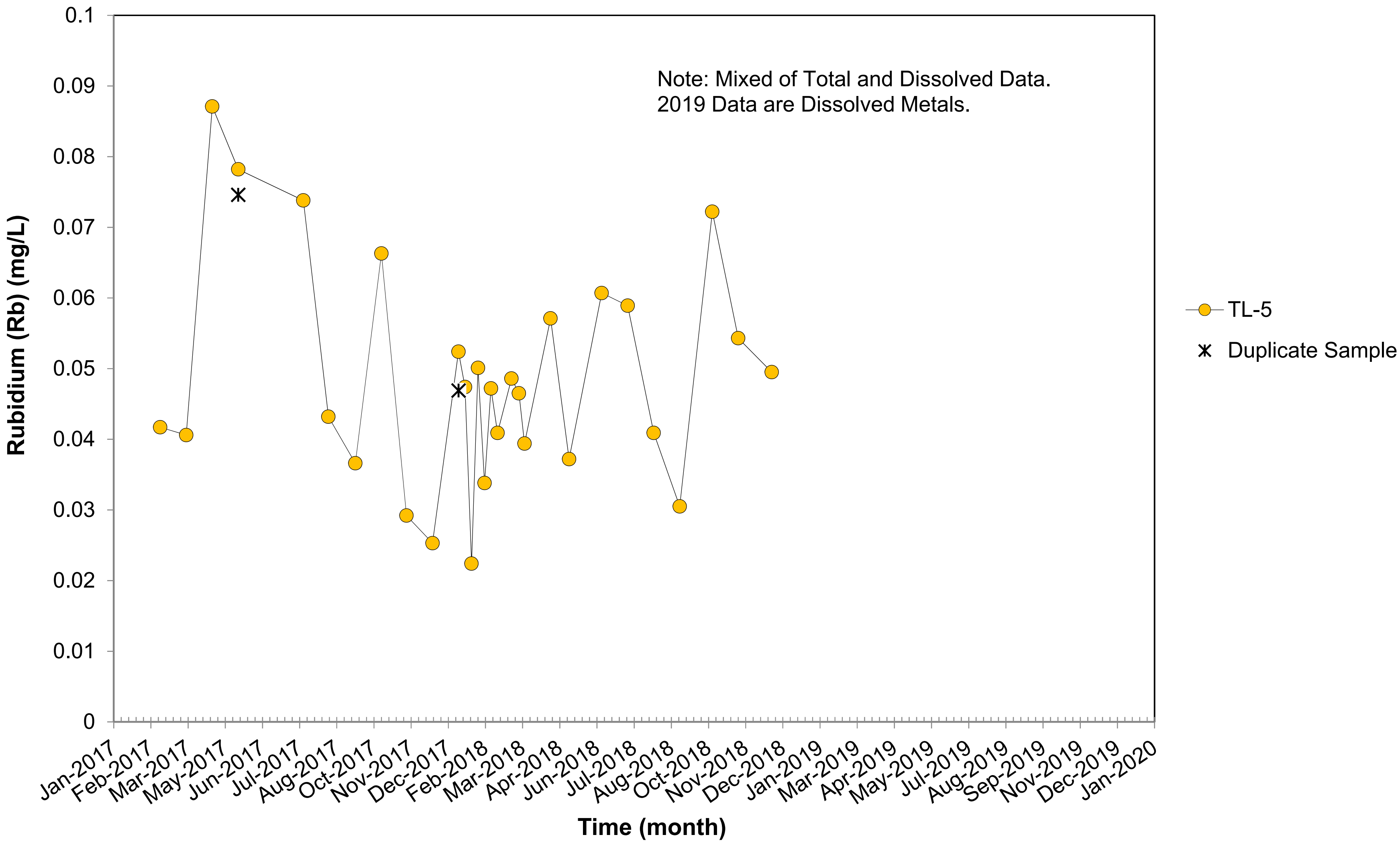

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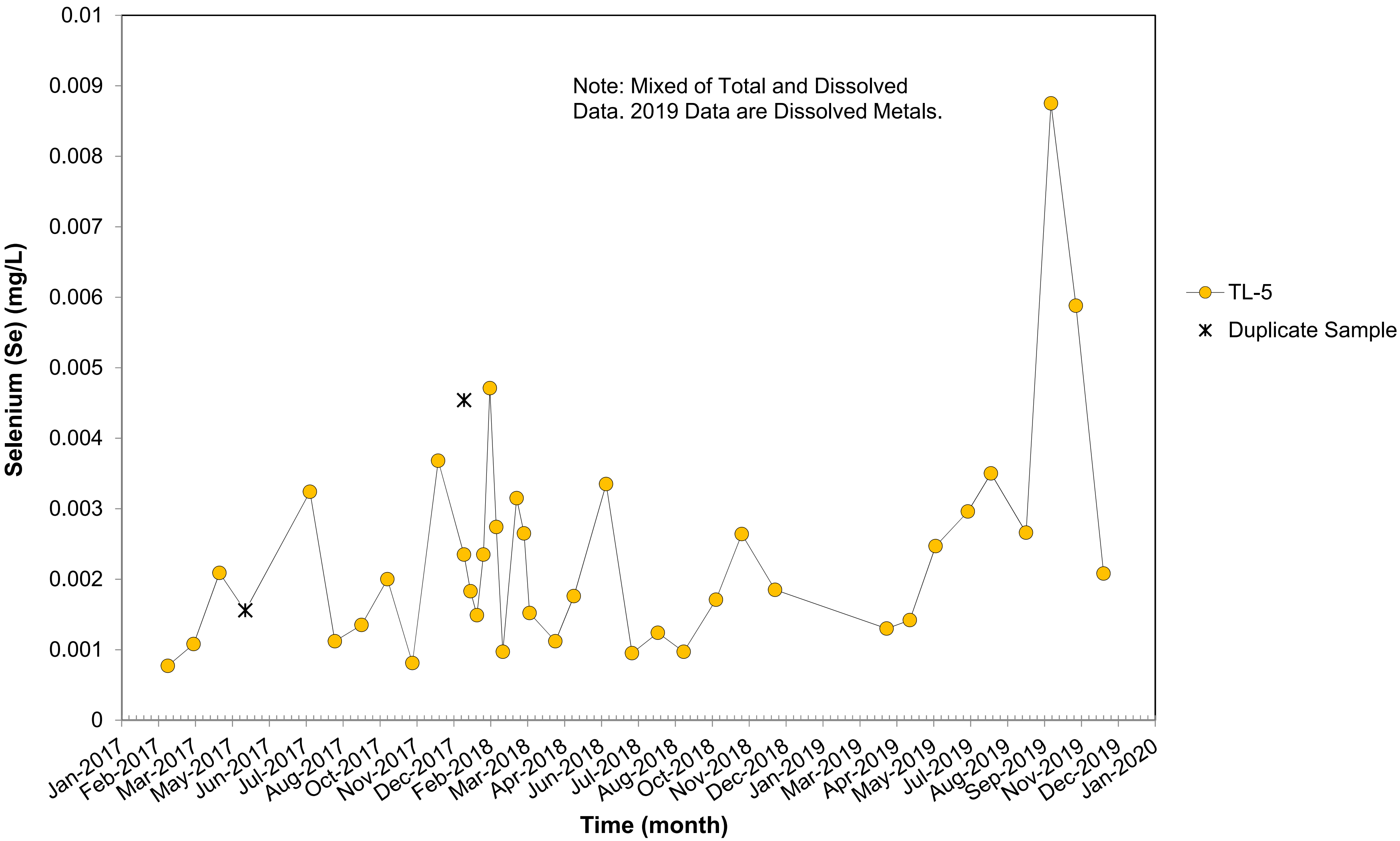

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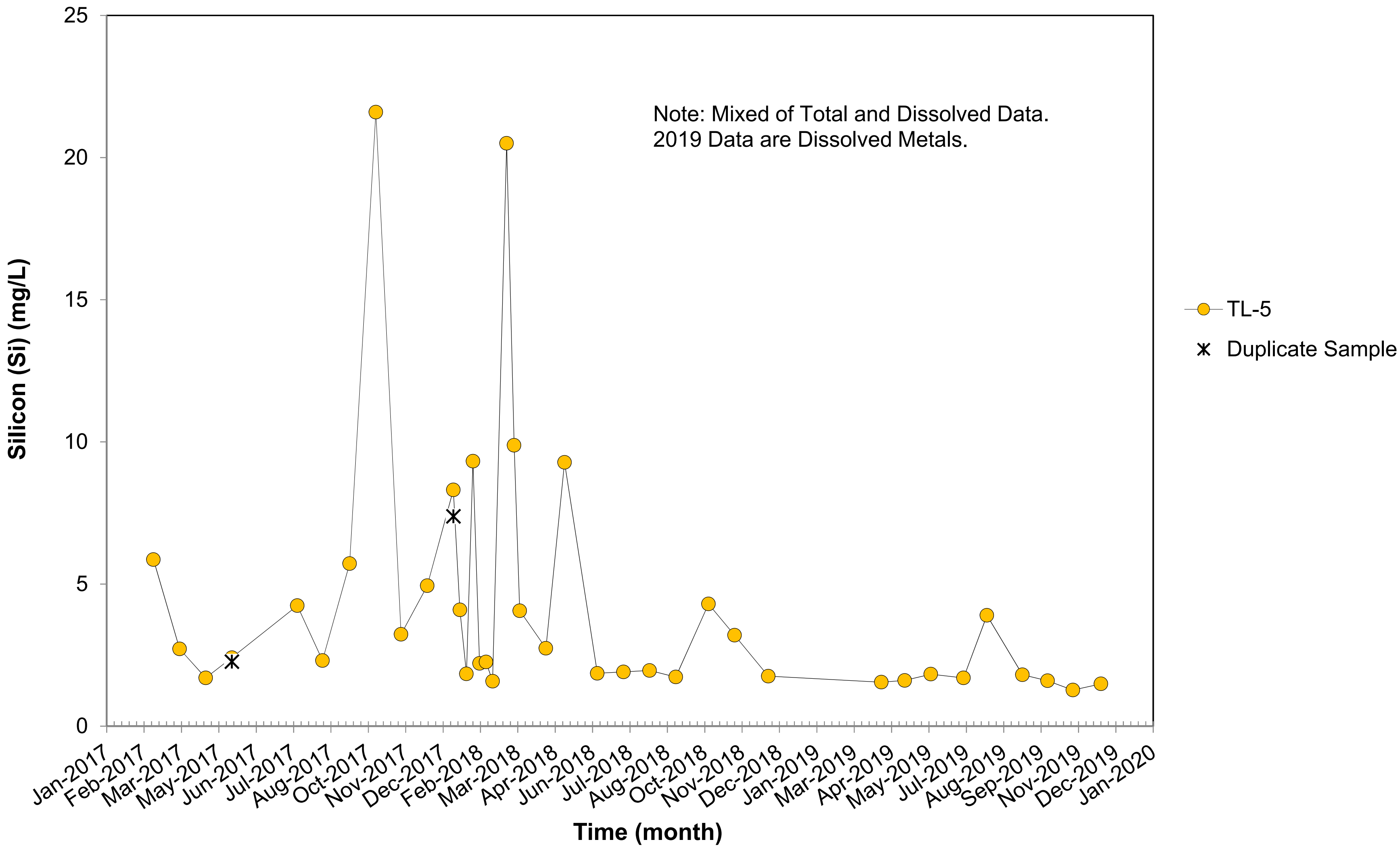

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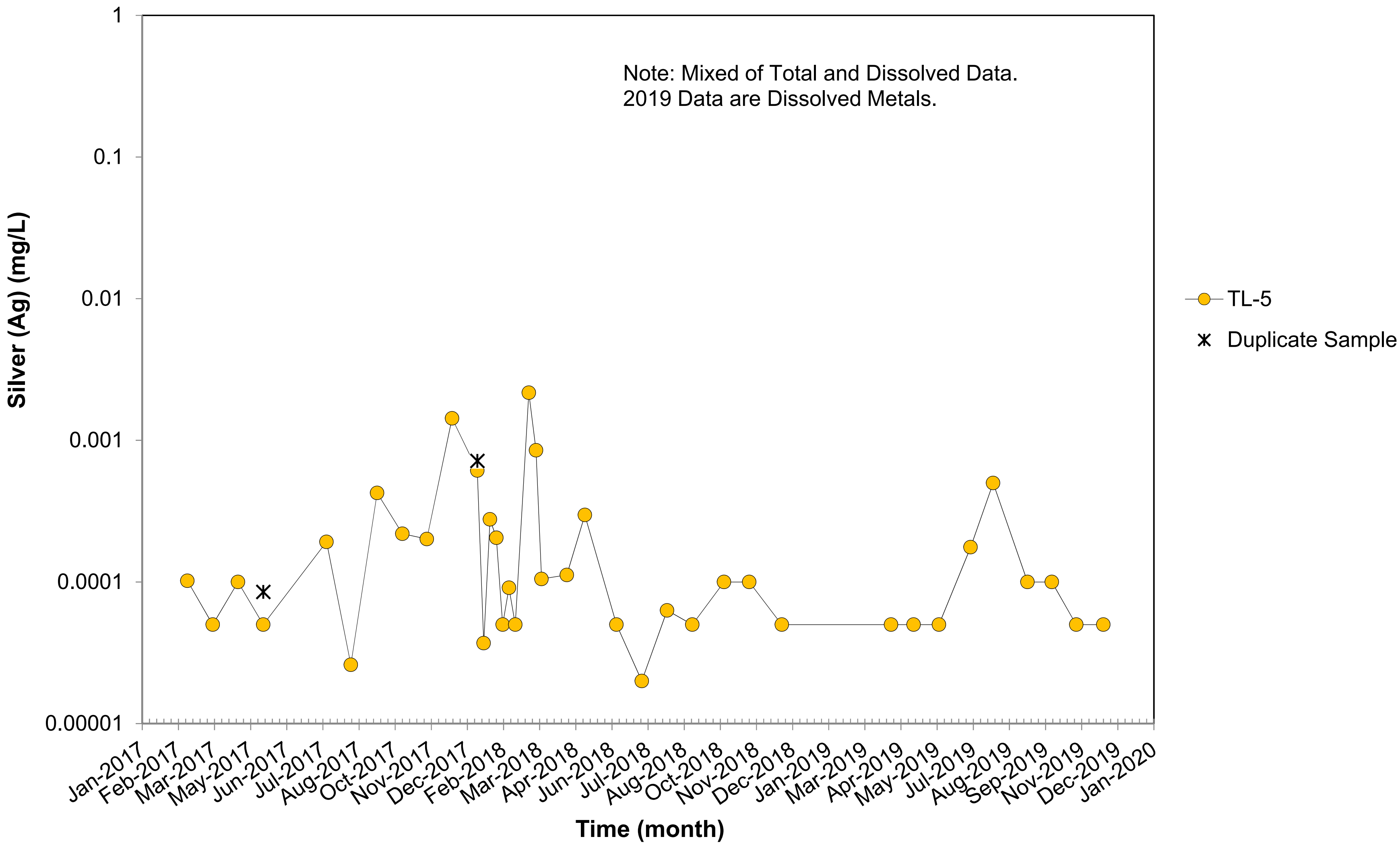

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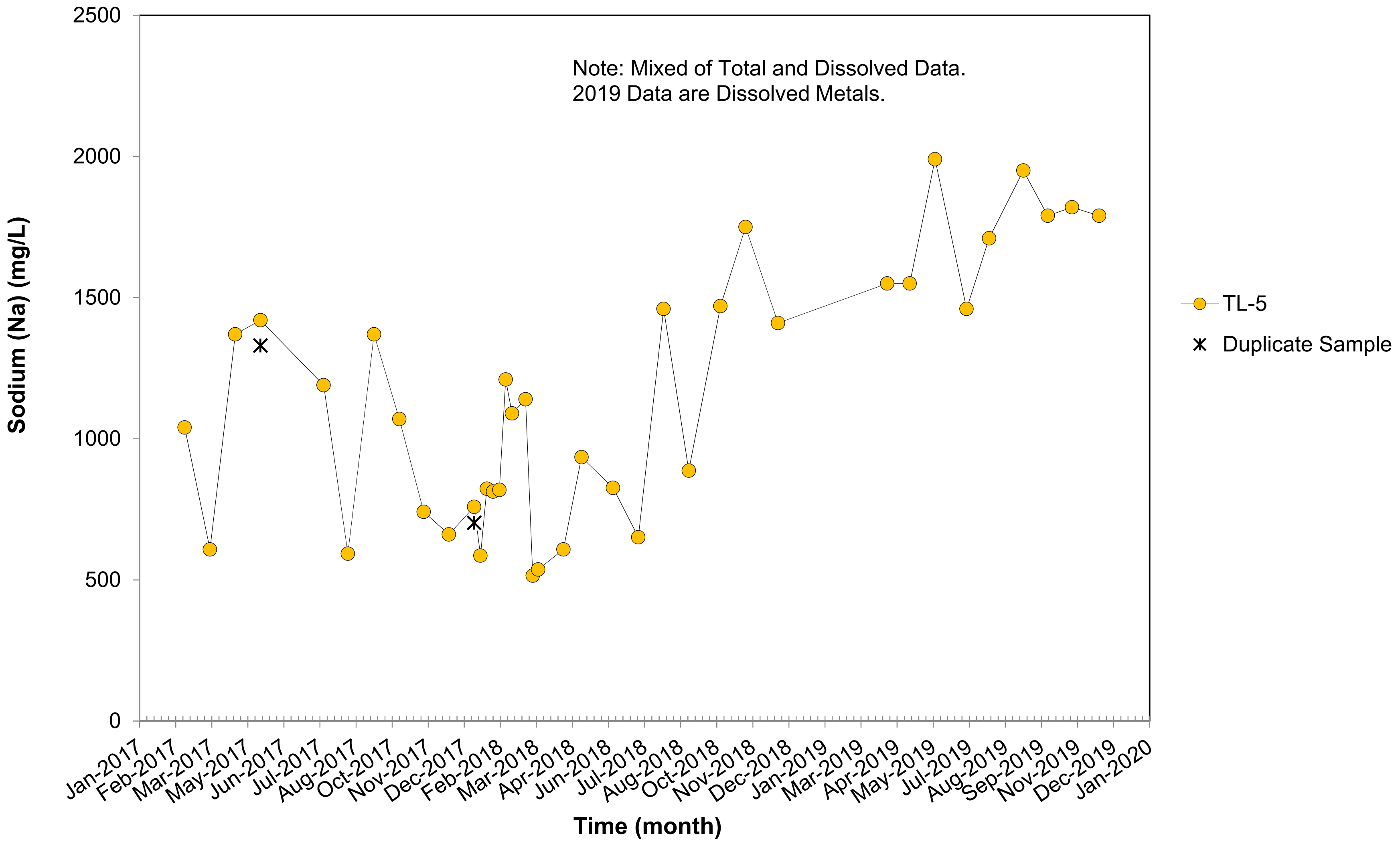

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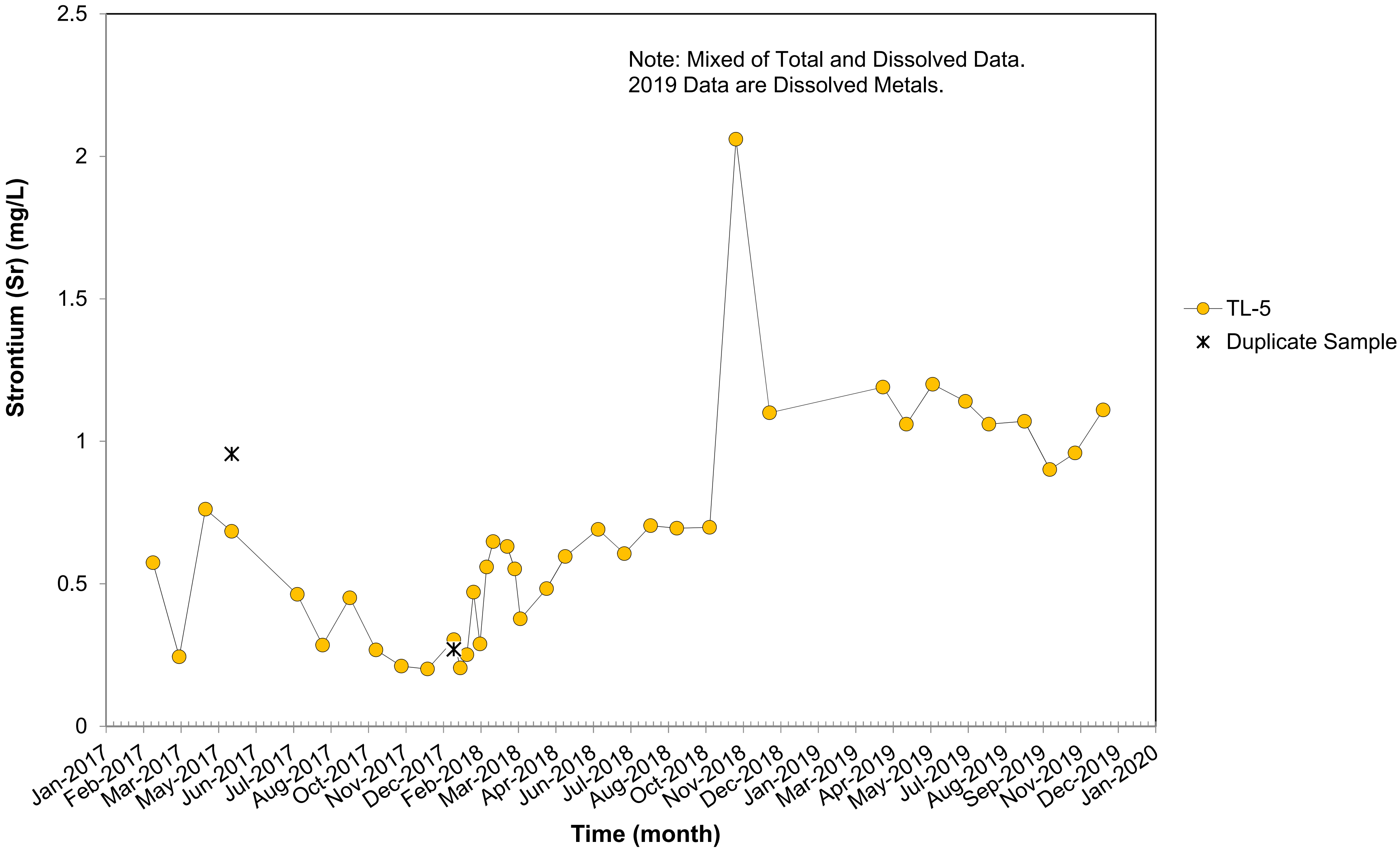

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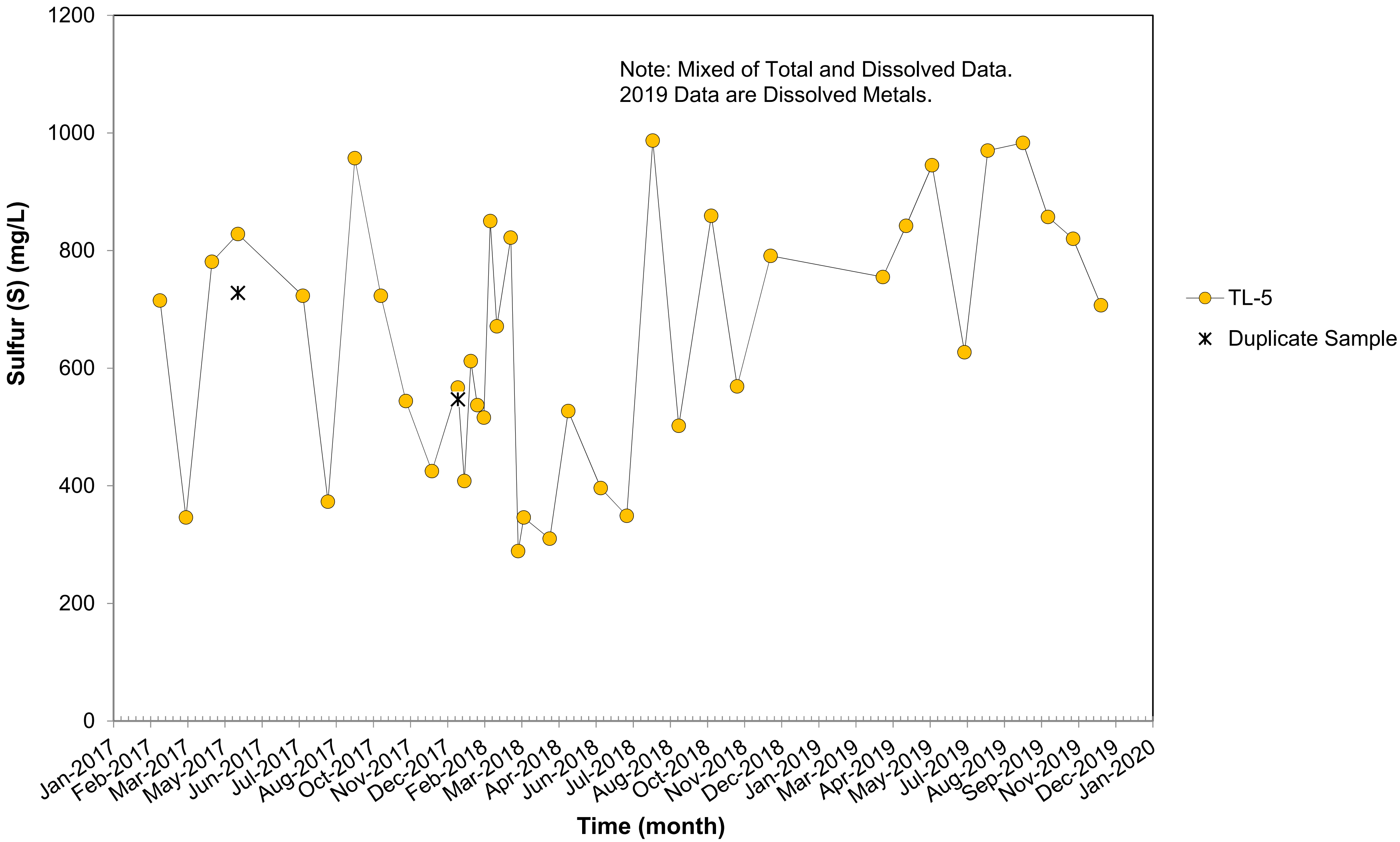

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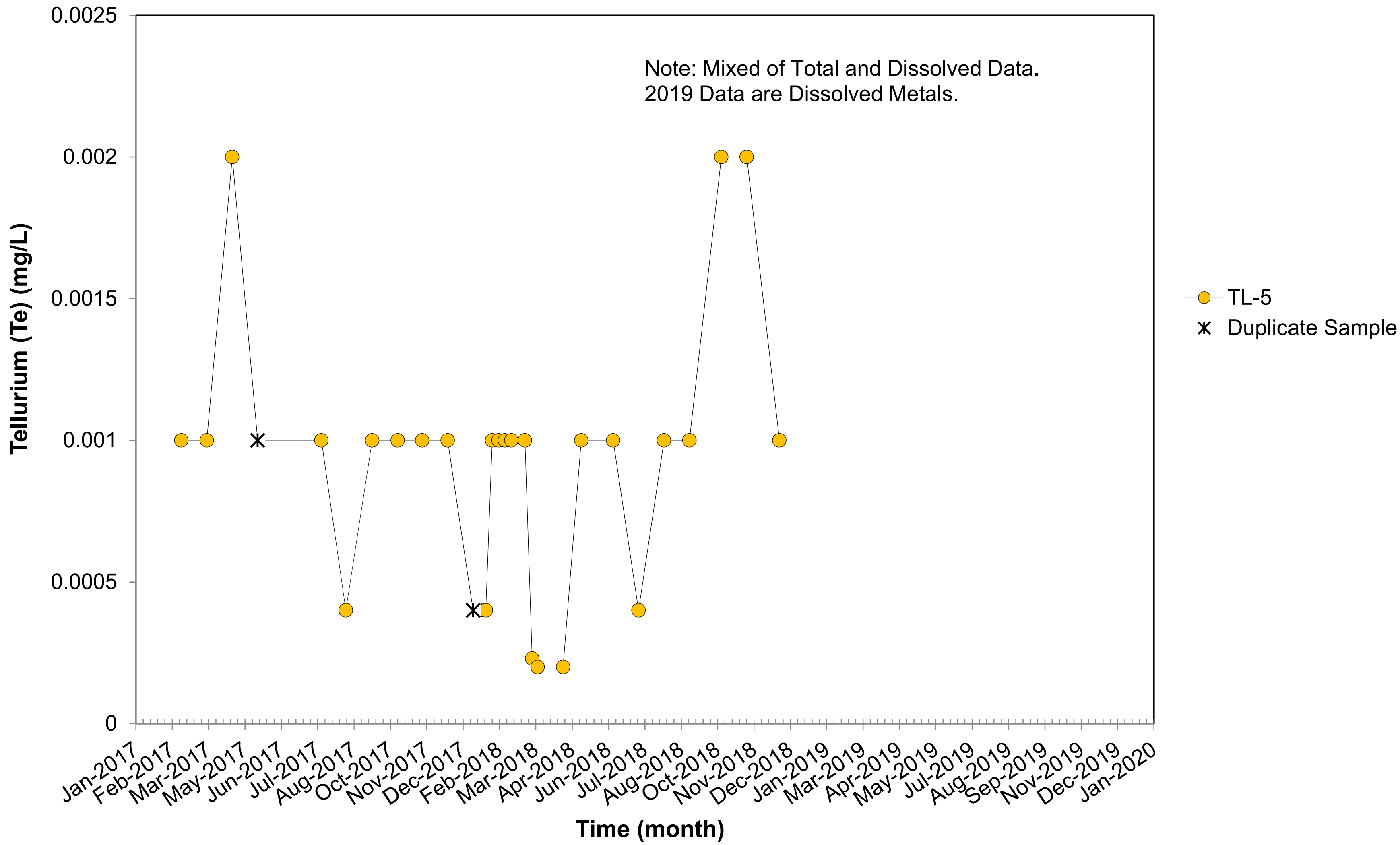

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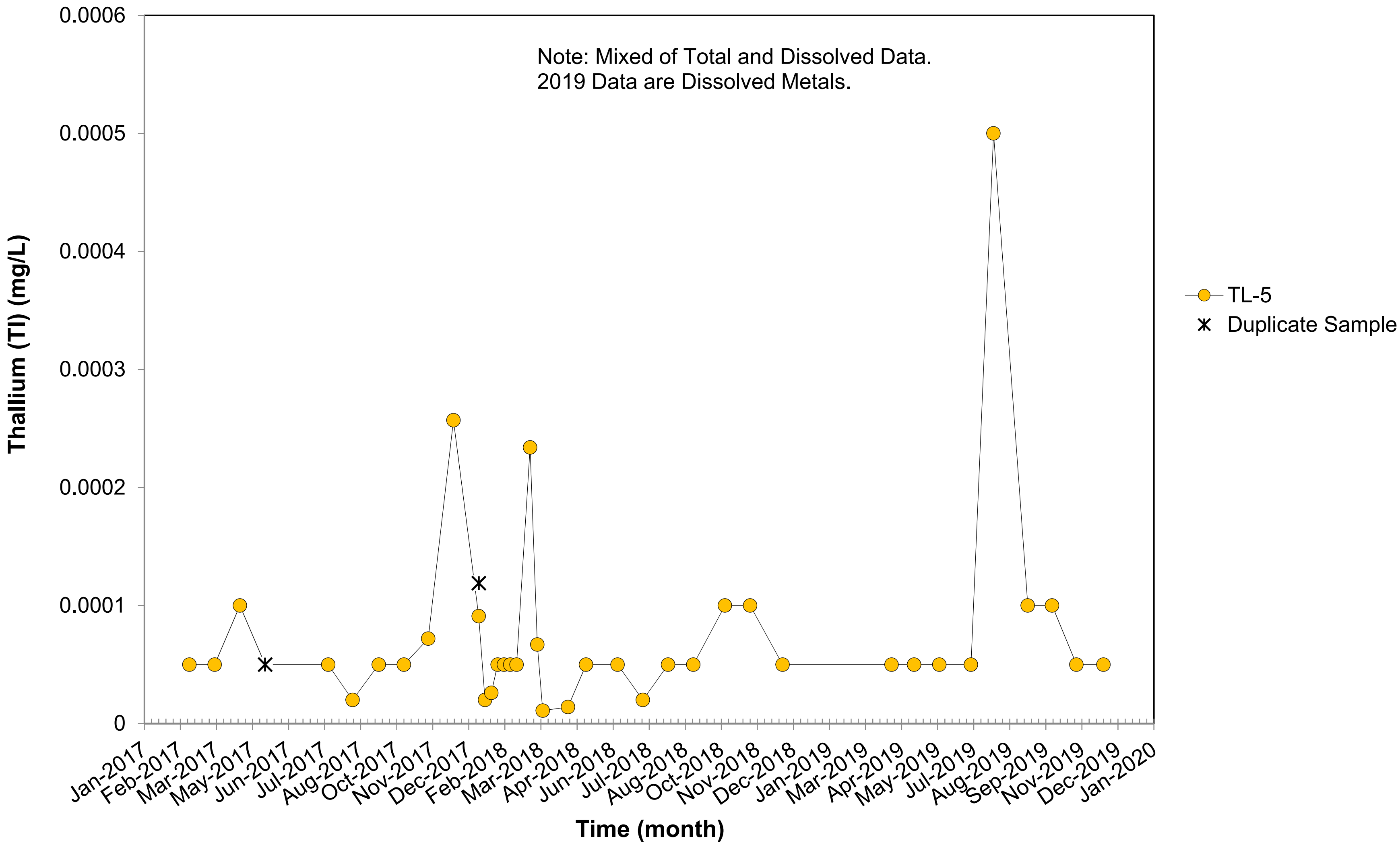

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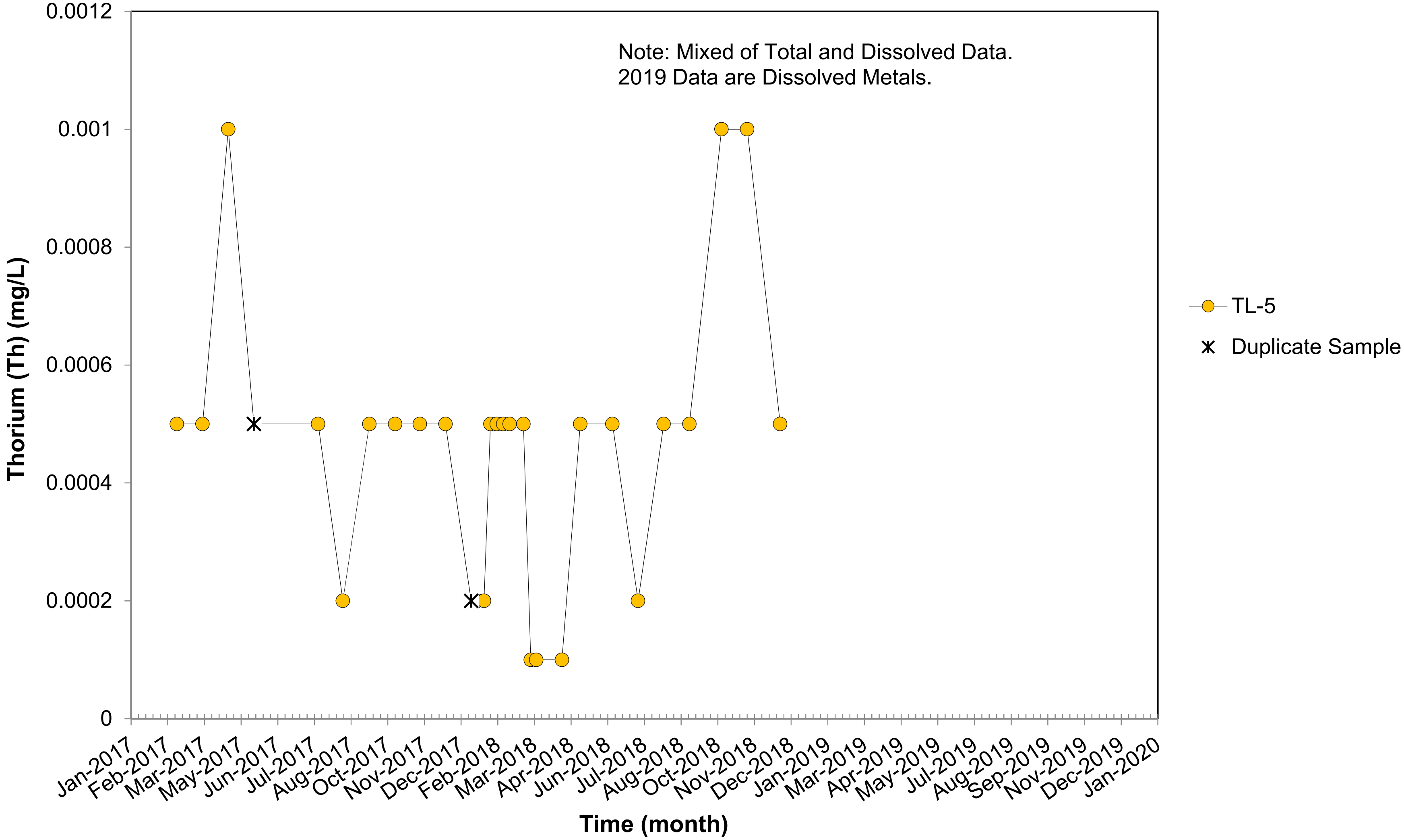

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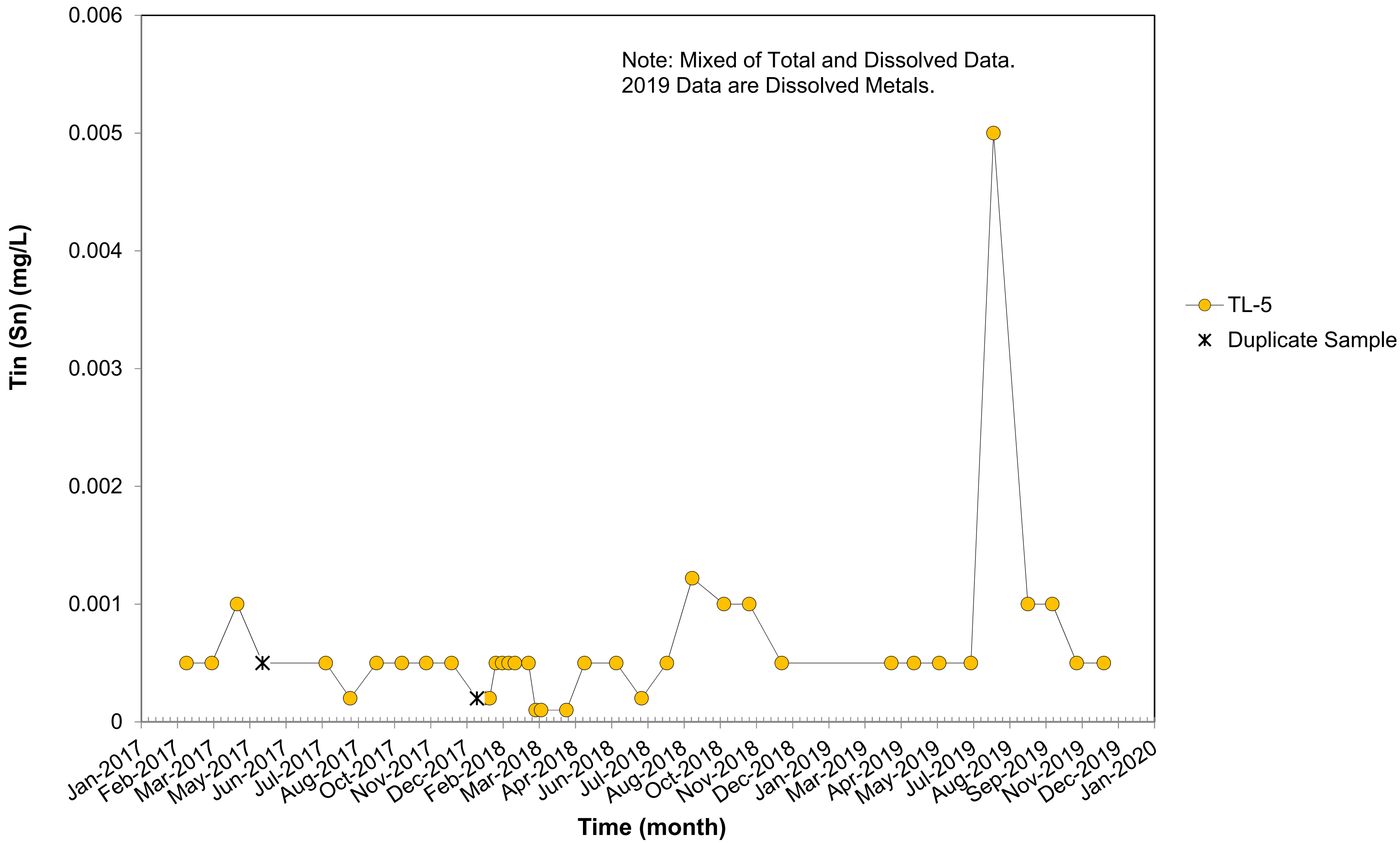

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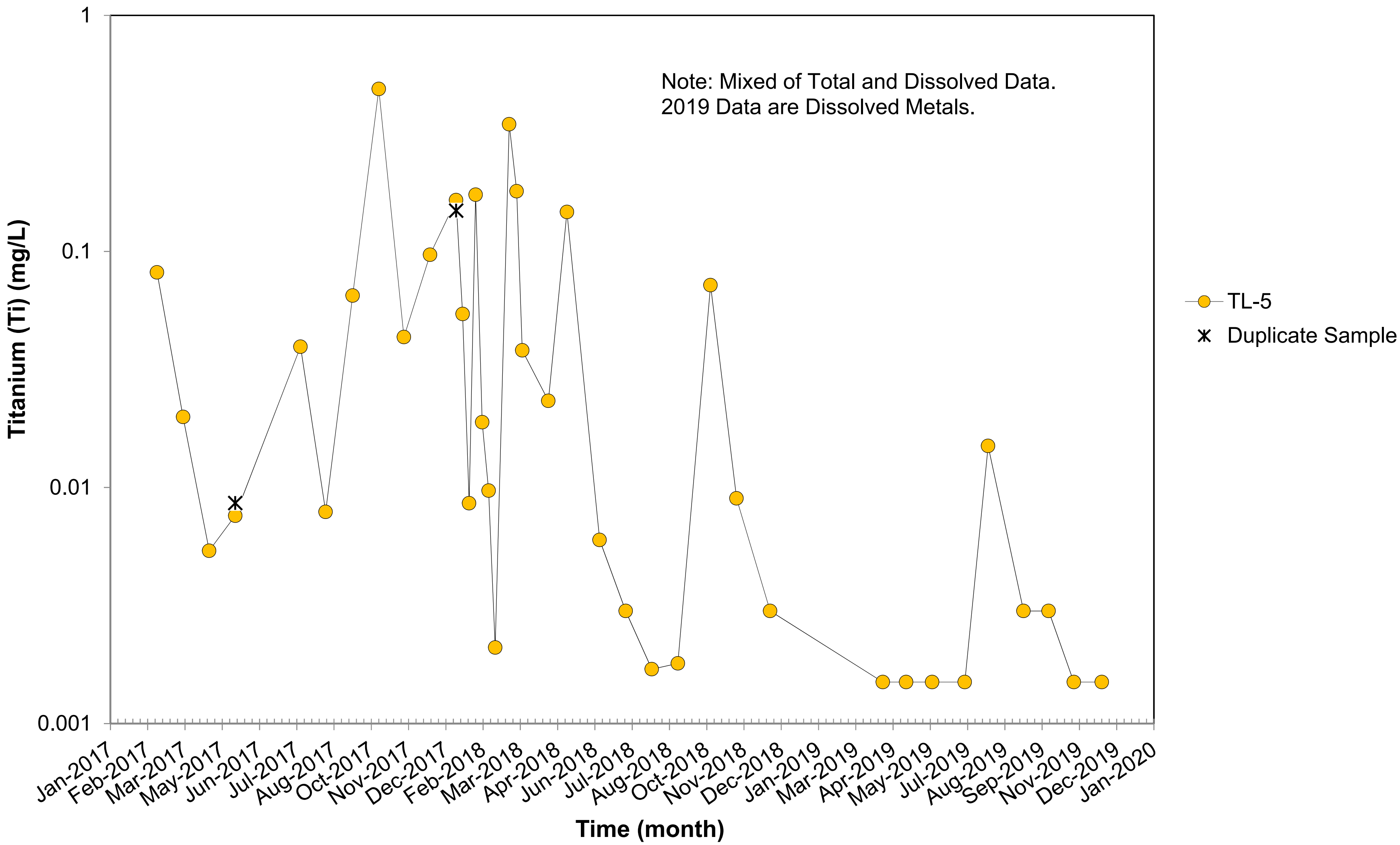

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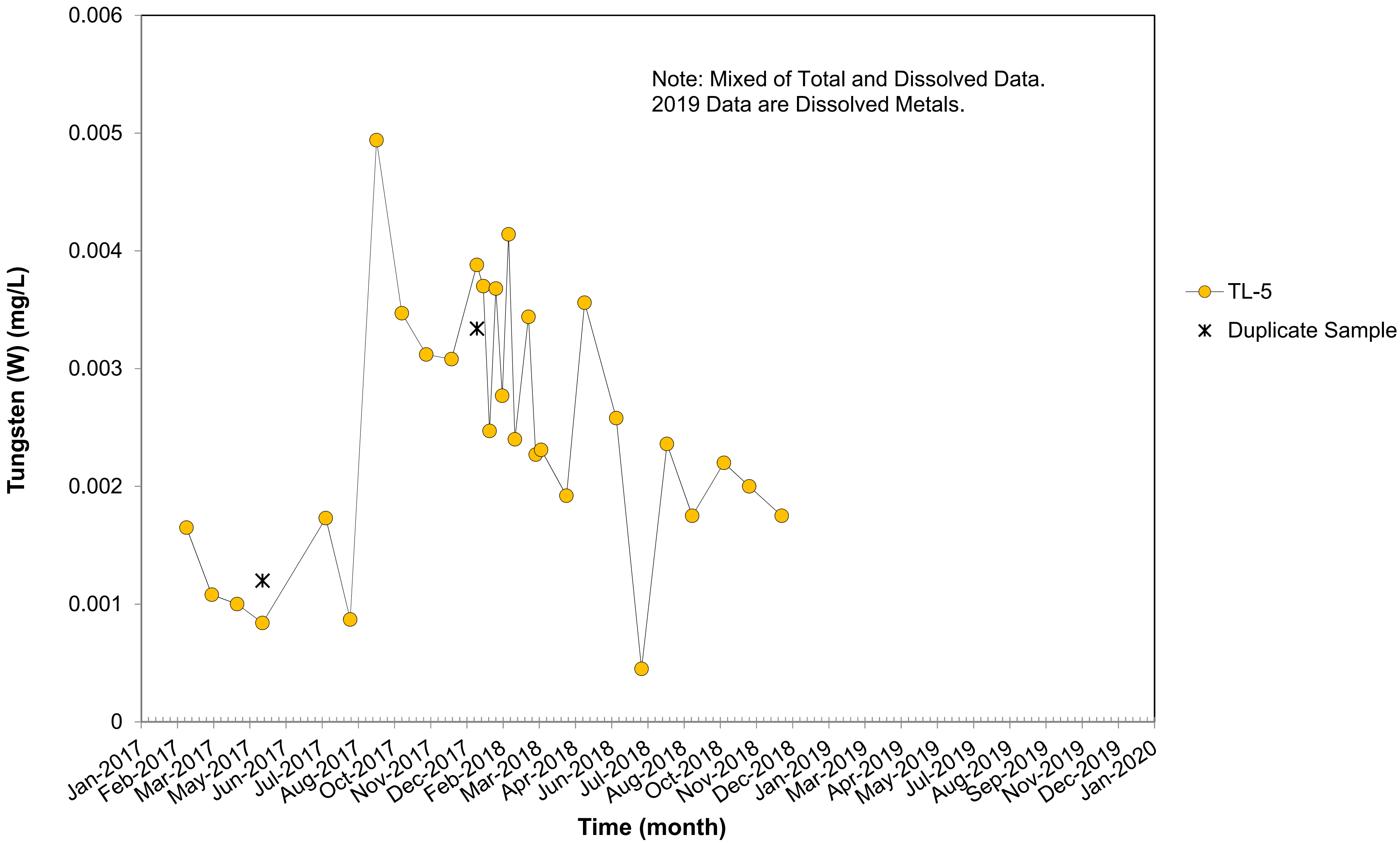

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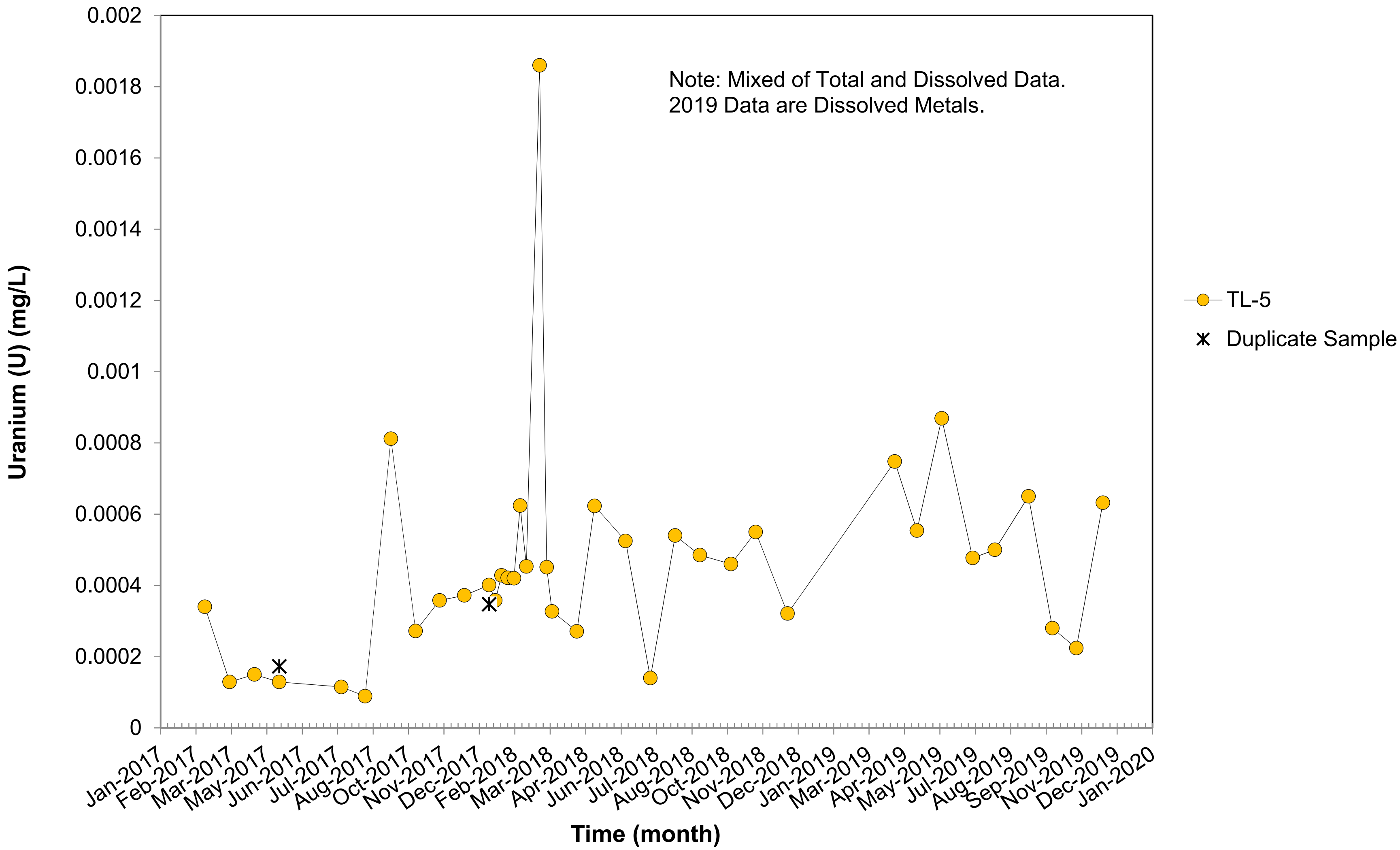

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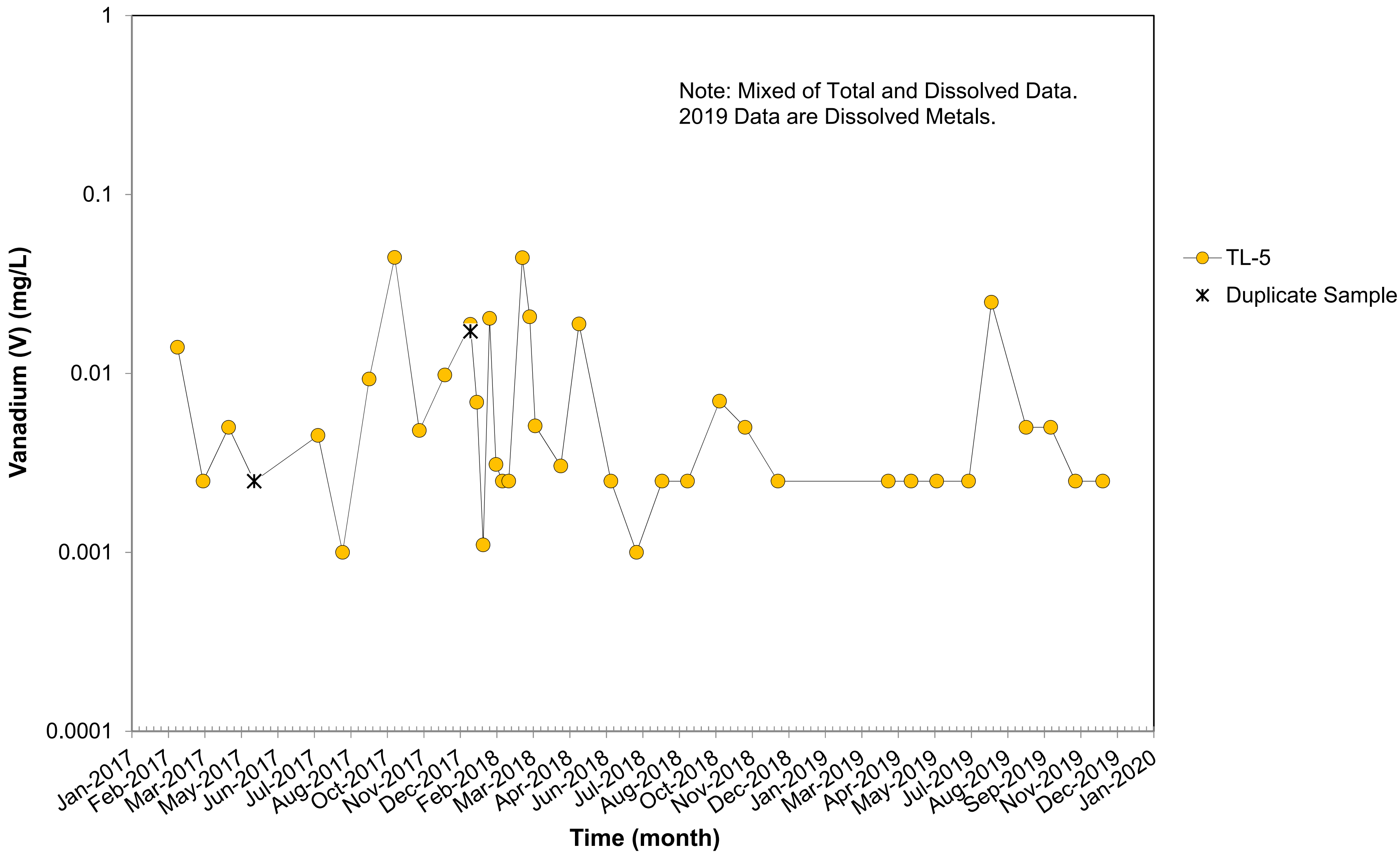

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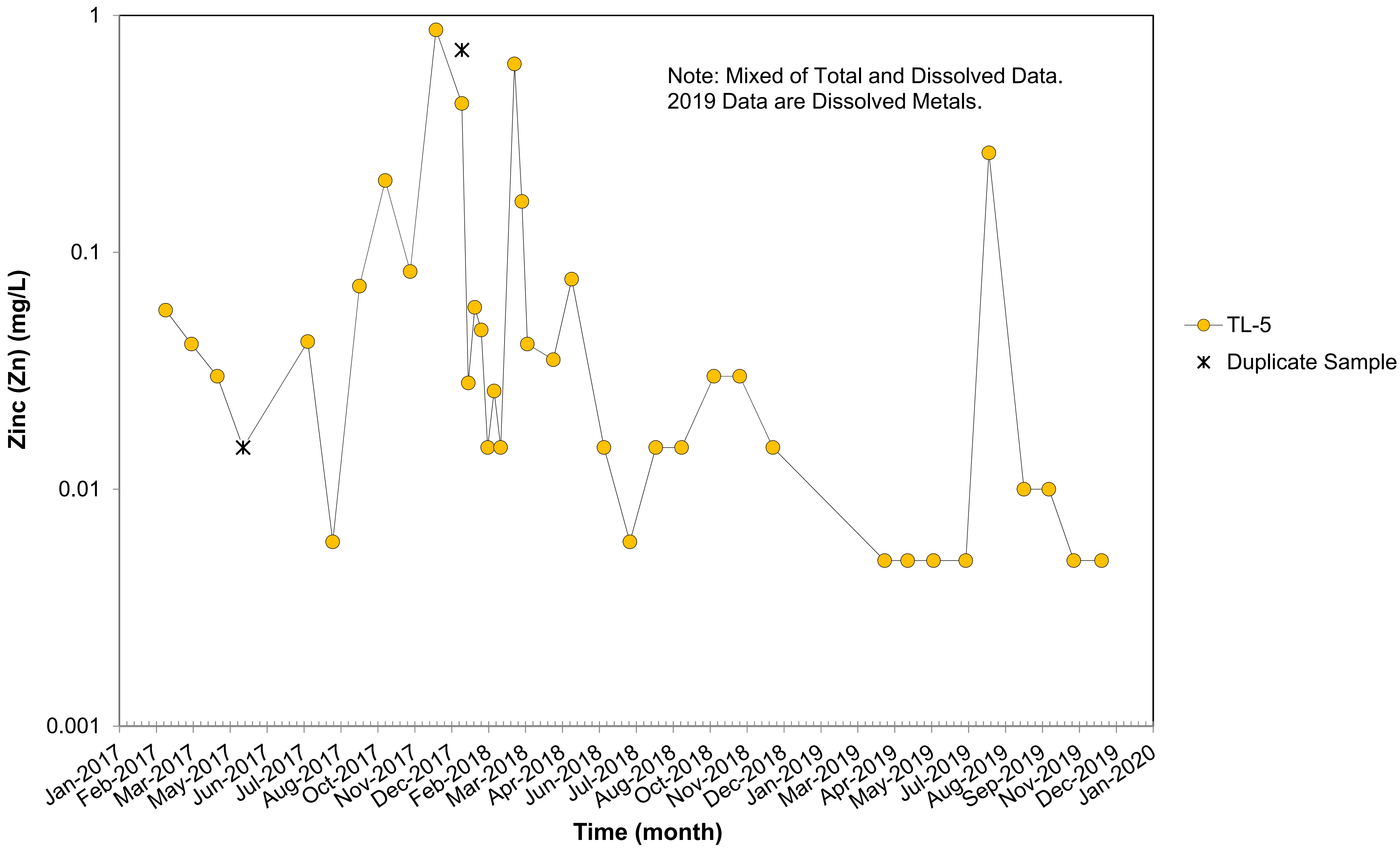

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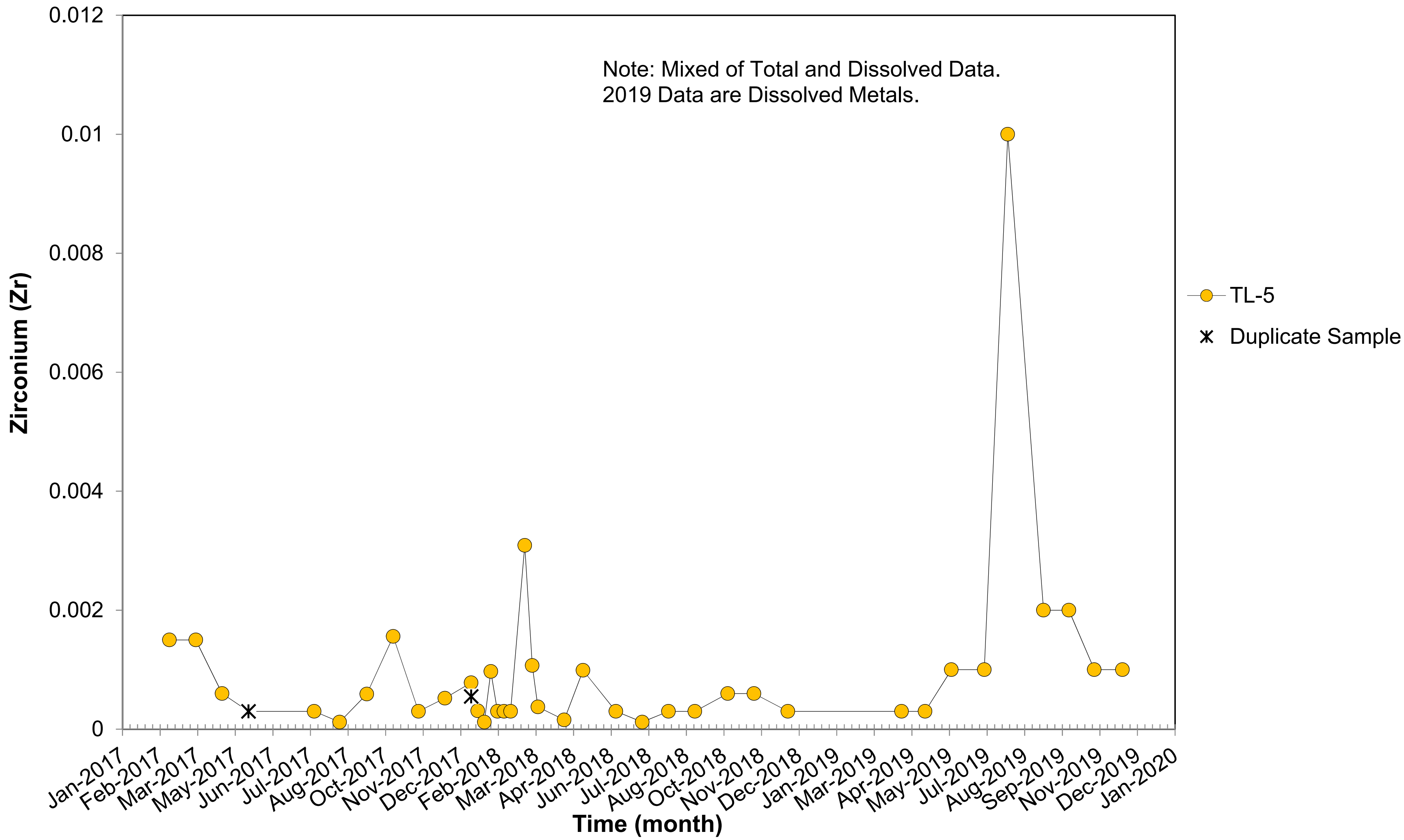

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Attachment E – TL-11 Geochemical Data

	Sample ID	TL11-A-27MAY19	TL11-B-27MAY19	TL11-C-27MAY19	TL11-D-27MAY19	TL11-E-27MAY19	TL11-F-27MAY19	TL11-A-15DEC19	TL11-B-15DEC19
	ALS ID	L2280421-1	L2280421-2	L2280421-3	L2280421-4	L2282417-1	L2282417-2	L2397363-1	L2397363-3
	Date Sampled	27-May-2019 10:35	27-May-2019 10:55	27-May-2019 11:20	27-May-2019 11:45	29-May-2019 10:20	29-May-2019 11:00	15-Dec-2019 10:50	15-Dec-2019 11:15
Parameter	**Units**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**
Conductivity	uS/cm	79500	84200	58400	3610	50000	67900	25400	27400
Hardness (as $CaCO_3$)	mg/L	30200	30700	17400	537	12800	21400	3720	3740
pH	pH	5.8	7.2	7.2	8.0	7.5	7.2	8.0	8.0
Total Suspended Solids	mg/L	13	41	20	15	18	3.5	666	37
Total Dissolved Solids	mg/L	68200	70800	47900	2580	33100	49700	17100	18300
Acidity (as $CaCO_3$)	mg/L	99	134	91	6.8	65	104	14	20
Alkalinity, Total (as $CaCO_3$)	mg/L	2.6	75	73	98	88	62	227	259
Ammonia, Total (as N)	mg/L	284	352	219	29	180	308	10	17
Chloride (Cl)	mg/L	33700	35000	22400	877	15300	26600	9030	9270
Nitrate (as N)	mg/L	474	429	278	35.4	206	391	13.7	16.3
Nitrite (as N)	mg/L	7.2	21	8.5	16	6.5	8.2	0.72	0.60
Sulfate (SO_4)	mg/L	1210	1070	1340	112	1090	1070	1160	1270
Cyanide, Total	mg/L	0.073	0.17	0.074	0.052	0.15	0.051	0.25	0.031
Cyanide, Weak Acid Diss	mg/L	0.011	0.018	<0.005	0.0069	0.026	0.011	0.01	0.0098
Cyanide, Free	mg/L	0.0087	0.0051	<0.005	0.0061	0.012	0.0095	0.01	0.0088
Aluminum (Al)-Total	mg/L	0.74	0.82	<0.15	0.54	<0.15	<0.15	18	0.22
Antimony (Sb)-Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	0.003
Arsenic (As)-Total	mg/L	<0.005	0.0051	0.005	0.0019	<0.005	<0.005	0.093	0.0076
Barium (Ba)-Total	mg/L	0.26	0.39	0.19	0.022	0.13	0.21	0.040	0.047
Beryllium (Be)-Total	mg/L	<0.005	<0.005	<0.005	0.0002	<0.005	<0.005	<0.002	<0.002
Bismuth (Bi)-Total	mg/L	-	-	-	-	<0.0025	<0.0025	<0.001	<0.001
Boron (B)-Total	mg/L	3.1	3.3	2.9	0.15	3.1	2.5	2.4	2.7
Cadmium (Cd)-Total	mg/L	0.032	0.011	0.0077	0.000019	0.0026	0.0090	0.00068	0.00047
Calcium (Ca)-Total	mg/L	9470	8640	5030	144	3380	6350	530	593
Cesium (Cs)-Total	mg/L	-	-	-	-	0.0035	0.0019	0.00089	0.00023
Chromium (Cr)-Total	mg/L	<0.005	<0.005	<0.005	0.016	0.005	0.005	0.024	<0.002
Cobalt (Co)-Total	mg/L	0.22	0.034	0.083	0.0032	0.025	0.11	0.082	0.054
Copper (Cu)-Total	mg/L	0.26	0.34	0.26	0.026	0.082	0.35	0.69	0.17
Iron (Fe)-Total	mg/L	1.57	2.3	<0.5	1.86	<0.5	<0.5	97	2.2
Lead (Pb)-Total	mg/L	0.012	0.0039	<0.0025	0.0014	0.0028	<0.0025	0.034	0.0019
Lithium (Li)-Total	mg/L	0.32	0.19	0.19	0.029	0.12	0.17	0.11	0.10
Magnesium (Mg)-Total	mg/L	1570	1740	1170	41.7	862	1170	687	742
Manganese (Mn)-Total	mg/L	9.7	7.5	7.2	0.11	3.5	6.9	3.2	1.8
Molybdenum (Mo)-Total	mg/L	0.020	0.063	0.029	0.0041	0.022	0.016	0.0074	0.0062
Nickel (Ni)-Total	mg/L	0.35	0.15	0.18	0.002	0.1	0.28	0.12	0.12
Phosphorus (P)-Total	mg/L	-	-	-	-	<2.5	<2.5	1.2	<1
Potassium (K)-Total	mg/L	508	561	360	38.9	235	393	147	160
Rubidium (Rb)-Total	mg/L	-	-	-	-	0.19	0.22	0.077	0.057
Selenium (Se)-Total	mg/L	0.012	0.0039	0.0069	0.0020	0.0036	0.0074	0.0025	0.0013
Silicon (Si)-Total	mg/L	-	-	-	-	<5	<5	23	3.5
Silver (Ag)-Total	mg/L	0.0099	0.013	0.0066	0.00013	0.0040	0.015	0.0020	0.00044
Sodium (Na)-Total	mg/L	11500	12300	8370	433	6520	8290	5090	5550
Strontium (Sr)-Total	mg/L	-	-	-	-	17.9	22.2	6.3	7.5
Sulfur (S)-Total	mg/L	-	-	-	-	511	507	440	494
Tellurium (Te)-Total	mg/L	-	-	-	-	<0.01	<0.01	<0.004	<0.004
Thallium (Tl)-Total	mg/L	0.00065	<0.0005	<0.0005	<0.00002	<0.0005	<0.0005	<0.0002	<0.0002
Thorium (Th)-Total	mg/L	-	-	-	-	<0.005	<0.005	<0.002	<0.002
Tin (Sn)-Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Titanium (Ti)-Total	mg/L	<0.03	0.024	<0.015	<0.015	<0.015	<0.015	0.37	<0.006
Tungsten (W)-Total	mg/L	-	-	-	-	<0.005	0.018	0.0027	<0.002
Uranium (U)-Total	mg/L	0.0029	0.0013	0.0019	0.00024	0.0015	0.0024	0.00034	0.00049
Vanadium (V)-Total	mg/L	<0.025	<0.025	<0.025	0.0054	<0.025	<0.025	0.064	<0.01
Zinc (Zn)-Total	mg/L	1.4	<0.15	0.19	0.0138	1.2	0.43	0.28	0.1
Zirconium (Zr)-Total	mg/L	-	-	-	-	<0.003	<0.003	<0.004	<0.004
Aluminum (Al)-Dissolved	mg/L	<0.05	<0.05	<0.05	0.012	<0.05	<0.05	<0.02	<0.02
Antimony (Sb)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.00039	<0.005	<0.005	<0.002	0.0032
Arsenic (As)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.0014	<0.005	<0.005	0.0052	<0.002
Barium (Ba)-Dissolved	mg/L	0.26	0.46	0.20	0.022	0.14	0.22	0.031	0.054
Beryllium (Be)-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.00004	<0.001	<0.001	<0.0004	<0.0004
Bismuth (Bi)-Dissolved	mg/L	<0.0025	<0.0025	<0.0025	<0.0001	<0.0025	<0.0025	<0.001	<0.001
Boron (B)-Dissolved	mg/L	3.1	3.8	3.1	0.15	3.5	2.7	2.4	2.4
Cadmium (Cd)-Dissolved	mg/L	0.034	0.012	0.0086	<0.00001	0.0033	0.010	0.00032	0.00056
Calcium (Ca)-Dissolved	mg/L	9620	9280	4990	144	3700	6690	457	517
Chromium (Cr)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.0154	<0.005	<0.005	<0.002	<0.002
Cobalt (Co)-Dissolved	mg/L	0.21	0.033	0.089	0.0025	0.026	0.12	0.031	0.057
Copper (Cu)-Dissolved	mg/L	0.25	0.25	0.25	0.015	0.069	0.37	0.039	0.10
Iron (Fe)-Dissolved	mg/L	<0.5	<0.5	<0.5	0.025	<0.5	<0.5	<0.2	<0.2
Lead (Pb)-Dissolved	mg/L	0.0068	<0.0025	<0.0025	<0.0001	<0.0025	<0.0025	<0.001	<0.001
Lithium (Li)-Dissolved	mg/L	0.32	0.21	0.20	0.029	0.13	0.18	0.097	0.092
Magnesium (Mg)-Dissolved	mg/L	1500	1820	1200	43.1	858	1130	628	595
Manganese (Mn)-Dissolved	mg/L	10.0	8.2	7.6	0.060	3.6	7.0	1.5	1.5
Molybdenum (Mo)-Dissolved	mg/L	0.022	0.065	0.029	0.0043	0.021	0.016	0.0062	0.0063
Nickel (Ni)-Dissolved	mg/L	0.35	0.15	0.18	0.0016	0.11	0.29	0.082	0.12
Phosphorus (P)-Dissolved	mg/L	<2.5	<2.5	<2.5	<0.1	<2.5	<2.5	<1	<1
Potassium (K)-Dissolved	mg/L	495	576	342	39	237	379	149	137
Selenium (Se)-Dissolved	mg/L	0.013	0.0048	0.0097	0.0019	0.005	0.0058	0.0012	<0.001
Silicon (Si)-Dissolved	mg/L	2.9	2.5	4.5	4.16	3.2	2.6	3.7	3.6
Silver (Ag)-Dissolved	mg/L	0.013	0.0095	0.0056	0.000088	0.0026	0.014	<0.0002	0.00022
Sodium (Na)-Dissolved	mg/L	10300	11700	7670	421	6710	8180	4690	4480
Strontium (Sr)-Dissolved	mg/L	28	32	19	1.06	17	22	6.0	6.2
Sulfur (S)-Dissolved	mg/L	593	563	601	52	499	509	420	450
Thallium (Tl)-Dissolved	mg/L	0.0009	<0.0005	<0.0005	<0.00002	<0.0005	<0.0005	<0.0002	<0.0002
Tin (Sn)-Dissolved	mg/L	<0.005	<0.005	<0.005	<0.0002	<0.005	<0.005	<0.002	<0.002
Titanium (Ti)-Dissolved	mg/L	<0.015	<0.015	<0.015	<0.0006	<0.015	<0.015	<0.006	<0.006
Uranium (U)-Dissolved	mg/L	0.0031	0.0013	0.0019	0.00023	0.0019	0.0026	0.00028	0.00059
Vanadium (V)-Dissolved	mg/L	<0.025	<0.025	<0.025	0.0042	<0.025	<0.025	<0.01	<0.01
Zinc (Zn)-Dissolved	mg/L	1.3	0.11	0.21	0.0082	1.2	0.42	0.026	0.094
Zirconium (Zr)-Dissolved	mg/L	<0.003	<0.003	<0.003	<0.0003	<0.003	<0.003	<0.004	<0.004

Appendix G
2019 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

MAC RESOURCES

2019 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.037
March 2020

2019 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

March 2020

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Project No: 1CT022.037

File Name: 2019_Summary_Report_BostonMonitoring_1CT022.037_20200318_FINAL_DM_LNB.docx

srk consulting

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Appendices

1 Introduction

At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston. Prior to TMAC Resources Inc.'s ownership, ore was subsequently used to resurface areas of the camp pad and airstrip. This practice does not continue under TMAC's ownership.

The seepage and ephemeral streams sampling programs are conducted annually in the context of the Boston waste rock and ore management and closure plans. A survey of rinse pH and conductivity of the ore is carried out every ten years as part of these plans and was last completed in 2018 (SRK 2019). This report presents results from the 2019 seepage and ephemeral streams monitoring at the Boston site, and complies with Part D "Conditions applying to Construction and Operation" Item 8 of Water Licence 2BB-BOS1835 (Nunavut Water Board 2018).

The report is organized as follows:

- A summary of the monitoring requirements is provided in Section 2.
- Results of the monitoring of seepage at the Boston site are summarized in Section 3.
- Results of the monitoring of ephemeral streams are summarized in Section 4.
- Detailed technical memorandum on each of these subjects are provided in Appendices A and B.

2 Monitoring Requirements

As a condition of Water Licence 2BB-BOS1727 (Part E, Item 2), TMAC is required to implement a water and ore/waste rock management plan that addresses the acid rock drainage (ARD) and metal leaching (ML) potential of the materials at the site (NWB 2017). TMAC acquired the Hope Bay project including the Boston site in 2013 and has maintained the Boston site in care and maintenance since.

2.1 Ore Stockpile

Geochemical characterization of waste rock and ore materials has indicated that all waste rock and most of the ore is non-acid generating with some of the ore classified as having an uncertain potential for ARD (SRK 2009a). Based on the uncertain classifications, the ore/waste rock management plan (SRK 2017) includes a commitment to monitor the oxidation of the ore by carrying out a survey of rinse pH and conductivity every ten years. This monitoring was conducted in 2018 and was not a requirement in 2019.

2.2 Seepage Monitoring

The objective of the seepage monitoring is to provide an indication of water quality from the waste rock (camp pad) and ore stockpiles. There are two seepage monitoring programs, SNP seepage monitoring at station BOS-8 and a freshet seepage survey along the north and east sides of the camp pad, and the southern end of the airstrip.

As stipulated in Water License 2AM-BOS1835 (Nunavut Water Board 2018), TMAC monitors the seepage station BOS-8A, BOS-8B, BOS-8C, and BOS-8D. In summary, sampling of water quality station BOS-8 and any opportunistic seeps, is required initially during spring thaw and at a minimum frequency of monthly whenever flow is observed. Samples collected at BOS-8 are to be analysed for pH, electrical conductivity (EC), total suspended solids (TSS), major anions (sulphate, chloride, ammonia), and total trace metals through an ICP scan.

A freshet seepage survey along the north and east sides of the camp pad and the full extent of the airstrip is to be completed in accordance with Section 5.2.1 of the Boston Water and Ore/Waste Rock Management Plan (SRK 2017). In summary, these areas of the pad are to be surveyed for seepage during freshet and samples collected opportunistically. The seepage monitoring program was executed in 2019.

2.3 Ephemeral Streams

As outlined in the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017), five ephemeral streams (A to E) within the catchments of the Boston camp pad are monitored during spring freshet. The objectives of the program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra. The ephemeral streams monitoring program was executed in 2019.

3 Monitoring of Boston Seepage

Details of the 2019 seepage monitoring programs are presented in Appendix A.

3.1 Sampling and Testing Program

A total of three opportunistic seepage samples were collected as part of the two seepage monitoring programs.

3.1.1 Airstrip and Camp Pad Seepage Survey

The freshet seep survey at Boston was conducted by TMAC on June 29, 2019. The survey included walking the north and east sides of the camp pad and the full extent of the airstrip, as outlined in the Water and Ore/Waste Rock Management Plan (SRK 2017).

Two seeps were identified and sampled, one on the eastern side of the camp pad, and the other located adjacent to the access road to the airstrip. No seepage was observed along the northern extent of the pad or along the airstrip. Field measurements of EC, pH, oxidation-reduction potential (ORP), temperature and flow rates (where possible) were measured at this location.

The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, total dissolved solids (TDS), total suspended solids (TSS), alkalinity, anions (sulphate, chloride, fluoride, and bromide), nutrients (nitrate, nitrite, ammonia and phosphorus) and dissolved metals.

3.1.2 SNP Seepage Monitoring

One sample was collected as part of the SNP seepage monitoring. The one sample was collected from SNP monitoring station BOS-8A (on June 29, 2019). No additional samples were collected in 2019 as no seepage was observed at SNP seepage monitoring stations after June 29. Field measurements of EC, pH, ORP, temperature and flow rates (where possible) were measured at each of these locations.

The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, TDS, TSS, alkalinity, anions (sulphate, chloride, fluoride, and bromide), nutrients (nitrate, ammonia, nitrite and phosphorus) and dissolved metals.

3.2 Results

The results for samples taken as part of both the Airstrip and Camp Pad Seepage Survey (Section 3.1.1) and the SNP seepage monitoring (Section 3.1.2) are presented in this section.

The three seepage samples were pH neutral to slightly alkaline (7.6 to 7.9 s.u.). Sulphate concentrations for the two samples from the NE Pad (19-BOS-01 and BOS-8A) were within the range of historical concentrations (ranging from 400 to 630 mg/L). Compared to BOS-8A, concentrations at 19-BOS-01 were higher for arsenic (0.9 mg/L or 20 times higher than BOS-8A) , cobalt (1.2 mg/L or 50 times higher), nickel (1.6 mg/L or 16 times higher), manganese (0.27 mg/L or 9 times higher) and selenium (0.0027 mg/L or 6 times higher). Concentrations of copper (0.003 and 0.004 mg/L) and iron (0.089 and 0.010 mg/L) were roughly equivalent for 19-BOS-01 and BOS-8A. All concentrations for the aforementioned parameters are within the range of historical concentrations and no long-term trend was identified. Chloride and nitrate at 19-BOS-01 (220 and 4 mg/L, respectively) were similarly equivalent to previous measurements.

The seep located at the toe of the road (19-BOS-02) had nitrate, chloride, dissolved arsenic, nickel, and selenium concentrations one to two orders of magnitude lower than the seep samples located at the NE camp pad. Sulphate concentrations at the access road were four to six times lower than the NE Pad and dissolved copper and iron concentrations were roughly equivalent at the two locations.

Continued monitoring will allow for further trends in the seepage to be established.

4 Monitoring of Ephemeral Streams

Details of the 2019 Boston ephemeral streams monitoring program are presented in Appendix B.

4.1 Sampling and Testing Program

TMAC inspected ephemeral streams A to E for flow on June 29, 2019. In 2019 flow was observed and samples collected from A2, D2 and E2 for a total of 3 samples. Field measurements included pH, EC, ORP, and temperature. The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, TDS, TSS, total alkalinity, anions (bromide, chloride, fluoride, and sulphate), nutrients (nitrate, nitrite, ammonia and phosphorus) and dissolved metals (field filtered).

4.2 Results

Contaminants of concern as identified by the 2009 water and load balance (Supporting Document B of SRK 2009) include nitrate, sulphate, arsenic, copper, iron, nickel and selenium.

The pH of ephemeral streams A2, D2 and E2 were neutral to slightly alkaline (7.7 to 8.0 s.u.). Sulphate values have oscillated for A2 and D2 whereas E2 has increased slightly since 2009. Chloride concentrations for ephemeral streams exhibit a decreasing trend. Nickel and arsenic values have oscillated for A2 and D2 whereas E2 has remained stable since the start of monitoring. Nitrate, copper, iron and selenium have stable trends.

Compared to SRK (Supporting Document B of 2009) model predictions, the 2019 monitoring data were below maximum predicted values for chloride, nitrate, arsenic, copper, iron, nickel and selenium at streams A2, D2 and E2. At D2 and E2, sulphate concentrations observed in 2019 exceeded the maximum modeled values (Supporting Document B of SRK 2009).

Sulphate concentrations at D2 and E2 were greater than the historical maximum observed in previous years (Figure 2). Sulphate values have oscillated for A2 and D2 whereas E2 has increased slightly since 2009. Higher sulphate concentrations were observed during periods of low flow resulting in lower sulphate loading rates (e.g. mg SO_4/s) compared to samples collected with higher flow rates and lower sulphate concentrations (e.g. D2 in 2011 and 2016), suggesting that concentration is related to dilution from surface waters. Future monitoring will establish sulphate trends.

Sulphate and chloride levels are not attenuated by the tundra and the concentrations measured in 2019 validate the 2009 water and load balance (Supporting Document B of SRK 2009). The 2009 water and load balance was developed specifically for the Boston camp pad to provide a conservative indication of the potential concentrations in drainage from the ore and waste rock before entering Aimaokatalok Lake and the natural attenuation of the tundra. The concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred. SRK recommends continued monitoring of the ephemeral stream sampling sites as outlined in SRK (2017).

5 Conclusions

The seepage program monitors contact water from the camp pad and ore stockpiles while the ephemeral stream program monitors drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra.

In 2019, TMAC surveyed i) the northern and eastern edges of the camp pad and the full extent of the airstrip for opportunistic seepage samples and ii) the five ephemerals streams (A to E) within the catchment of the Boston camp pad. In total, TMAC collected two seepage samples along the eastern side of the camp pad, one seepage sample located adjacent to the access road to the airstrip and three ephemeral streams samples from streams A2, D2 and E2.

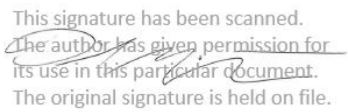
All seepage and ephemeral stream samples were pH neutral to slightly alkaline, indicating that the waste rock on the camp pad is not acidic.

Monitoring of the seepage from the camp pad and the ore stockpiles indicates that water quality for the contaminants of concern are within the range of the historical data.

The analysis of the water quality data for ephemeral streams A2, D2 and E2 indicated that concentrations were either decreasing or consistent with historical data except for sulphate at E2 which is increasing. For sulphate concentrations at D2 and E2, values were greater than the maximum predicted value but a loading assessment indicated that concentration is related to dilution from surface waters. Future monitoring will establish any trends.

SRK recommends continued annual monitoring according to the Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017).

This report, 2019 Waste Rock and Ore Monitoring Report, was prepared by



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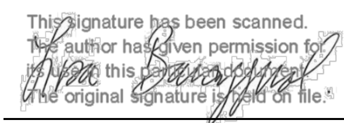

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

6 References

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Appendix A – 2019 Boston Seepage Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter, PGeo Lisa Barazzuol, PGeo	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 17, 2020
Subject:	Results from the Boston Seepage Monitoring Program 2019		

1 Introduction

At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston. Since that time, the site has been primarily in care and maintenance, with periodic use of the camp and airstrip in support of exploration activities.

2019 seepage monitoring activities include:

- A freshet seepage survey along the north and east sides of the camp pad, and the full extent of the airstrip, as outlined in the Water and Ore/Waste Rock Management Plan (SRK 2017), and
- Surveillance Network Program (SNP) seepage monitoring at station BOS8.

This memo presents the results of all Boston seepage samples collected in 2019 and complies with Part D “Conditions Applying to Construction and Operation” Item 8 of Water Licence 2AM-BOS1835 (Nunavut Water Board 2018).

2 Methods

2.1 Sample Collection

2.1.1 Airstrip and Camp Pad Seepage Survey

The freshet seep survey at Boston was conducted on June 29, 2019 by TMAC Resources (TMAC) with guidance from SRK. The survey included walking the north and east sides of the camp pad and the full extent of the airstrip. Seep locations were established opportunistically by walking the toe of the survey areas to identify and sample seepage flowing out of the toe of the camp pad. Two seeps were identified and sampled, one (19-BOS-01) on the eastern side of the camp pad, and the other located adjacent to the access road to the airstrip (19-BOS-02, Figure

1). No seeps were observed along the airstrip or the northern extent of the camp pad. Field measurements of electrical conductivity (EC), pH, oxidation-reduction potential (ORP), temperature were measured at each of these locations.

Samples were collected by TMAC from all stations for laboratory analysis. The water quality samples were submitted by TMAC to ALS Environmental (ALS) in Burnaby, British Columbia for pH, EC, total dissolved solids (TDS), total suspended solids (TSS), alkalinity, anions (bromide, chloride, fluoride, and sulphate), nutrients (ammonia, nitrate, nitrite, and phosphorus) and dissolved metals. All samples were filtered and preserved in the field. In addition, one duplicate sample and two field blanks were collected and submitted for laboratory analysis.

2.1.2 SNP Seepage Monitoring (BOS-8)

As stipulated in Water License 2AM-BOS1835 (Nunavut Water Board 2018), TMAC monitors the seepage station BOS-8A, BOS-8B, BOS-8C, and BOS-8D. At minimum, monthly samples are to be collected if flowing seepage is observed. In 2019, TMAC collected one sample at BOS-8A on June 29, 2019. Field measurements of EC, pH, ORP, temperature and flow rates (where possible) were measured. No additional samples were collected in 2019 as no seepage was observed at these monitoring stations after June 29.

The sample was collected from the one station for laboratory analysis. The water quality sample was submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia. The sample was analyzed for pH, EC, hardness, ammonia, sulphate, and total metals, as per the water licence.

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Legend

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage

	pH 6 to 7	pH 7 to 8	pH 7 to 8
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

srk consulting

SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Annual_Boston_Seepage_2019

MAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations
Boston Area

DATE: Jan 2020

APPROVED:

FIGURE: 1

2.2 Data Quality Assurance and Quality Control

2.2.1 2019 Data

SRK conducted a QA/QC review of the three June seepage samples including the duplicate and field blanks.

Laboratory and field values of pH and EC were compared, as well as TDS and lab conductivity. Conductivity values were near parity for all samples. Values of pH were similar between field and lab readings. For all samples, TDS demonstrated a strong positive correlation with lab conductivity.

Ion balances ranged from -1.8 to -1.2% for the seep samples 19-BOS-01 and 19-BOS-02. All samples complied with SRK's criteria of ±10%. The ion balance for the SNP sample BOS-8A could not be assessed due to an incomplete suite of anions. All parameters in the field blank samples passed the QA/QC criteria of being below two times the detection limit. The one set of field duplicate samples were assessed by relative percent difference (RPD), with all RPD values less than 30% with less than 10% of parameters failing.

SRK considered all data acceptable.

2.2.2 Historic Data

The historic seepage data set is comprised of 52 samples collected between 2008 and 2018, with the majority of samples analyzed for total metals rather than dissolved metals (Attachment 1). SRK collected three seepage samples in 2008 and based on QA/QC screening concluded that the data were acceptable (SRK 2009). All other historic samples were collected by Hope Bay Mining Ltd (HBML) or TMAC as part of the SNP water licence monitoring program or the seepage monitoring program (Attachment 2). SRK did not conduct QA/QC of the historic seepage data collected by HBML or TMAC prior to 2017 because the limited analytical suite precluded the calculation of ion balances and other QA/QC checks. SRK accepted all SNP monitoring data as-is.

3 Results

3.1 Field Observations

Field parameters for the three seeps sampled in 2019 are presented in Table 3-1. Field electrical conductivity varied from 410 to 1,900 μS/cm, with the minimum value at 19-BOS-02, and the maximum value at 19-BOS-01. The pH ranged from 7.6 to 7.9.

Table 3-1: 2019 Field Observations

Sample ID	Field pH *s.u.*	Field EC *µS/cm*	ORP *mV*	Temperature *ºC*	Flow *L/s*	Comments
BOS-8A	7.6	1000	44	16	--	NE Camp Pad (SNP station)
19-B0S-01	7.8	1900	100	6.2	--	NE Camp Pad
19-B0S-02	7.9	410	120	12	--	Flowing out of access road to airstrip to the East

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3.2 Laboratory Results

Table 3-2 and Table 3-3 present the 2019 Boston seepage data and compares the data to a statistical summary of historical Boston seepage samples (2008 to 2018). When available, dissolved metals data are presented in Table 3-3; however, total metals are also presented as they are analyzed as part of the seepage monitoring conducted as part of the Boston water licence. Figure 2 to Figure 9 present sulphate, chloride, nitrate and the dissolved and total arsenic, copper, iron, nickel and selenium concentrations observed since 2008.

The pH for two samples collected from the NE camp pad (19-BOS-01 and BOS-8A) were 7.8 and 8.0. Sulphate concentrations for 19-BOS-01 and BOS-8A were within the range of historical concentrations and ranged from 400 to 630 mg/L (Figure 2). Compared to BOS-8A, concentrations at 19-BOS-01 were higher for arsenic (0.9 mg/L or 20 times higher than BOS-8A) , cobalt (1.2 mg/L or 50 times higher), nickel (1.6 mg/L or 16 times higher), manganese (0.27 mg/L or 9 times higher) and selenium (0.0027 mg/L or 6 times higher). Concentrations of copper (0.003 and 0.004 mg/L) and iron (0.089 and 0.010 mg/L) were roughly equivalent for 19-BOS-01 and BOS-8A. All concentrations for the aforementioned parameters are within the range of historical concentrations. Chloride and nitrate at 19-BOS-01 (220 and 4 mg/L, respectively) were similarly equivalent to previous measurements.

For the seep at the access road (19-BOS-02) , concentrations of sulphate (97 mg/L) were four to six times lower than the seepage samples at the NE camp pad whereas nitrate (0.34 mg/L), chloride (22 mg/L), dissolved arsenic (0.0089 mg/L), nickel (0.016 mg/L), and selenium (0.00024 mg/L) were one to two orders of magnitude lower. Dissolved copper and iron concentrations were roughly equivalent at the two seepage monitoring locations.

Table 3-2: Summary of General Parameters, Anions and Nutrients, 2019 and Historical Seepage Samples

Sample ID	Sample Date	Anions and Nutrients						
		Conductivity	pH	Alkalinity, Total (as $CaCO_3$)	Ammonia	Nitrate	Chloride	Sulphate
		µS/cm	s.u.	mg/L as $CaCO_3$	mg/L as N	mg/L as N	mg/L	mg/L
BOS8A	2019-06-29	1000	7.8	-	0.0062	-	-	400
19-BOS-01	2019-06-29	1800	8.0	100	0.37	4.0	220	630
19-BOS-02	2019-06-29	390	8.0	71	<0.005	0.34	22	97
Historic Seepage data								
P5		400	7	26	0.011	0.07	20	81
P50		1300	7.8	83	0.05	3.3	150	340
P95		2700	8.1	180	8.3	45	1100	690
Number of samples		53	53	30	51	29	29	53

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Table 3-3: Summary of Trace Elements, 2019 and Historical Seepage Samples

Sample ID	Aluminum	Arsenic	Cadmium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Selenium	Zinc
Dissolved Metals											
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
BOS8A (total)	0.009	0.047	0.00002	0.024	0.0032	0.089	0.001	0.029	0.098	0.00041	0.005
19-BOS-01 (dissolved)	0.0025	0.90	0.000032	1.2	0.0041	0.01	0.00005	0.268	1.6	0.0027	0.0024
19-BOS-02 (dissolved)	0.0087	0.0089	0.0000069	0.0032	0.004	0.00001	0.00005	0.010	0.016	0.00024	0.001
Historic Seepage data											
Dissolved Metals											
P5	0.0023	0.034	0.0000094	0.018	0.0019	0.01	<0.00005	0.068	0.072	0.00047	0.0019
P50	0.0047	0.11	0.000031	0.25	0.0041	0.022	<0.00005	0.21	0.41	0.0026	0.0044
P95	0.028	0.85	0.00038	1.1	0.008	0.20	0.00043	0.91	1.6	0.0094	0.035
Maximum	0.034	0.99	<0.0005	1.1	0.0085	0.25	<0.0005	1.4	1.8	0.014	0.041
Number of samples	11	11	11	11	11	8	7	11	11	11	11
Total Metals											
P5	0.015	0.0027	0.000015	0.002	0.0014	0.034	0.0001	0.015	0.01	0.00039	0.0038
P50	0.099	0.12	0.00005	0.05	0.0049	0.3	0.0005	0.2	0.13	0.002	0.0057
P95	0.9	0.74	0.001	0.79	0.011	4.2	0.005	0.7	1.4	0.008	0.096
Maximum	6.9	5.6	0.002	1.4	0.045	16	0.022	2.0	4.0	0.017	0.10
Number of samples	43	41	45	43	45	45	45	43	45	41	43

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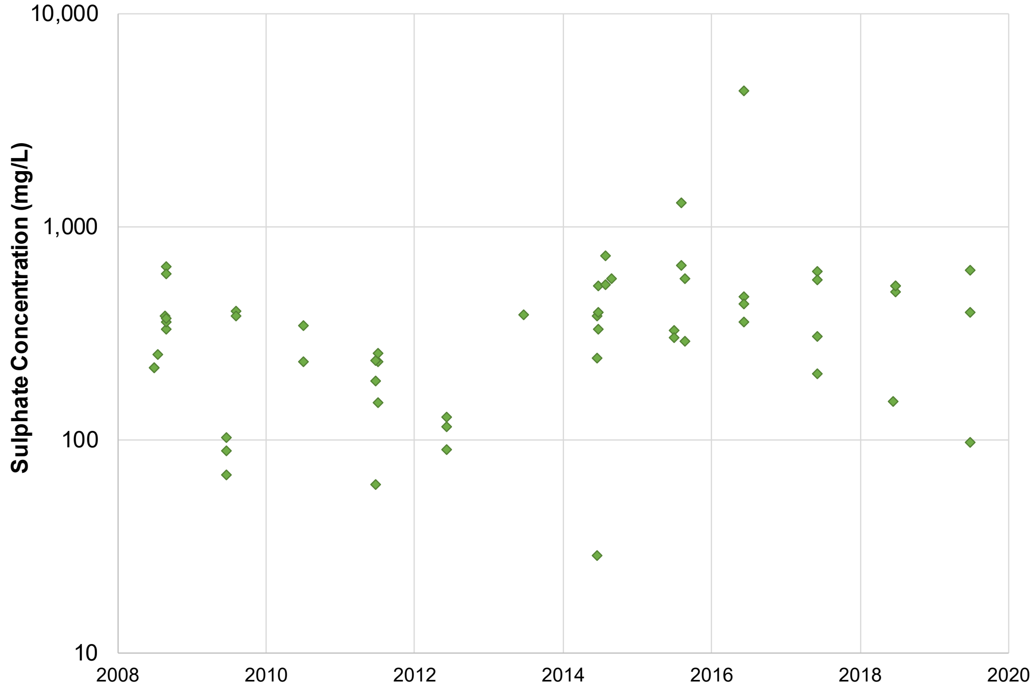

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Figure 2: Sulphate Concentrations Observed in Seeps at the Boston Camp since 2008

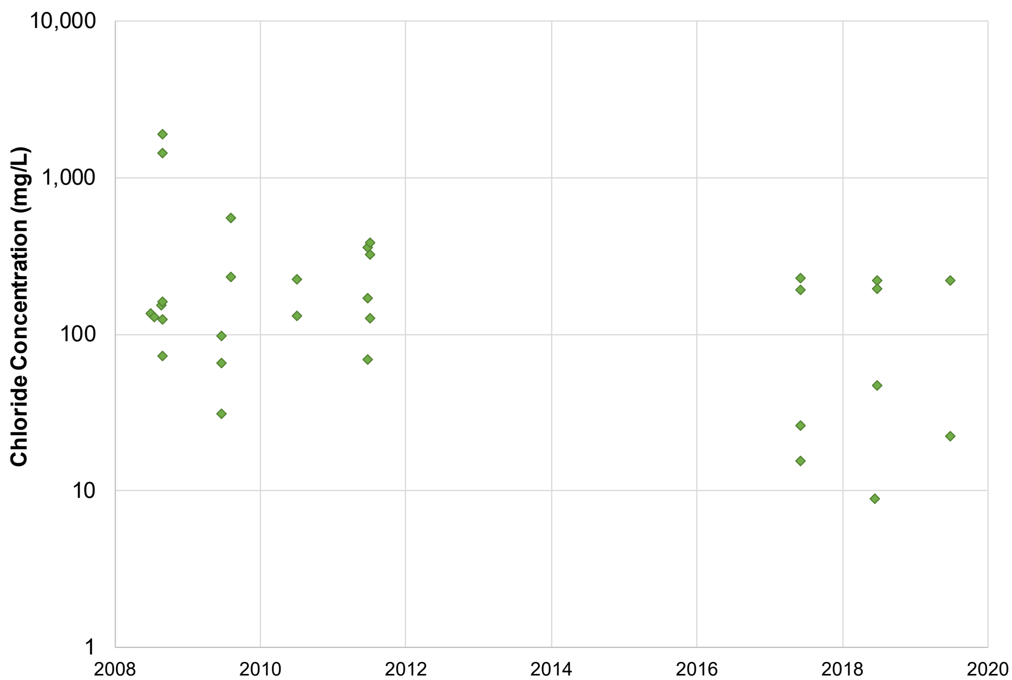

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Figure 3: Chloride Concentrations Observed in Seeps at the Boston Camp since 2008

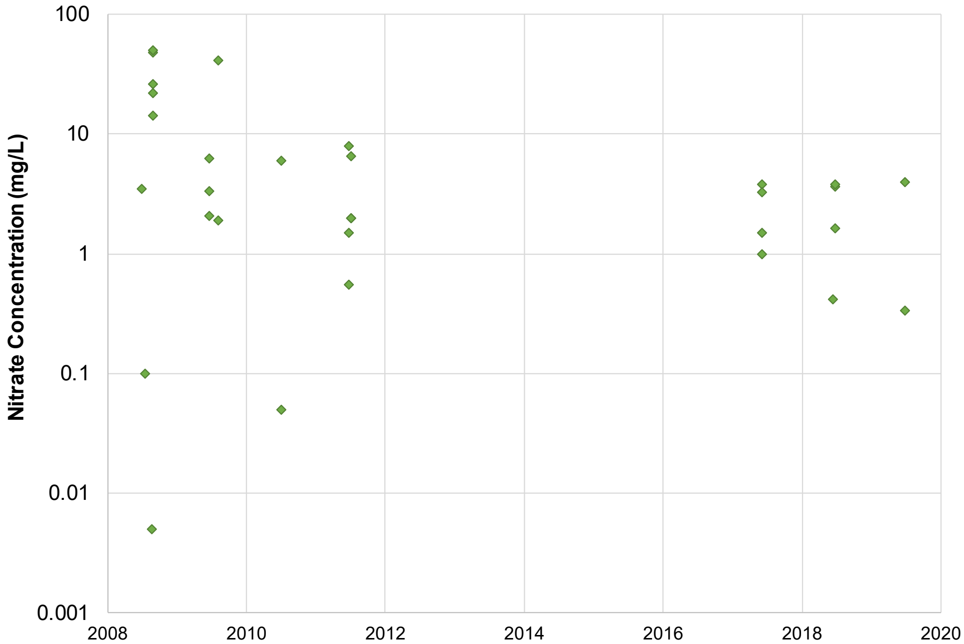

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Figure 4: Nitrate Concentrations Observed in Seeps at the Boston Camp since 2008

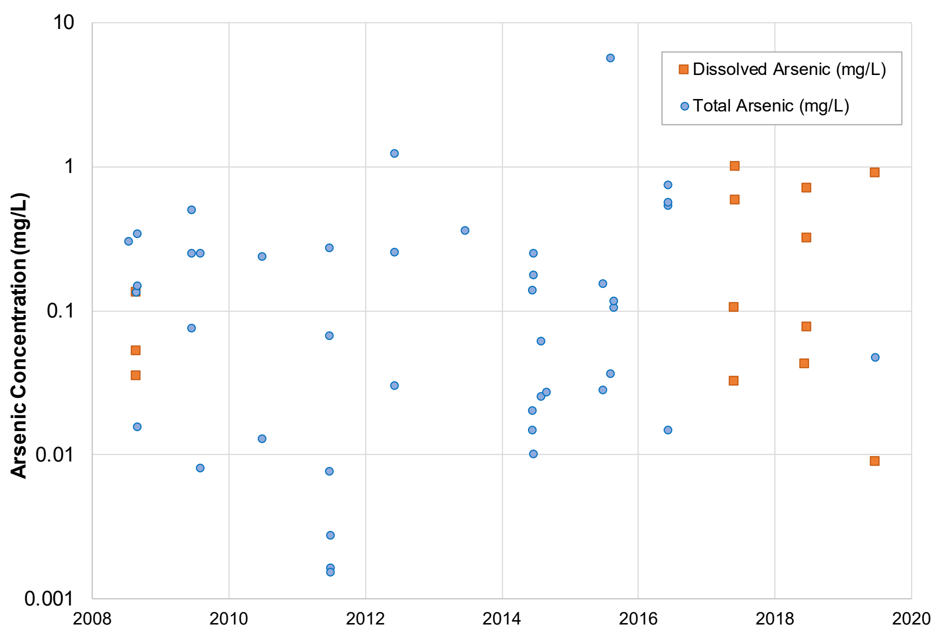

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Figure 5: Arsenic Concentrations Observed in Seeps at the Boston Camp since 2008

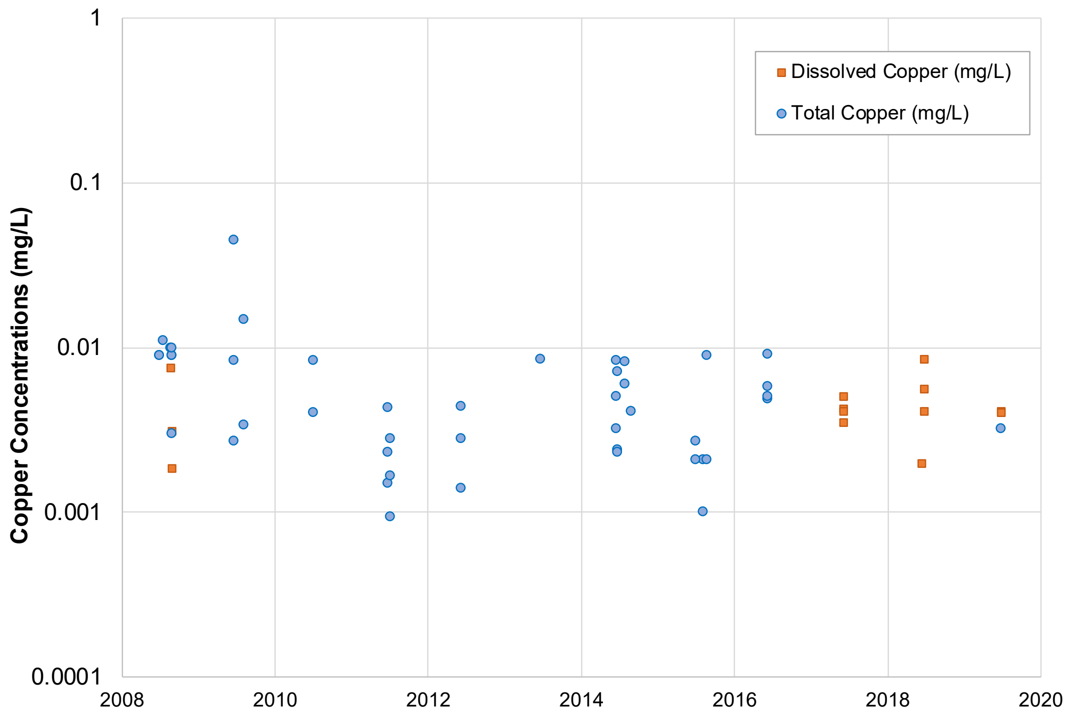

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Figure 6: Copper Concentrations Observed in Seeps at the Boston Camp since 2008

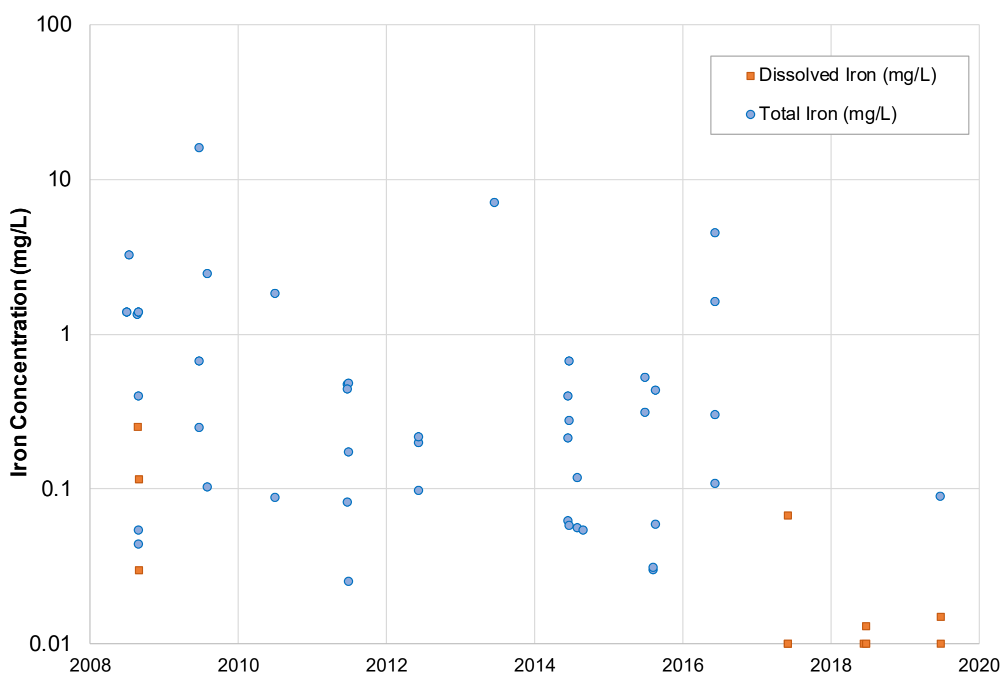

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Figure 7: Iron Concentrations Observed in Seeps at the Boston Camp since 2008

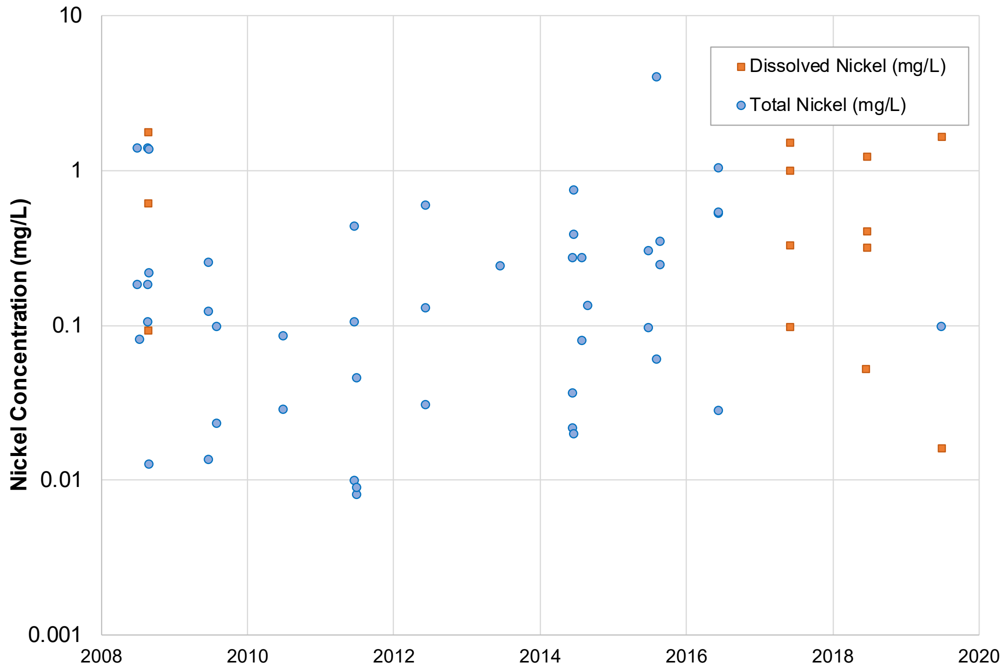

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Figure 8: Nickel Concentrations Observed in Seeps at the Boston Camp since 2008

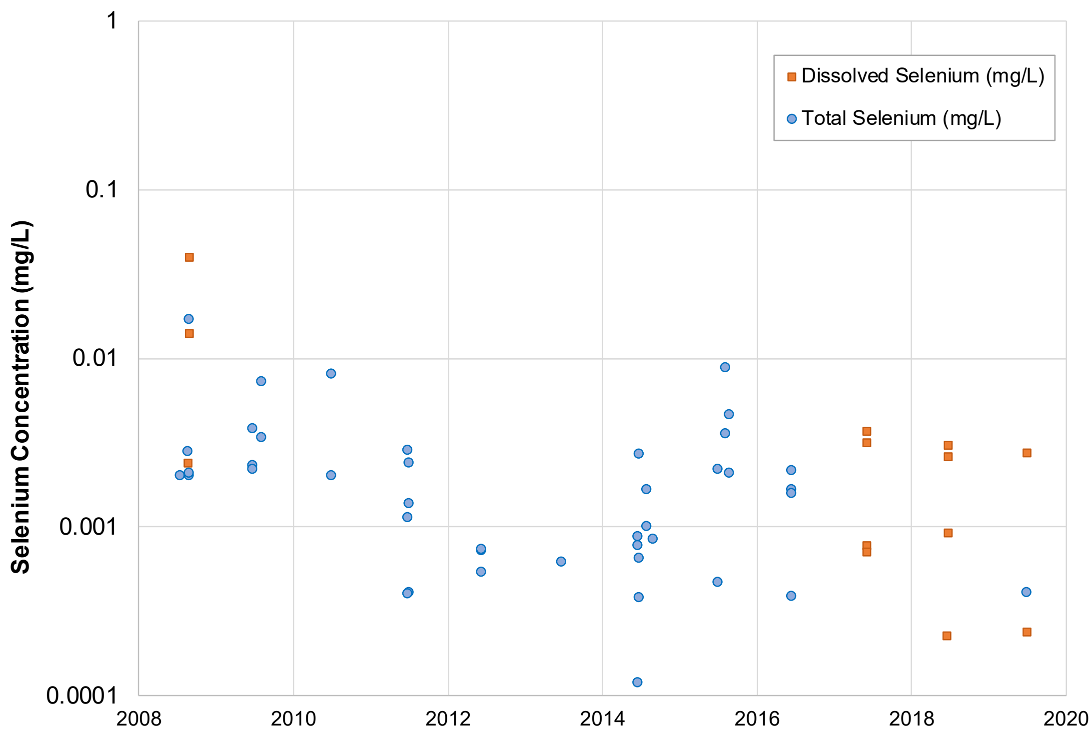

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Figure 9: Selenium Concentrations Observed in Seeps at the Boston Camp since 2008

4 Conclusions and Recommendations

Seepage surveys in 2019 at Boston included i) the freshet survey of the north and east sides of the camp pad and the full extent of the airstrip and ii) monthly surveys of SNP station BOS-8. This memo presents the results from both seepage surveys. In 2019, a total of three opportunistic seepage samples were collected: two from the northeast side of the camp pad, and one along the road to the airstrip. No seepage was observed along the northern extent of the pad or along the airstrip.

All seepage samples were pH neutral to slightly alkaline (7.8 to 8.0). The seepage chemistry is summarized as follows:

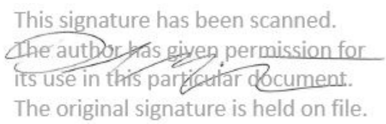
- Sulphate concentrations for the two samples from the NE Pad (19-BOS-01 and BOS-8A) were within the range of historical concentrations and ranged from 400 to 630 mg/L. Compared to BOS-8A, concentrations at 19-BOS-01 were higher for arsenic (0.9 mg/L or 20 times higher than BOS-8A) , cobalt (1.2 mg/L or 50 times higher), nickel (1.6 mg/L or 16 times higher), manganese (0.27 mg/L or 9 times higher) and selenium (0.0027 mg/L or 6 times higher). Concentrations of copper (0.003 and 0.004 mg/L) and iron (0.089 and 0.010 mg/L) were roughly equivalent for 19-BOS-01 and BOS-8A. All concentrations for the aforementioned parameters are within the range of historical concentrations and no long-term trend was identified. Chloride and nitrate at 19-BOS-01 (220 and 4 mg/L, respectively) were similarly equivalent to previous measurements.

- The seep located at the toe of the road (19-BOS-02) had nitrate, chloride, dissolved arsenic, nickel, and selenium concentrations one to two orders of magnitude lower than the seep samples located at the NE camp pad. Sulphate concentrations at the access road were four to six times lower than the NE Pad and dissolved copper and iron concentrations were roughly equivalent at the two locations.

Continued monitoring will allow for further trends in the seepage to be established.

Regards,

SRK Consulting (Canada) Inc.



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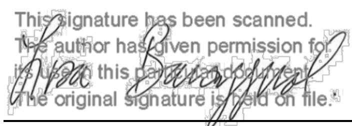

Lisa Barazzuol, PGeo (NT/NU)
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SRK Consulting (Canada) Inc., 2017. Water and Ore/Waste Rock Management Plan for the Boston Site, Hope Bay Project, Nunavut. Report 1CH008.022 for TMAC Resources Inc. January 2017.

Attachment 1: 2019 Field Observations and Water Quality Results

Sample ID	Unit	*Detection Limit*	BOS8A	BOS8A-DUP	FIELD BLANK2	19-BOS-01	19-BOS-01-DUP	19-BOS-02	FIELD BLANK3
Date			2019-06-29	2019-06-29	2019-06-29	2019-06-29	2019-06-29	2019-06-29	2019-06-29
Time			2:20:00 PM	2:20:00 PM	2:20:00 PM	3:10:00 PM	3:10:00 PM	3:40:00 PM	3:10:00 PM
Easting			441272			441334		441318	
Northing			7505473			7505410		7505265	
ALS Sample ID			L2301937-1	L2301937-2	L2301937-3	L2301987-1	L2301987-2	L2301987-3	L2301987-4
Description			NE camp pad (?)			--		Flowing out of access Rd to airstrip to the East	
pH	pH units		7.6			7.8		7.9	
Temperature	ºC		16			6.2		12.2	
Conductivity	µS/cm		1018			1928		408	
ORP	mV		44			101		120	
Photos			Y (24-26)			Y (31-33)		Y (36-38)	
Flow	L/s		-			-		-	
Duplicate			Y			Y		N	
Blank			Y			Y		N	
Physical Tests (Water)									
Conductivity	uS/cm	2	1030	1040	2	1810	1820	394	2
Hardness (as CaCO3)	mg/L	0.5	544	541	0.5	1010	987	185	0.5
pH	pH	0.1	7.8	7.79	5.77	8.04	8.05	7.98	5.33
Total Suspended Solids	mg/L	3	3	3.5	3	3	3	11.9	3
Total Dissolved Solids	mg/L	10				1680	1770	299	10
Anions and Nutrients (Water)									
Acidity (as CaCO3)	mg/L	1	-	-	-	3.4	3.3	1.7	2
Alkalinity, Total (as CaCO3)	mg/L	1	-	-	-	100	104	70.5	1
Ammonia, Total (as N)	mg/L	0.005	0.0062	0.0057	0.005	0.372	0.385	0.005	0.005
Bromide (Br)	mg/L	0.05	-	-	-	0.5	0.56	0.05	0.05
Chloride (Cl)	mg/L	0.5	-	-	-	219	222	22.3	0.5
Fluoride (F)	mg/L	0.02	-	-	-	0.2	0.2	0.049	0.02
Nitrate (as N)	mg/L	0.005	-	-	-	3.99	4.03	0.335	0.005
Nitrite (as N)	mg/L	0.001	-	-	-	0.017	0.017	0.001	0.001
Phosphorus (P)-Total	mg/L	0.002	-	-	-	0.0302	0.0319	0.0078	0.002
Sulfate (SO4)	mg/L	0.3	395	397	0.3	629	636	97	0.3
Total Metals (Water)									
Aluminum (Al)-Total	mg/L	*0.005*	0.0090	0.0088	0.005	-	-	-	-
Antimony (Sb)-Total	mg/L	*0.0005*	0.00401	0.00413	0.0005	-	-	-	-
Arsenic (As)-Total	mg/L	*0.0005*	0.0471	0.0503	0.0005	-	-	-	-
Barium (Ba)-Total	mg/L	*0.02*	0.025	0.025	0.02	-	-	-	-
Beryllium (Be)-Total	mg/L	*0.0001*	0.0001	0.0001	0.0001	-	-	-	-
Boron (B)-Total	mg/L	*0.1*	0.10	0.10	0.1	-	-	-	-
Cadmium (Cd)-Total	mg/L	*0.000005*	0.0000222	0.0000245	0.000005	-	-	-	-
Calcium (Ca)-Total	mg/L	*0.1*	136	133	0.1	-	-	-	-
Chromium (Cr)-Total	mg/L	*0.001*	0.001	0.001	0.001	-	-	-	-
Cobalt (Co)-Total	mg/L	*0.0003*	0.0244	0.0286	0.0003	-	-	-	-
Copper (Cu)-Total	mg/L	*0.001*	0.0032	0.0031	0.001	-	-	-	-
Iron (Fe)-Total	mg/L	*0.03*	0.089	0.092	0.03	-	-	-	-
Lead (Pb)-Total	mg/L	*0.0005*	0.0005	0.0005	0.0005	-	-	-	-
Lithium (Li)-Total	mg/L	*0.001*	0.0068	0.0066	0.001	-	-	-	-
Magnesium (Mg)-Total	mg/L	*0.1*	49.5	50.8	0.1	-	-	-	-
Manganese (Mn)-Total	mg/L	*0.0003*	0.0286	0.0328	0.0003	-	-	-	-
Molybdenum (Mo)-Total	mg/L	*0.001*	0.0012	0.0012	0.001	-	-	-	-
Nickel (Ni)-Total	mg/L	*0.001*	0.0979	0.112	0.001	-	-	-	-
Potassium (K)-Total	mg/L	*2*	6.4	6.5	2	-	-	-	-
Selenium (Se)-Total	mg/L	*0.00005*	0.000411	0.000456	0.00005	-	-	-	-
Silver (Ag)-Total	mg/L	*0.00002*	0.00002	0.00002	0.00002	-	-	-	-
Sodium (Na)-Total	mg/L	*2*	21.1	21.7	2	-	-	-	-
Thallium (Tl)-Total	mg/L	*0.00001*	0.00001	0.00001	0.00001	-	-	-	-
Tin (Sn)-Total	mg/L	*0.0005*	0.0005	0.0005	0.0005	-	-	-	-
Titanium (Ti)-Total	mg/L	*0.01*	0.01	0.01	0.01	-	-	-	-
Uranium (U)-Total	mg/L	*0.0002*	0.0002	0.0002	0.0002	-	-	-	-

Sample ID Date Time	Unit	*Detection Limit*	BOS8A 2019-06-29 2:20:00 PM	BOS8A-DUP 2019-06-29 2:20:00 PM	FIELD BLANK2 2019-06-29 2:20:00 PM	19-BOS-01 2019-06-29 3:10:00 PM	19-BOS-01-DUP 2019-06-29 3:10:00 PM	19-BOS-02 2019-06-29 3:40:00 PM	FIELD BLANK3 2019-06-29 3:10:00 PM
Vanadium (V)-Total	mg/L	*0.0005*	0.00054	0.0005	0.0005	-	-	-	-
Zinc (Zn)-Total	mg/L	*0.005*	0.005	0.005	0.005	-	-	-	-
Dissolved Metals (Water)									
Aluminum (Al)-Dissolved	mg/L	*0.001*	-	-	-	0.0025	0.0020	0.0087	0.001
Antimony (Sb)-Dissolved	mg/L	*0.0001*	-	-	-	0.0338	0.0348	0.00278	0.0001
Arsenic (As)-Dissolved	mg/L	*0.0001*	-	-	-	0.903	0.901	0.00888	0.0001
Barium (Ba)-Dissolved	mg/L	*0.0001*	-	-	-	0.0176	0.0177	0.00950	0.0001
Beryllium (Be)-Dissolved	mg/L	*0.00002*	-	-	-	0.00002	0.00002	0.00002	0.00002
Bismuth (Bi)-Dissolved	mg/L	*0.00005*	-	-	-	0.00005	0.00005	0.00005	0.00005
Boron (B)-Dissolved	mg/L	*0.01*	-	-	-	0.189	0.183	0.045	0.01
Cadmium (Cd)-Dissolved	mg/L	*0.000005*	-	-	-	0.0000319	0.0000303	0.0000069	0.000005
Calcium (Ca)-Dissolved	mg/L	*0.05*	-	-	-	278	271	47.0	0.05
Chromium (Cr)-Dissolved	mg/L	*0.0001*	-	-	-	0.0001	0.0001	0.00010	0.0001
Cobalt (Co)-Dissolved	mg/L	*0.0001*	-	-	-	1.21	1.19	0.00320	0.0001
Copper (Cu)-Dissolved	mg/L	*0.0002*	-	-	-	0.00413	0.00412	0.00400	0.0002
Iron (Fe)-Dissolved	mg/L	*0.01*	-	-	-	0.01	0.01	0.015	0.01
Lead (Pb)-Dissolved	mg/L	*0.00005*	-	-	-	0.00005	0.00005	0.00005	0.00005
Lithium (Li)-Dissolved	mg/L	*0.001*	-	-	-	0.0398	0.0385	0.0046	0.001
Magnesium (Mg)-Dissolved	mg/L	*0.1*	-	-	-	75.6	75.4	16.5	0.1
Manganese (Mn)-Dissolved	mg/L	*0.0001*	-	-	-	0.268	0.266	0.0102	0.0001
Mercury (Hg)-Dissolved	mg/L	*0.000005*	-	-	-	0.000005	0.0000055	0.0000055	0.0000160
Molybdenum (Mo)-Dissolved	mg/L	*0.00005*	-	-	-	0.00284	0.00289	0.000931	0.00005
Nickel (Ni)-Dissolved	mg/L	*0.0005*	-	-	-	1.64	1.62	0.0161	0.0005
Phosphorus (P)-Dissolved	mg/L	*0.05*	-	-	-	0.05	0.05	0.05	0.05
Potassium (K)-Dissolved	mg/L	*0.1*	-	-	-	13.5	13.4	2.31	0.1
Selenium (Se)-Dissolved	mg/L	*0.00005*	-	-	-	0.00273	0.00298	0.000238	0.00005
Silicon (Si)-Dissolved	mg/L	*0.05*	-	-	-	1.98	1.96	0.825	0.05
Silver (Ag)-Dissolved	mg/L	*0.00001*	-	-	-	0.00001	0.00001	0.00001	0.00001
Sodium (Na)-Dissolved	mg/L	*0.05*	-	-	-	36.8	37.9	8.74	0.05
Strontium (Sr)-Dissolved	mg/L	*0.0002*	-	-	-	1.61	1.66	0.170	0.0002
Sulfur (S)-Dissolved	mg/L	*0.5*	-	-	-	211	209	32.1	0.5
Thallium (Tl)-Dissolved	mg/L	*0.00001*	-	-	-	0.00001	0.00001	0.00001	0.00001
Tin (Sn)-Dissolved	mg/L	*0.0001*	-	-	-	0.0001	0.0001	0.0001	0.0001
Titanium (Ti)-Dissolved	mg/L	*0.0003*	-	-	-	0.0003	0.0003	0.0003	0.0003
Uranium (U)-Dissolved	mg/L	*0.00001*	-	-	-	0.000257	0.000260	0.000042	0.00001
Vanadium (V)-Dissolved	mg/L	*0.0005*	-	-	-	0.00128	0.00128	0.0005	0.0005
Zinc (Zn)-Dissolved	mg/L	*0.001*	-	-	-	0.0024	0.0025	0.001	0.001
Zirconium (Zr)-Dissolved	mg/L	*0.0003*	-	-	-	0.0003	0.0003	0.0003	0.0003
*Note: Blue text indicates value below the limit of detection									

Attachment 2: Boston Seepage Data 2008-2019

Attachment 2: Boston Seepage Data 2008-2018

Year	Sample Code	Station Code	Date	Conductivity	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)	Fluoride (F)
			Units	uS/cm	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	2	0.5	0.1	3	10	1	1	0.005	0.05	0.5	0.02
2008	2008-BOS-001	2008-BOS-001	2008-08-23	1470	596	7.9	18.7	1110	12.2	162	0.155	<0.05	152	0.065
2008	2008-BOS-003	2008-BOS-003	2008-08-25	1890	901	7.71	<5	1490	6.4	76.7	6.04	<0.05	73	0.106
2008	BOS-8	BOS-8A	2008-08-25	6720	2740	6.9	19	8200	19.1	42.8	14.2	3.4	1890	1.3
2008	BOS-8A	BOS-8A	2008-06-30	1190	464	8	11	-	-	149	-	-	136	-
2008	BOS-8A	BOS-8A	2008-06-30	1190	464	8	11	-	-	149	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	1280	490	8.1	40	-	-	172	0.1	-	129	0.09
2008	BOS-8A	BOS-8A	2008-08-29	1330	548	8	-	-	-	130	0.05	-	124	-
2009	BOS-8A	BOS-8A	2009-06-21	483	161	8.04	19	260	-	111	1.41	-	30.9	0.073
2009	BOS-8A	BOS-8A	2009-08-04	1820	660	8.2	34	1110	-	188	0.138	-	231	0.061
2010	BOS-8A	BOS-8A	2010-07-01	1210	481	7.85	-	-	-	198	0.05	-	130	0.083
2011	BOS-8A	BOS-8A	2011-06-23	763	274	7.71	-	-	-	68.4	0.381	-	68.6	-
2011	BOS-8A	BOS-8A	2011-07-03	1050	362	7.99	-	-	-	72	0.05	-	127	-
2012	BOS-8A	BOS-8A	2012-06-10	394	149	7.78	3	-	-	-	0.127	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	1320	687	8.28	15	-	-	-	0.05	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	1560	571	7.9	-	-	-	128	0.05	-	160	-
2009	BOS-8B	BOS-8B	2009-06-21	724	209	7.71	4	387	-	63.8	2.12	-	96.8	0.054
2009	BOS-8B	BOS-8B	2009-08-04	2800	956	7.73	3	1640	-	38.6	0.05	-	548	0.05
2010	BOS-8B	BOS-8B	2010-07-01	1520	583	7.48	-	-	-	58.2	0.05	-	224	0.05
2011	BOS-8B	BOS-8B	2011-06-23	1690	635	6.87	-	-	-	10.1	0.0246	-	355	-
2011	BOS-8B	BOS-8B	2011-07-03	1850	708	7.6	-	-	-	38.4	0.05	-	383	-
2012	BOS-8B	BOS-8B	2012-06-10	462	168	7.73	3	-	-	-	0.142	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	4860	1890	7.4	-	-	-	47	10.6	-	1440	-
2009	BOS-8C	BOS-8C	2009-06-21	520	176	7.55	656	275	-	37.2	1.4	-	65.5	0.05
2011	BOS-8C	BOS-8C	2011-06-23	786	281	7.58	-	-	-	33.8	0.0139	-	171	-
2011	BOS-8C	BOS-8C	2011-07-03	1450	502	7.51	-	-	-	29.8	0.05	-	320	-
2012	BOS-8C	BOS-8C	2012-06-10	358	124	6.4	3	-	-	-	0.05	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	683	346	7.93	<3	-	-	-	0.0149	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	1040	461	7.86	3.2	-	-	-	0.013	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	347	106	7.95	8.8	-	-	-	0.0421	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	974	537	8.03	<3	-	-	-	0.0164	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	1110	506	7.96	<3	-	-	-	0.0068	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	2160	1040	7.75	9.5	-	-	-	0.194	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	1610	885	7.72	4.3	-	-	-	0.195	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	1460	742	7.02	<3	-	-	-	0.0081	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	951	416	7.72	<3	-	-	-	0.0308	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	1490	721	7.16	12.1	-	-	-	0.0074	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	944	426	8.03	<3	-	-	-	0.0134	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	1320	669	7.18	<3	-	-	-	0.0305	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	2620	1370	7.6	<3	-	-	-	16	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	1610	739	7.9	28	-	-	-	0.0678	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	1370	601	7.14	<3	-	-	-	0.33	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	1500	762	7.6	<3	-	-	-	0.0146	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	1220	529	7.49	<3	-	-	-	0.153	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	1470	668	7.91	9.8	-	-	-	0.0383	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	1470	669	7.94	10.1	-	-	-	0.017	-	-	-
2017	BOS8A-04JUN	BOS-8A	2017-06-04	811	0	7.61	<3.0	611	5.5	91.2	0.0145	<0.25	26.1	<0.10
2017	2017-BOS-001	2017-BOS-001	2017-06-04	577	0	7.09	32.8	428	8.1	61	0.0267	<0.050	15.6	0.032
2017	17-BOS-02	BOS-8B	2017-06-06	1830	968	8.03	6.7	1440	4.8	109	0.198	0	228	<0.20
2017	17-BOS-03	17-BOS-03	2017-06-06	1690	903	8.04	11.7	1250	4.6	108	0.122	0	192	<0.20
2018	18-BOS-01	BOS8	2018-06-16	401	-	7.31	12.7	288	4.3	22	0.0246	-	8.88	0.024
2018	18-BOS-01	BOS8	2018-06-25	1200	666	7.81	4.1	967	4.5	129	0.0239	-	47.2	<0.1
2018	18-BOS-02	18-BOS-02	2018-06-25	1840	916	8.04	3.7	1500	2.8	90.1	0.349	-	220	<0.2
2018	18-BOS-03	18-BOS-03	2018-06-25	1640	826	8.05	3.3	1370	4	88.8	0.0302	-	194	<0.1
2019	BOS8A	BOS-8A	2019-06-29	1030	544	7.8	<3	-	-	-	0.0062	-	-	-
2019	19-BOS-01	19-BOS-01	2019-06-29	1810	1010	8.04	<3	1680	3.4	100	0.372	<0.5	219	<0.2
2019	19-BOS-02	18-BOS-02	2019-06-29	394	185	7.98	11.9	299	1.7	70.5	<0.005	<0.05	22.3	0.049

Attachment 2: Boston Seepage Data 2008-2018

Year	Sample Code	Station Code	Date	Nitrate (as N)	Nitrite (as N)	Phosphorus (P)-Total	Ortho Phosphate as P	Sulfate (SO4)	Dissolved Mercury Filtration Location	Dissolved Metals Filtration Location	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved
			Units	mg/L	mg/L	mg/L	mg/L	mg/L			mg/L	mg/L	mg/L	mg/L
			LOR	0.005	0.001	0.002	0.001	0.3	n/a	n/a	0.001	0.0001	0.0001	0.00005
2008	2008-BOS-001	2008-BOS-001	2008-08-23	<0.005	0.0019	-	-	380	-	-	0.0146	0.00437	0.0521	0.0314
2008	2008-BOS-003	2008-BOS-003	2008-08-25	47.6	0.542	-	-	650	-	-	<0.005	0.0142	0.0353	0.011
2008	BOS-8	BOS-8A	2008-08-25	49.7	0.261	-	-	603	-	-	0.023	0.0206	0.134	0.126
2008	BOS-8A	BOS-8A	2008-06-30	3.5	0.05	-	-	217	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	217	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	0.1	0.05	0.27	-	253	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	22.1	0.05	0.08	-	333	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	2.07	0.05	0.186	0.186	69	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	1.91	0.05	0.161	0.161	402	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	0.05	0.05	-	0.216	232	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	1.5	0.05	-	0.0593	188	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	1.96	0.05	-	0.02	233	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	90.1	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	387	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	14.3	0.05	0.02	-	358	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	6.26	0.071	0.102	0.102	103	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	41	0.05	0.02	0.02	384	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	5.95	0.05	-	0.103	343	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	7.87	0.05	-	0.0393	236	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	6.52	0.05	-	0.02	254	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	128	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	26.3	0.16	0.17	-	374	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	3.33	0.055	0.282	0.282	89.5	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	0.549	0.05	-	0.0156	61.6	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	1.98	0.05	-	0.02	150	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	116	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	242	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	383	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	28.7	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	333	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	398	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	526	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	733	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	662	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	359	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	569	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	325	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	535	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	1300	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	468	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	292	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	575	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	301	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	4350	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	434	-	-	-	-	-	-
2017	BOS8A-04JUN	BOS-8A	2017-06-04	1.48	<0.0050	0.0275	-	305	FIELD	-	0.0047	0.00691	0.105	0.0127
2017	2017-BOS-001	2017-BOS-001	2017-06-04	0.983	0.0028	0.0356	-	205	FIELD	-	0.0335	0.00407	0.0323	0.0106
2017	17-BOS-02	BOS-8B	2017-06-06	3.81	<0.010	0.0314	-	619	FIELD	-	0.0025	0.0363	0.989	0.0188
2017	17-BOS-03	17-BOS-03	2017-06-06	3.23	0.026	0.03	-	566	FIELD	-	0.0042	0.027	0.578	0.0256
2018	18-BOS-01	BOS8	2018-06-16	0.42	0.0071	0.0155	-	152	-	-	0.0044	0.0025	0.0427	0.00445
2018	18-BOS-01	BOS8	2018-06-25	1.62	<0.005	0.0384	-	493	-	-	0.0054	0.00648	0.0758	0.0191
2018	18-BOS-02	18-BOS-02	2018-06-25	3.62	0.012	0.0507	-	527	-	-	0.002	0.038	0.707	0.0156
2018	18-BOS-03	18-BOS-03	2018-06-25	3.79	0.0172	0.0213	-	527	-	-	0.0043	0.0244	0.315	0.0254
2019	BOS8A	BOS-8A	2019-06-29	-	-	-	-	395	-	-	-	-	-	-
2019	19-BOS-01	19-BOS-01	2019-06-29	3.99	0.017	0.0302	-	629	FIELD	FIELD	0.0025	0.0338	0.903	0.0176
2019	19-BOS-02	18-BOS-02	2019-06-29	0.335	<0.001	0.0078	-	97	FIELD	FIELD	0.0087	0.00278	0.00888	0.00950

Year	Sample Code	Station Code	Date	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Calcium (Ca)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.00002	0.00005	0.01	0.000005	0.05	0.0001	0.0001	0.0002	0.01	0.00005	0.001
2008	2008-BOS-001	2008-BOS-001	2008-08-23	<0.001	<0.001	0.147	<0.0001	137	0.0011	0.0113	0.00756	0.253	<0.0001	0.014
2008	2008-BOS-003	2008-BOS-003	2008-08-25	<0.0025	<0.0025	0.295	<0.00025	202	<0.0025	0.253	0.00183	<0.03	<0.00025	<0.025
2008	BOS-8	BOS-8A	2008-08-25	<0.005	<0.005	0.43	<0.0005	888	<0.005	1.02	0.0031	0.115	<0.0005	0.195
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2017	BOS8A-04JUN	BOS-8A	2017-06-04	<0.00010	<0.000050	0.065	0.0000138	94.2	0.00014	0.141	0.00505	<0.010	<0.000050	0.005
2017	2017-BOS-001	2017-BOS-001	2017-06-04	<0.00010	<0.000050	0.087	0.0000367	62.2	0.00015	0.0716	0.00424	0.068	<0.000050	0.0012
2017	17-BOS-02	BOS-8B	2017-06-06	<0.000020	<0.000050	0.203	0.0000353	264	<0.00010	1.1	0.0035	<0.010	<0.000050	0.0524
2017	17-BOS-03	17-BOS-03	2017-06-06	<0.000020	<0.000050	0.205	0.0000299	239	<0.00010	0.754	0.00411	<0.010	<0.000050	0.0483
2018	18-BOS-01	BOS8	2018-06-16	<0.0001	<0.00005	0.025	<0.000005	50.8	<0.0001	0.0246	0.00198	<0.01	<0.00005	0.0022
2018	18-BOS-01	BOS8	2018-06-25	<0.00002	<0.00005	0.078	0.0000247	166	<0.0001	0.109	0.00848	0.013	<0.00005	0.0069
2018	18-BOS-02	18-BOS-02	2018-06-25	<0.00002	<0.00005	0.176	0.0000287	256	<0.0001	0.956	0.00555	<0.01	<0.00005	0.0456
2018	18-BOS-03	18-BOS-03	2018-06-25	<0.00002	<0.00005	0.178	0.0000313	226	<0.0001	0.345	0.00406	<0.01	<0.00005	0.0399
2019	BOS8A	BOS-8A	2019-06-29	-	-	-	-	-	-	-	-	-	-	-
2019	19-BOS-01	19-BOS-01	2019-06-29	<0.00002	<0.00005	0.189	0.0000319	278	<0.0001	1.21	0.00413	<0.01	<0.00005	0.0398
2019	19-BOS-02	18-BOS-02	2019-06-29	<0.00002	<0.00005	0.045	0.0000069	47.0	0.00010	0.00320	0.00400	0.015	<0.00005	0.0046

Attachment 2: Boston Seepage Data 2008-2018

Year	Sample Code	Station Code	Date	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.1	0.0001	0.000005	0.00005	0.0005	0.05	0.1	0.00005	0.05	0.00001	0.05
2008	2008-BOS-001	2008-BOS-001	2008-08-23	62.1	0.135	<0.00005	0.00278	0.0928	<0.3	14.8	0.0024	0.588	<0.00002	85.9
2008	2008-BOS-003	2008-BOS-003	2008-08-25	96.6	0.374	<0.00005	0.00656	0.613	<0.3	17.9	0.014	1.21	<0.00005	50.5
2008	BOS-8	BOS-8A	2008-08-25	128	1.44	<0.00005	0.00385	1.75	<0.3	51	<0.04	3.88	<0.0001	182
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-
2017	BOS8A-04JUN	BOS-8A	2017-06-04	40.3	0.112	<0.0000050	0.000868	0.326	<0.050	4.5	0.000781	1.36	<0.000010	14
2017	2017-BOS-001	2017-BOS-001	2017-06-04	28.4	0.285	<0.0000050	0.00074	0.0971	<0.050	5.53	0.000713	1.56	<0.000010	11.3
2017	17-BOS-02	BOS-8B	2017-06-06	75.2	0.3	<0.0000050	0.0024	1.51	<0.050	14.1	0.00367	2.33	0.000014	38.9
2017	17-BOS-03	17-BOS-03	2017-06-06	74.5	0.208	<0.0000050	0.00288	0.99	<0.050	13.7	0.00314	2.35	0.000019	37.1
2018	18-BOS-01	BOS8	2018-06-16	13	0.0241	<0.000005	0.00036	0.0519	<0.05	1.68	0.000226	0.246	<0.00001	4.11
2018	18-BOS-01	BOS8	2018-06-25	61.4	0.111	<0.000005	0.0011	0.315	<0.05	6.27	0.000927	2.11	0.000012	24.8
2018	18-BOS-02	18-BOS-02	2018-06-25	67.6	0.25	<0.000005	0.00313	1.23	<0.05	13.3	0.00305	1.93	0.000011	36.3
2018	18-BOS-03	18-BOS-03	2018-06-25	63.5	0.133	<0.000005	0.00401	0.406	<0.05	10.9	0.00261	1.88	0.000014	31.3
2019	BOS8A	BOS-8A	2019-06-29	-	-	-	-	-	-	-	-	-	-	-
2019	19-BOS-01	19-BOS-01	2019-06-29	75.6	0.268	<0.000005	0.00284	1.64	<0.05	13.5	0.00273	1.98	<0.00001	36.8
2019	19-BOS-02	18-BOS-02	2019-06-29	16.5	0.0102	0.0000055	0.000931	0.0161	<0.05	2.31	0.000238	0.825	<0.00001	8.74

Year	Sample Code	Station Code	Date	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Thallium (Tl)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved	Zirconium (Zr)-Dissolved	Aluminum (Al)-Total	Antimony (Sb)-Total	Arsenic (As)-Total	Barium (Ba)-Total
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.0002	0.5	0.00001	0.0001	0.0003	0.00001	0.0005	0.001	0.0003	0.001	0.0001	0.0001	0.00005
2008	2008-BOS-001	2008-BOS-001	2008-08-23	0.767	-	<0.0002	<0.0002	0.012	0.000186	<0.002	<0.002	-	0.377	0.00448	0.134	0.0342
2008	2008-BOS-003	2008-BOS-003	2008-08-25	0.553	-	<0.0005	<0.0005	0.012	0.000419	<0.005	0.0068	-	0.11	-	-	0.032
2008	BOS-8	BOS-8A	2008-08-25	7.26	-	<0.001	<0.001	<0.01	0.00019	<0.01	0.022	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	0.11	-	-	0.032
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	-	-	-	-	-	-	-	-	0.94	0.003	0.301	0.0304
2008	BOS-8A	BOS-8A	2008-08-29	-	-	-	-	-	-	-	-	-	0.15	0.0114	0.148	0.0281
2009	BOS-8A	BOS-8A	2009-06-21	-	-	-	-	-	-	-	-	-	0.268	0.00874	0.247	0.0127
2009	BOS-8A	BOS-8A	2009-08-04	-	-	-	-	-	-	-	-	-	0.426	0.00532	0.248	0.0598
2010	BOS-8A	BOS-8A	2010-07-01	-	-	-	-	-	-	-	-	-	0.08	0.00496	0.235	0.0341
2011	BOS-8A	BOS-8A	2011-06-23	-	-	-	-	-	-	-	-	-	0.167	0.0033	0.0664	0.0239
2011	BOS-8A	BOS-8A	2011-07-03	-	-	-	-	-	-	-	-	-	0.0461	0.00124	0.00274	0.0386
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	-	-	-	-	-	0.132	0.00884	0.253	0.0075
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	-	-	-	-	-	0.292	0.00322	0.359	0.0355
2008	BOS-8B	BOS-8B	2008-08-29	-	-	-	-	-	-	-	-	-	0.04	0.0116	0.0155	0.0428
2009	BOS-8B	BOS-8B	2009-06-21	-	-	-	-	-	-	-	-	-	0.155	0.00833	0.0749	0.0289
2009	BOS-8B	BOS-8B	2009-08-04	-	-	-	-	-	-	-	-	-	0.042	0.00318	0.00801	0.113
2010	BOS-8B	BOS-8B	2010-07-01	-	-	-	-	-	-	-	-	-	0.051	0.0045	0.0128	0.0442
2011	BOS-8B	BOS-8B	2011-06-23	-	-	-	-	-	-	-	-	-	0.099	0.0218	0.271	0.107
2011	BOS-8B	BOS-8B	2011-07-03	-	-	-	-	-	-	-	-	-	0.0145	0.00614	0.00164	0.0803
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	-	-	-	-	-	0.122	0.00287	0.03	0.0119
2008	BOS-8C	BOS-8C	2008-08-29	-	-	-	-	-	-	-	-	-	0.2	0.029	0.341	0.088
2009	BOS-8C	BOS-8C	2009-06-21	-	-	-	-	-	-	-	-	-	6.91	0.00672	0.495	0.0496
2011	BOS-8C	BOS-8C	2011-06-23	-	-	-	-	-	-	-	-	-	0.136	0.00073	0.00767	0.0382
2011	BOS-8C	BOS-8C	2011-07-03	-	-	-	-	-	-	-	-	-	0.0087	0.00214	0.00151	0.0612
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	-	-	-	-	-	0.181	0.00179	1.23	0.0077
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	0.0311	0.00947	0.138	<0.02
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	0.036	0.00252	0.0148	0.027
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	0.0988	0.00105	0.02	0.034
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	0.0233	0.00918	0.175	0.025
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	0.0231	0.00201	0.01	0.032
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	0.105	0.0294	0.247	0.041
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	0.0579	0.0121	0.0615	0.032
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	0.0246	0.00498	0.0362	0.039
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	0.0401	0.00139	0.0146	<0.02
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	0.074	0.00548	0.105	0.025
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	0.0148	0.00208	0.0281	<0.02
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	0.0663	0.0032	0.0251	0.021
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	0.0167	0.118	5.62	<0.02
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	0.541	0.0353	0.739	<0.02
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	0.021	0.0102	0.116	0.033
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	-	-	-	-	-	0.0216	0.00317	0.0272	0.021
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	0.0285	0.0113	0.154	0.027
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	0.116	0.03	0.534	<0.02
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	1.24	0.0291	0.56	0.021
2017	BOS8A-04JUN	BOS-8A	2017-06-04	0.25	111	<0.000010	<0.00010	<0.00030	0.000145	<0.00050	0.0044	<0.000060	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	0.215	75.4	<0.000010	<0.00010	0.00079	0.000033	<0.00050	0.0056	0.00016	-	-	-	-
2017	17-BOS-02	BOS-8B	2017-06-06	1.56	215	<0.000010	<0.00010	<0.00030	0.000284	0.00142	0.0028	<0.00030	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	1.43	207	<0.000010	<0.00010	<0.00030	0.000295	0.00076	0.0407	<0.00030	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	0.108	50.5	<0.00001	<0.0001	<0.0003	0.000035	<0.0005	0.0017	<0.00006	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	0.42	160	<0.00001	<0.0001	<0.0006	0.000284	<0.0005	0.0027	<0.0003	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	1.63	181	<0.00001	<0.0001	<0.0003	0.000247	0.0009	0.002	<0.0003	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	1.44	168	<0.00001	<0.0001	<0.0003	0.000268	<0.0005	0.0292	<0.0003	-	-	-	-
2019	BOS8A	BOS-8A	2019-06-29	-	-	-	-	-	-	-	-	-	0.0090	0.00401	0.0471	0.025
2019	19-BOS-01	19-BOS-01	2019-06-29	1.61	211	<0.00001	<0.0001	<0.0003	0.000257	0.00128	0.0024	<0.0003	-	-	-	-
2019	19-BOS-02	18-BOS-02	2019-06-29	0.170	32.1	<0.00001	<0.0001	<0.0003	0.000042	<0.0005	<0.001	<0.0003	-	-	-	-

Year	Sample Code	Station Code	Date	Beryllium (Be)-Total	Bismuth (Bi)-Total	Boron (B)-Total	Cadmium (Cd)-Total	Calcium (Ca)-Total	Chromium (Cr)-Total	Cobalt (Co)-Total	Copper (Cu)-Total	Iron (Fe)-Total	Lead (Pb)-Total	Lithium (Li)-Total	Magnesium (Mg)-Total	Manganese (Mn)-Total	Mercury (Hg)-Total	Molybdenum (Mo)-Total	Nickel (Ni)-Total
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.00002	0.00005	0.01	0.000005	0.05	0.0001	0.0001	0.0002	0.01	0.00005	0.001	0.1	0.0001	0.000005	0.00005	0.0005
2008	2008-BOS-001	2008-BOS-001	2008-08-23	<0.001	<0.001	0.158	<0.0001	136	0.0052	0.0147	0.01	1.32	0.00062	0.014	62	0.153	<0.00005	0.00226	0.104
2008	2008-BOS-003	2008-BOS-003	2008-08-25	0.002	-	0.17	0.001	112	0.005	0.052	0.009	1.38	0.005	-	40.5	0.224	-	0.005	0.183
2008	BOS-8	BOS-8A	2008-08-25	-	-	-	0.001	-	0.005	-	0.009	1.38	0.005	-	-	-	-	-	1.38
2008	BOS-8A	BOS-8A	2008-06-30	0.002	-	0.17	0.001	112	0.005	0.052	0.009	1.38	0.005	-	40.5	0.224	-	0.005	0.183
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	0.001	-	0.005	-	0.009	1.38	0.005	-	-	-	-	-	1.38
2008	BOS-8A	BOS-8A	2008-07-14	0.001	0.0001	0.12	0.0002	81.9	0.0192	0.0248	0.011	3.23	0.002	-	42.6	0.277	-	0.004	0.0805
2008	BOS-8A	BOS-8A	2008-08-29	0.001	0.0001	0.16	0.0002	132	0.0029	0.0503	0.009	0.398	0.0005	-	48.1	0.072	-	0.0059	0.215
2009	BOS-8A	BOS-8A	2009-06-21	0.001	-	0.096	0.0002	42.8	0.005	0.0603	0.0083	0.665	0.00085	0.01	16.3	0.146	0.0001	0.005	0.123
2009	BOS-8A	BOS-8A	2009-08-04	0.001	-	0.214	0.00005	133	0.0062	0.0312	0.0147	2.46	0.00294	0.013	60.8	0.311	0.0001	0.005	0.097
2010	BOS-8A	BOS-8A	2010-07-01	0.001	-	-	0.00005	109	0.005	0.0223	0.0083	1.82	0.00038	0.011	50.5	0.219	-	0.005	0.0843
2011	BOS-8A	BOS-8A	2011-06-23	0.001	-	0.113	0.00005	60	0.005	0.0967	0.0043	0.469	0.00032	0.01	36.3	1.97	0.0001	0.005	0.104
2011	BOS-8A	BOS-8A	2011-07-03	0.0005	-	0.0497	0.000015	79.1	0.00045	0.00064	0.00278	0.173	0.000114	0.005	38.1	0.0136	-	0.000604	0.00804
2012	BOS-8A	BOS-8A	2012-06-10	0.001	-	0.067	0.000015	42.3	0.0014	0.0618	0.0044	0.199	0.00032	0.01	12.8	0.0573	0.00002	0.005	0.129
2013	BOS-8A	BOS-8A	2013-06-21	0.001	-	0.118	0.000052	157	0.0041	0.114	0.0085	7.04	0.00137	0.01	57.6	0.695	0.00002	0.005	0.239
2008	BOS-8B	BOS-8B	2008-08-29	0.001	0.0001	0.15	0.0002	120	0.0019	0.0025	0.003	0.044	0.0001	-	58.6	0.002	-	0.0042	0.0127
2009	BOS-8B	BOS-8B	2009-06-21	0.001	-	0.078	0.0002	43.5	0.005	0.0093	0.0027	0.246	0.00036	0.01	22	0.198	0.0001	0.005	0.0135
2009	BOS-8B	BOS-8B	2009-08-04	0.001	-	0.201	0.00008	210	0.005	0.0057	0.0034	0.103	0.00014	0.011	110	0.04	0.0001	0.005	0.0233
2010	BOS-8B	BOS-8B	2010-07-01	0.004	-	-	0.0002	107	0.005	0.0044	0.004	0.088	0.0004	0.024	63.3	0.0359	-	0.005	0.0287
2011	BOS-8B	BOS-8B	2011-06-23	0.001	-	0.193	0.00005	171	0.005	0.245	0.0015	0.082	0.0001	0.051	35.8	0.188	0.0001	0.0081	0.43
2011	BOS-8B	BOS-8B	2011-07-03	0.0005	-	0.128	0.000039	226	0.00018	0.00893	0.00165	0.478	0.00005	0.0387	48.7	0.0432	-	0.000609	0.0454
2012	BOS-8B	BOS-8B	2012-06-10	0.001	-	0.079	0.000026	43.9	0.001	0.0138	0.0028	0.214	0.00027	0.01	19.3	0.146	0.00002	0.005	0.0305
2008	BOS-8C	BOS-8C	2008-08-29	0.01	0.001	0.5	0.002	661	0.019	0.813	0.01	0.054	0.001	-	87	0.912	-	0.079	1.35
2009	BOS-8C	BOS-8C	2009-06-21	0.001	-	0.095	0.0002	57.5	0.141	0.129	0.0452	16	0.0223	0.016	16.4	0.398	0.0001	0.005	0.254
2011	BOS-8C	BOS-8C	2011-06-23	0.001	-	0.078	0.00005	89.6	0.005	0.0028	0.0023	0.439	0.00045	0.011	19.6	0.0259	0.0001	0.005	0.0098
2011	BOS-8C	BOS-8C	2011-07-03	0.0005	-	0.108	0.000014	161	0.00013	0.0013	0.00094	0.025	0.00005	0.0227	32.5	0.0109	-	0.000818	0.00885
2012	BOS-8C	BOS-8C	2012-06-10	0.001	-	0.128	0.000054	34	0.001	0.123	0.0014	0.097	0.0001	0.01	8.26	0.063	0.00002	0.005	0.592
2014	BOS8-16JUN14a	BOS8	2014-06-16	<0.001	-	<0.1	0.00002	89.3	<0.001	0.132	0.005	0.062	<0.0005	0.0068	30	0.127	-	0.0012	0.272
2014	BOS8-16JUN14b	BOS8	2014-06-16	<0.001	-	0.11	0.00003	100	<0.001	0.0143	0.0032	0.212	<0.0005	<0.005	51.4	0.171	-	<0.001	0.0361
2014	BOS8-16JUN14c	BOS8	2014-06-16	<0.001	-	<0.1	0.000025	26.9	<0.001	0.00618	0.0083	0.398	<0.0005	<0.005	9.48	0.0413	-	<0.001	0.0216
2014	BOS8-23JUN14a	BOS8	2014-06-23	<0.001	-	0.12	0.000037	136	<0.001	0.154	0.0071	0.667	<0.0005	0.0076	47.7	0.267	-	0.0017	0.384
2014	BOS8-23JUN14b	BOS8	2014-06-23	<0.001	-	0.14	0.000017	111	<0.001	0.0019	0.0024	0.058	<0.0005	<0.005	55.7	0.0253	-	<0.001	0.0199
2014	BOS8-23JUN14c	BOS8	2014-06-23	<0.001	-	0.25	0.000086	299	0.0026	0.576	0.0023	0.274	<0.0005	0.0492	71.2	0.277	-	0.003	0.744
2014	BOS8-31JUL14	BOS8	2014-07-31	<0.001	-	0.2	0.000039	227	0.0011	0.0588	0.0082	0.117	<0.0005	0.0134	77	0.0547	-	0.0019	0.272
2015	BOS8A-09AUG15	BOS8	2015-08-09	<0.001	-	0.27	0.000129	192	<0.001	0.0599	<0.001	<0.03	<0.0005	0.0348	64	0.0974	-	<0.001	0.0601
2016	BOS8A-12JUN16	BOS8	2016-06-12	<0.001	-	<0.1	0.0000295	91.5	<0.001	0.00817	0.0049	0.107	<0.0005	0.002	45.6	0.325	-	<0.001	0.0279
2015	BOS8A-24AUG15	BOS8	2015-08-24	<0.001	-	0.17	0.0000322	168	<0.001	0.0349	0.0089	0.431	<0.0005	0.0056	73.3	0.677	-	<0.001	0.245
2015	BOS8A-29JUN15	BOS8	2015-06-29	<0.001	-	0.11	0.0000133	89.2	<0.001	0.0198	0.0027	0.313	<0.0005	0.0025	49.2	0.624	-	<0.001	0.0952
2014	BOS8A-31JUL14	BOS8	2014-07-31	<0.001	-	0.16	0.000073	142	<0.001	0.0171	0.006	0.056	<0.0005	<0.005	75.9	0.701	-	<0.001	0.0793
2015	BOS8C-09AUG15	BOS8	2015-08-09	<0.001	-	0.6	0.000061	346	<0.001	1.35	0.0021	0.031	<0.0005	0.0758	122	0.465	-	0.0056	3.98
2016	BOS8C-12JUN16	BOS8	2016-06-12	<0.001	-	0.17	0.0000366	210	0.0136	0.82	0.0058	1.62	0.00061	0.0425	51.9	0.312	-	0.0025	1.03
2015	BOS8C-24AUG15	BOS8	2015-08-24	<0.001	-	0.22	0.0000753	185	<0.001	0.167	0.0021	0.059	<0.0005	0.0299	34	0.24	-	0.0016	0.344
2014	BOS8C-28AUG14	BOS8	2014-08-28	<0.001	-	0.14	0.000018	155	<0.001	0.0105	0.0041	0.054	<0.0005	<0.005	91	0.299	-	<0.001	0.132
2015	BOS8C-29JUN15	BOS8	2015-06-29	<0.001	-	0.26	0.0000601	157	<0.001	0.178	0.0021	0.521	<0.0005	0.0248	33.4	0.256	-	0.0032	0.302
2016	BOS8D-12JUN16a	BOS8	2016-06-12	<0.001	-	0.18	0.0000159	188	0.0026	0.431	0.005	0.298	<0.0005	0.0417	48.3	0.131	-	0.003	0.523
2016	BOS8D-12JUN16b	BOS8	2016-06-12	<0.001	-	0.18	0.0000261	186	0.0284	0.436	0.0091	4.49	0.00174	0.042	49.3	0.257	-	0.003	0.536
2017	BOS8A-04JUN	BOS-8A	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-02	BOS-8B	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	BOS8A	BOS-8A	2019-06-29	<0.0001		0.10	0.0000222	136	<0.001	0.0244	0.0032	0.089	<0.0005	0.0068	49.5	0.0286		0.0012	0.0979
2019	19-BOS-01	19-BOS-01	2019-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	19-BOS-02	18-BOS-02	2019-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Attachment 2: Boston Seepage Data 2008-2018

Year	Sample Code	Station Code	Date	Phosphorus (P)-Total	Potassium (K)-Total	Selenium (Se)-Total	Silicon (Si)-Total	Silver (Ag)-Total	Sodium (Na)-Total	Strontium (Sr)-Total	Thallium (Tl)-Total	Tin (Sn)-Total	Titanium (Ti)-Total	Uranium (U)-Total	Vanadium (V)-Total	Zinc (Zn)-Total
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.05	0.1	0.00005	0.05	0.00001	0.05	0.0002	0.00001	0.0001	0.0003	0.00001	0.0005	0.001
2008	2008-BOS-001	2008-BOS-001	2008-08-23	<0.3	15.3	0.0028	1.42	0.000042	86.5	0.782	<0.0002	<0.0002	0.024	0.000173	0.0032	0.0037
2008	2008-BOS-003	2008-BOS-003	2008-08-25	-	12	-	-	0.005	59	0.619	0.05	0.05	0.002	-	0.002	0.103
2008	BOS-8	BOS-8A	2008-08-25	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	12	-	-	0.005	59	0.619	0.05	0.05	0.002	-	0.002	0.103
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	13.7	0.002	-	0.0004	69	0.694	0.0001	0.0004	0.013	0.0002	0.0075	0.099
2008	BOS-8A	BOS-8A	2008-08-29	-	12.3	0.002	-	0.0004	65	0.64	0.0001	0.0004	0.005	0.0003	0.002	0.008
2009	BOS-8A	BOS-8A	2009-06-21	-	6.64	0.0023	-	0.0001	18.5	-	0.0001	0.05	0.0018	0.00028	0.0017	0.0071
2009	BOS-8A	BOS-8A	2009-08-04	-	17.3	0.0034	-	0.0001	102	-	0.0001	0.05	0.0052	0.00015	0.0045	0.0318
2010	BOS-8A	BOS-8A	2010-07-01	-	12.6	0.002	-	0.0001	-	-	0.0001	0.05	0.0029	0.00018	0.0017	0.0049
2011	BOS-8A	BOS-8A	2011-06-23	-	8.93	0.00113	-	0.0001	37	-	0.0001	0.05	0.001	0.00011	0.001	0.0068
2011	BOS-8A	BOS-8A	2011-07-03	-	7.3	0.00041	-	0.000093	51.4	-	0.00005	0.0001	0.00066	0.000047	0.00021	0.0038
2012	BOS-8A	BOS-8A	2012-06-10	-	3.73	0.00072	-	0.00002	11.9	-	0.0001	0.05	0.0029	0.00011	0.001	0.0042
2013	BOS-8A	BOS-8A	2013-06-21	-	10.4	0.00062	-	0.000066	40.5	-	0.0001	0.05	0.0036	0.00058	0.0021	0.0079
2008	BOS-8B	BOS-8B	2008-08-29	-	18.7	0.0021	-	0.0004	96	0.53	0.0001	0.0004	0.005	0.0002	0.0015	0.009
2009	BOS-8B	BOS-8B	2009-06-21	-	9.53	0.0038	-	0.0001	36.5	-	0.0001	0.05	0.001	0.0001	0.001	0.0063
2009	BOS-8B	BOS-8B	2009-08-04	-	23.2	0.0072	-	0.0001	180	-	0.0001	0.05	0.001	0.0001	0.0011	0.0091
2010	BOS-8B	BOS-8B	2010-07-01	-	14.6	0.008	-	0.0004	-	-	0.0004	0.05	0.0024	0.0004	0.002	0.016
2011	BOS-8B	BOS-8B	2011-06-23	-	12	0.00285	-	0.0001	40	-	0.0001	0.05	0.0032	0.0001	0.001	0.0055
2011	BOS-8B	BOS-8B	2011-07-03	-	13.2	0.00238	-	0.000032	54.7	-	0.00005	0.0001	0.00044	0.00002	0.00016	0.0055
2012	BOS-8B	BOS-8B	2012-06-10	-	5.38	0.00054	-	0.000038	16	-	0.0001	0.05	0.001	0.0001	0.001	0.0057
2008	BOS-8C	BOS-8C	2008-08-29	-	42.8	0.017	-	0.004	174	5.83	0.001	0.004	0.05	0.001	0.006	0.04
2009	BOS-8C	BOS-8C	2009-06-21	-	4.94	0.0022	-	0.0001	11.1	-	0.0001	0.05	0.108	0.00011	0.0373	0.0717
2011	BOS-8C	BOS-8C	2011-06-23	-	5.46	0.0004	-	0.0001	22.9	-	0.0001	0.05	0.0012	0.0001	0.001	0.004
2011	BOS-8C	BOS-8C	2011-07-03	-	9.15	0.00137	-	0.00001	48.9	-	0.00005	0.0001	0.0003	0.00001	0.00011	0.003
2012	BOS-8C	BOS-8C	2012-06-10	-	5.95	0.00074	-	0.00002	9.1	-	0.0001	0.05	0.0011	0.0001	0.001	0.0099
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	4.7	0.00078	-	0.000021	14.2	-	<0.0002	<0.0005	0.011	<0.0002	<0.001	<0.005
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	10.5	0.00088	-	0.00005	42	-	<0.0002	<0.0005	0.011	<0.0002	<0.001	<0.005
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	3.1	0.00012	-	0.000842	4.6	-	<0.0002	<0.0005	<0.01	<0.0002	<0.001	<0.005
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	7.7	0.00065	-	0.00003	26.5	-	<0.0002	<0.0005	0.014	0.00035	<0.001	0.0064
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	10.6	0.00038	-	<0.00002	48.3	-	<0.0002	<0.0005	0.013	<0.0002	<0.001	<0.005
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	16.9	0.00271	-	0.000114	50.9	-	<0.0002	<0.0005	0.018	<0.0002	<0.001	0.0071
2014	BOS8-31JUL14	BOS8	2014-07-31	-	5.3	0.001	-	<0.00002	44.4	-	<0.0002	<0.0005	0.019	0.00042	<0.001	0.0053
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	13.5	0.00357	-	<0.00002	23.5	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0077
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	7.4	0.000389	-	0.000025	30	-	<0.0002	<0.0005	<0.01	0.00034	<0.0005	<0.005
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	12.9	0.00209	-	0.000032	53.7	-	<0.0002	<0.0005	<0.01	0.00062	0.00052	<0.005
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	8.9	0.000472	-	<0.00002	32.6	-	<0.0002	<0.0005	<0.01	0.00024	<0.0005	<0.005
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	13.2	0.00166	-	0.000026	55.9	-	<0.0002	<0.0005	0.016	0.00067	<0.001	0.0053
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	31.8	0.00884	-	0.000031	46.6	-	<0.0002	<0.0005	<0.01	0.0003	0.0037	<0.005
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	11.8	0.00216	-	0.000163	28.2	-	<0.0002	<0.0005	0.011	0.00025	0.00394	<0.005
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	15.1	0.00464	-	0.000028	43.3	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0068
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	12.7	0.00084	-	<0.00002	67.9	-	<0.0002	<0.0005	0.017	0.00042	<0.001	<0.005
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	12.8	0.00218	-	0.000065	28.7	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0051
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	11	0.00167	-	0.000073	26.1	-	<0.0002	<0.0005	<0.01	0.00027	0.00138	0.0213
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	10.9	0.00159	-	0.000221	25.8	-	<0.0002	<0.0005	0.02	0.00027	0.00691	0.0322
2017	BOS8A-04JUN	BOS-8A	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-02	BOS-8B	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	0.0155	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	0.0384	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	0.0507	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	0.0213	-	-	-	-	-	-	-	-	-	-	-	-
2019	BOS8A	BOS-8A	2019-06-29		6.4	0.000411		<0.00002	21.1		<0.00001	<0.0005	<0.01	<0.0002	0.00054	<0.005
2019	19-BOS-01	19-BOS-01	2019-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	19-BOS-02	18-BOS-02	2019-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B – 2019 Boston Ephemeral Streams Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter Lisa Barazzuol	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 17, 2020
Subject:	Boston Ephemeral Stream Monitoring 2019		

1 Introduction

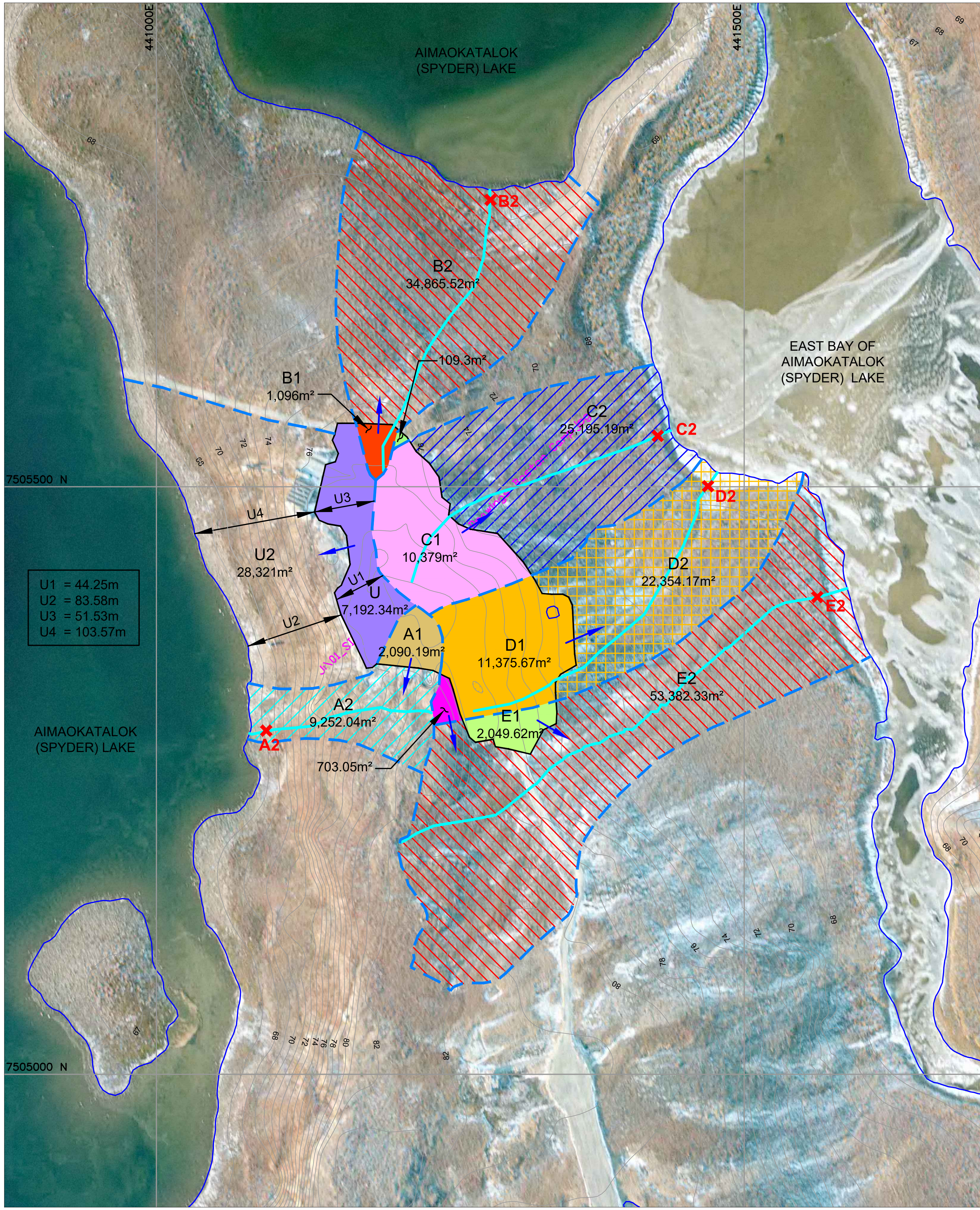
At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston.
The ore/waste rock and associated runoff are managed as part of Water License 2AM-BOS1835 (Nunavut Water Board (NWB) 2018), and the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017).

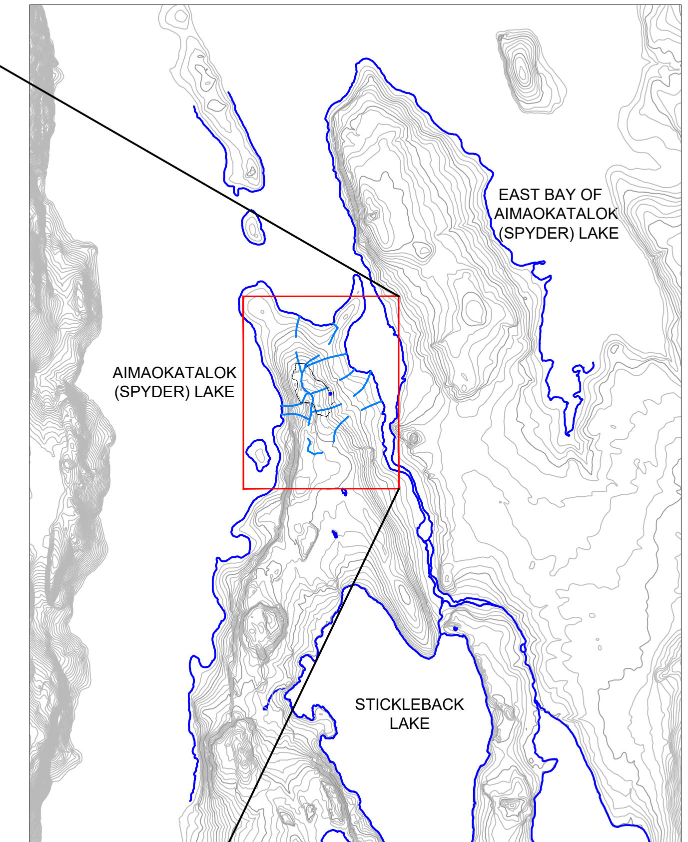
As recommended in the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017), ephemeral streams downgradient of the waste rock pile have been monitored during spring freshet since 2009 to monitor seepage downgradient of the Boston camp pad and to provide an indication of whether contaminants of potential concern from the ore and waste rock piles are reaching the shoreline of Aimaokatalok Lake. This memo presents the results of the 2019 ephemeral streams monitoring program.

2 Methods

2.1 Sample Collection

Five ephemeral stream sites have been identified in previous surveys of the area, as shown in Figure 1. TMAC Resources surveyed each of these sites for flow on June 29, 2019. Flow was observed at stations A2, D2 and E2 only. Field measurements included pH, electrical conductivity (EC), oxidation-reduction potential (ORP), temperature and flow rate at one station. The other stations had too shallow and fragments flow to measure accurately. The water quality samples were collected from stations A2, D2 and E2 and submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, EC, total dissolved solids, total alkalinity, anions (bromide, chloride, fluoride, and sulphate), nutrients (nitrate, nitrite, ammonia and phosphorus) and dissolved metals (filtered and preserved in the field). The quality assurance and quality control (QA/QC) sampling program included the collection of one field duplicate and one field blank.





Legend

	Contours (1m)		Catchment Boundary
	Ephemeral streams		Flow direction
	Camp pad perimeter		
A2, B2, C2, D2, E2, U2	Dilution Zone (Hatch)	25,195.19m²	Catchment Areas
		C2 ✕	Ephemeral Stream Sampling Station

1:4000 — 0 50 100 150 200 Metres

srk consulting	TMAC Resources	Boston Ephemeral Stream Monitoring
SRK JOB NO.: 1CT022.037	Hope Bay Project	Ephemeral Stream Monitoring Locations
FILE NAME: Boston_Catchments_20160324.dwg		DATE: Jan. 2020 · APPROVED: MCN · FIGURE: 1

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2.2 Quality Assurance and Control

One field duplicate and one field blank were collected as part of the QA/QC program. The QA/QC review of all data was conducted by SRK. In addition, ALS carried out its own QA/QC checks which were deemed acceptable.

Ion charge balances ranged from -3.8 to -1.5% for the four samples. These were deemed acceptable as they comply with SRK's criteria of ±10%.

Both the field conductivity and lab conductivity, and field pH and lab pH for collected samples were within the SRK criteria of an RPD ±30%.

The field duplicate (19-EPH-E2-DUP) was collected at E2. As per SRK's criteria, less than 10% of the parameters (with concentrations above 10 times the detection limit) had relative percent difference (RPD) values of over 30%, indicating a high reproducibility of sampling and low heterogeneity in the stream.

Field blanks typically indicate field contamination either due to sampling or environmental influences such as dust and ambient water. No dissolved metals were detected in the field blank; therefore, the field blank passed SRK's criteria. SRK considered all data acceptable.

3 Results

3.1 Field Observations

Table 1 presents a comparison of field parameters for ephemeral streams A2, D2 and E2 from 2019 to the historical data set. Consistent with previous years, field pH values were slightly alkaline or neutral. EC at D2 (1,400 µS/cm) was higher than A2 and E2 (250 and 530 µS/cm, respectively). The flowrate measured at A2 on June 29 was an order of magnitude lower than historical flowrates. All other field parameters are within historical ranges.

Table 1: Comparison of 2019 Field Observations to Historic Monitoring Data (2009-2018)

Ephemeral Stream			Field pH	Field EC	ORP	Temperature	Flow
			s.u.	***µS/cm***	***mV***	***°C***	***L/s***
A2	Sample Date	June 2019	8.2	250	22	19	0.008
	Statistic	P5	7.5	130	63	4.2	0.053
		P50	7.8	270	130	6.7	0.074
		P95	8	570	260	16	0.39
		n	7	7	7	7	4
D2	Sample Date	June 2019	7.6	1400	31	17	n/a
	Statistic	P5	6.5	160	45	2.9	0.41
		P50	6.7	810	200	3.8	0.69
		P95	7.2	2000	370	16	0.97
		n	7	7	7	7	2
E2	Sample Date	June 2019	7.6	530	20	15	n/a
	Statistic	P5	7.1	130	110	2.7	0.73
		P50	7.3	630	320	4.2	2.8
		P95	7.5	720	370	13	4.8
		n	7	7	7	7	2

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 135 Boston Eph Streams\1. Working file\1CT022.037-135_2019EphemeralStreams_Working_Rev02_JCE.xlsx

Note:

Flowrate was too low to measure at D2 and E2; n = sample count

3.2 Laboratory Results

A summary of water quality results for 2019 is provided in Table 2. Full results of the 2019 water quality data are presented in Attachment 1. Parameters identified by SRK (2009) as potential parameters of concern are presented in Figure 2 to Figure 9. Values below the detection limit are graphed as being at the detection limit. Lines are included in the figure for ease of trend identification; however, samples from each ephemeral stream are not necessarily collected from the same location each year.

Table 2: Summary of Water Quality Results for Stations A2, D2 and E2, 2009 to 2019

Sample ID	Year	General Parameters		Anions and Nutrients					Dissolved Metals								
		pH	EC	Alkalinity, Total	Ammonia	Nitrate	Sulphate	Chloride	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Nickel	Selenium	Zinc
		s.u.	µS/cm	mg/L as $CaCO_3$	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
A2	2012	7.9	740	44	0.0077	0.31	43	180	0.0045	0.018	<0.00001	0.0009	<0.01	0.0001	0.004	<0.0001	0.0029
	2013	7.8	590	33	0.013	0.052	57	130	0.02	0.021	<0.00001	0.0014	0.052	0.000068	0.0047	<0.0001	0.0018
	2014	7.8	310	38	<0.005	<0.005	27	58	0.0027	0.036	<0.00001	0.0013	<0.01	<0.00005	0.018	<0.0001	0.0022
	2015	7.9	210	44	0.011	0.0083	24	22	0.0071	0.075	<0.000005	0.00099	<0.01	<0.00005	0.0039	<0.00005	0.0023
	2016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2017	8.0	270	67	<0.0050	0.017	27	26	0.01	0.022	<0.0000050	0.0015	<0.010	<0.000050	0.015	0.000053	0.0017
	2018 (06-16)	7.8	670	51	0.0065	0.47	240	31	0.014	0.0038	0.000013	0.0022	0.015	<0.00005	0.0088	0.00046	0.0016
	2018 (06-25)	8.0	530	63	0.0078	0.088	77	80	0.0081	0.019	0.0000055	0.0017	0.011	<0.00005	0.01	0.000065	0.001
	2019	8.0	250	52	0.0064	0.013	35	22	0.013	0.035	<0.000005	0.0017	0.012	<0.00005	0.0096	0.000078	<0.001
D2	2009	6.7	--	25	0.024	4	200	460	0.012	<0.002	<0.000085	0.0016	<0.03	<0.00025	0.0053	<0.006	<0.005
	2010	--	--	30	0.03	2.1	220	550	0.0057	<0.003	<0.00025	0.0014	<0.03	<0.00025	0.0083	<0.005	<0.005
	2011	7.3	--	29	0.12	1	63	190	0.0063	0.0024	<0.000050	0.00076	<0.030	<0.000050	0.0058	0.0015	<0.0030
	2012	7.6	1500	31	0.0065	0.3	160	370	0.0067	0.00093	0.000016	0.001	<0.010	<0.000050	0.006	0.00077	0.0025
	2013	7.4	1600	35	0.0069	0.12	190	420	0.0066	0.0012	0.000026	0.00092	0.021	<0.000050	0.0069	0.00056	0.0034
	2014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2015	7.7	1300	42	0.018	0.31	250	250	0.0031	0.0014	0.0000094	0.0011	0.011	<0.00005	0.0085	0.00062	0.0043
	2016	7.6	550	49	0.0075	<0.005	85	83	0.017	0.001	<0.000050	0.0011	0.02	<0.00005	0.0034	0.000063	0.0024
	2017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2019	7.9	1400	57	0.0051	2.7	480	170	0.0083	0.0065	0.000025	0.0013	<0.01	<0.00005	0.03	0.0014	<0.001
E2	2009	7.0	--	43	0.022	2.2	48	170	0.016	<0.002	0.000063	0.003	<0.03	0.000068	0.006	<0.001	0.0055
	2010	--	--	59	<0.005	<0.005	50	140	0.0076	0.0016	<0.00005	0.001	<0.03	<0.00005	0.0029	<0.001	<0.001
	2011	7.7	--	36	0.023	0.02	34	48	0.01	0.002	<0.00005	0.001	<0.03	<0.00005	0.0018	<0.001	<0.003
	2012	7.8	380	43	<0.005	<0.005	50	59	0.013	0.00099	<0.00001	0.0018	0.014	<0.00005	0.003	<0.0001	0.0015
	2013	7.7	670	47	0.0055	<0.005	110	120	0.0075	0.0013	<0.00001	0.0012	0.01	<0.00005	0.0028	<0.0001	0.0011
	2014	7.6	440	46	0.0051	<0.005	83	62	0.0089	0.0013	<0.00001	0.0013	0.012	<0.00005	0.0026	<0.0001	0.0037
	2015	7.8	560	49	0.01	<0.005	110	77	0.013	0.00095	<0.000005	0.0014	0.016	<0.00005	0.0029	0.000072	0.0019
	2016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2019	7.7	500	58	0.0073	<0.005	120	51	0.013	0.0019	0.000022	0.0015	0.014	<0.00005	0.0054	0.000054	0.0012

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 135 Boston Eph Streams\1. Working file\1CT022.037-135_2019EphemeralStreams_Working_Rev02_JCE.xlsx

A summary of the 2019 water quality data at A2, D2 and E2 is as follows:

- Sulphate concentrations ranged from 35 to 480 mg/L and at D2 and E2 were greater than the historical maximum observed in previous years (Figure 2). Sulphate values have oscillated for A2 and D2 whereas E2 has increased slightly since 2009. Higher sulphate concentrations were observed during periods of low flow resulting in lower sulphate loading rates (e.g. mg SO_4/s) compared to samples collected with higher flow rates and lower sulphate concentrations (e.g. D2 in 2011 and 2016, Table 2), suggesting that concentration is related to dilution from surface waters.
- Alkalinity levels at A2, D2 and E2 ranged from 52 to 58 mg/L and were within the range of historical levels.
- Chloride concentrations were uniformly low at A2 and E2 (22 and 51 mg/L, respectively), and higher at D2 (170 mg/L) and were within the historical range of data. Chloride concentrations for ephemeral streams exhibit a decreasing trend (Figure 3).
- Copper concentrations (ranging from 0.0013 to 0.0017 mg/L) were within the range of historical data and have remained stable since 2011 (Figure 4).
- Nitrate concentrations were low for A2 (0.013 mg/L) and E2 (<0.005 mg/L), and two orders of magnitude greater for D2 (2.7 mg/L). All values were within the historical range of data and have remained stable since 2009 (Figure 5).
- Arsenic concentrations at A2 (0.035 mg/L), D2 (0.0065 mg/L) and E2 (0.0019 mg/L) were within the range of historical concentrations. Arsenic values have oscillated for A2 whereas D2 and E2 have remained stable since 2009.
- Iron concentrations ranged from <0.01 to 0.014 mg/L. Values were within the range of the historical data and have remained stable since 2014 (Figure 7).
- Nickel concentrations (Figure 8) observed were within the range of historical data with the exception of sample D2, which had nickel concentration (0.03 mg/L) greater than the historical maximum concentration observed in 2015 (0.0085 mg/L). Nickel values have oscillated for A2 and D2 whereas E2 has remained stable since the start of monitoring.
- Selenium concentrations (Figure 9) were between 0.000078 and 0.0014 mg/L and within the range of historical data. Values have remained stable since 2012.
- Concentrations of the remaining dissolved metals presented in Table 2 were within the range of historical data.

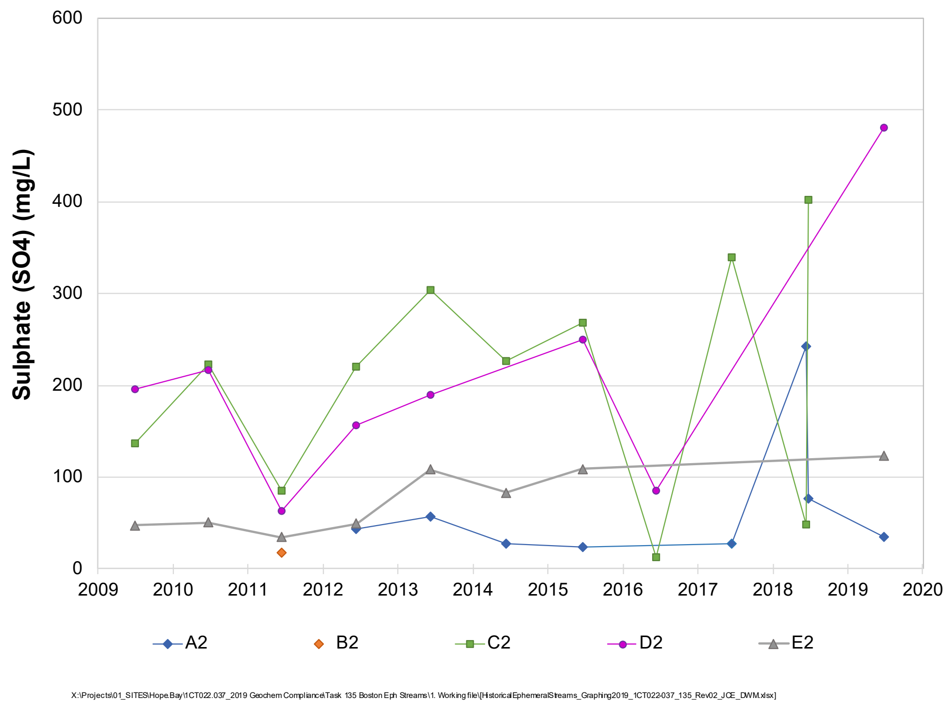

Figure 2: Ephemeral Stream Sulphate Concentrations

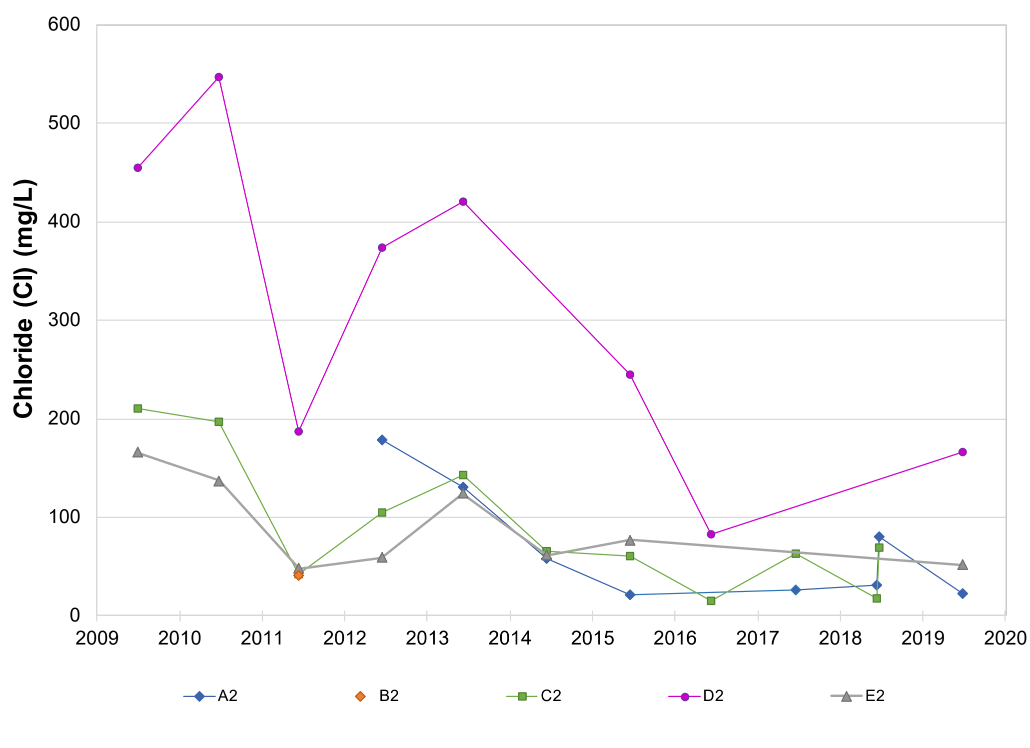

Figure 3: Ephemeral Stream Chloride Concentrations

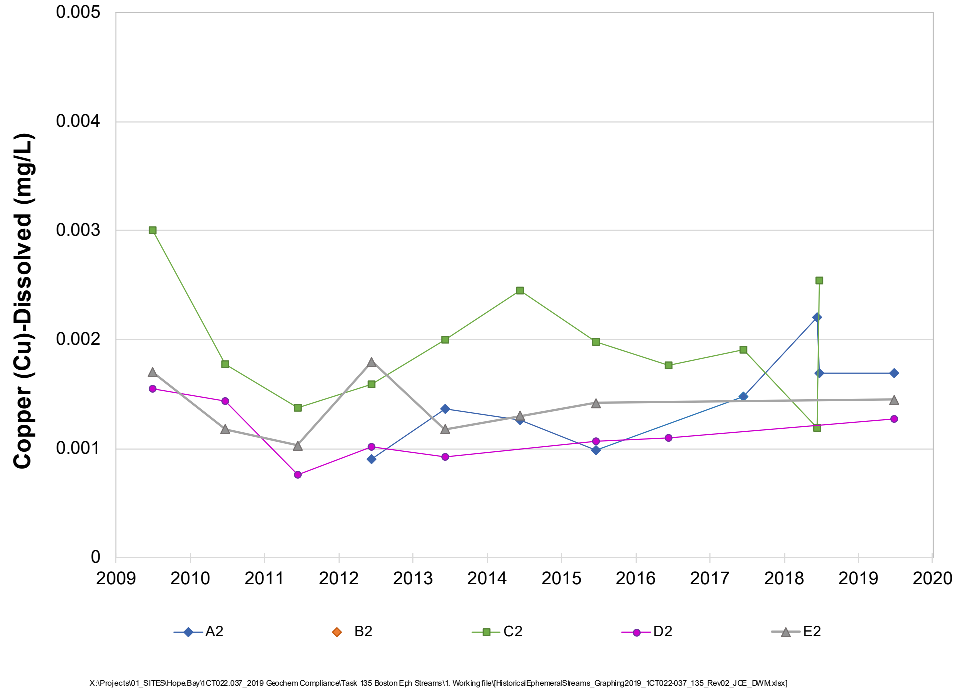

Figure 4: Ephemeral Streams Copper Concentrations

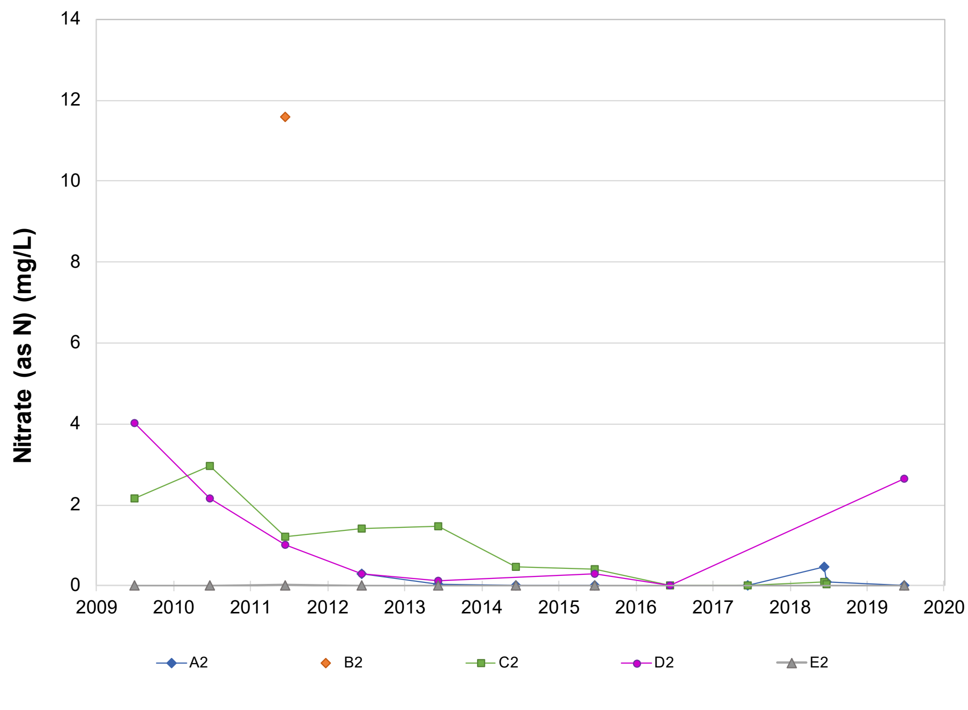

Figure 5: Ephemeral Streams Nitrate Concentrations

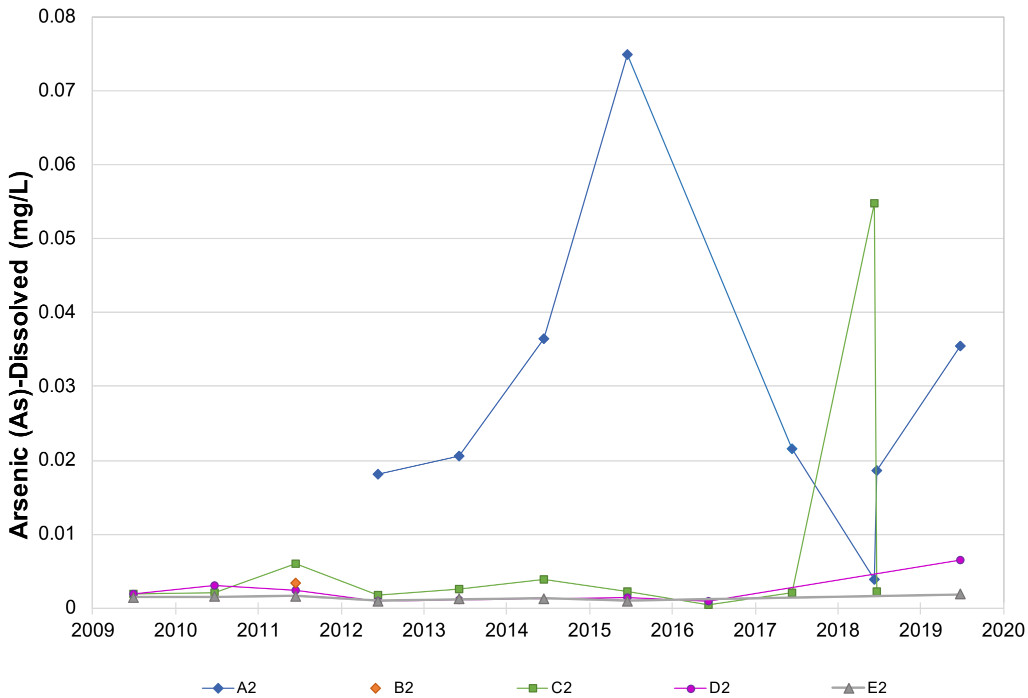

Figure 6: Ephemeral Streams Arsenic Concentrations

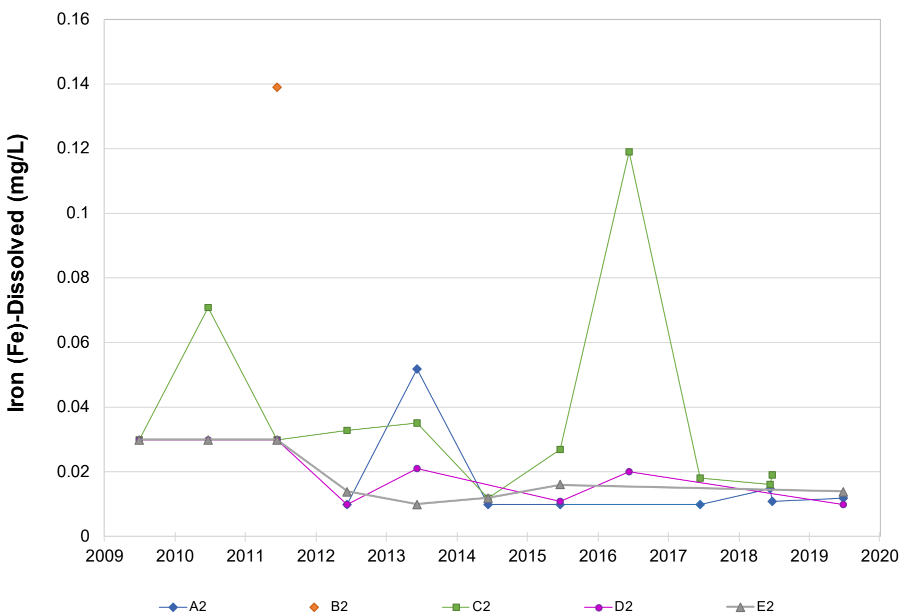

Figure 7: Ephemeral Streams Iron Concentrations

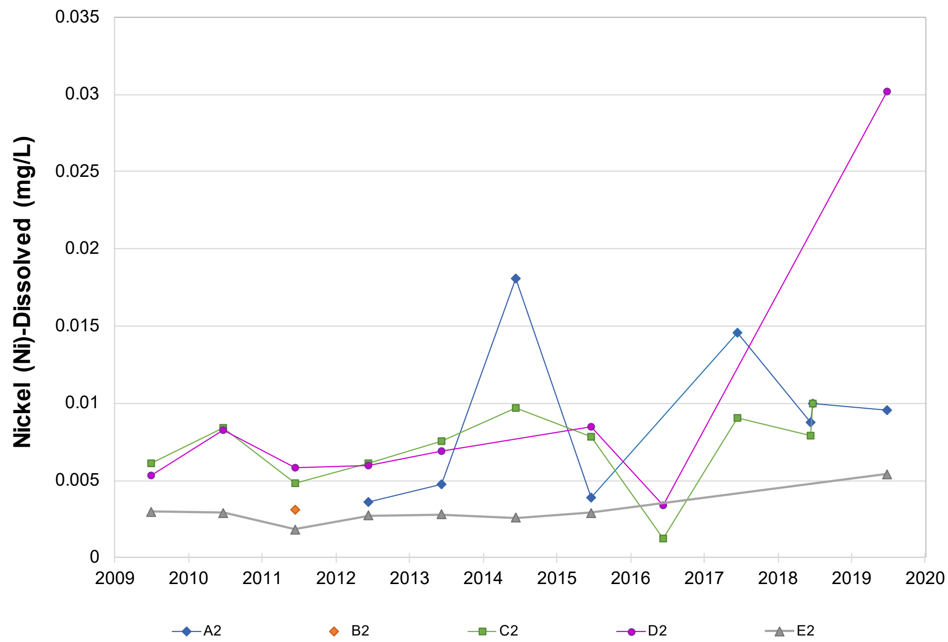

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Figure 8: Ephemeral Streams Nickel Concentrations

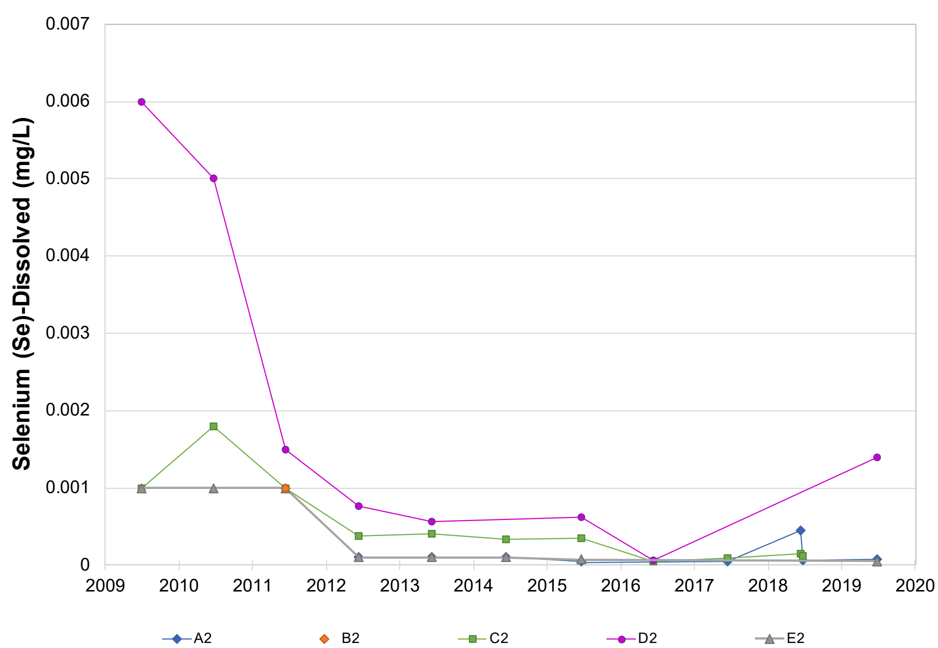

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Figure 9: Ephemeral Streams Selenium Concentrations

4 Discussion

Seepage chemistry predictions were made as part of the former Boston Water and Ore/Waste Rock Management Plan (Supporting Document B of SRK 2009). The report calculated average and maximum predicted concentrations of sulphate, chloride, nitrate, arsenic, copper, iron, nickel and selenium that may be expected to discharge from the ore stockpile. Table 3 presents these model predictions for the ephemeral streams compared to the 2019 concentrations of these parameters.

At D2 and E2, sulphate concentrations observed in 2019 exceeded the maximum modeled values; however, as discussed in Section 3.2, higher concentrations are observed with lower flow samples and have lower sulphate loading rates than lower concentration samples with higher flow. Additionally, according to TMAC, in September 2018, repairs to a berm might have disturbed ore material which may have contributed an increase in sulphate within ephemeral streams catchment D2 (Figure 1), and there was no water discharged to catchment D2 or E2 during the monitoring period. Further monitoring will establish sulphate trends at D2 and E2. All other 2019 monitoring data were below maximum predicted values at streams A2, D2 and E2.

Table 3: Comparison of 2019 Water Quality Results to Model Predictions (SRK 2009)

Parameters	Units	Predicted Value			Max Predicted Value			2019 Measure Values		
		A2	D2	E2	A2	D2	E2	A2	D2	E2
Chloride	mg/L	95	140	160	360	560	640	22	170	51
Nitrate (as N)	mg/L	3.4	6.3	0.68	9.2	17	2.0	0.013	2.7	<0.0050
Sulphate	mg/L	70	130	15	120	220	25	35	**<u>480</u>**	**<u>120</u>**
Arsenic	mg/L	0.03	0.056	0.0063	0.063	0.1	0.013	0.035	0.0065	0.0019
Copper	mg/L	0.0026	0.0028	0.0017	0.0033	0.005	0.002	0.0017	0.0013	0.0015
Iron	mg/L	0.41	0.44	0.37	0.89	1.3	0.46	0.012	<0.010	0.014
Nickel	mg/L	0.095	0.17	0.02	0.32	0.59	0.065	0.0096	0.03	0.0054
Selenium	mg/L	0.0015	0.0024	0.0007	0.0035	0.0061	0.0011	0.000078	0.0014	0.000054

Source: P:\01_SITES\Hope.Bay\1CH008.022 Boston WR Management Plan\Boston Ephemeral Streams\2018\3. Working file\[2018EphemeralStreams_Working_1CT022-027_Rev00_MCN.xlsx]

Note – Underlined and bolded value indicates measured values greater than the maximum predicted value

5 Conclusions and Recommendations

Nitrate, sulphate, arsenic, copper, iron, nickel and selenium were identified by the water and load balance as potential contaminants of concern (SRK 2009). Monitoring of the ephemeral streams A2, B2, C2, D2 and E2 (Attachment 1) was initiated in 2009. In 2019, flow was observed, and samples collected on June 29 from A2, D2 and E2.

Field pH values were slightly alkaline or neutral. The flowrate measured at A2 was an order of magnitude lower than historical flowrates. All other field parameters are within historical ranges.

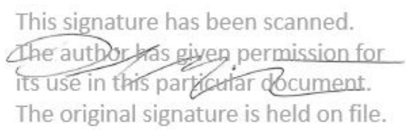
Sulphate values have oscillated for A2 and D2 whereas E2 has increased slightly since 2009. Chloride concentrations for ephemeral streams exhibit a decreasing trend. Nickel and arsenic values have oscillated for A2 and D2 whereas E2 has remained stable since the start of monitoring. Nitrate, copper, iron and selenium have stable trends.

Compared to SRK (2009) model predictions, the 2019 monitoring data were below maximum predicted values for chloride, nitrate, arsenic, copper, iron, nickel and selenium at streams A2, D2 and E2. At D2 and E2, maximum sulphate concentrations observed in 2019 exceeded the maximum modeled values. Further monitoring will establish sulphate trends.

Sulphate and chloride are not attenuated by the tundra and the concentrations measured in 2019 validate the 2009 water and load balance. The concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern such as arsenic and selenium and the breakthrough of the effectiveness of the attenuation process has not occurred. SRK recommends continued monitoring of the ephemeral stream sampling sites as outlined in SRK (2017).

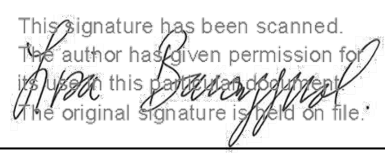
Regards,

SRK Consulting (Canada) Inc.



Derrick Midwinter, PGeo (ON)
Staff Consultant

Reviewed by



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant

6 References

Nunavut Water Board, 2018. Water Licence No: 2AM-BOS1835. December 2018.

SRK Consulting (Canada) Inc., 2009. Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut. Report 1CH008.022 for Hope Bay Mining Ltd. July 2009.

SRK Consulting (Canada) Inc., 2017. Water and Ore/Waste Rock Management Plan for the Boston Site, Hope Bay Project, Nunavut. Report 1CT022.009 for TMAC Resources Inc. January 2017.

Attachment 1: 2019 Water Quality Results

Sample	Date	Start time	Coordinates (E)	Coordinates (N)	Description of location	Field measurements pH s.u.	Conductivity µS/cm	ORP mV	Temp. ºC	ALS Sample ID unit detection limit	Conductivity µS/cm 2	Hardness (as CaCO3) mg/L 0.5	pH s.u. 0.1
19-EPH-A2	2019-06-29	13:50:00	441091	7505330	Sample taken upstream from lake in small pool	8.2	251	22	18.8	L2301883-1	248	103	7.97
19-EPH-D2	2019-06-29	12:35:00	441397	7505440	Sample taken 94m up from GPS point. Lake levels high.	7.6	1403	31	16.9	L2301883-2	1430	737	7.9
19-EPH-E2	2019-06-29	11:50:00	441470	7505373	Sample taken 97m up from GPS point. Lake levels high.	7.6	533	20	15	L2301883-3	500	228	7.69
19-EPH-E2-DUP	2019-06-29	11:50:00	-	-	-	-	-	-	-	L2301883-4	505	240	7.7
FIELD BLANK 1	2019-06-29	11:50:00	-	-	-	-	-	-	-	L2301883-5	<2.0	<0.50	5.38

Sample	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)	Fluoride (F)	Nitrate (as N)	Nitrite (as N)	Phosphorus (P)-Total	Sulfate (SO4)	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	3	1	1	1	0.005	0.05	0.5	0.02	0.005	0.001	0.002	0.3	0.001	0.0001	0.0001	0.00005	0.00002	0.00005	0.01	0.000005
19-EPH-A2	<3.0	180	1.9	52.2	0.0064	<0.050	22.2	0.029	0.0133	0.0013	0.0087	34.7	0.0128	0.00112	0.0354	0.00638	<0.000020	<0.000050	0.044	<0.0000050
19-EPH-D2	8.1	1270	2.6	56.8	0.0051	0.39	166	<0.10	2.66	0.0053	0.0086	481	0.0083	0.0108	0.00647	0.0474	<0.000020	<0.000050	0.144	0.0000251
19-EPH-E2	4.3	406	3.2	57.5	0.0073	0.057	51.4	0.039	<0.0050	<0.0010	0.0101	123	0.0125	0.00066	0.0019	0.0318	<0.000020	<0.000050	0.036	0.0000223
19-EPH-E2-DUP	<3.0	422	2.6	57.4	0.0513	0.084	51.6	0.04	<0.0050	<0.0010	0.0108	123	0.0127	0.00067	0.00182	0.0328	<0.000020	<0.000050	0.037	0.0000264
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Sample	Calcium (Ca)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved	Strontium (Sr)-Dissolved
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	0.05	0.0001	0.0001	0.0002	0.01	0.00005	0.001	0.1	0.0001	0.000005	0.00005	0.0005	0.05	0.1	0.00005	0.05	0.00001	0.05	0.0002
19-EPH-A2	27.6	<0.00010	0.00025	0.00169	0.012	<0.000050	0.0048	8.19	0.00083	<0.0000050	0.000363	0.00958	<0.050	1.69	0.000078	0.418	<0.000010	8.34	0.193
19-EPH-D2	203	<0.00010	0.00419	0.00127	<0.010	<0.000050	0.022	55.8	0.00584	<0.0000050	0.000894	0.0302	<0.050	11.2	0.0014	2.12	0.000021	29.2	1.34
19-EPH-E2	58.8	0.00017	0.00359	0.00145	0.014	<0.000050	0.0056	19.8	0.452	<0.0000050	0.000444	0.00541	<0.050	1.71	0.000054	2.04	<0.000010	15.3	0.371
19-EPH-E2-DUP	62.8	0.00015	0.00361	0.00155	0.013	<0.000050	0.0056	20.3	0.467	<0.0000050	0.000398	0.00571	<0.050	1.73	0.000062	2.07	<0.000010	15.7	0.368
FIELD BLANK 1	<0.050	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	<0.10	<0.00010	<0.0000050	<0.000050	<0.00050	<0.050	<0.10	<0.000050	<0.050	<0.000010	<0.050	<0.00020

Sample	Sulfur (S)-Dissolved mg/L 0.5	Thallium (Tl)-Dissolved mg/L 0.00001	Tin (Sn)-Dissolved mg/L 0.0001	Titanium (Ti)-Dissolved mg/L 0.0003	Uranium (U)-Dissolved mg/L 0.00001	Vanadium (V)-Dissolved mg/L 0.0005	Zinc (Zn)-Dissolved mg/L 0.001	Zirconium (Zr)-Dissolved mg/L 0.0003
19-EPH-A2	11.5	<0.000010	<0.00010	<0.00030	0.000021	<0.00050	<0.0010	<0.00030
19-EPH-D2	166	<0.000010	<0.00010	<0.00030	0.000028	<0.00050	<0.0010	<0.00030
19-EPH-E2	41.1	<0.000010	<0.00010	0.00035	0.00001	<0.00050	0.0012	<0.00030
19-EPH-E2-DUP	42.1	<0.000010	<0.00010	0.00042	<0.000010	<0.00050	0.0011	<0.00030
FIELD BLANK 1	<0.50	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	<0.0010	<0.00030

Appendix H

Hope Bay Project Spill Contingency Plan (TMAC, March 2020)

Hope Bay Project
Spill Contingency Plan

Hope Bay, Nunavut

March 2020

Hope Bay Project Spill Contingency Plan

Plain Language Overview:

This Plan describes the spill response procedures to be used at the TMAC Resources Inc. Hope Bay Project. This Plan ensures that 1) human life is protected and the potential for injury during spill response activities is minimized to the extent possible, 2) all potentially harmful environmental impacts are kept to a minimum, 3) resources are used effectively and efficiently, and 4) all required internal and regulatory reporting is completed on time and as required.

Hope Bay, Nunavut

Publication Date: March 2020

Hope Bay Project
181 University Avenue
Suite 300, PO Box 33
Toronto, Ontario, M5H 3M7
Phone: 647-480-3106

Hope Bay Emergency Phone Numbers

Onsite Contacts	Day (7 am to 7 pm)	Night (7 pm to 7 am)
24 hour Emergency Line Mill Control Room Operator	1-867-988-6882 ext. 150	1-867-988-6882 ext. 150
Mine General Manager Jerome Girard Assistant General Manager Andy Fortin	1-867-988-6882 ext. 104	Offsite Cell: 1-514-234-3261
Maintenance Manager Brad Dahl	1-867-988-6882 ext. 101	Offsite Cell: 1-250-488-1217
Mill (Process) Manager Chad Parent	1-867-988-6882 ext. 141	Offsite Cell: 1-907-223-7512
Manager of Mining Vince Kapinus	1-867-988-6882 ext. 125	
Health and Safety Manager Doug Brown Health and Safety Superintendent Ken Cook	1-867-988-6882 ext.138	
Environmental Superintendent Sarah Warnock Kyle Conway	1-867-988-6882 ext. 102	
Surface Superintendent Chris McMahon Scott Pye	1-867-988-6882 ext. 131	
Medics Gabriel Bernard Kwame Sarpong	1-867-988-6882 ext. 105	1-867-988-6882 ext. 115
Security Officer Brent Cecchini Bob Fogarty	1-867-988-6882 ext. 165	
Offsite Contacts	**Day (7 am to 7 pm)**	**Night (7 pm to 7 am)**
V.P. Environmental Affairs Oliver Curran	1-416-628-0216	1-416-577-5829
Chief Operating Officer Gil Lawson	1-416-628-0216	1-416-561-0363
President & Chief Executive Officer Jason Neal	1-416-628-0216	
V.P. Corporate Social Responsibility Cambridge Bay Alex Buchan	1-867-983-2385	1-867-445-6675

Site Radio Channels

Channel 1	Emergency
Channel 2	Security
Channel 3	Aviation
Channel 4	Roads
Channel 5	Site Services
Channel 6	Medic
Channel 7	Environment Department

Key Government Contacts

Organization	Contact	Location	Telephone	Fax
NT-NU Spill Centre	24 hour Spill Report Line	Yellowknife	867-920-8130	867-873-6924
Canadian Coast Guard – Central and Arctic Region (Any discharge to the marine environment)	24 hour Spill Report Line	Yellowknife	800-265-0237	
GN Department of Environment	Director Environmental Protection Division	Iqaluit	867-975-7748	
Nunavut Water Board	Executive Director	Gjoa Haven	867-360-6338	867-360-6369
Kitikmeot Inuit Association (KIA)	Sr. Lands Officer	Kugluktuk	867-982-3310	867-982-3311
CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada)	Field Operations Manager	Iqaluit	867-975-4553	867-979-6445
CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada)	Inspector	Iqaluit	867-975-4655	867-979-6445
ECCC (Environment and Climate Change Canada)	Manager of Enforcement	Yellowknife	867-669-4730	867-669-6831
ECCC (Environment and Climate Change Canada)	Environmental Enforcement Officer	Yellowknife	867-669-4785	
DFO (Fisheries & Oceans Canada)	Habitat Team Leader	Ottawa	705-522-9909	
Transport Canada, Marine	Regional Preparedness & Response Officer	Jasper	780-442-1945	780-495-8607

Offsite Resource Contacts

Organization	Contact	Location	Telephone
Mackenzie Delta Spill Response Corporation	Tim Taylor	Inuvik	403-457-3661
Riverspill	Ian Lambton	Burnaby	604-434-0994
Points West Archaeology	Gabriella Prager	Langley	780-980-2079
Focus Wildlife	Chris Bataglia	North Vancouver	1-800-578-3048

Immediately Reportable Spills

Per GNWT-ENR Report a Spill Website (https://www.enr.gov.nt.ca/en/services/report-spill)

Description of Contaminant	Amount Spilled	TDG Class
Explosives	Any amount	1.0
Compressed gas (toxic/corrosive)		2.3 / 2.4
Infectious substances		6.2
Sewage and Wastewater (Unless otherwise authorized)		6.2
Radioactive materials		7.0
Unknown substance		None
Compressed gas (Flammable) Compressed gas (Non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100 L	2.1 2.2
Flammable Liquid	≥ 100L	3.1 / 3.2 / 3.3
Flammable Solid Substances liable to spontaneous combustion Water reactant substances	≥ 25kg	4.1 4.2 4.3
Oxidizing substances	≥ 50 L or 50 kg	5.1
Organic peroxides Environmentally hazardous substances intended for disposal	≥ 1 L or 1 kg	5.2 9.2
Toxic substances	≥ 5 L or 5 kg	6.1
Corrosive substances Miscellaneous products, substances or organisms	≥ 5 L or 5 kg	8.0
PCB mixtures of 5 or more ppm	≥ 0.5 L or 0.5 kg	9.1
Other contaminants – for example, crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, wastewater	≥ 100 L or 100 kg	None
Sour natural gas (i.e., contains H_2S) Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more	None
Flammable liquid Vehicle fluid	≥ 20 L when released on a frozen water body that is being used as a working surface	3.1 / 3.2 / 3.3 None
Reported releases or potential releases of any substance that: Are near or in an open water body (freshwater or marine); Are near or in a designated sensitive environment or habitat; Pose an imminent threat to human health or safety; or Pose an imminent threat to a listed species at risk or its critical habitat	Any amount	None

In the event that a particular material spill meets or exceeds the amount specified or conditions outlined in the above table the Environmental Superintendent will immediately report the spill by telephone to the NT-NU 24 Hour Spill Report Line, Yellowknife, Tel: 867-920-8130 (Email: spills@gov.nt.ca; Fax: 867-873-6924) using the NT-NU Spill Report.

Any spill or discharge that occurs to the marine environment must immediately be reported to the Canadian Coast Guard – Central and Arctic Region station at Tel: 1-800-265-0237.

First Responder

When someone on site sees an unanticipated discharge or spill, he or she is immediately designated as the First Responder and, as such, shall complete the following actions

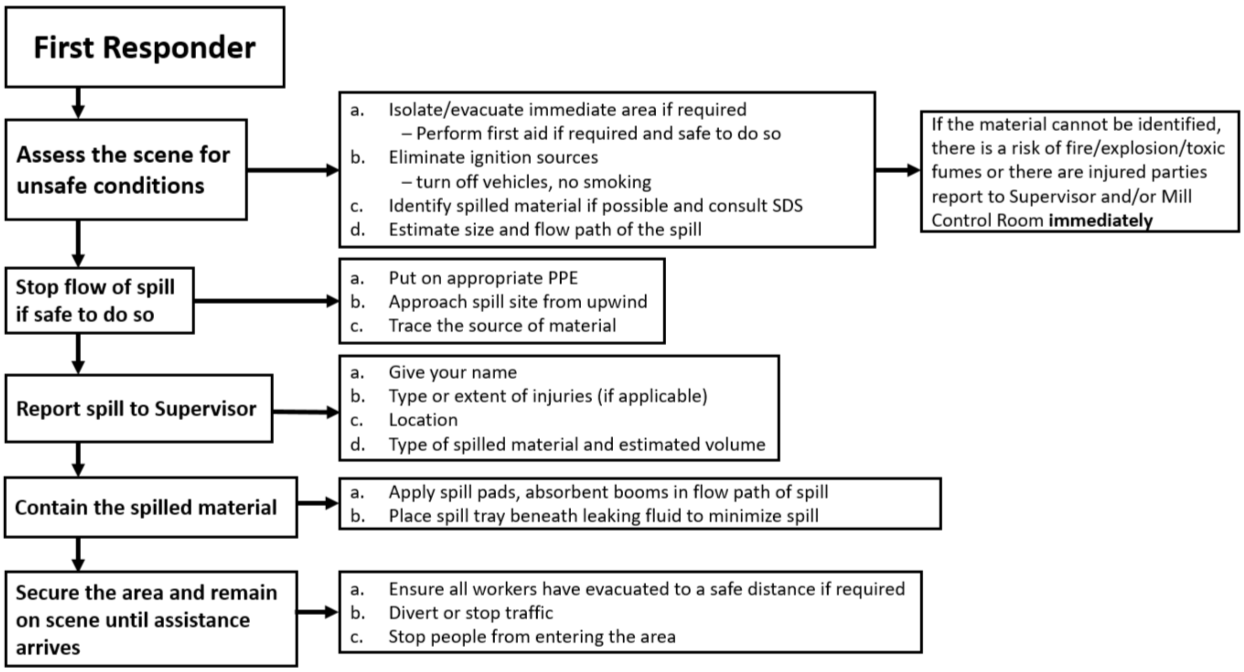

Figure I. First Responder Spill Response Actions

Spill Response Organization Structure

When a Supervisor receives a report of an unanticipated discharge or spill, he or she shall immediately complete the following actions:

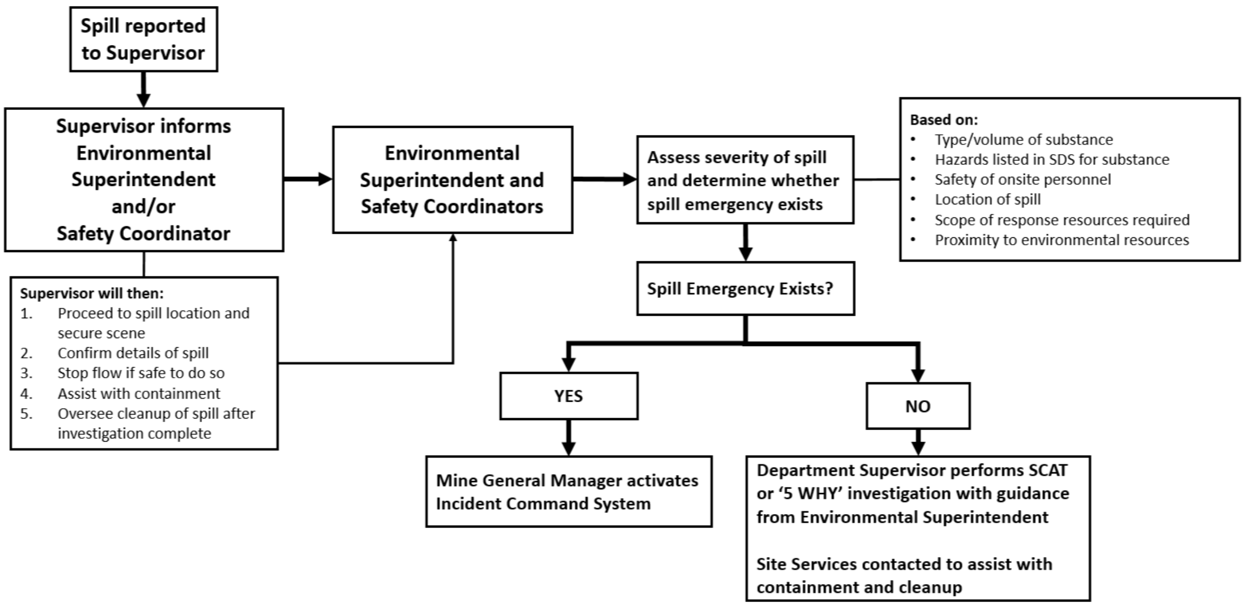

Figure II. Spill Response Organizational Structure

Spill Emergency Incident Command System

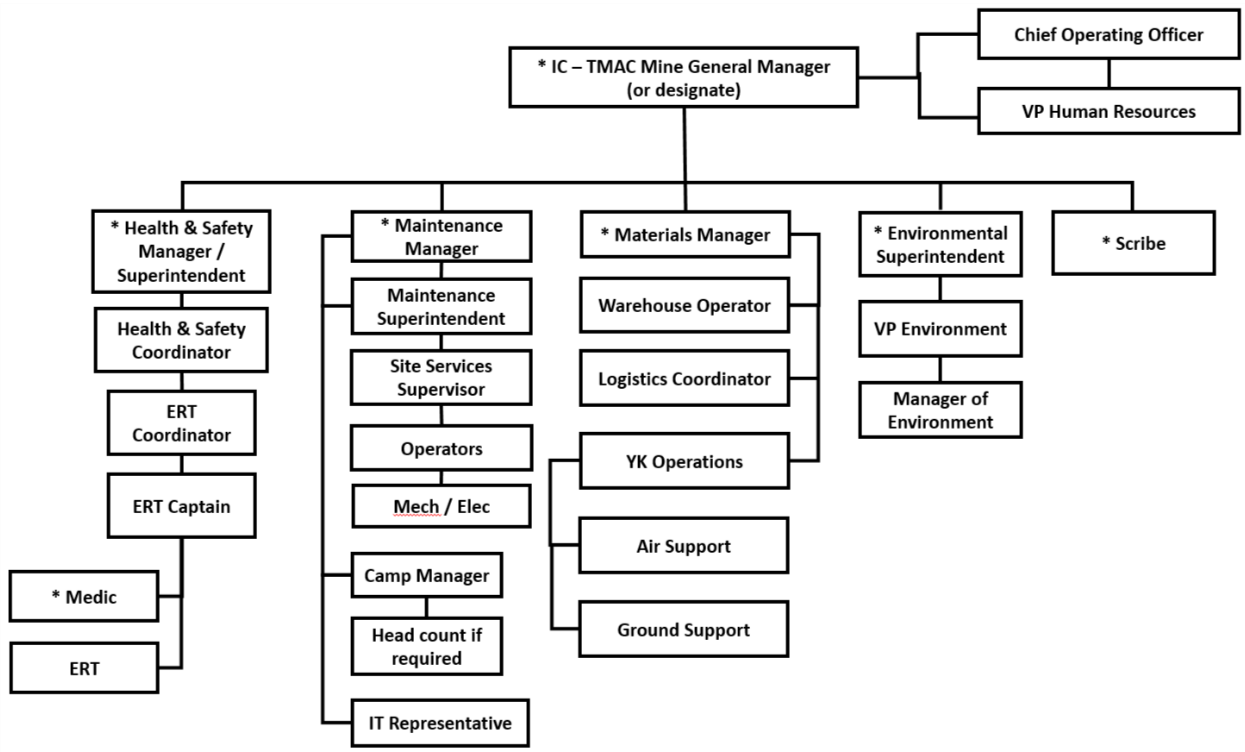

Figure III. Incident Command System organizational structure in the event of a spill emergency

Revisions

Revision #	Date	Section	Changes Summary
1	2009		Hope Bay Project Spill Contingency Plan, August 2009
2	Feb 2010		Update phone numbers
3	Jul 2010		Update phone numbers
4	2011	Throughout	Update channels, figures, included OPPP info, updated phone numbers, revised fuel storage locations
5	2012	Throughout	Overall revision for change to Care and Maintenance. Updated roles and responsibilities, phone numbers, fuel storage, added non-hydrocarbon chemicals, updated spill response procedures
6	2014	Throughout	Overall revision to include Care and Maintenance under ownership of TMAC Resources Inc. Updated roles and responsibilities, contact information, fuel storage, updated spill response procedures
7	Apr 2016	Throughout	Updated to reflect comments on 2014 Plan and other stakeholder inputs. Changes to document structure and addition of licence specific modules and Incident Command System response structure. Revisions to reflect Construction and Operations phases for Doris and anticipated chemical storage quantities. Inclusion of Product-specific response plans, updated contacts.
8	Jan 2017	Throughout	Revisions in consideration of comments on 2016 Plan, and in consideration of planned resumption of exploration activity at Boston
9	Nov 2017	Throughout	Revisions to emergency contact information, spill response organizational and ICS structure. Updates to fuel/chemical storage quantities/locations and spill kit location maps in all modules. Addition of Module C: Madrid as per licence 2BB-MAE1727. Revisions to Module D: Boston as per licence 2BB-BOS1727. Addition of Aviation fuel Product Specific Spill Response Plan to Module A.
10	Mar 2019	Throughout	Revisions to emergency contact information, spill response organizational and ICS structure. Updates to fuel/chemical storage quantities/locations and spill kit location maps in all modules.
11	Sep 2019	Throughout, Module A	Revisions to emergency contact information, addition of spill prevention measures along the Roberts Bay Discharge Pipeline in Module A
12	Mar 2020	Throughout, Appendix	Overall revisions to the plan

Contents

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Glossary

Term	Definition
CWS	Canadian Wildlife Services
COO	Chief Operating Officer
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada (formerly INAC)
DoE	Department of Environment
ECCC	Environment and Climate Change Canada
ERT	Emergency Response Team
ERP	Emergency Response Plan
GN	Government of Nunavut
IC	Incident Commander
ICS	Incident Command System
KIA	Kitikmeot Inuit Association
MGM	Mine General Manager
NWB	Nunavut Water Board
PSER	Product Specific Emergency Response Plan
PPE	Personal Protection Equipment
SDS	Safety Data Sheet

1 Introduction

This Hope Bay Spill Contingency Plan (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region. This Plan has been developed to also meet the requirements of the Environmental Emergency (E2) Regulations as well as the Metal and Diamond Mining Effluent Regulations enacted under the Canadian Environmental Protection Act (CEPA, 1999).

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices for response are implemented in the event of a spill or unintentional release, and that the conditions of water licences, project permits and relevant legislations are met.

This Plan is structured in a manner such that one document pertaining to spill response is approved and implemented across all TMAC Hope Bay project sites, while still addressing site- and licence-specific needs: the main document outlines TMAC's approach to spill response planning and management as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site may need to be revised. This is intended for consistency and efficiency across operations and for compliance management.

This Plan has been developed to be applicable for all phases of the various Hope Bay Belt projects. This Plan is reviewed annually and updated as necessary.

1.1 Objectives

TMAC's vision and values which strive for zero harm are protective of people and the environment. Safe work procedures and training provided to all employees promote best practices and sound environmental management; however, the potential exists for unanticipated discharges or spills to occur during the course of operations. TMAC recognizes that prompt, effective and organized responses to an unanticipated discharge or spill will enhance the health and safety of all employees, minimize the potential adverse environmental impacts resulting from such an event, and ensure effective communication with the appropriate regulatory agencies and the public. Consistent with TMAC's intent to be a responsible operator, these objectives are described as follows:

- Provide procedures for every employee should he/she identify an unanticipated discharge or spill;
- Define roles, responsibilities and procedures for spill response actions, documentation, reporting, incident investigation and review following an event;
- Outline a process to be followed when conducting spill clean-up activities to promote safe and effective recovery of spilled materials and minimize impacts to the environment;
- Provide information on available resources and potential operational hazards/risks that may be encountered during spill response activities;
- Define methods to provide spill response training for all employees; and
- Implement a process to evaluate and continuously improve site spill response procedures.

1.2 Relevant Legislation and Guidance

Table 1.1 provides a summary of federal and territorial regulations relevant to this Plan and associated guidelines.

Table 1.1. List of Federal and Territorial Regulations Relevant the Hope Bay Spill Contingency Plan

Acts	Regulations	Guidelines
Federal		
Arctic Waters Pollution Prevention Act (R.S.C., 1985, c.A-12)	Arctic Shipping Pollution Prevention Regulations (C.R.C., c. 353)	
Canadian Environmental Protection Act (R.S.C.1999 c.33)	Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (SOR/2008-197)	Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (Canadian Council of the Ministers of Environment (CCME) 2003)
	Environmental Emergency Regulations (SOR/2019-51)	
	Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2002-301)	Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CCME2008)
	Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149)	
Fisheries Act (1985, c.F-14)	Metal and Diamond Mining Effluent Regulations (SOR/2002-222)	
Explosives Act (1985, c.E-17)	Explosives Regulations (C.R.C., c.1516)	
Nunavut Waters and Nunavut Surface Rights Tribunal Act (2002)	Nunavut Water Regulations (2013)	
National Fire Code of Canada (2010)		
Transportation of Dangerous Goods Act (1992, C.34)	Transportation of Dangerous Goods Regulations (SOR/2001-286)	2016 Emergency Response Guidebook (Transport Canada and U.S. Department of Transportation, 2016)
Territorial Lands Act (R. S. 1985, c.T-7)	Northwest Territories and Nunavut Mining Regulations (C.R.C., c.1516)	
	Territorial Land Use Regulations (C.R.C., c.1524)	
	Territorial Lands Regulations (C.R.C., c.1525)	
Hazardous Products Act	*Controlled Products Regulations*	*Workplace Hazardous Materials Information System (WHMIS)*
Nunavut Act (1993 c.28)		

Acts	Regulations	Guidelines
Territorial – Nunavut		
Environmental Protection Act	Spill Contingency Planning and Reporting Regulations (NWT Reg (Nu) 068-93) Used Oil and Waste Fuel Management Regulations (NWT Reg 064-2003)[The removal of hazardous materials will require the registration with the Government of Nunavut, Department of Environment (DOE) as a waste generator as well as carrier (if applicable) prior to transport]	Government of Nunavut (GN) Environmental Guidelines for the Management of: • General Management of Hazardous Waste in Nunavut (GN, 2010) • Waste Paint (GN, 2010) • Mercury-Containing Products and Waste Mercury (GN, 2010) • Industrial Waste Discharges into Municipal Solid Waste and Sewage Disposal Facilities (GN, 2011) • Waste Batteries (GN, 2011) • Waste Solvent (GN, 2011) • Waste Antifreeze (GN, 2011) • Used Oil and Waste Fuel (GN, 2012) • Biomedical and Pharmaceutical Waste (GN, 2014) • Canada-Wide Standards for Petroleum Hydrocarbons (PHC) In Soil (CCME 2008)
Mine Health and Safety Act (SNWT (Nu) 1994, c.25)	Mine Health and Safety Regulations (NWT Reg (Nu) 125-95)	
Workers' Compensation Act (RSNWT, 1998, c.W-6)	Workers' Compensation General Regulations (Nu Reg 017-2010)	
Explosives Use Act (RSNWT (Nu) 1988, c.E-10)	Explosives Regulations (RRNWT (Nu) 1990, c.E-27)	
Fire Prevention Act (RSNWT (Nu) 1988, c.F-6)	Fire Prevention Regulations (RRNWT (Nu) 1990, c.F-12)	
Motor Vehicles Act (RSNWT (Nu) 1988, c.M-16)	Large Vehicle Control Regulations (RRNWT (Nu) 1990, c.M-30)	
Public Health Act (RSNWT (Nu) 1988, c.P12)	Camp Sanitation Regulations (RRNWT (Nu) 1990, c.P-12)	
Safety Act (RSNWT 1988, c.S-1)	General Safety Regulations (RRNWT (Nu) 1990, c.P-16)	
	Work Site Hazardous Materials Information System Regulations (RSNWT 1988, c.81 (Supp))	
Transportation of Dangerous Goods Act (1990, RSNWT (Nu) 1988, c.81 (Supp))	Transportation of Dangerous Goods Regulations (1991, NWT Reg (Nu) 095-91)	

1.3 Related TMAC Documents

The documents listed in Table 1.2 are expected to be referenced and utilized in conjunction with the Spill Contingency Plan.

Table 1.2. List of TMAC documents related to the Hope Bay Spill Contingency Plan

Document Title	Year	Relevance
Hazardous Waste Management Plan	2020	Describes proper handling, storage and disposal procedures for hazardous wastes.
Non-Hazardous Waste Management Plan	2017	Describes proper handling, storage and disposal procedures for non-hazardous wastes.
Hope Bay Project Hydrocarbon Contaminated Material Management Plan	2017	Describes process for remediating hydrocarbon contaminated soil, water and gravel and criteria for determining level of remediation.
Emergency Response Plan	2020	Describes Incident Command System and actions relating to all surface emergencies.
Doris-Madrid Tailings Impoundment Area Operations, Management and Surveillance (OMS) Plan	2020	Describes the tailings management procedures and the aspects of the pipelines designed to reduce spills of tailings and effluent.
Oil Pollution Prevention and Oil Emergency Preparedness Plan	2019	Describes spill response actions associated with fuel transfer activities during annual sea-lift fuel offload.

1.4 Plan Management

The Chief Operating Officer (COO) has the overall responsibility for implementing this management plan and will provide the on-site resources to respond to unanticipated discharges and spills that occur in the Hope Bay Belt in accordance with this plan.

The Mine General Manager (MGM) is responsible for implementing this plan at the Hope Bay site, and providing on-site support and resources for spill response management. The MGM will act as Incident Commander (IC) in the event that a spill occurs that requires activation of the Emergency Response Plan (ERP). As Incident Commander, the MGM will coordinate the spill response efforts that protect the health and safety of all responders, and minimizes impacts to the environment.

The Environmental Superintendent is responsible for revising this plan and will assist departmental supervisors with investigation of spill incidents, development of corrective actions for those incidents as necessary, maintain records of all spill events, and complete appropriate reporting as required by TMAC policies and relevant regulations as identified in this plan. The Environmental Superintendent will also conduct and record regular inspections of spill response resources. In the event that a spill requires activation of the Emergency Response Plan, the Environmental Superintendent will provide guidance to the MGM regarding implementing response actions according to this plan and evaluating priorities for protection of sensitive habitats/species and archeological features at risk.

1.5 Plan Implementation

In accordance with the requirements of the General Conditions (Part B) of the applicable water licences, the Environmental Emergency Regulations (SOR/2019-51) and the Metal and Diamond Mining Effluent Regulations (SOR/2002-222), this plan will be immediately implemented following its submission, subject to any modifications proposed by the NWB as a result of the review and approval process.

This plan will be reviewed annually and updated as necessary to capture changes to site operational structure/contacts, response technologies or applicable legislation and regulations.

1.6 Project Description

The Hope Bay Project (the Project) is a gold mining project located in the West Kitikmeot region of Nunavut approximately 125 km southwest from Cambridge Bay and 75 km northeast from Umingmaktok. The various elements of the Hope Bay Project are centered at approximately N 68° 09’ and W 106° 40’ and extend from the head of Roberts Bay (an extension of Melville Sound) at the north end of the Project to south of the Boston site located approximately 60 km to the south. Two jetties extend into Roberts Bay and are located on foreshore Crown Land. The Hope Bay mineral exploration rights property comprises an area of 1078 km^2 and forms a contiguous block that is approximately 80 km long by up to 20 km wide. Descriptions of project infrastructure pertinent to each licence area are provided in the appended modules.

The Hope Bay Project area has a low arctic eco-climate and consists of coastal lowland habitats with numerous fresh water lakes and ponds. The drainage basins are generally long and narrow and predominately oriented along the north-south axis and are separated by bedrock ridges. Continuous permafrost covers the project area with a surficial active layer of approximately 1 m. Groundwater movement only occurs in the shallow active layer during the seasonal thaw period and within the talik zones (unfrozen ground underlying larger water bodies). Permafrost underlying the area is generally impervious to groundwater movements.

2 Spill Response and Management

2.1 Spill Incident Alerts

Any person on the Hope Bay Project site who comes across or sees an unanticipated discharge or spill is designated as the First Responder and will complete the following actions (Figure I):

1. Assess the Site:
   (a) Isolate/evacuate immediate area if required;
   (b) Perform first aid if required and safe to do so;
   (c) Eliminate ignition sources – turn off vehicles, no smoking;
   (d) Identify spilled material if possible and consult product SDS; and
   (e) Estimate size and flow path of the spill.

   NOTE: If the material cannot be identified, there is a risk of fire/explosion/toxic fumes produced or there are injured parties report to Supervisor **immediately** or call **Mill Control** if applicable (Step 3)**.**

2. Stop flow of spill if safe to do so:
   (a) Put on appropriate PPE;
   (b) Approach spill site from upwind; and
   (c) Trace the source of material.

3. Report spill to Supervisor:
   (a) Give your name;
   (b) Type or extent of injuries (if applicable);
   (c) Location; and
   (d) Type of spilled material and estimated volume.

   NOTE: Mill Control can be contacted on Radio **Channel 1**, Phone Extension **911** or **150**.

4. Contain the spilled material:
   (a) Apply spill pads, absorbent booms in flow path of spill; and
   (b) Place spill tray beneath leaking fluid to minimize spill.

5. Secure the area and remain on scene until assistance arrives:
   (a) Ensure all workers have evacuated to a safe distance if required;
   (b) Divert or stop traffic; and
   (c) Stop people from entering the area.

All personnel receive appropriate training during their initial site orientation of what to do when he/she sees an unanticipated discharge or spill anywhere at the Hope Bay site. A flow-chart summarizing the First Responder spill actions is provided in Figure I as a quick reference at the beginning of this plan and is available in all spill kits on site.

2.2 Spill Response Organizational Structure

Once a spill has been identified by the First Responder the following spill response organizational structure will be implemented. The responsibilities of the individuals involved in spill response actions are summarized in the sections below. A flow-chart summarizing this structure is provided in Figure II as a quick reference at the beginning of this plan.

2.2.1 Supervisors

In the event that a Supervisor is informed of a spill by an employee, he/she will immediately inform the Environmental Superintendent and/or Safety Coordinator that a spill has occurred and provide details of the spill as outlined in Section 2.1 above. The Supervisor will proceed to the spill location, secure the scene, confirm the type of material/size of the spill and assist with containment actions. Depending on the severity of the spill incident, either the Mine General Manager (MGM) or Environmental Superintendent will provide direction to the Supervisor regarding the removal, storage and disposal of the spilled material. The incident scene is not to be disturbed until an incident investigation can be completed.

Removal and disposal of spill materials is only to be conducted after this investigation is complete and the scene is released by the MGM and/or Environmental Superintendent.

2.2.2 Mine General Manager

Once notified of the spill, the MGM will consult with the Environmental Superintendent and Health & Safety Manager/Superintendent to assess the severity of the spill incident and determine whether a spill emergency exists that requires activation of the Incident Command System (ICS) emergency procedures. This assessment will take into account the type and volume of the substance that has spilled, the location of the spill, safety of site personnel, scope of resources required to respond and the proximity of the spill to environmental resources at risk, including water bodies, sensitive habitat, archeological sites or sensitive species in the area.

The ICS is a command structure used in the Emergency Response Plan (ERP) at the Hope Bay site. This structure is designed to have a documented sequence of decisions that has been reviewed in advance of an emergency situation and establishes a chain of command to minimize confusion, so that employees will have no doubt who has the authority for making decisions.

If the ICS is activated in response to a spill emergency, the MGM (or designate) becomes the Incident Commander and implements the ICS command system outlined in Figure III at the beginning of this plan. The Incident Commander will communicate with onsite managers and direct all efforts in the spill response including evacuating personnel, identifying resources required to respond to the incident and activating the Emergency Response Team (ERT). The Incident Commander will direct the Maintenance Manager to coordinate containment and clean-up actions based on safety of the responders and environmental protection priorities as identified by the Health & Safety Manager/Superintendent and the Environmental Superintendent. In the event of a large spill, the Incident Commander may direct the Materials Manager to secure off-site resources and facilitate shipment to the Hope Bay site. The Incident Commander will establish communications with the Chief Operating Officer and offsite Communications Delegate and regularly brief these individuals on the status of the spill emergency. A scribe will be assigned to the Incident Commander to document all communications and response actions of the spill incident.

After the spill emergency has been contained, the Incident Commander will conduct an incident investigation with the assistance of the Environmental Superintendent, Health & Safety Manager/ Superintendent and other site managers as required.

If the spill is not deemed an emergency by the MGM, the ICS will not be activated and the Environmental Superintendent will provide direction to Site Services for containment and clean-up of the spill after an incident investigation has been completed.

2.2.3 Environmental Superintendent

The Environmental Superintendent will assist the MGM in evaluating the severity of a spill situation to determine whether a spill emergency exists. The Environmental Superintendent will identify environmental resources at risk, including water bodies, sensitive habitat and species, or archeological sites in proximity to the spill based on the size/location of the spill, anticipated path of flow and weather conditions at the time. If a spill emergency exists that triggers the ICS, the Environmental Superintendent will advise the Incident Commander on the prioritization of containment and clean-up efforts. If the ICS is not triggered, the Environmental Superintendent will provide direction to Site Services for containment and clean-up of the spill after an incident investigation has been completed.

The Environmental Superintendent will assist departmental Supervisors to document and investigate the cause of all spills, and work with onsite managers to develop corrective actions as required to prevent a repeat occurrence of the incident.

The Environmental Superintendent is also responsible for reporting of incidents as outlined in Section 3 of this plan and implementing follow-up monitoring actions deemed necessary to evaluate the extent of the spill and effectiveness of clean-up/remediation efforts. The Environmental Superintendent will communicate with the Vice President of Environmental Affairs at any time as required to determine effective clean-up measures, discuss reporting submissions and implement environmental monitoring as necessary.

2.2.4 Health & Safety Manager/Superintendent

The Health & Safety Manager/Superintendent will assist the MGM in evaluating the severity of a spill situation in instances where hazardous conditions may exist for site personnel as a result of a spill. This includes events involving injured personnel or damage to property resulting from the event, and/or situations where risk of fire, explosion or toxic fumes may be created as a result of the spill. The Health & Safety Manager/Superintendent will identify risks to site personnel and emergency responders and advise the Incident Commander on the response in conjunction with the Emergency Response Plan (ERP).

2.2.5 Emergency Response Team Coordinator

The Emergency Response Team (ERT) Coordinator is responsible for the implementation and training of the Emergency Response/Mine Rescue Team. During a spill emergency event, the ERT Coordinator will initially direct the response action of the ERT.

2.2.6 Emergency Response Team/Mine Rescue Team

The Emergency Response Team/Mine Rescue Team (ERT/MRT) may be the primary responders to a spill emergency event depending on the severity of spill incident and the containment and clean-up efforts.

2.2.7 Communications Delegate

In the event of a spill emergency, a Communications Delegate will be identified by TMAC Executive, and will communicate regularly with the Incident Commander to monitor the spill response and maintain a log of internal and external communications. The Communications Delegate will inform all appropriate agencies, which may include the Kitikmeot Inuit Association, the Nunavut Water Board, the Nunavut Impact Review Board, Environment and Climate Change Canada, Crown-Indigenous Relations and Northern Affairs Canada, the Department of Fisheries and Oceans Canada and will advise the public in the immediate vicinity of the spill if warranted. The Communications Delegate may designate alternative personnel to perform these communications. This individual will also update the TMAC Executive as required.

2.2.7.1 Spill Response Communications

During a spill emergency, on-site staff WILL NOT communicate directly with regulatory agencies, the press or other parties off of the mine site. All external communication is to be through the Communications Delegate. Communication systems will be shut down at the direction of the Incident Commander and only emergency radio and phone lines identified in the Incident Command organizational structure will remain operational.

All on-site communication with the Communications Designate will occur through or at the direction of the Incident Commander. On-site communications will use portable radios on designated radio channels. Independent satellite phones are available for crews for emergency communications in the unlikely event that the radio and phone systems fail.

2.2.8 Spill Response Actions

Most chemicals stored onsite are kept in small quantities and not expected to result in a major spill incident. Any chemical product which is listed under the E2 Regulations and which will be stored in quantities on site equal to or greater than that listed in Schedule 1 of these regulations will have an additional Product Specific Emergency Response (PSER) Plan detailed for that product. These PSER plans can be found in Appendix 1 of this document.

Chemical containers are appropriately labelled to identify their contents in the event of a spill. The product label will be used to identify the substance and hazards, the Safety Data Sheet (SDS) will be consulted to determine the proper PPE requirements and appropriate spill response procedures. The following sections outline general spill response actions to be taken in the event of a spill in each associated environment. The basic spill response steps to be taken in the event of the spill are illustrated in Figure 2.1 below.

Note that some substances can be highly reactive in contact with water, air, or other substances and should not be addressed unless safe to do so.

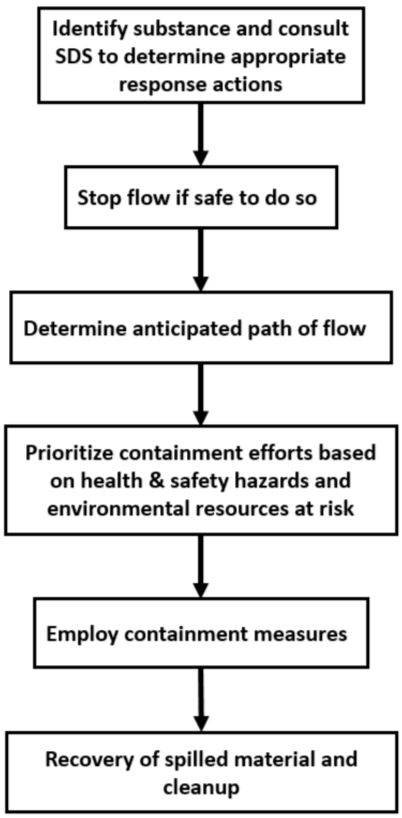

Figure 2.1. General Spill Response Actions

2.2.9 Spills on Land and Water

In the event of a liquid spill on gravel, rock, soil or vegetation, it is very important to prevent the liquid from entering any body of water where it will spread and likely have greater environmental impact. Liquid spills on land will be contained and cleaned up by:

- Covering the spill with appropriate absorbent pads and placing absorbent booms in the path of flow of the spill;

- Constructing temporary berms from soil or snow at the leading edge of the spill to minimize flow:
  - Plastic tarps can be placed over and at the foot of the berm to capture pooling liquid and facilitate recovery; and
  - Temporary berms are an interim measure and will be removed as soon as possible after the spill is contained and remedial actions complete.
- Pumping spilled material to empty drums or tanks;
- Using a vacuum truck to recover spilled material;
- Excavators and other heavy equipment may be used to excavate contaminated materials; and
- If safe to do so, blow torches (Tiger Torches) may be used to clean small hydrocarbon spills that occur on unlined areas of the camp pad to reduce waste generation and handling.

In the event of a spill on water, the spread of the spilled material will be limited to the extent possible. The following steps will be taken to contain and clean-up a spill on water:

- Identify the direction and speed of the flow path of the product based on weather conditions and drainage patterns:
  - Monitor the spread of the material using a drone or from a helicopter if possible to identify the area of spread.
- Use appropriate absorbent pads, socks and similar materials to recover spilled product:
  - Granular sorbent materials are NOT to be used for spill response on water.
- Hydrophobic absorbent booms will be deployed to contain large spills and to facilitate recovery:
  - Absorbent booms will be drawn slowly in to encircle the spilled product and absorb it.
  - High winds, waves and other factors may limit the effectiveness of these materials.
- Skimmers will be deployed in open-water areas to remove product from the water surface and boards or plywood may be used in streams or culverts to reduce the flow of spilled product on the surface and limit the area of the spill on the water;
- Use of sub-surface barriers to contain spilled product that may sink;
- Pump contaminated water into tanks or storage bladders if possible:
  - A vacuum truck may be used to recover spilled product.
- Contaminated substrate and vegetation will be removed either manually or with the use of heavy equipment if feasible; and
- Chemical dispersants should not be used as a spill response technique at the Hope Bay project, seek direction from VP Environmental Affairs.

Also see Section 2.3.18 of this document for guidance related to additional spill protection, clean-up, and reporting measures for environmentally sensitive species and archaeological sites.

2.2.10 Spills in a Marine Environment

The most effective way to minimize environmental damage is to focus on source control and to prevent product from spreading. The following steps will be taken in the event of a spill in the marine environment:

- Identify the direction, speed and flow path of the product based on weather conditions and drainage patterns:
  - Monitor the spread of the material using a drone or from a helicopter if possible to identify the area of spread.
- Use of appropriate absorbent pads, socks and similar materials to recover small volumes of spilled product:
  - Floating spill response booms will be used to encircle a barge prior to off-loading chemicals and fuel from the barge as a precautionary measure.
  - Granular sorbent materials are NOT to be used for spill response on water.
- Hydrophobic absorbent booms will be deployed to contain large spills and to facilitate recovery:
  - Absorbent booms will be drawn slowly in to encircle the spilled fuel and absorb it.
  - High winds, waves and other factors may limit the effectiveness of these materials.
  - Granular sorbent materials are NOT to be used for spill response on water.
- Skimmers will be deployed in open-water areas to remove product from the water surface;
- Use of sub-surface barriers to contain spilled product that may sink;
- Pump contaminated water into tanks or storage bladders if possible; and
- Chemical dispersants should not be used as a spill response technique at the Hope Bay project, seek direction from VP Environmental Affairs.

Also see Section 2.3.18 of this document for guidance related to additional spill protection, clean-up, and reporting measures for environmentally sensitive species and archaeological sites.

Spill response measures specific to bulk fuel offloads completed at Roberts Bay are detailed in the Hope Bay Ocean Pollution Prevention Plan/Oil Pollution Emergency Plan (OPPP/OPEP). The OPPP/OPEP is the main document of reference for spill control actions during a fuel offload at the Hope Bay project and is revised annually.

2.2.11 Spills on Snow

Spills on snow will be contained and recovered by:

- Use of appropriate absorbent pads, socks and similar materials to recover spilled product;
- Compacting the snow into snow-berms and placing a liner of plastic sheeting at the toe and over the berm to collect spilled material and facilitate recovery;

- Using the snow as a natural absorbent to collect spilled product; and
- An excavator, grader or other heavy equipment may be used to scrape up contaminated snow to be stored in a lined containment area or placed in steel drums.

2.2.12 Spills on Ice

Spills on ice will be contained and cleaned up by:

- Use of appropriate absorbent pads, socks and similar materials to recover spilled product;
- Creating snow-berms by compacting snow around the edge of the spill and placing a liner of plastic sheeting at the toe and over the berm to collect spilled material and facilitate recovery;
- Scraping contaminated snow/ice from the ice surface and placing in lined containment:
  - Snow may act as a natural absorbent to collect spilled product.
- In broken-ice conditions a skimmer may be used to collect product on the surface of open-water areas:
  - Caution must be used when conducting spill response efforts in broken-ice situations. An appropriate Task Hazard Analysis safety plan and PPE must be determined before initiating these actions.
- An excavator, grader or other heavy equipment may be used to scrape up contaminated ice to be stored in a lined containment area or placed in steel drums:
  - A vacuum truck may be employed to recover large volumes of spilled material.

2.2.13 Spills under Ice of Substances that Float

Hydrocarbon spills under ice will be addressed by:

- An appropriate Task Hazard Analysis safety plan and PPE must be determined before initiating these actions;
- Testing of the ice to ensure thickness is safe for personnel to work on the surface;
- Once ice has been deemed safe, slots will be cut in the ice surface in the area surrounding the spill and downstream of the anticipated direction of flow/spread:
  - Contaminant will rise to the surface within the slots.
  - Determine the direction of any currents (if expected; this would not be the case in an ice-covered lake) to identify the direction of flow and conduct ice profiling beyond the extent of the spill to identify any spread of the contaminant.
- Contaminant will be skimmed/scooped out from within the slots and placed into empty pails/drums as it is recovered;
- Pockets within the ice where contaminants can pool will be identified (this applies to ice which may have buckled areas where spills may pool; largely an ocean occurrence);

- Appropriate absorbent pads and booms will be used to contain spill if there is water moving past the ice edge (if any) where the spill took place:
    - Set booms ahead of the spill based on the direction of anticipated flow.
- A vacuum truck may be employed to recover larger volumes of spilled material or utilizing an Auger and pump system to pump spilled material into containers (e.g., drums).

2.2.14 Spills under Ice of Substances that Sink

- Response to spills below ice of substances which sink will be evaluated on a quantity, substance-specific, and risk basis. In many circumstances, particularly for small releases of non-toxic substances, the appropriate response may solely be to limit discharge as soon as possible and safe to do so. TMAC will assess each individual situation and may consult a remediation specialist for advice in addition to discussions with the KIA, CIRNAC, DFO, and ECCC, where appropriate;
- Allowing substance to settle with minimal disturbance to limit spread (for waterbodies without current);
- A vacuum truck may be employed to recover larger volumes of spilled material or utilizing an Auger and pump system to pump spilled material into containers (e.g., drums);
- Use of sub-surface barriers to contain spilled product if there is water moving past the ice edge (if any) where the spill took place; and
- Appropriate subsurface containment will be used to contain spilled material if there is water moving past the ice edge (if any) where the spill took place.

2.2.15 Spills under Ice of Substances that Dissolve

- Response to spills below ice of substances which dissolve will be evaluated on a quantity, substance-specific, and risk basis. In many circumstances, particularly for small releases of non-toxic substances, the appropriate response may solely be to limit discharge as soon as possible and safe to do so. TMAC will assess each individual situation and may consult a remediation specialist for advice in addition to discussions with the KIA, CIRNAC, DFO, and ECCC, where appropriate;
- A vacuum truck or an Auger and pump system may be used to pump contaminated water into containers (e.g., drums) if rate of dissolution is slow enough/contaminated water volume is small enough to make this feasible; and
- For Sodium Cyanide spills see substance-specific emergency response plan in Appendix 1.

2.2.16 Spills of Compressed Gas

If an accidental release of compressed gas occurs:

- Stop the source if safe to do so;
- Ventilate the area well to dilute the gas;

- Cordon off the area to prevent accidental ignition, explosion or inhalation by personnel; and
- Only employees with proper training and PPE will attempt to mitigate the release.

2.2.17 Burning Spills

Small spills of hydrocarbons (< 100 L) may be removed from unlined camp pad areas by using a propane torch (Tiger torch). This response method would reduce the waste production and handling/storage of contaminated materials associated with the spill, and would reduce the risk of spreading or contaminating other areas during transport of these materials. No water would be used and no waste would be deposited to water as a result of this response method.

Extra safety precautions must be taken prior to the use of a propane torch in the event of a spill. A Task Hazard Analysis will be completed prior to undertaking this activity. The SDS for the product will be reviewed to check for the reaction of the substance to heat. PPE such as Fire Resistant clothing and the proper gloves and respirator will also be worn and a spotter with a fire extinguisher rated for the type of spill and fire must be present during the clean-up.

Burning of larger spills may be considered on a case by case basis and only once TMAC has consulted with and received approval from ECCC, the KIA, the CIRNAC Inspector and any other associated regulatory agencies. This method of response is only useful if quick action is possible, and prior to natural spill dispersal and loss of the more ignitable hydrocarbon fraction.

2.2.18 Spills Affecting Environmentally Sensitive Species or Archeological Sites

The Hope Bay Project contains a number of habitats, species and sites of archeological and historical importance. The possibility exists for a spill to impact these environmental and cultural resources.

TMAC and previous companies operating on the Hope Bay site have conducted numerous ecological surveys to identify these areas at risk, with the focus of identifying those areas immediately surrounding Project infrastructure which are at greatest risk of impact from a spill.

In the event that a spill enters the natural environment, the Environmental Superintendent may use maps identifying these sensitive areas to prioritize the protection of these resources. Prioritization of environmental sensitivities will not be at the expense of safety or of reaching or maintaining control of the release. Sensitivity maps are provided in Appendix 3.

Should decisions be required which protect some sensitive areas at the expense of others, the hierarchy of protection will attempt to favour (except as directed otherwise by regulatory agencies):

1. waterbodies;
2. sensitive habitat types;
3. archaeological sites;
4. rare plants; and
5. active raptor nest or wildlife den.

For spills in water, prioritization will attempt to avoid vegetated and finer substrate shoreline areas (sand, gravel and cobble) from which recovery is most difficult and which may be of high value to fish.

All of the communications outlined in this section would occur in addition to any appropriate spill reporting outlined in Section 3.

2.2.18.1 Mitigation of Impacts to Wildlife

All reasonable measures will be taken to deter wildlife from coming into contact with any spilled material. In the event that wildlife does come in contact with a spilled material, TMAC will contact the KIA and either ECCC (in the case of migratory birds (does not include raptors)) or GN Wildlife Officers (in the case of other animals) to inform them of the impact and determine an appropriate course of action. In cases where wildlife can be rescued, wildlife spill response experts will be contacted for assistance and guidance.

2.2.18.2 Mitigation of Impacts to Birds

In the event that a contaminant is released to a body of water, initial wildlife response measures will be exercised in alignment with the Birds and Oil-CWS Response Plan Guidance document if migratory birds are or may be impacted. Environment and Climate Change Canada's Canadian Wildlife Service (ECCC-CWS) will be consulted to determine response strategies including the most appropriate humane treatment of oiled wildlife. TMAC may also engage contract response agencies specialized in wildlife response actions during a spill event. Initial wildlife response measures should include:

- Hazing to deter wildlife from using spill area:
  - Watercraft;
  - Sound makers such as whistles or horns; and
  - Helicopter* (if available and safe to do so).
- Wildlife monitoring:
  - Assessment surveys for oiled and unoiled wildlife; and
  - Wildlife observers will be on vessels and aircraft if possible.
- Bird Collection*:
  - To collect dead and live birds within the spill area and adjacent. All response vessels should be equipped with dip nets, large plastic collecting bags to hold dead birds, and cloth bags or cardboard boxes to hold live oiled birds.

** The use of aircraft to deter migratory birds and the collection of live and dead birds require an authorization from ECCC-CWS.*

2.2.18.3 Mitigation of Impacts to Archeological Features and Sensitive Habitats

If a spill is determined to have impacted any archeological or historic resources, prior to removing soil or vegetation, TMAC will immediately contact the Project Archaeologist. The Project Archaeologist will provide advice on next steps, and may travel to site to mitigate the archeological site. The Archeologist will also coordinate permits and communications with the Government of Nunavut Territorial Archaeologist.

In the event that shoreline substrates or aquatic vegetation have been impacted, TMAC will contact Environment and Climate Change Canada and the Department of Fisheries and Ocean for advice prior to initiating removal.

2.3 Disposal of Contaminated Materials

All contaminated materials generated during a spill event will be contained and disposed of as per the product specific SDS and as outlined in the Hazardous Waste Management Plan and Non-Hazardous Waste Management Plan. Empty drums, barrels, mega-bags and storage tanks are available to store contaminated materials for disposal.

Hydrocarbon contaminated soil, snow and water may be remediated in Landfarm facilities if these materials meet the requirements for remediation as per the Hydrocarbon Contaminated Material Management Plan or may be placed within the underground mine.

2.4 Spill Response Resources

2.4.1 On-Site Resources

Spill Response Kits will be available near (within 200 m) any areas where chemicals are stored and used on site, including near all bulk fuel berms and smaller fuel tanks. Spill response kits will be easily accessible for personnel responding to a spill. As project activities evolve and new locations of chemical storage and use are identified new spill kits will be added as needed, and all active construction areas where equipment is operating will also have a spill kit located within 200 m.

Additional spill response equipment is maintained for response in an aquatic environment. This equipment is stored in ten moveable containers that can be relocated for rapid response to a spill in a stream, lake or marine environment.

TMAC maintains an on-site supply of appropriate Personal Protective Equipment compatible with the chemical products used on site, including chemical resistant suits, gloves and boots, face shields/goggles and respirators. In the event of a spill, this equipment is used by spill responders as outlined in the product SDS. Specialty equipment, such as Self-Contained Breathing Apparatus, air quality monitors and fire retardant clothing are available and used as needed to ensure a safe response to a spill incident.

All fuel transfer vehicles are also equipped with a spill kit designed to address smaller spills of hazardous fluids (< 40 L). Personnel are trained in proper fueling procedures and spill trays are used during all fueling activities to minimize the potential of an unintentional release.

A list of supplies contained in each spill kit type, supplies in the aquatic spill response containers, and PPE/specialized equipment for spill response is provided in Appendix 2.

TMAC also maintains an on-site supply of roll, pad and mat absorbents, plug and dyke kits, mini booms, absorbent socks, peat moss, crushed corn cobs, coconut mats, hand tools, empty storage tanks and various pieces of heavy equipment including a vacuum truck, grader, dozers, loaders, excavators and haul trucks that would be used in the event of a large spill.

Spill kits are replenished as needed after use and inspected at least once per quarter. The purpose of the inspection is to evaluate the location of spill kit proximity to associated work activities, inspect the condition of the spill kit, and check that all required contents are available and in good condition.

The aquatic response supplies and equipment are inspected annually prior to fuel offloading events and after use in the event of a spill to the aquatic environment.

2.4.2 Off-Site Resources

The Hope Bay Project is a remote location that is only accessible by plane for the majority of the year, with a short open-water ship access season. The Hope Bay Project Spill Contingency Plan does not rely on off-site resources to successfully respond to anticipated upset conditions. The Plan has been developed such that the resources required to respond to spills have been positioned on site. It is anticipated that the Hope Bay Project will have sufficient resources and trained personnel to respond to all types/sizes of spills that could potentially occur on site.

Additional off-site resources are available to the Hope Bay Project from the Mackenzie Delta Spill Response Corporation, which focuses on the protection of the Arctic Marine environment. TMAC may secure additional equipment or assistance from the Mackenzie Delta Spill Response Corporation in the event of a significant spill to an aquatic environment.

3 Spill Investigation, Documentation and Reporting

3.1 Spill Investigation

A spill investigation will be completed for all spill events that occur at the Hope Bay site. This investigation will be aimed at determining the root cause of a spill and identifying corrective actions that may reduce the risk of a repeated incident.

For spills that exceed the volume thresholds outlined in the Immediately Reportable Spills table at the beginning of this plan, a 'Systematic Cause Analysis Technique' (SCAT) Investigation will be completed. SCAT is an in-depth root cause analysis used to investigate significant incidents and identify corrective actions. The SCAT investigation form will be completed by the departmental Supervisor with support from the departmental Manager and the Environmental Superintendent within 7 days of the spill occurrence. The Safety Manager/ Safety Superintendent and MGM may participate in the investigation and assist in developing corrective actions.

For spills that do not exceed the volume thresholds outlined in the Immediately Reportable Spills table, a '5 Why' Investigation will be completed. The '5 Why' method is a simple question-asking technique used to determine the cause/effect relationships underlying a spill. The objective is to identify the root cause by repeatedly asking 'Why?' the event occurred. The '5 Why' investigation form will be completed by the departmental Supervisor within 48 hours of the event and forwarded to the Environmental Superintendent.

Records of all spill events and investigations will be maintained by the Environmental Superintendent and documented in the Environmental Incident Register. Any corrective actions that are identified will be entered into the Environmental Incident Register and implemented immediately by the departmental Supervisor and/or Manager.

3.2 TMAC Internal Reporting

An Incident Event notification will be sent by the departmental Supervisor to the Environmental Superintendent prior to the end of the shift in which the spill event occurred. This notification will provide a brief description of the spill, consequences of the spill, root cause of the event if identified and a brief description of the response including containment and cleanup actions.

Results of the SCAT Investigation and the '5 Whys' Investigation will be communicated to all site Supervisors, Superintendents and Managers, as well as offsite Environmental personnel. Corrective actions generated by these investigations will be discussed with all personnel at the Hope Bay site through email communications and/or discussions at departmental safety meetings.

All details of the spill investigation and implementation of corrective/preventative actions will be documented in the Environmental Incident Register by the Environmental Superintendent.

3.3 External Reporting Requirements

In the event that a particular material spill meets or exceeds the amount specified in the Immediately Reportable Spills Table (located at https://www.enr.gov.nt.ca/en/services/report-spill, and at the beginning of this plan), the Environmental Superintendent or representative will complete the NT-NU Spill Report form (available through the preceding link) and report the spill to the NT-NU 24 Hour Spill Report Line by phone (867-920-8130) and/or e-mail (spills@gov.nt.ca) as soon as possible within 24 hours of the event. The CIRNAC Inspector and the KIA will be copied on these submissions. The submission of the report will not be delayed even if not all information is available at the time of submission.

In the event that a spill or an unauthorized deposit of a deleterious substance has occurred to the marine environment, the MGM and/or Environmental Superintendent will also notify the ECCC Enforcement Officer, the KIA and the Canadian Coast Guard station immediately and provide details on the time and location of the discharge, type and quantity of pollutant, description of assistance and salvage measures employed and any other relevant information. A written report will also be submitted within 24 hours. A copy of this report will be submitted to a Transport Canada Marine Safety Inspector if required.

The Environmental Superintendent will communicate with the VP Environmental Affairs during the incident to determine additional notifications to be submitted to regulatory agencies during the event.

In the unlikely event that an environmental emergency occurs which may adversely affect members of the public (closest community is located >120km away) the VP Environmental Affairs will work with the Communications Delegate to provide notification to the public during and after the event.

Within 30 days of the event, the Environmental Superintendent will submit a detailed written spill report to the appropriate regulatory agencies. This report will include a description of the spill location, type and quantity of spilled material, associated causes that led to the incident, details of actions taken to remediate affected areas and potential effects of the spill, measures undertaken to reduce the potential for a reoccurrence of a similar incident, results of monitoring activities undertaken and details of any further actions required. Other applicable details such as the names of agencies on the scene, persons or agencies advised concerning the spill, a chronological sequence of events including internal/external notifications, and lessons learned from events leading up to the spill and the response actions taken may be included in this report. Additional follow-up engagement may occur as deemed appropriate by the VP Environmental Affairs and based on the specific spill and stakeholder input.

A list of spills reported to the NT-NU Spill Report Line will also be provided in the annual report for each of the licence areas.

3.4 Monitoring and Restoration

Monitoring activities may be conducted to assess the impacts of the spill and the effectiveness of associated cleanup/remediation efforts in the event spilled material cannot be removed. This may include a number of monitoring techniques and collection of samples for laboratory analysis. The monitoring program will be developed by the Environmental Superintendent in consultation with the Environmental Affairs Department and associated regulatory agencies.

Monitoring may be triggered in the event of spills to water of substances that dissolve or sink or where substance recovery is unlikely. Samples will be collected to characterize 1) the material discharged (if not of known characteristics), 2) the water at the location of entry into the waterbody as soon after the discharge as possible, and 3) water at a ‘reference’ location, preferably within the same waterbody but outside of the area of potential impact and collected at approximately the same time as the sample collected at the point of entry.

Monitoring may also be triggered in the event of externally reportable spills to land for which recovery of spilled material is unlikely or may be incomplete. Samples will be collected from locations of suspected highest remaining contamination, or as a composite sample from the remediated area. Samples will be compared to soil remediation criteria and background soil concentration data to verify appropriate clean-up has occurred.

The Environmental Superintendent will be responsible for overseeing the implementation of these monitoring activities. No person will be permitted to sample spilled materials unless that person has received adequate training in the identification of the hazards associated with the spilled material, the selection and use of appropriate personal protective equipment, and safe sampling procedures.

The final required clean-up, restoration (or mitigation) and on-going monitoring will be conducted as needed, and where appropriate in consultation with, and satisfaction of, the CIRNAC Inspector and the KIA. Site specific studies may be required to determine the appropriate final clean-up criteria.

If required, continuing and progressive sample collection/analysis will be conducted and reported upon until the completion of all prescribed remedial activities.

3.5 Incident Review and Root Cause Analysis

A review of incidents and root cause analysis will be conducted by the Environmental Superintendent quarterly. The purpose of this review will be to identify trends in root cause. Lessons learned from this exercise will be used to develop additional corrective actions including awareness campaigns for site personnel, improvements to operational equipment and spill response resources.

4 Spill Management and Mitigation

Site supervisors and managers are responsible for ensuring work area inspections and risk assessments are conducted of their respective work areas. Risk assessments include evaluation of hazardous materials available and in use in the work area, and likelihood and potential consequences of various spills. Where appropriate based on likelihood and potential severity, mitigation, management and/or substance-specific spill response plans will be developed.

The following section outlines currently identified potential spill risks with potential for high severity and/or probability of occurrence (worst case scenarios) and the management and mitigation measures employed to reduce the likelihood of these occurrences and/or the potential severity. Additional scenarios, as well as appropriate management and mitigation actions, will be added to this section through time as they are identified.

4.1 Issue: Spill from a Chemical Storage Tank or Other Containment

A fuel storage tank, containment area, sump, emergency dump catch basin or other product container may release their contents for a number of reasons, such as damage due to puncture, openings developed over time due to degradation (such as rusting), or overfilling.

Equipment malfunction or facility failure may cause a spill event to occur, particularly during extreme winter temperature conditions experienced at the Hope Bay site.

4.1.1 Management Response

This risk is minimized through the use of secondary containment and spill containment. All bulk fuel facilities are located in secondary containment (i.e., containment designed to contain volumes equivalent or greater than 110% of the aggregate or total volume of the largest container in the containment – whichever is greater). Smaller chemical storage tanks are either double walled (have built-in secondary containment), and are located in spill trays such that any leakage from hoses or lines are further contained or are located in secondary containment berms. Spill trays are used under fuel drums and other smaller chemical containers.

Inspections of all containment structures will be conducted weekly to ensure concerns are noted and are addressed promptly.

In the event that a spill exceeded the capacity of a containment berm (for example, if more than one container in a berm was breached) or a containment berm became compromised, the spill response actions outlined in Section 2 would be implemented. Containment measures would be deployed to prevent the spread of the chemical into the natural environment. This would include deploying absorbent materials or booms and constructing diversion trenches or sumps to intercept the spilled product. The vacuum truck and all available pumps would be deployed to transfer spilled product into empty storage tanks or alternative containment berms if necessary.

4.2 Issue: Spill during Transport

Spills may occur during the transport of chemicals from one site location to another.

4.2.1 Management Response

As new chemicals, fuels and hazardous materials are brought to site, standard operating procedures are developed that outline the process for safely transporting or transferring these products between locations at site. Experienced operators transport these materials and are familiar with site road conditions. Traffic right-of-way procedures are established that reduce the risk of an accident between two vehicles and all vehicles are equipped with radio communication to ensure operators can remain in contact at all times. A spotter is used to direct operators loading and off-loading these materials from transport vehicles to reduce the risk of damage to chemical storage containers during transport and loading. Spill trays are used when chemicals are transferred to equipment or secondary containers for use.

4.3 Issue: Spill during Transfer

Spills have an increased likelihood of occurring during transfer of chemicals. This may be the case during equipment refuelling, transfer of chemicals between containers, or transfer of wastewater or tailings in pipelines. Such spills may result from human error (overfilling, inaccurate filling) or equipment malfunction (such as a break in the transfer line/pipe due to wear or freeze/thaw cycles).

4.3.1 Management Response

As new chemicals, fuels and hazardous materials are brought to site, standard operating procedures are developed that outline the process for safely using these chemicals during operations. Workers who use chemicals or fuels during daily operational activities receive training in the proper handling, storage and disposal of these materials prior to commencement of work. Any applicable SDS sheets are reviewed by all workers using these chemicals to identify potential hazards. Workers are encouraged to plan work activities before beginning a task to reduce the potential for inadvertent errors.

Fueling of mobile equipment generally takes place at designated fueling stations, which are located inside of secondary containment berms, minimizing risk to the environment. Remote fueling, such as occurs for stationary equipment and helicopters, requires a spill kit be easily accessible and spill trays are used.

Fuel tanks are not filled to full capacity, to reduce the possibility of overflow during fueling or due to expansion.

Workers are provided with on-site training in spill response techniques and are familiar with the response resources available in the event of a spill.

Wastewater transfer pipelines, for sewage as well as other wastewaters, are constructed to reduce breakage due to freeze/thaw cycles and are routinely inspected to ensure they are functioning.

Delineators are used to mark pipelines to ensure vehicle and equipment operators are aware of pipeline locations when travelling on site roads.

Additional design features of the tailings lines which reduce the risk of spills are outlined in the Hope Bay Project Doris Tailings Impoundment Area Operations, Maintenance and Surveillance (OMS) Manual.

Should any of the above measures fail, spill response would be undertaken as outlined in this document.

4.4 Issue: Spills from Equipment

Spills may occur from mobile and stationary equipment during routine maintenance or due to equipment malfunction or wear combined with extreme weather conditions.

4.4.1 Management Response

All equipment at site undergoes routine preventative maintenance, and mobile equipment is subject to daily pre-operational inspections to identify specific issues for mechanical resolution. Where possible, all equipment maintenance is performed in designated maintenance areas. During equipment maintenance, spill trays are used as needed. Spill trays are also used for stationary equipment, or those parked for extended periods of time.

4.5 Issue: Health and Safety of Spill Responders

Some products and chemicals used at the Hope Bay site may pose a risk to the health and safety of personnel responding to a spill. Spilled materials may create toxic, explosive or flammable hazards that must be considered during response efforts.

4.5.1 Management Response

Personnel working at the Hope Bay site are provided on-site training in the proper handling, storage and disposal of chemicals related to their tasks. The product SDS is reviewed by personnel prior to using these chemicals to identify potential hazards related to handling these materials.

The SDS for each chemical outlines the specific personal protective equipment (PPE) required when handling each product and provides information on methods for clean-up in the event of an accidental release to the environment. SDS sheets are maintained at site for all chemicals stored and used at the Hope Bay Project.

In the event that a spill poses toxic, explosive, flammable or other hazards that endanger personnel or the environment, the Emergency Response Team (ERT) will be activated through the Incident Command System. Members of the ERT are equipped with additional PPE that allows them to safely respond to hazardous situations and receive additional training in response techniques for these scenarios.

Site chemicals are reviewed annually and compared to the Environmental Emergency Regulations. If any chemicals are anticipated to be stored in quantities exceeding the volume thresholds outlined in these regulations a Product Specific Emergency Response Plan will be developed and submitted as an addendum to this Plan. Product Specific Emergency Response Plans identified as necessary for products stored at the Hope Bay site are located in Appendix 1 of this Plan.

4.6 Issue: Spills to Water

Spills to water are of particular concern due to the sensitivity of water environments and potential of rapid spread of spills into water.

4.6.1 Management Response

No chemicals are stored within 31 m of water. All chemicals are kept in containment, and spill kits are located nearby which contain small booms and absorbent pads. In the event of a large spill to water, additional itemized and audited Aquatic Spill Response Equipment is located at Roberts Bay in movable seacans. Response actions protective of wildlife are outlined in Section 2.2.18 Environmentally Sensitive, above.

4.7 Issue: Operational Considerations for Spill Response

Hope Bay is a remote project site that experiences extreme weather conditions and seasonal daylight variations which may impact the effectiveness of spill response actions. The Hope Bay Project is only accessible by plane for the majority of the year, with a short open-water ship access season.

4.7.1 Management Response

This Plan has been developed such that the resources required to respond to spills have been positioned on site. It is anticipated that the Hope Bay Project will have sufficient resources and trained personnel to respond to all types/sizes of spills that could potentially occur on site.

The majority of activities conducted at the site occur on the project infrastructure roads and camp pads. In the event that a spill occurs off the site infrastructure, helicopters and off-road tundra (low impact) vehicles, such as the Rim-pull, will be used to mobilize spill response resources. The impact from these vehicles will be monitored and damage to the surrounding tundra minimized to the extent possible.

Extreme weather conditions, such as sub-zero temperatures, that may impact the response capabilities of personnel will be mitigated by rotating personnel from response activities to break areas as needed. This may include using heated vehicles, portable shelters or heated buildings.

Portable light plants are available on-site and will be used in seasonal darkness to aid in spill response containment, clean-up and remedial actions.

5 Training

All personnel working at the Hope Bay site receive onsite training during the initial site orientation. At that time, every employee is informed that he/she is potentially a First Responder to any spill or unanticipated discharge event and is provided a brief explanation of the actions expected of every First Responder and where to find the First Responder SOP (flow chart) which is included in the site spill kits. Spill response plans are also located in accessible public locations on site.

Supervisors provide task-specific training to workers using chemicals onsite which includes appropriate handling, storage, disposal, and where to find guidance on spill response for these chemicals. Workers are provided with information on spill response requirements and the locations of spill kits in their immediate work area. Spill response techniques are reviewed in departmental safety meetings by the Environmental Superintendent on a regular basis and lessons learned from spill investigations are communicated to all workers as corrective actions are developed.

Additionally, more detailed training is provided to workers involved in fuel offloading activities, through consultants such as Riverspill Response Canada Ltd. The instructional sessions include site safety, materials properties and strategies as well as tactics for containment and recovery in-facility, on land (brief) and on water spills. This training also includes the performance of mock spill response practical exercises in years of fuel offload, including deployment of spill response equipment under typical operating conditions.

Members of the Emergency Response Team receive frequent training regarding a variety of incident scenarios and response techniques applicable at the Hope Bay site. This training includes response to fire, explosive or toxic incidents, including spill of materials that could result in these conditions.

These training programs ensure that Hope Bay Project personnel understand the procedures in the Hope Bay Project Spill Contingency Plan, the hazards of the materials stored on-site, who is responsible for what activities, how to initiate a response, where to find and use response equipment, and how to obtain off-site resources.

5.1 Spill Response Simulation Exercises

A spill response simulation exercise will be conducted annually in coordination with TMAC Management and the Emergency Response Team. The exercise will simulate one of the environmental emergencies identified in Appendix 1 for an E2 Schedule 1 listed hazardous chemical or product stored on site. The exercise will simulate the release of one of these products to the environment and will test the response actions of the Incident Command System and Emergency Response Teams.

Every 5 years, a full-scale simulation exercise will be conducted which will test the response actions of the Incident Command System and Emergency Response Teams, and will include deployment of personnel, resources and equipment during the simulation.

Each annual exercise will simulate the release of a different E2 Schedule 1 listed product stored on site until all environmental emergencies identified in the Product Specific Emergency Response Plans have been tested, at which point the cycle will begin again. Emergency Response Plans for E2 Schedule 1 listed products stored on site are provided in Appendix 1 of this Plan.

Details of spill response simulation exercises will be documented and improvements identified will be incorporated into updates to the Spill Contingency and Emergency Response Plans. A record of these exercises, results and modifications to these plans will be maintained on file for 5 years and available for inspection upon request.

Once completed, a notice regarding the simulation exercise will be submitted to the Minister as outlined in Schedule 5 of the Environmental Emergency Regulations.

6 References

2010. *Consolidation of Environmental Protection Act* (R.S.N.W.T 1988, c.E-7). Current to August 29, 2010, Government of Nunavut.

2011. *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (S.C.2002, c.10) Current to May 5, 2011, Aboriginal Affairs and Northern Development Canada.

Consolidation of Environmental Emergency Regulations (S.O.R. 2019-51). Current to November 19, 2019, Environment and Climate Change Canada.

Consolidation of Regulation R-068-93 Spill Contingency Planning and Reporting Regulations as provided by the Government of Nunavut website.

Contingency Planning and Spill Reporting in Nunavut, A Guide to the New Regulations. Environmental Protection Service, Department of Sustainable Development, Government of Nunavut.

Implementation Guidelines for Environmental Emergency Regulations. 2011. Environment and Climate Change Canada.

Canadian Wildlife Services. 2012. *Birds and oil-CWS Response Plan*.

INAC. 2007. *Guidelines for Spill Contingency Planning*. Water resource Division, Indian and Northern Affairs Canada, April 2007.

International Council on Metals and the Environment. 1999. *The Management of Cyanide in Gold Extraction.*

Mudder, T.I. *Cyanide Spills Prevention and Response.*

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module A: Doris

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-DOH1335	H	1.	The Licensee shall implement the following plans as approved by the Board: *Surface Emergency Response Plan*, *Underground Emergency Responses Plan*, and *Hope Bay Project Spill Contingency Plan*. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board in writing.	This Plan
		2.	All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.6
		3.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering Water.	Section 2 Section 4.6
		4.	The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	Section 4.1
		5.	The Licensee shall perform weekly inspections of petroleum products storage and containment facilities, fuel tanks and connectors, for leaks and settlement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be requested by an Inspector.	Section 4.1
		8.	The Licensee shall conduct emergency maintenance and servicing on equipment, in designated areas, and shall implement measures to collect motor fluids and other Waste to prevent and contain spills.	Section 4.4
		9.	The Licensee shall, subject to Section 16 of the Regulations, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent, and:	See below
		9a.	• employ the Spill Contingency Plan;	Section 2
		9b.	• report the incident immediately via the 24-Hour Spill Reporting Line *[see pg. iii Key Government Contact List]*, to the Inspector at [see pg. iii Key Government Contact List] and to the Kitikmeot Inuit Association at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		9c.	• for each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initially reporting the event, which includes the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		10.	The Licensee shall, in addition to Part H, Item 9, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3
	I	11.	The Licensee shall submit to the Board for review, at least sixty (60) days prior to operation of the Roberts Bay Discharge System, an addendum to the Spill Contingency Plan detailing spill prevention measures along the pipeline.	A3
	Schedule B		The Annual Report referred to in Part B, Item 2 shall include the following:	See below
		8.	A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken	Section 3.3

A1 Introduction

The Type A Water Licence No. 2AM-DOH1335 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part I. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2AM-DOH1335 Licence area includes the Doris Camp and the necessary infrastructure to support surface exploration, underground mining and development activities, and ore processing. Refer to Module C of this plan for details and description of chemical storage related to Madrid infrastructure under this licence.

A2 Chemical Storage at Doris

A list of fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within each facility for the Doris area is provided in Table A.1 below. Chemical storage locations are also depicted on the photographs provided below, in addition to the default spill kit locations.

Table A.1. Doris Fuel and Chemical Storage Locations

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Roberts Bay Bulk Fuel Storage Facility (Quarry 1 / ST-6a)	1 @ 5,000,000 L Tank	Field-erected	Gravel/HDPE, 6,270,000 L	Diesel Fuel	5,000,000 L
Roberts Bay Bulk Fuel Storage Facility (ST-6b)	4 @ 5,000,000 L 1@ 400,000 L Tanks	Field-erected	Gravel/HDPE, 9,190,000 L	Diesel Fuel Jet-A	20,000,000 L 400,000 L
Batch Plant/ equipment storage	2 @ 1240 L	Pre-fabricated, double-walled, portable	Spill containment	Diesel Fuel	2 @1116 L
Doris Camp Site Fuel Storage Facility (ST-5)	5 @ 1,500,000 L Tanks Dispensing Module (Active)	Field-erected	Gravel/HDPE, 2,976,000 L	Diesel Fuel	7,500,000 L
Doris Helipad (office, washcar)	1 @ 1240 L	Pre-fabricated, double-walled, portable	Insta-berm, spill containment	Diesel Fuel	1116 L
Doris Helipad (Jet-A Storage)	Drums in Seacan (maximum 64 drums) 2 @ 3000 L Tanks	Drums Pre-fabricated, double-walled, portable	HDPE spill containment Spill containment	Jet A Fuel Jet-A Fuel	13,120 L 5400 L
Doris Helipad (landing pads)	Drum fuel (8) placed at each active helicopter landing pad	Drums	Plastic spill pallets, 220 L	Jet A Fuel	1640 L

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Doris Muster Station	1 @ 1240 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	1116 L
Doris Powerhouse (old)	1 @ 15,000 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	15,000 L
Doris Powerhouse (new)	4 @ 5000 L	Pre-fabricated, double-walled, portable	4 @ 5500 L each, Concrete	Diesel Fuel	20,000 L
Roberts Bay Waste Management Facility Generator	Internal tank @ 2250 L	Pre-fabricated, double-walled,	Internal steel spill containment	Diesel Fuel	2025 L
Roberts Bay Incinerator	1 @ 1500 L (Inactive) 2 @ 1000 L (Inactive)	Pre-fabricated, double-walled Pre-fabricated, double-walled	Steel Spill containment	Diesel Fuel Diesel Fuel	1350 L 2 @ 1000 L
Quarry 2 Incinerator	1 @ 4500 L	Pre-fabricated, double-walled	Steel Spill containment	Diesel Fuel	4500 L
Waste Management Facility Waste Oil Burner	2 @ 850 L	Plastic Cube	Spill containment	Waste Oil	1700 L
Rob Bay Muster Station	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel Spill containment	Diesel Fuel	1116 L
Doris Vent Raise	1 @ 70,000 L	Pre-fabricated, double-walled, portable	Gravel/HDPE, 77,000 L	Diesel Fuel	70,000 L
Doris Airport Tower Generator	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment; in seacan	Diesel Fuel	1116 L
Doris Pump House	1 @ 1240 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	1116 L
Geotech Shop	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	1116 L
Main Shop	2 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	2 @ 1116 L
Explosive Berm (TIA Access Road)	Seacan	NA	NA	Amex (Ammonium nitrate)	900,000 kg
Mill Building	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	1116 L

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Upper Laydown TIA Reagent Berm	Locked Seacan	NA	Seacans	Collector	90,000 kg
	Locked Seacan	NA	Seacans	Promoter	30, 100kg
	Locked Seacan	NA	Seacans	Frother	16,000 kg
	Locked Seacan	NA	Seacans	Flocculant Low pH	16, 000 kg
	Locked Seacan	NA	Seacans	Sodium Cyanide	240,000 kg
	Locked Seacan	NA	Seacan	Caustic Soda	450,000 kg
	Locked Seacan	NA	Seacans	Flocculant High pH	2,000 kg
	Locked Seacan	NA	Seacan	Sodium Metabisulphate	240,000 kg
	Locked Seacan	NA	Seacans	Copper Sulphate	125,000 kg
	Locked Seacan	NA	Seacans	Hydrochloric Acid	4000 kg
	Locked Seacan	NA	Seacans	Sodium Benzoate	20,000 kg
	Locked Seacan	NA	Seacans	Silica Sand	5000 kg
	Locked Seacan	NA	Seacans	Borax	12,500 kg
	Locked Seacan	NA	Seacans	Soda Ash	8750 kg
	Locked Seacan	NA	Seacans	Potassium Nitrate	5000 kg
Lower Laydown	Seacans with 1000 kg mega bags	NA	NA	Calcium Chloride	11,030 tonnes
	Seacan	NA	NA	Acetylene	10 - WTL bottles (~3600 cu. ft. of product)
	Seacan	NA	NA	Propane	30 – 100 lb bottles (3000 lbs)
	Seacan ERT building ERT building	NA	NA	Oxygen	10 - K bottles (6900 L ea) 3 - M bottles (3000 L ea) 4 - D bottles (350 L ea) (~79,400 L. of product)

Plate A.1. Roberts Bay Laydown (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars [or a yellow circle in the case of the aquatic mobile response spill response equipment] indicate default spill kit locations.)

Plate A.2. Doris Camp (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

Plate A.3. Quarry 2, Laydowns, Airstrip (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

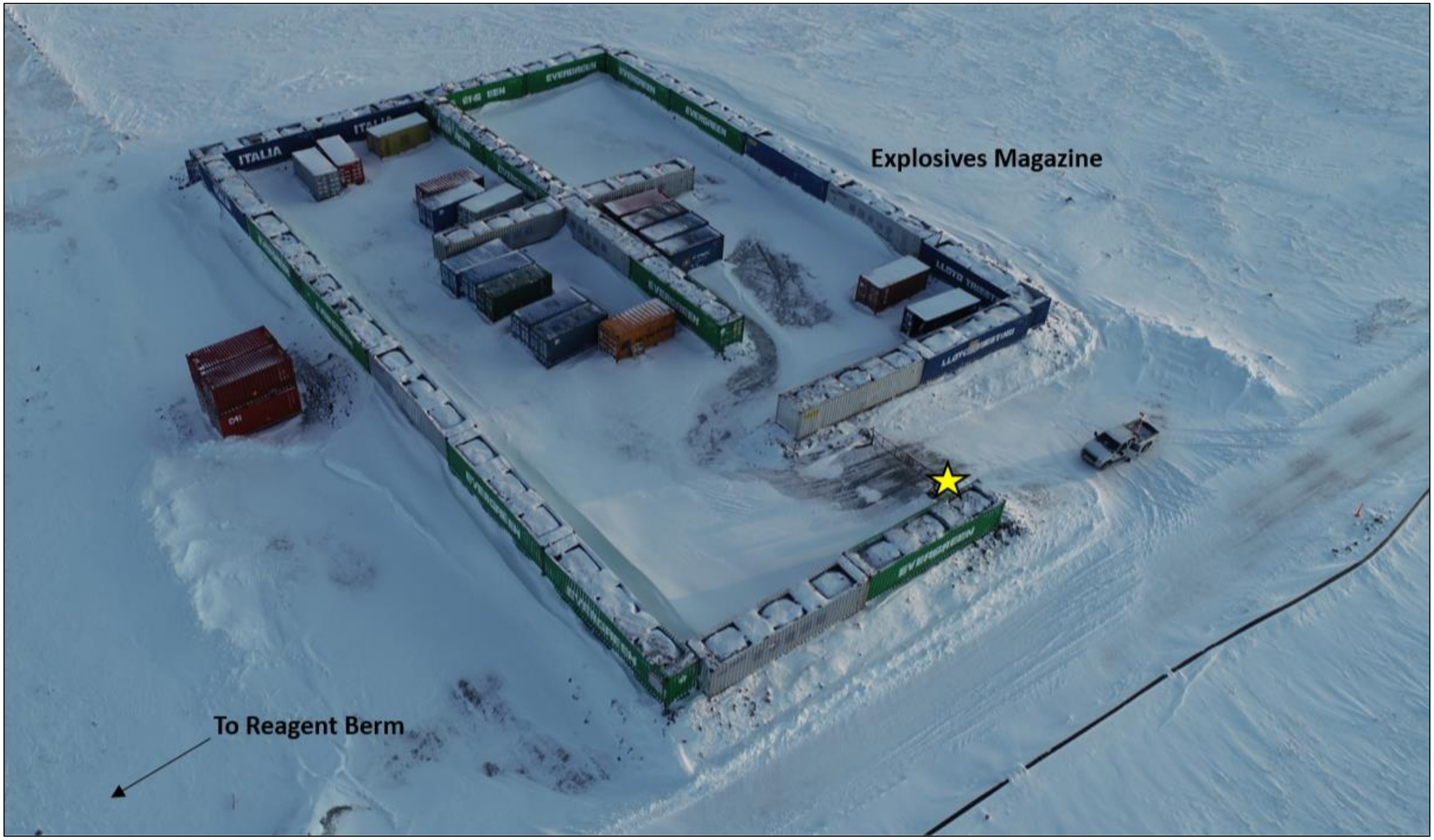

Plate A.4. Explosive Magazine (Note: Yellow star indicate default spill kit locations.)

A3 Water Treatment Process

Underground mine water is pumped from a settling sump system to a Water Treatment Plant (WTP) on surface designed to provide Total Suspended Solids (TSS) removal from the effluent stream prior being pumped to the RBDS Water Management Facility and to final discharge to Roberts Bay. The multi-stage process consists of coarse suspended solids removal via a lamella clarifier and the addition of a polymer flocculent followed by fine suspended solids removal utilizing multimedia filters. This treatment process is capable of meeting the authorized limits for TSS outlined in Schedule 4 of the MDMER.

A4 Roberts Bay Discharge System

The Roberts Bay Discharge System (RBDS) is designed to transport compliant effluent from the Doris underground mine and excess water from the Tailings Impoundment Area (TIA) to a subsea diffuser extending 2.1km into Roberts Bay. The Roberts Bay Discharge System consists of an insulated pipeline, the Roberts Bay Discharge Pipeline, which runs from the RBDS Water Management Facility, along to the Primary Road and the airstrip to the Roberts Bay Laydown Areas. At Roberts Bay the pipeline runs in front of the 20 Ml fuel tank farm, along the south side of the Roberts Bay Jetty Access Road and laydown pads, to the Roberts Bay shoreline along the south side of the Roberts Bay Discharge Access Road. The discharge pipeline enters the Roberts Bay marine environment through a Marine Outfall Berm, which extends from the shoreline to approximately the 40 m bathymetric contour and terminates at the Roberts Bay Diffuser.

A5 Spill Prevention

All pipelines in the system are constructed from HDPE material resistant to wear. Each pipe connection has been fuse welded to remove the risk introduced by Victaulic clamp installations which are susceptible to expansion during freeze/thaw conditions and wear resulting in leaks. The number of elbow joints on the pipelines has been minimized to the extent possible; elbow joints are more susceptible to wear over time due to increased force/pressure of effluent travelling through the joint. The system will operate at relatively low pressures, therefore leakage from normal operating modes is highly unlikely.

Flow meters have been installed between the TIA Intake Pump station and the RBDS Water Management Facility, and between the RBDS Water Management Facility and the Marine Outfall Berm Pump station to monitor flow within the pipeline. These flow meters are connected by fibre optic communication lines linked to a PLC system which communicates real-time flow measurements to the Process Plant Control Room. The Process Plant Control Room is manned 24hrs a day allowing for continuous monitoring of the discharge pipeline. An unanticipated drop in flow registered on these flow meters will trigger an immediate inspection of the pipeline to investigate cause. If a leak is detected during this inspection, discharge from the pipeline will be immediately shut down minimizing the volume of the release.

Inline instrumentation has been installed to measure TSS in each effluent stream prior to being combined. TSS is also measured after the effluent streams have been combined to determine compliance with the authorized limits for TSS outlined in Schedule 4 of the MDMER prior to discharge from the Final Discharge Point (FDP) to the environment. Low and high level alarms have been established to provide early notification of an increase in TSS to the Process Plant Control Room. If the low level alarm is triggered, the Water Treatment Operator is notified and is able to respond to any potential treatment upsets. If the high level alarms are triggered for either effluent stream, the system is automatically placed into recirculation back to the TIA until effluent streams are determined to be in compliance with the authorized discharge limits, and discharge to the environment may then be resumed. This real time monitoring significantly reduces the likelihood of non-compliant effluent being discharged to the environment.

The pipeline connecting the Underground sump system to the RBDS Water Management Facility is located upstream of the Doris Sedimentation and Pollution Control Ponds. Any leak from this system would report to these water management ponds and be transferred to the TIA.

Delineators are used to mark pipelines to ensure vehicle and equipment operators are aware of pipeline locations when travelling on site roads. Pipelines in this system have been aligned adjacent to roadways to the extent possible to allow for thorough inspections and to reduce the risk of vehicle and equipment interaction with the pipelines.

Pipeline inspections are conducted during each 12hr shift. This inspection includes driving the entire length of the pipeline and visually assessing the line for signs of leaks or spills.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module B: Windy

Conformity Table

Licence	Part	Item	Topic	Report Section
2BE-HOP1222	B	2.	The Licensee shall file an Annual Report on the appurtenant undertaking with the Board no later than March 31st of the year following the calendar year being reported which shall contain the following information:	See below
		2.e	• an update to the Spill Contingency Plan, if required, including contact information in the form of an addendum.	This report
	H	1.	The Licensee has submitted, September 23, 2011, a Spill Contingency Plan entitled Hope Bay Project Spill Contingency Plan, for the Hope Bay Project, which encompasses the Hope Bay Belt projects including Roberts Bay, the Doris, Boston and Windy camps. This Plan covers the Windy Camp with respect to care and maintenance of the site. The Licensee shall submit to the Board for approval in writing, within ninety (90) days of issuance of this Licence, a revised Plan that takes into consideration the status of the entire Hope Bay Belt project as it influences the activities, environmental and safety issues of the Windy Camp and the Hope Bay Regional Exploration Project.	This report
		2.	Licensee shall submit to the Board for approval in writing, sixty (60) days prior to the resumption of exploration activity at the Hope Bay Regional Exploration Project, a revised Spill Contingency Plan that is specific to the scope of this Licence and prepared in accordance with the *Spill Contingency Planning and Reporting Regulations* developed under Section 34 of the *Environmental Protection Act*.	Plan filed in March 2014, updated here. Sections 2 and B2
		3.	The Licensee shall, if not approved by the Board, revise the Plan referred to in Part H, Item 1, and resubmit to the Board for approval within thirty (30) days of receiving notification of the Board's decision.	Section 1.5
		4.	The Licensee shall implement the Plan specified in Part H, Item 1 as and when approved by the Board.	Section 1.5
		5.	The Licensee shall review the Plan referred to in this Part as required by changes in operation and/or technology and modify the Plan accordingly. Revisions to the Plan are to be submitted in the form of an Addendum, to be included with the Annual Report unless directed otherwise by an Inspector.	Section 1.4
		6.	The Licensee shall ensure that any chemicals, petroleum products or wastes associated with the project do not enter water. All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary high water mark of any adjacent water body and inspected on a regular basis.	Section 2 Section 4.6
		7.	The Licensee shall ensure that any equipment maintenance and servicing be conducted only in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		8.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		8a.	• employ the Spill Contingency Plan;	Section 2
		8b.	• report the spill immediately to the 24-Hour Spill Line and to the Inspector at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		8c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3

B1 Introduction

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

B2 Chemical Storage at Windy

Windy Camp is located 10km south of Doris Camp at N 68° 03.715’ W 106° 37.109’ and is in the process of being decommissioned. Fuel storage at Windy Camp is limited to one tank (double-walled Tidy Tank) containing a maximum of 1240L of diesel fuel. This tank is located more than 31 m from any waterbody and fuels a generator used to heat a pump house structure located at the potable freshwater intake south of Windy Camp. Water is used to supply Doris Camp with potable water, and regular inspection of this facility occurs as per the requirements of the Doris Water Licence. In case of a potential spill involving the Tidy Tank, there is a spill kit located at the pump house (at the shoreline).

No other hydrocarbons or chemicals are stored at Windy Camp. Any hydrocarbons or chemicals needed for decommissioning the camp structures will be brought to Windy Camp and consumed on an as-needed basis. Spill kits will be available within 200 m of working equipment during these activities. Chemical storage and spill kit locations at Windy Camp are shown in the photo below.

The Bulk Fuel Storage Facility at Patch Lake was fully dismantled in 2012 and the area is in the process of being reclaimed. There are no hydrocarbons or chemicals stored at the Patch Lake Facility. Fuel or lubes required to complete reclamation work will be brought in for immediate equipment use, and a spill kit will be available on site to support operating machinery.

In case of exploration drilling on land and on ice, chemicals will be brought in to assist with the drilling process and stored within secondary containment. Each drill will have its own fully stocked spill kit and chemicals stored will be kept to an amount needed for each shift. Excess chemicals will not be stored within Windy Camp.

One permitted facility for explosives materials is located at Quarry A on the west side of the Doris-Windy all-weather road. This facility can store a maximum of 40,800 kg of explosive materials containing ammonium nitrate. In the event of a spill of this material, the spill response actions would be completed as outlined in the Product Specific Emergency Response plan in Appendix 1 of this document.

B3 Windy Fuel and Chemical Storage Locations

Plate B.1. Windy Camp (Note: Red circle is fuel storage location. Yellow star indicates spill kit location.)

Plate B.2. Quarry A Explosives Magazine (Note: Yellow star indicates spill kit location.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module C: Madrid (Exploration and Operations)

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-DOH1335	H	1.	The Licensee shall implement the following plans as approved by the Board: Surface Emergency Response Plan, Underground Emergency Responses Plan, and Hope Bay Project Spill Contingency Plan. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board in writing.	This Plan
		2.	All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.6
		3.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering Water.	Section 2 Section 4.6
		4.	The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	Section 4.1
		5.	The Licensee shall perform weekly inspections of petroleum products storage and containment facilities, fuel tanks and connectors, for leaks and settlement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be requested by an Inspector.	Section 4.1
		8.	The Licensee shall conduct emergency maintenance and servicing on equipment, in designated areas, and shall implement measures to collect motor fluids and other Waste to prevent and contain spills.	Section 4.4
		9.	The Licensee shall, subject to Section 16 of the Regulations, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent, and:	See below
		9a.	• employ the Spill Contingency Plan;	Section 2
		9b.	• report the incident immediately via the 24-Hour Spill Reporting Line [see pg. iii Key Government Contact List], to the Inspector at [see pg. iii Key Government Contact List] and to the Kitikmeot Inuit Association at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		9c.	• for each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initially reporting the event, which includes the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		10.	The Licensee shall, in addition to Part H, Item 9, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3
	I	11.	The Licensee shall submit to the Board for review, at least sixty (60) days prior to operation of the Roberts Bay Discharge System, an addendum to the Spill Contingency Plan detailing spill prevention measures along the pipeline.	A3

Licence	Part	Item	Topic	Report Section
	Schedule B		The Annual Report referred to in Part B, Item 2 shall include the following:	See below
		8.	A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken	Section 3.3
2BB-MAE1727	B	2.	The Licensee shall file an Annual Report on the Appurtenant Undertaking with the Board no later than 31st of March, of the year following the calendar year being reported, containing the following information:	See below
		2j.	• Updates or revisions to the Water Management Plan, Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, and Spill Contingency Plan and/or any other management plan.	This Plan
	H	1.	The Licensee shall submit for Board approval in writing, within ninety (90) days following issuance of the Licence, a spill contingency Plan that is specific to the scope of this Licence, addresses comments received by the parties, and is prepared in the format set out by the Consolidation of Spill Contingency Planning and Reporting Regulations, R-068-93.	This Plan
		2.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering water. All Sumps and fuel caches shall be located at a distance of at least thirty-one (31) metres from the ordinary High Water Mark of any adjacent water body and inspected on a regular basis.	Section 2 Section 4.1
		3.	The Licensee shall conduct any equipment maintenance and servicing in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		4.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		4a.	• employ the Spill Contingency Plan;	This plan
		4b.	• report the spill immediately to the 24-Hour Spill Line at *[see pg. iii Key Government Contact List]* and to the Inspector at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		4c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		5.	The Licensee shall, in addition to Part H, Item 4, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3

C1 Introduction

The Type A Water Licence No. 2AM-DOH1335 and the Type B Water Licence No. 2BB-MAE1727 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2AM-DOH1335 Licence Area includes the Madrid North and Madrid South sites. Work at the Madrid North site began in 2019 and includes the necessary infrastructure to support surface mining at the Naartok East Crown Pillar trench and underground mining at the Madrid North portal. This infrastructure includes the Madrid North Contact Water Pond, Madrid North Waste Rock storage pad, as well as laydown pads and shop facilities.

No work has yet been conducted at the Madrid South site.

C2 Chemical Storage at Madrid North and Madrid South

A list of fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within each facility for the Madrid North site is provided in Table C.1 below. Chemical storage locations are also depicted on the photographs provided below, in addition to the default spill kit locations. All storage facilities are located at a distance greater than 31 m from any water body.

Table C.1. Madrid North Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Madrid North Fuel Storage Area ** (MMS-8)	3 @ 1,500,000 Tanks	Field erected	Gravel/HDPE	Diesel Fuel	4,500,000 L
Madrid North Portal Laydown	1 @ 10,000 L	Pre-fabricated double wall tank	Steel spill containment	Diesel Fuel	10,000 L
	Seacans with 1000 kg mega bags	NA	NA	Calcium Chloride	11,030 tonnes

**Additional portable storage facilities may be used depending on Project activity.*
*** Facility not yet constructed.*

Photos of chemical storage locations at the Madrid South site will be provided in the annual update of this plan once these facilities are constructed. A list of anticipated fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored at the Madrid South site is provided in Table C.2 below.

Table C.2. Madrid South Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Madrid South Fuel Storage Area ** (MAE-07)	1 @ 750,000 Tank	Field erected	Gravel/HDPE	Diesel Fuel	4,500,000 L

**Additional portable storage facilities may be used depending on Project activity.*
*** Facility not yet constructed.*

C3 Madrid Fuel and Chemical Storage Locations

Plate C.1. Surface Equipment Shop and Office/Lunchroom (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

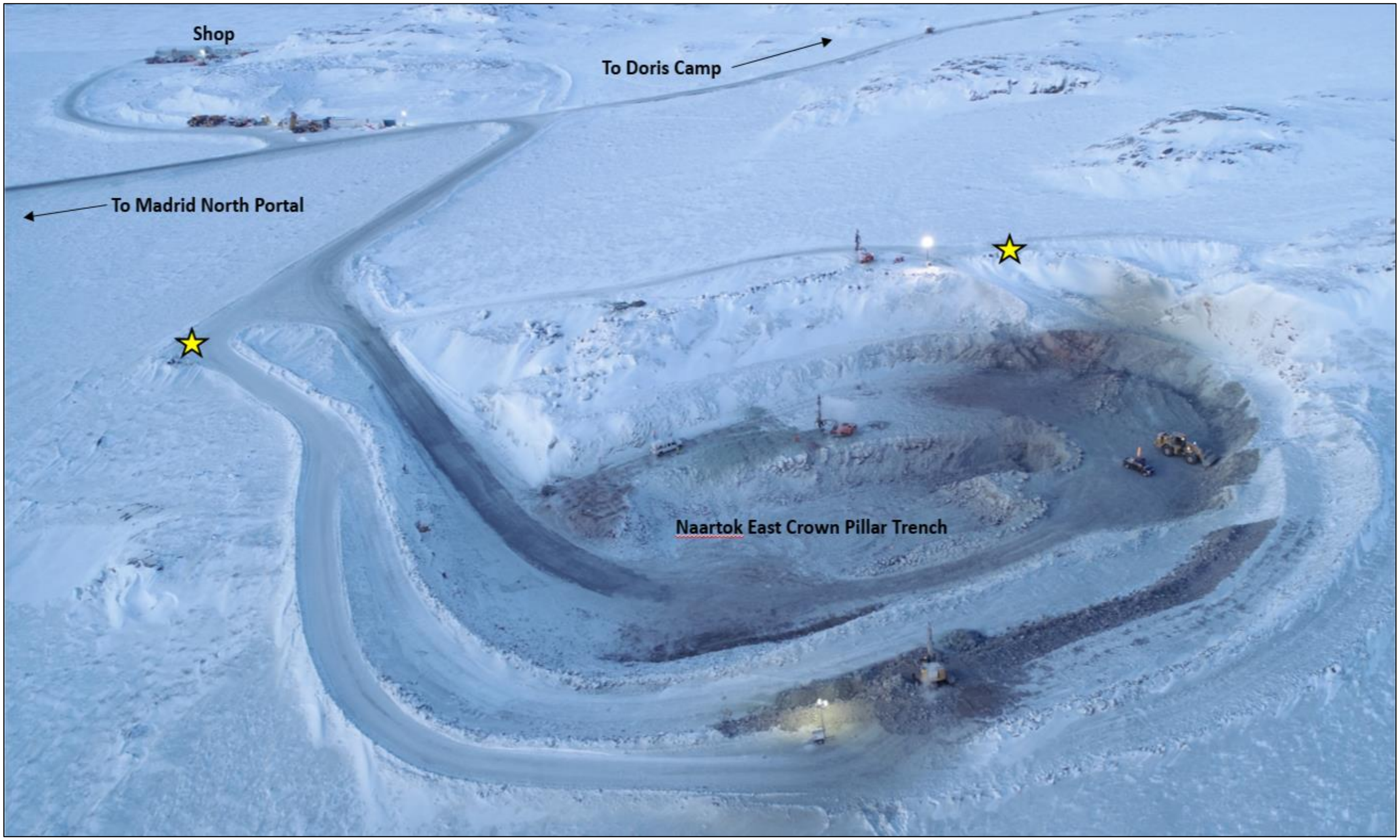

Plate C.2. Naartok East Crown Pillar Recovery Trench (Note: Yellow stars indicate default spill kit locations.)

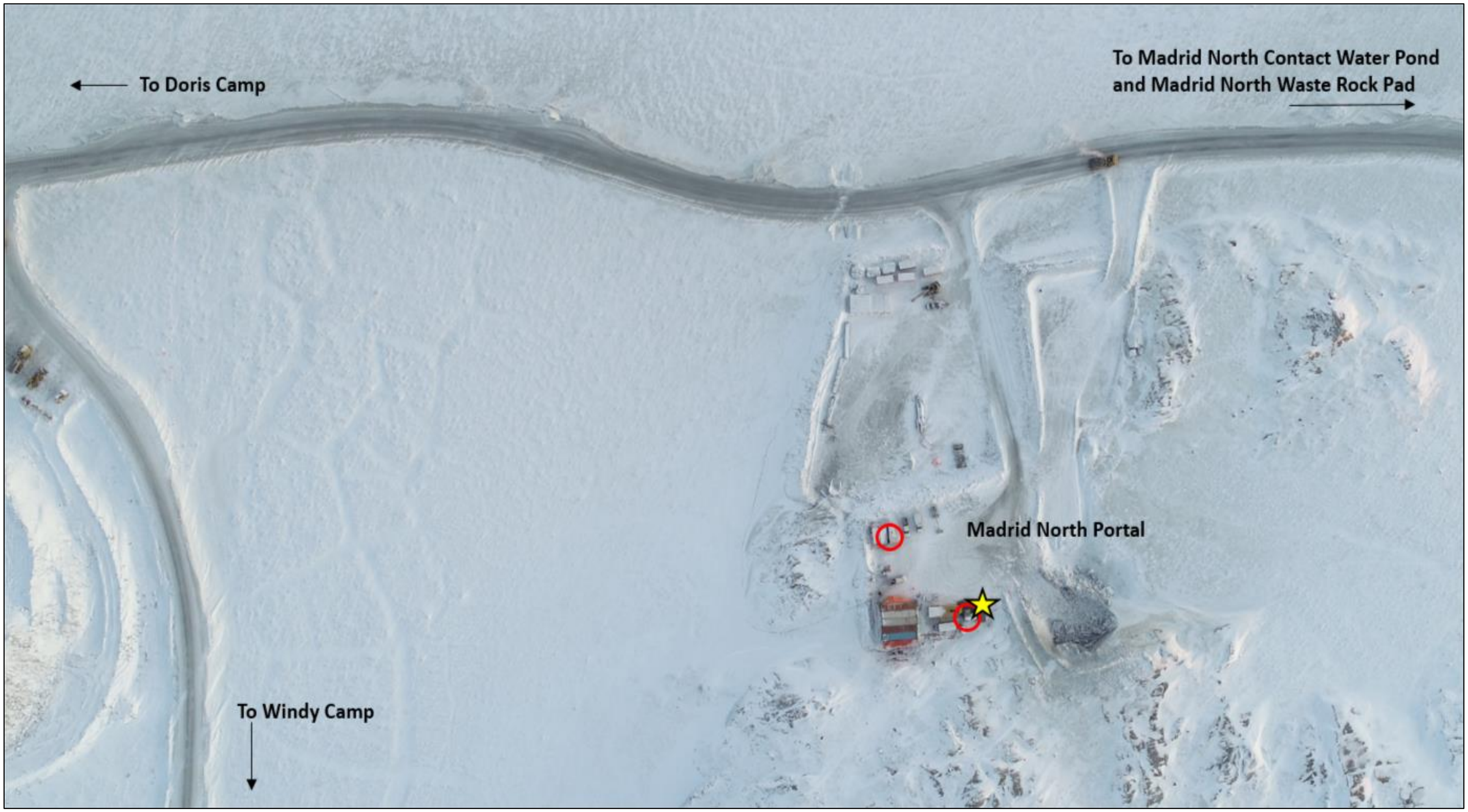

Plate C.3. Madrid North Portal (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

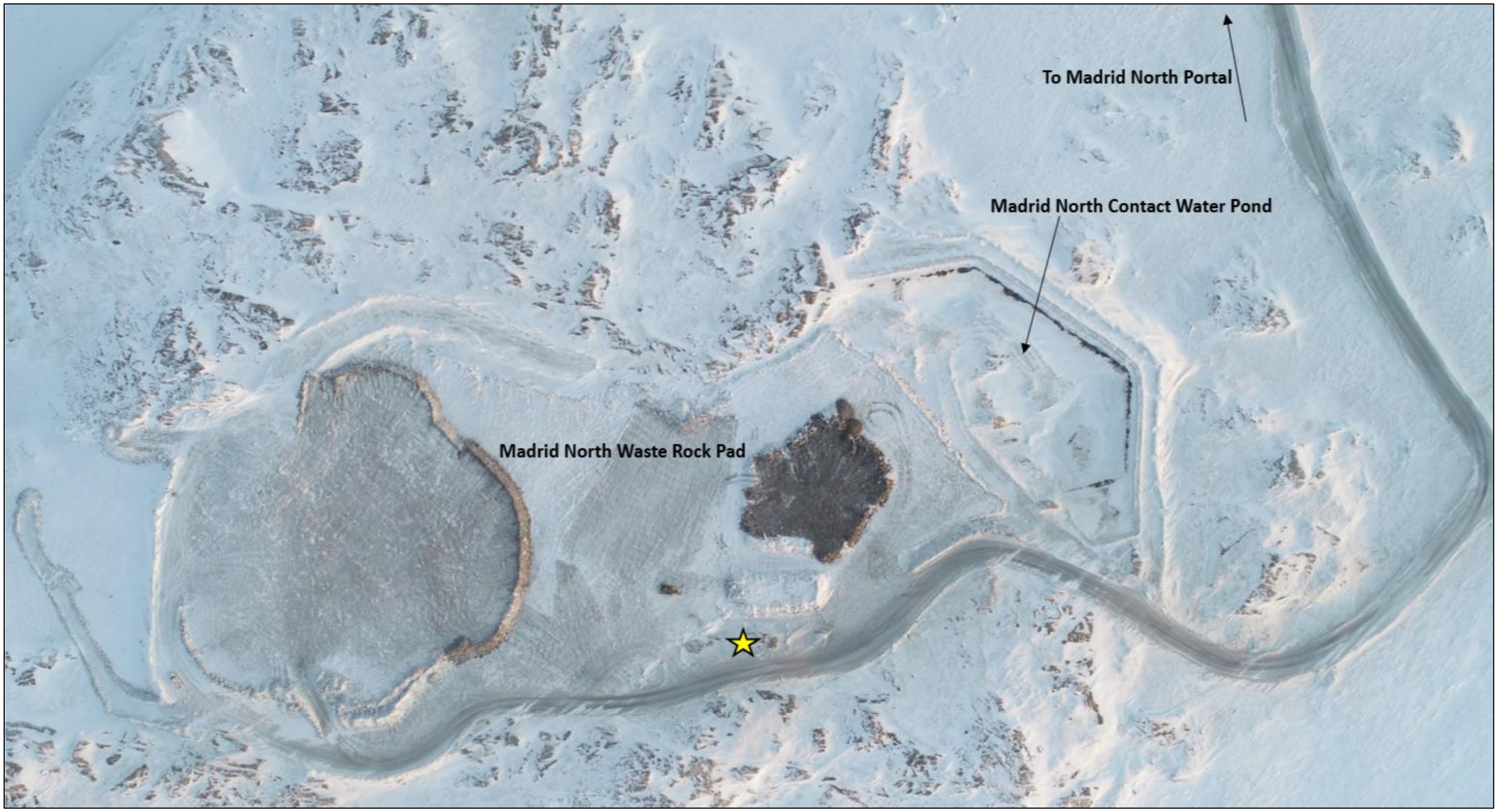

Plate C.4. Madrid North Contact Water Pond and Waste Rock Pad (Note: Yellow stars indicate default spill kit locations.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module D: Boston (Exploration and Operations)

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-BOS1727	B	9.	The Licensee shall file an Annual Report on the appurtenant undertaking with the Board no later than March 31st of the year following the calendar year being reported which shall contain the following information:	See below
		9l.	• updates or revisions to the Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, Spill Contingency Plan, and Landfarm Plan.	This Plan
	H	2.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering Water. All Sumps and fuel caches shall be located at a distance of at least thirty-one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.1
		3.	The Licensee shall conduct any equipment maintenance and servicing in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		4.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		4a.	• employ the Spill Contingency Plan;	This plan
		4b.	• report the spill immediately to the 24-Hour Spill Line at *[see pg. iii Key Government Contact List]* and to the Inspector at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		4c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		5.	The Licensee shall, in addition to Part H, Item 4, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3
2AM-BOS1835	H	1.	The Licensee shall implement the following plans as approved by the Board: *Surface Emergency Response Plan*, *Underground Emergency Responses Plan*, and *Hope Bay Project Spill Contingency Plan*. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board in writing.	This Plan
		2.	All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.6
		3.	The Licensee shall prevent any chemicals, petroleum products or unauthorized Wastes associated with the project from entering Water.	Section 2 Section 4.6

Licence	Part	Item	Topic	Report Section
		4.	The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	Section 4.1
		5.	The Licensee shall perform regular inspections of Fuel Storage and Containment Facilities, Sumps, Emergency Dump Catch Basins, other fuel tanks and connectors for leaks and movement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be required at the request of an Inspector	Section 4.1
		8.	The Licensee shall conduct emergency maintenance and servicing on equipment, in designated areas, and shall implement measures to collect motor fluids and other Waste to prevent and contain spills.	Section 4.4
		9.	The Licensee shall, subject to Section 16 of the Regulations, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent, and:	See below
		9a.	• employ the Spill Contingency Plan;	Section 2
		9b.	• report the incident immediately via the NT-NU 24-Hour Spill Reporting Line *[see pg. iii Key Government Contact List]* and to the Inspector at *[see pg. iii Key Government Contact List]*; and	Section 3.3
		9c.	• for each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initially reporting the event, which includes the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3 Section D3.2
		10.	The Licensee shall, in addition to Part H, Item 9, regardless of the quantity of release of harmful substance, report to the NT-NU 24-Hour Spill Report Line if the release is near or into a Water body.	Section 3.3
		11.	The Licensee shall submit to the Board for review, at least sixty (60) days prior to operation of the Aimaokatalok Lake Discharge System, an addendum to the Spill Contingency Plan detailing spill prevention measures along the pipeline.	To be provided 60 days prior to operation of Aimaokatalok Lake Discharge System
	Schedule B		The Annual Report referred to in Part B, Item 2 shall include the following:	See below
		8.	A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken.	Section 3.3

D1 Introduction

The Type A Water Licence No. 2AM-BOS1835 and Type B Water Licence No. 2BB-BOS1727 issued to TMAC by the Nunavut Water Board (NWB) require the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2BB-BOS1727 Licence Area includes the current Boston Camp site, which is opened seasonally to support exploration activities.

Facilities outlined in the 2AM-BOS1835 Licence have not yet been constructed and there is no activity occurring at Boston Camp under this licence at this time.

D2 Chemical Storage at Boston

Photos of current chemical storage locations and a list of current fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within the facility for the Boston Licence area is provided below. All storage facilities are located at a distance greater than 31m from any water body.

Photos of anticipated fuel and chemical storage locations associated with facilities identified in the licence 2AM-BOS1835 for the Boston Project will be provided when these facilities are constructed.

The current and anticipated fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within each facility associated with development of Boston are provided in Table D.1 below.

D3 Additional Spill Contingency Management at Boston

D3.1 Issue: Bulk Fuel Tank Farm

Eight fuel tanks are currently located in a lined fuel berm covered with crush material at the Boston Site. The berm was constructed on permafrost and the crush pad is thin in some areas which may lead to permafrost degradation beneath the berm over time. Foundation settlement of the tanks due to permafrost degradation could potentially occur over time and could cause the fuel tank to destabilize creating risk of one or more of the fuel tanks to destabilize and tip.

D3.2 Management Response

Fuel tanks are visually monitored for differential settlement during seasonal visits when the Boston site is accessible and during annual geotechnical inspections. Measurements of tank movement may also be collected if visual monitoring indicates a potential issue with one or more of the tanks. This may involve measuring the vertical angle of the fuel tank sidewall. A comparison of these values over time will indicate if differential settlement is occurring.

If settlement of the fuel tanks at the Boston site are detected beyond and acceptable limit, TMAC will discontinue the use of the tank(s) that are effected by settlement and engage the Engineer of Record (SRK Consulting) for guidance and recommendations for correcting the settlement issue.

Table D.1. Boston Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Boston Camp Bulk Fuel Storage Facility (BOS-5)	6 @ 77,000L Tanks 2 @ 33,500L Tanks	Pre-fabricated	Gravel/HDPE, 84,700 L	Diesel Fuel	377,127 L
Boston Fuelling Stations (tidy tank beside bulk storage)	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Fuelling Stations (fly tank beside bulk storage)	1 @ 785 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Gasoline	628 L
Boston Helipad	Drum storage (8 drums)	Drums	Plastic spill pallets, 220 L each	Jet A Fuel	1640 L (empty when Project closed)
Boston Jet A fuel storage	Drum storage (Portable Insta-Berm)	Drums	2 x 25,500 L	Jet A	51,250 L
Boston Generator Daytanks	2 @ 1240 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment (2)	Diesel Fuel	2232 L
Boston Tent Heaters Daytank	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Daytank (inside)	1 @ 350 L	Pre-fabricated, Single walled	Steel floor and kickplate	Diesel Fuel	315 L
Boston Camp Daytank (NE side of camp between main camp and tents	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Incinerator	1 @ 400 L	Pre-fabricated, double-walled	Steel spill containment	Diesel Fuel	360 L
Boston Bulk Fuel Storage Facility**	5 @ 1,500,000	Field erected	Gravel/HDPE spill containment	Diesel Fuel	7,500,000

** Additional portable storage facilities may be used depending on Project activity.*

*** Anticipated fuel storage as part of proposed Phase 2 Boston development outlined in Type A Water Licence 2AM-BOS1835.*

D4 Boston Fuel and Chemical Storage Locations

Plate D.1. North end Boston Camp (Note: Red circles are fuel or chemical storage locations, smaller storage locations may vary. Yellow star indicates spill kit locations.)

Plate D.2. South end Boston Camp (Note: Red circles are fuel or chemical storage locations, smaller storage locations may vary. Yellow star indicates spill kit locations.)

Plate D.3. Boston Airstrip (Note: Red circles are fuel or chemical storage locations, smaller storage locations may vary. Yellow star indicates spill kit locations.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 1: Hazardous Materials and Product Specific Emergency Response Plans

Poisonous and Toxic Substances

Sodium Cyanide Specific Spill Response Plan

Note: Sodium cyanide is not currently listed in Schedule 1 of the E2 regulations. However, a Product Specific Emergency Response Plan has been developed for this product based on the environmental and health and safety impacts of a potential spill. Hydrogen cyanide is produced when sodium cyanide reacts with water, acids or oxidizing agents. Hydrogen cyanide is listed in Schedule 1 of the E2 regulations.

CAS No: 143-33-9 (Sodium cyanide)

Hazards Identification:

Physical State: Solid (granular), White
Odor: Almond-like

Emergency Overview: DANGER. MAY BE FATAL IF INHALED, ABSORBED THORUGH SKIN OR SWALLOWED

Potential Acute Health Effects: Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, and of inhalation. Corrosive to eyes and skin. Cyanide is classified as extremely toxic.

Environmental Effects: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Usage: Sodium cyanide is used in gold recovery process within the process plant.

Storage: Sodium cyanide briquettes will be packaged in 1,000 kg bags. These bags must be kept dry, away from heat and sources of ignition. Keep away from oxidizing agents, acids and moisture. Bags will be stored on pallets in lined seacans or located in a lined containment berm or inside the Mill building as used. Do not store above 24°C. Avoid exposure to acid, water or weak alkalines which can react to form a toxic hydrogen cyanide (HCN) gas.

Personal Protective Equipment for Spill Response

- Self-contained breathing apparatus (SCBA) while conducting air quality monitoring to confirm HCN levels prior to initiating response and clean-up;
- SCBA required for response activities if HCN levels >2.5ppm;
- Full face respirator with vapor or dust cartridges, half face respirator with vapor or dust cartridges and splash goggles or safety glasses with face shield may be worn if HCN levels <2.5ppm;
- Full body chemical resistant suit (rubber);
- Rubber boots (chemical resistant); and
- Rubber gloves (chemical resistant).

Emergency response for a Sodium Cyanide Spill

- Isolate and evacuate the spill area if HCN has potentially been released.
  - Evacuation of other site locations may be required (large spills in water may require protection of personnel up to 5 km downwind).
- Report spill to Supervisor immediately. Provide location, estimated quantity, physical nature of the spilled material (e.g., solid or solution) and other substances/conditions that may create hazardous conditions during response (e.g., exposure of substance to water, acids, oxidizing agents).
- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response:
  - Based on size, location of spill and potential hazardous conditions/environmental impacts; and
  - SDS will be consulted to confirm appropriate response measures and associated hazards.
- Ventilate the area of the spill or leak and eliminate all ignition sources.
  - Air quality monitoring will be conducted in enclosed spaces to determine concentration of hazardous vapours prior to initiating spill response efforts.
- Stop the flow of spill.
- Contain the spill by placing spill booms or constructing interception dikes ahead of the flow (prioritizing prevention of release to waterways or onto ice).
- Protect the spill area from water runoff by constructing dike/berm. If raining, use tarps to cover the area to minimize water contact and spread of contamination.
- For spill to land:
  - Recover spilled solid material by shoveling into drums or containers free from impurities, seal container with lid and clearly label per WHMIS guidelines.
  - Minimize dust generated to the extent possible. Use water spray to reduce vapours; avoid contact of water spray with spilled material. Use tarps to cover spill area if water spray is used to reduce vapours.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into containers with lid, and clearly labeled as per WHMIS guidelines.
  - Recovered material which cannot be used will be packaged into drums for offsite disposal at an approved waste management facility.
  - Neutralize residual spill material with appropriate agent as recommended by the SDS (sodium or calcium hypochlorite solution) or continue to excavate area until no visible spilled solid remains. Use suitable spill absorbent or soil to absorb the neutralized residue.

- For spill to water:
  - NaCN dissolves in water producing highly toxic hydrogen cyanide gas – use extreme caution.
  - Pump contaminated water to drums, tanks or lined containment berms if possible. Isolate/confine the spill by damming or diversion if feasible.
  - Water treatment is only effective if it can be accomplished in conjunction with the spill.
  - Treatment chemicals (sodium or calcium hypochlorite) must not be added to surface waters (e.g., streams, lakes) as these are not generally effective and could result in additional environmental impacts.
  - Hydrogen peroxide for treatment of solution spills or a sulfur dioxide/air process for treatment of slurry spills may be considered. This measure may only be used as a last resort if containment is not achievable and the spill can be treated directly at the point of release.
- For indoor spills:
  - Recover spilled solid material by shoveling into drums or containers free from impurities, seal container with lid and clearly label per WHMIS guidelines.
  - Minimize dust generated to the extent possible. Use water spray to reduce vapours; avoid contact of water spray with spilled material. Use tarps to cover spill area if water spray is used to reduce vapours.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into containers with lid, and clearly labeled as per WHMIS guidelines.
  - Recovered material which cannot be used will be packaged into drums for offsite disposal at an approved waste management facility.
  - Neutralize residual spill material with appropriate agent as recommended by the SDS (sodium or calcium hypochlorite solution) or continue to excavate area until no visible spilled solid remains. Use suitable spill absorbent or soil to absorb the neutralized residue and package into drums for offsite disposal at an approved waste management facility.
  - Mop the affected area using detergent and water.
  - Place this water in labeled waste drums for offsite disposal at an approved waste management facility
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Ammonium Nitrate Specific Spill Response Plan

Notes: Ammonium Nitrate is a substance listed on Schedule 1 of the E2 Regulations, with a threshold of 20 tonnes. Ammonium nitrate is part of the Amex explosives (UN No 0082) mixture used at site.

CAS No: 6484-52-2 (Ammonium Nitrate)

UN No: 0082 (Amex)

Hazards Identification:

Physical State: Solid, pale oil-covered prills
Odour: Fuel oil

Emergency Overview: DANGER. STRONG OXIDIZER. CONTACT WITH OTHER MATERIALS MAY CAUSE FIRE OR EXPLOSION

Potential Acute Health Effects: Highly Explosive. Hazardous in case of contact with skin, eyes, ingested and if inhaled. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation.

Environmental Effects: Cause release of nitrogen compounds (nitrate, nitrite, ammonia) into aquatic environments. Potential effects include algal blooms, reduced oxygen and eutrophication of surface water bodies.

Usage: Amex is used for surface and subsurface blasting associated with quarrying and subsurface blasting related to mine development and mining.

Storage: Ammonium Nitrate is found in mixture form on site, in the form of Amex. Amex is stored in locked seacans located within the explosives berms or storage magazines, as well as temporary use locations during blasting preparation both underground and surface sites. The magazines and explosives berm locations are established and permitted through NRCan or the Ministry of Mines as appropriate.

The explosives storage areas are constructed and located so as to minimize risk to personnel and as permitted by the Ministry of Mines. The expected quantity to be stored on site is 1350 tonnes of Amex. The maximum allowed capacity of the largest container in which the substance is stored is 40,800 kgs.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemically resistant gloves;
- Protective glasses or chemical safety goggles;
- Chemically resistant coveralls or tyvek coveralls; and
- Dust mask if spill is in confined space.

Emergency response for an Ammonium Nitrate Spill

- Isolate and evacuate the spill area if potential for explosion.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area). Remove all uncontaminated combustible materials or organic compounds from spill area.
- Stop flow if safe to do so.
  - Ventilate space prior to entering, if indoors.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or dike using suitable absorbent materials, soil or other appropriate barriers.
  - Vacuum or sweep the spilled residue using non-metal, non-sparking tools.
  - Avoid shock, friction and contact with grit. Wet spillage with water to prevent dust generation.
  - Place the residue in a plastic container, label as per WHMIS Guidelines and transport to waste management for offsite disposal.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into suitable containers with lid, and clearly labelled as per WHMIS Guidelines.
- For spills to water:
  - Ammonium nitrate sinks and mixes with water.
  - Isolate/confine the spill from spreading by damming or diversion if feasible.
  - Pump contaminated water to drums, tanks or lined containment berms if possible.
  - Label drums for offsite disposal at an approved waste management facility.
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Explosive Materials

Aviation Fuel (Jet-A) Specific Spill Response Plan

Notes: Aviation fuel is a substance listed in Schedule 1 of the E2 regulations. The quantities of Aviation fuel currently stored at the Hope Bay Project do not exceed the Schedule 1 thresholds; however, a Product Specific Emergency Response Plan has been developed for this product based on the environmental and health and safety impacts of a potential spill. If spilled, aviation fuel could be immediately harmful to humans and/or the environment and has the potential to cause pool fires and vapour cloud explosion (dependent on manufacturer specific additives).

CAS No: 8008-20-06 (Kerosene)

UN No: 1223 (Kerosene)

Hazards Identification:

Physical State: Liquid, pale yellow
Odor: Petroleum/solvent
Flash Point: > 38˚C

Emergency Overview: HIGHLY COMBULSTIBLE. FLASH FIRE/EXPLOSION POTENTIAL. MATERIAL IS STATIC ACCUMULATOR.

Potential Acute Health Effects: Highly Explosive when vapour meets the air. Causes combustion and explosion. Hazardous if ingested or inhaled. May cause irritation to the eyes and respiratory tract. Reacts with oxidizing agents. Hazardous decomposition product: Carbon monoxide.

Environmental Effects: Toxic to aquatic organisms, may cause long-term adverse effects in aquatic environments.

Usage: Jet-A is used to fuel aircraft operating at the Hope Bay site (helicopters, airplanes).

Storage: Jet-A is stored in steel fuel tanks or manufactured fuel bladders within the secondary containment berm. Smaller quantities are stored in steel drums within ventilated seacans or within lined containment facilities at the location of use.

The expected quantity to be stored on site is 775 tonnes of Jet-A fuel. The maximum allowed capacity of the largest container in which the substance is stored is 400,000 L.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemical-resistant gloves (e.g., nitrile);
- Protective glasses or chemical safety goggles;

- Chemically resistant coveralls or Tyvek coveralls;
- Half face respirator with organic vapour cartridges or self-contained breathing apparatus; and
- Anti-static clothing.

<u>Emergency response for a Jet-A Spill</u>

- Isolate and evacuate the spill area if potential for explosion or combustion.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area).
- Stop flow if safe to do so.
  - Low-lying areas can trap explosive vapours.
  - Air quality monitoring will be conducted in enclosed spaces to determine concentration of hazardous vapours prior to initiating spill response efforts.
  - Ventilate space prior to entering, if indoors.
  - Restrict access to area and approach upwind of spill.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or berm using suitable non-combustible absorbent materials (e.g., sand, diatomaceous earth).
  - Do not contain spill if there is any chance of igniting vapours.
  - Cover small spills with non-combustible absorbent materials.
  - Use non-metal, non-sparking tools to collect absorption materials.
  - Place the residue in a steel container, clearly labeled as per WHMIS guidelines. Close tightly.
  - Ground tools and containers when collecting absorption material.
  - Transport to waste management for offsite disposal. Store in ventilated areas away from incompatible materials.
- For spills to water:
  - Jet-A fuel floats on surface of water.

  - Light hydrocarbon with narrow boiling range and low viscosity. Will evaporate or naturally disperse within a day or less in open water (NOAA Office of Response & Restoration, 2019).
  - Do not attempt to contain or remove spills (high explosion potential due to quick evaporation).
  - If Flash Point exceeds the Ambient Temperature by 10˚C or more, use containment booms and remove from the surface by skimming.
  - If Flash Point does not exceed the Ambient Temperature by 10˚C or is less than the Ambient Temperature, use booms as a barrier to protect shorelines and allow the material to evaporate.
  - Use booms to prevent spread of spill. Protect spread to shoreline where fuel can penetrate quickly into porous sediments.
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Diesel Fuel Specific Spill Response Plan

Notes: Diesel Fuel is a substance listed in Schedule 1 of the E2 regulations, with a threshold of 2500 tonnes. Diesel fuel is used on site to for power and to fuel various pieces of light/heavy equipment.

CAS No: 68334-30-5

UN No: UN1202

Hazards Identification:

Physical State: Liquid, clear to yellow
Odor: Petroleum/solvent
Flash Point: >= 40.0˚C

Emergency Overview:

Potential Acute Health Effects: Flammable liquid and vapour. Harmful if swallowed. May be fatal if swallowed and enters airways. Causes skin and serious eye irritation. Harmful if inhaled.

Environmental Effects: Toxic to aquatic life with long lasting effects.

Usage: Diesel is used for power generation and to fuel various pieces of light/heavy equipment operating at site.

Storage: Diesel is stored in steel fuel tanks within secondary containment berm or double walled fuel tanks.

The expected quantity to be stored on site is 24,000 tonnes of diesel fuel. The maximum allowed capacity of the largest container in which the substance is stored is 5,000,000 L.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemical-resistant gloves (e.g., nitrile);
- Protective glasses or chemical safety goggles;
- Chemically resistant coveralls or Tyvek coveralls;
- Full face respirator with organic vapour cartridges or self-contained breathing apparatus

Emergency response for a Diesel Spill

- Isolate and evacuate the spill area if potential for explosion or combustion. Stay upwind of spill/leak.
- Eliminate ignition sources.

- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area).
- Stop flow if safe to do so.
  - Air quality monitoring will be conducted in enclosed spaces to determine concentration of hazardous vapours prior to initiating spill response efforts.
  - Ventilate space prior to entering, if indoors.
  - Restrict access to area and approach upwind of spill.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or berm using suitable non-combustible absorbent materials (e.g., sand, diatomaceous earth).
  - Cover small spills with non-combustible absorbent materials, appropriate absorbent pads and placing absorbent booms in the path of flow of the spill.
  - Constructing temporary berms from soil or snow at the leading edge of the spill to minimize flow
  - Plastic tarps can be placed over and at the foot of the berm to capture pooling liquid and facilitate recovery
  - Pumping spilled material to empty drums or tanks
  - Excavators and other heavy equipment may be used to excavate contaminated materials
  - Use non-metal, non-sparking tools to collect absorption materials.
  - Place the residue in a steel container, clearly labeled as per WHMIS guidelines. Close tightly.
  - Ground tools/equipment and containers when collecting absorption material.
  - Transport to waste management for offsite disposal. Store in ventilated areas away from incompatible materials.
- For spills to water:
  - Diesel fuel floats on surface of water.
  - Identify the direction and speed of the flow path of the product based on weather conditions and drainage patterns

- Monitor the spread of the material using a drone or from a helicopter if possible to identify the area of spread
- Use appropriate absorbent pads, socks and similar materials to recover spilled product
- Granular sorbent materials are NOT to be used for spill response on water
- Hydrophobic absorbent booms will be deployed to contain large spills and to facilitate recovery
- Absorbent booms will be drawn slowly in to encircle the spilled product and absorb it
- Skimmers will be deployed in open-water areas to remove product from the water surface and boards or plywood may be used in streams or culverts to reduce the flow of spilled product on the surface and limit the area of the spill on the water
- Pump contaminated water into tanks or storage bladders if possible

* Remove, bag and label personal protective equipment for offsite disposal.
* Thoroughly wash skin with soap.

Acetylene Specific Spill Response Plan

Notes: Acetylene is a substance listed in Schedule 1 of the E2 regulations, with a threshold of 4.5 tonnes. Acetylene is used on site for welding on site.

CAS No: 74-86-2

UN No: UN1001

Hazards Identification:

Physical State: Dissolved gas, colourless
Odor: Garlic-like
Flash Point: -18˚C
Lower Flammable Limit: 2.4%

Emergency Overview: EXTREMELY FLAMMABLE GAS. CHEMICALLY UNSTABLE. STORED UNDER PRESSURE. CAN CAUSE RAPID SUFFOCATION. IMMEDIATE FIRE AND EXPLOSION HAZARD EXISTS WHEN CONCENTRATIONS EXCEED LOWER FLAMMABILITY LEVEL.

Potential Acute Health Effects: Extremely flammable gas. May react explosively even in absence of air at elevated pressure and/or temperature. Contains gas under pressure. May explode if heated. May form explosive mixtures in air.

Environmental Effects: No known eco-toxicological effects.

Usage: Acetylene is used for welding on site.

Storage: Acetylene is stored in steel compressed gas cylinder secured in cages or racks in seacans.

The expected quantity to be stored on site is 175 tonnes of Acetylene gas. The maximum allowed capacity of the largest container in which the substance is stored is 242 cubic ft.

Spill Response

Personal Protective Equipment for Spill Response:

- Self-contained breathing apparatus when entering confined spaces

Emergency response for an Acetylene Spill:

- Isolate and evacuate the spill area. Suffocation potential.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.

- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area).
- Never enter confined space or other area where flammable gas concentration is > 10% of its lower flammable limit.
- Ventilate area and monitor concentrations.
- Stop flow if safe to do so.

Hydrochloric Acid Specific Spill Response Plan

Notes: Hydrochloric Acid is a substance listed in Schedule 1 of the E2 regulations, with a threshold of 6.8 tonnes. Hydrochloric acid is used within the process plant.

CAS No: 7647-01-0

UN No: UN1789

Hazard Identification:

Physical State: Liquid, clear to pale yellow
Odor: Pungent

Emergency Overview: MAT BE FATAL IF INHALED. CAUSES RESPIRATORY TRACT, DIGESTIVE TRACT, EYE AND SKIN BURNS

Potential Acute Health Effects: Very toxic by inhalation. Corrosive to eyes, skin, respiratory system and digestive tract. Causes burns. Do not breathe vapor or mist. Do not ingest. Do not get in eyes or on skin or clothing.

Environmental Effects: Toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment.

Usage: Hydrochloric acid is used within the process plant.

Storage: Hydrochloric acid is stored plastic totes inside seacans.

The expected quantity to be stored on site is 140 tonnes of hydrochloric acid. The maximum allowed capacity of the largest container in which the substance is stored is 240 kg.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemical-resistant gloves (e.g., nitrile);
- Protective glasses or chemical safety goggles;
- Chemically resistant coveralls or Tyvek coveralls;
- Self-contained breathing apparatus.

Emergency response for a Hydrochloric Acid Spill

- Isolate and evacuate the spill area.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.

- Supervisor will report the spill immediately to the Environmental Superintendent or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Do not touch or walk through spilled material.
- Do not breathe vapor or mist. Provide adequate ventilation.
- Stop flow if safe to do so.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or berm using suitable non-combustible absorbent materials (e.g., sand, diatomaceous earth).
  - Neutralize with soda ash or lime. Use caution neutralization reaction can cause splashes, fumes and yield large amounts of heat resulting in boiling.
  - Dilute with water and mop up or absorb with inert dry material
  - Place in appropriate waste disposal container and seal tightly
  - Keep away from alkalis
  - Transport to waste management for offsite disposal. Store in ventilated areas away from incompatible materials.
- For spills to water:
  - Hydrochloric acid is soluble in water.
  - Do not attempt to contain or remove spills (high explosion potential).
  - Use booms to prevent spread of spill.
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Additional E2 Regulations Schedule 2 Materials to be Stored Onsite

The hazardous materials to be stored onsite and listed in the E2 Regulations may include the following substances throughout the duration of the project:

- Formalin;
- Unleaded Gasoline;
- Ethyl Mercaptan
- Propane; and
- Nitric acid.

The quantities of these products are not anticipated to meet the thresholds under the E2 Regulations for the development of a product specific spill response plan. However, if at any time the quantities of these materials stored onsite reach the threshold volume identified in these regulations a product specific spill plan will be developed and submitted as an addendum to this Plan.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 2: Spill Response Resources

Mobile Equipment

Any mobile equipment present on site may be used as a resource for spill response or spill clean-up. This includes pick-ups, skid steers, excavators, loaders, dozers, vacuum trucks, haul trucks, and flatbed trucks.

Spill Kit Contents

Each Spill Kit contains:

- 1 roll absorbent or bundle of spill pads;
- 2 plug and dyke kits;
- 1 – 3 m x 4 m tarpaulin;
- 2 pairs of disposable coveralls;
- 4 mini booms;
- 1 bag of corncob and/or peat moss absorbent;
- 1 bag of gravel type fire retardant granular for aviation stations (helipad and airstrip);
- 2 pair of neoprene gloves (i.e., POL [petroleum/oil/lubricants] resistant);
- 2 sets of splash proof POL resistant goggles;
- 1 shovel;
- 10 disposable waste bags and ties; and
- A copy of the First Responder diagram (Figure I at the beginning of this plan).

Aquatic Environment Response Equipment

Response equipment available in the event of a spill to the aquatic environment is stored in ten moveable seacans, with the exception of the boats. This equipment includes:

- 450 feet of 24" solid floatation boom;
- 70 lb, 43 lb, 25 lb, and 17 lb Danforth anchors;
- 8 lb Grapnel Anchors;
- 36" sea anchors;
- Anchor pins;
- Anchor Buoys;
- Anchor lines;
- 150 feet Towline;

- Boom towing bridles;
- 1250 feet of skirted booms (preassembled with tow lines, bridles and floats);
- 200 feet of inflatable Shore Saver booms (with inflation kit);
- 1TDS-118 Drum Skimmer;
- 1 P10E Power Pack;
- 2 Pump;
- 175 L Drum Response Kits c/w lids;
- Disposable coveralls (i.e., Tyvek suits);
- POL (petroleum/oil/lubricants) resistant gloves;
- POL resistant goggles;
- Toolbox c/w assorted tools;
- 45 Gallon containers c/w lids;
- Pails and Rubbermaid tubs;
- 300 foot Nylon rope (3/8);
- Bags of Oclansorb™ Peat Moss or crushed corn cobs;
- Bundles of oil sorbent pads;
- Bundles of universal sorbent pads;
- Oil Sorbent booms;
- Oil snares;
- Universal sorbent booms;
- Bag of Sorbent scraps (spaghetti);
- Containment tanks and berms;
- Plug and dyke kits;
- HAZMAT Disposal Bags and Garbage bags;
- Portable fuel bladders;
- Ice scrapers;
- A net for capturing seabirds/oiled wildlife;
- An 18-foot landing craft boat (with boat safety kit); and
- An 18-foot Zodiac (with boat safety kit and repair kit).

The above aquatic response equipment is considered more than necessary for the potential spills covered under this Plan. Spills to the aquatic environment are limited in potential scale as all fuel storage tanks are located in secondary containment and most are located away from water. The Roberts Bay multiple tank fuel farm berm also has significant excess capacity to contain failure of more than one tank.

As a consequence, spills that may reach water are expected to be limited in size, manageable and recoverable using the aquatic response equipment available on site. If for any reason additional resources are needed, they are available through Mackenzie Delta Spill Response Corporation.

Large spills to the marine environment resulting from bulk fuel offloads are addressed through the OPPP/OPEP. As outlined therein, shipping contractors provide all necessary equipment needed to appropriately respond to a fuel-offload spill, with TMAC supplies serving as additional resources available.

Specialized Response Equipment

A stock of specialized spill response equipment is maintained on site and available for use in the event that a product spill as outlined in a Product Specific Spill Response plan occurs. This equipment includes:

- Full body chemical resistant suits (Tyvek);
- Rubber chemical resistant jackets, pants;
- Chemical resistant boots and gloves;
- Splash goggles and full face shields;
- Full and half face respirators with appropriate filters (e.g. organic vapour cartridges);
- Drager Self-contained breathing apparatus;
- Fire retardant coveralls and firefighting bunker gear;
- Drager BG-4 breathing apparatus (not to be used if product has explosive potential);
- Air quality monitors equipped with HCN, CO and O2 sensors;
- Non sparking tools, such as plastic shovels; and
- Sodium hypochlorite solution.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 3:
Environmental Resource Maps

Environmental Resource Maps

Shown in the following resource maps are areas of particular vegetation meaningful to the local wildlife and ecosystems which surround the project as well as raptor nests, rare plants and fish habitat. Additional detailed information may be found in baseline and monitoring reports available from the Environmental Superintendent and publically available on the Nunavut Impact Review Board and Nunavut Water Board websites. Information regarding archeological sites that have been identified on the Hope Bay belt is available to the Environmental Superintendent in the event of a spill. At the requirement of the Territorial Archaeologist, the locations of these sites are strictly confidential and information on these locations is only shared on an as needed basis. Spill containment will attempt to minimize impacts to sensitive habitats and archaeological sites.

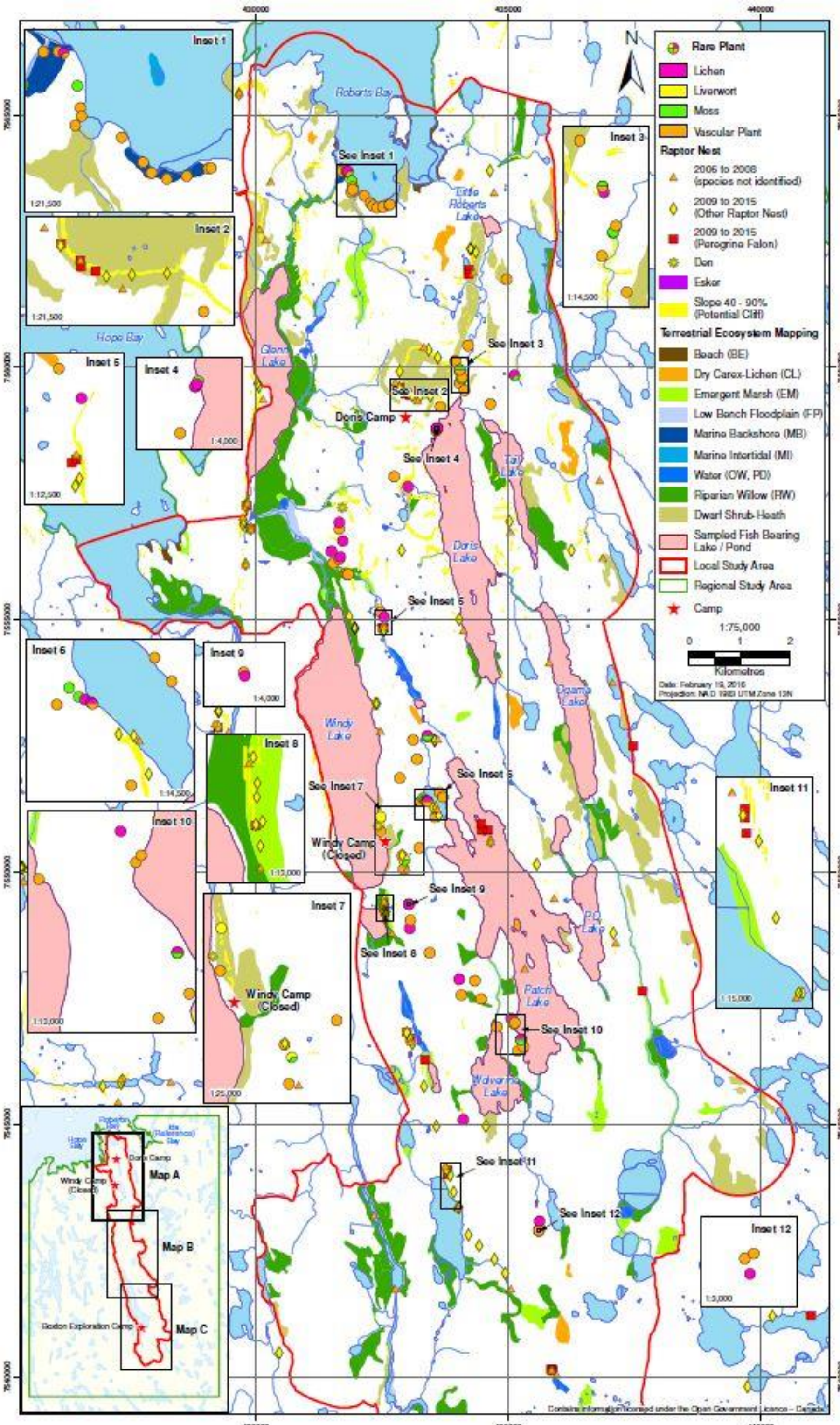

Figure 3.1. Environmental Sensitivity Mapping-Map A

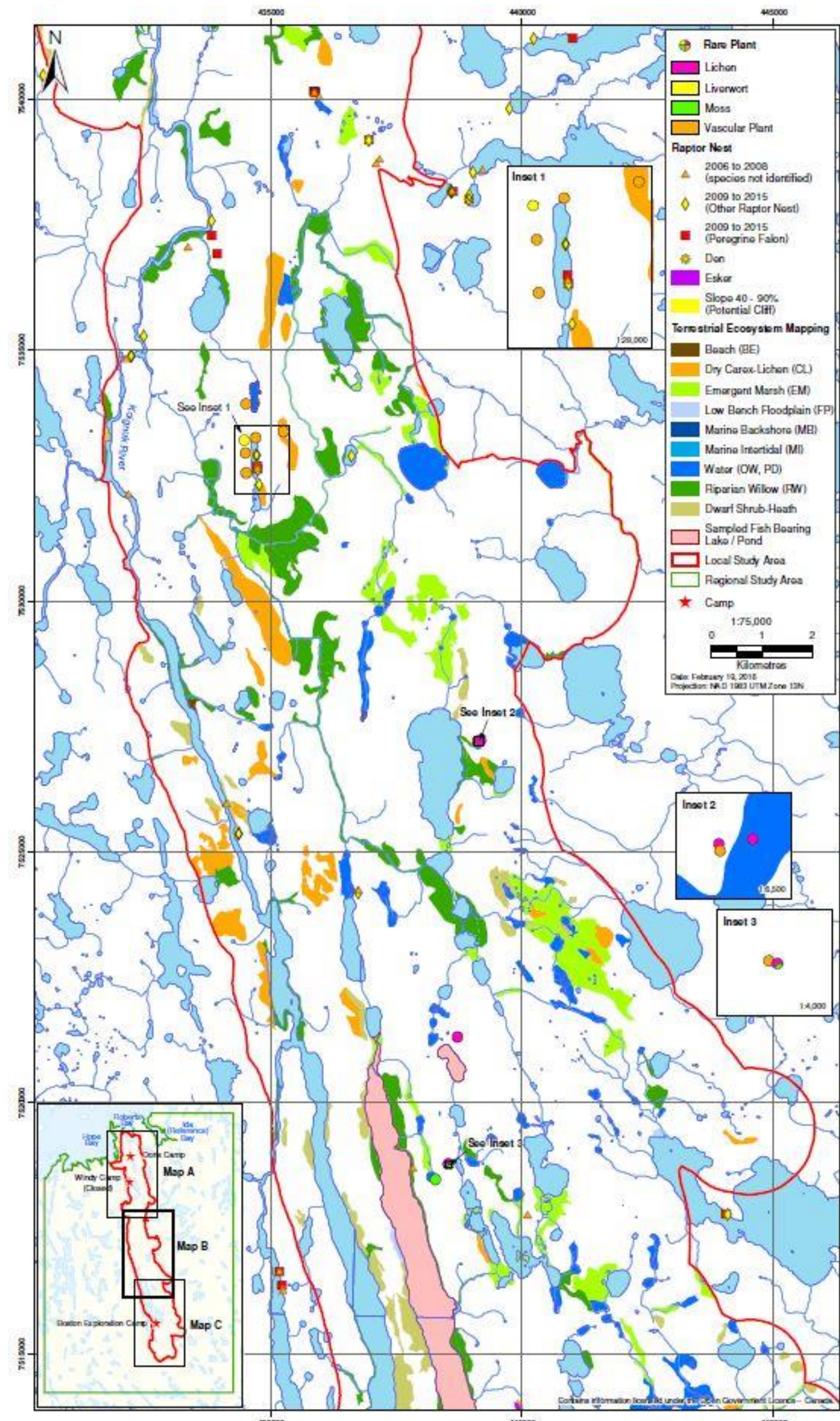

Figure 3.2. Environmental Sensitivity Mapping-Map B

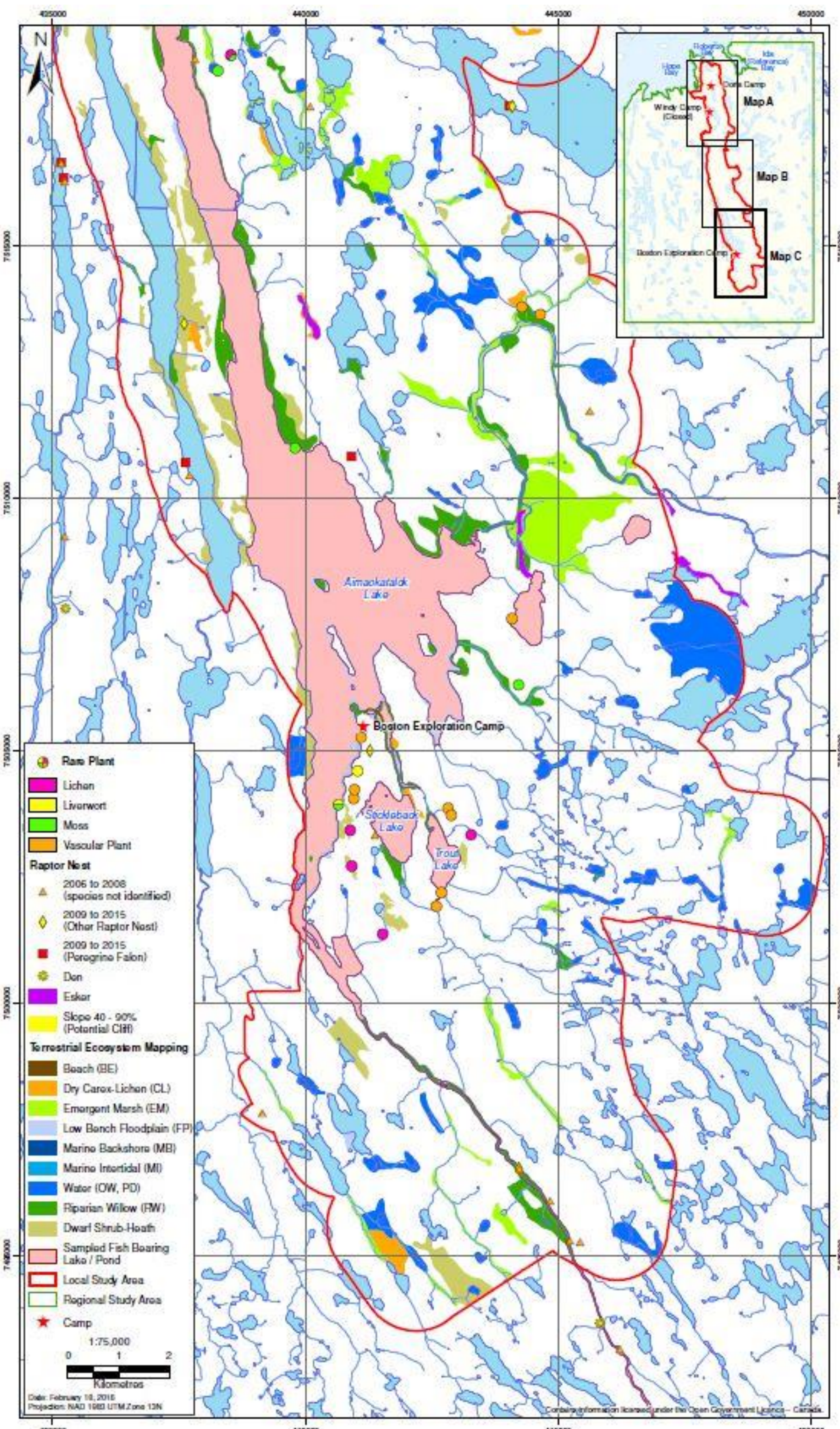

Figure 3.3. Environmental Sensitivity Mapping-Map C

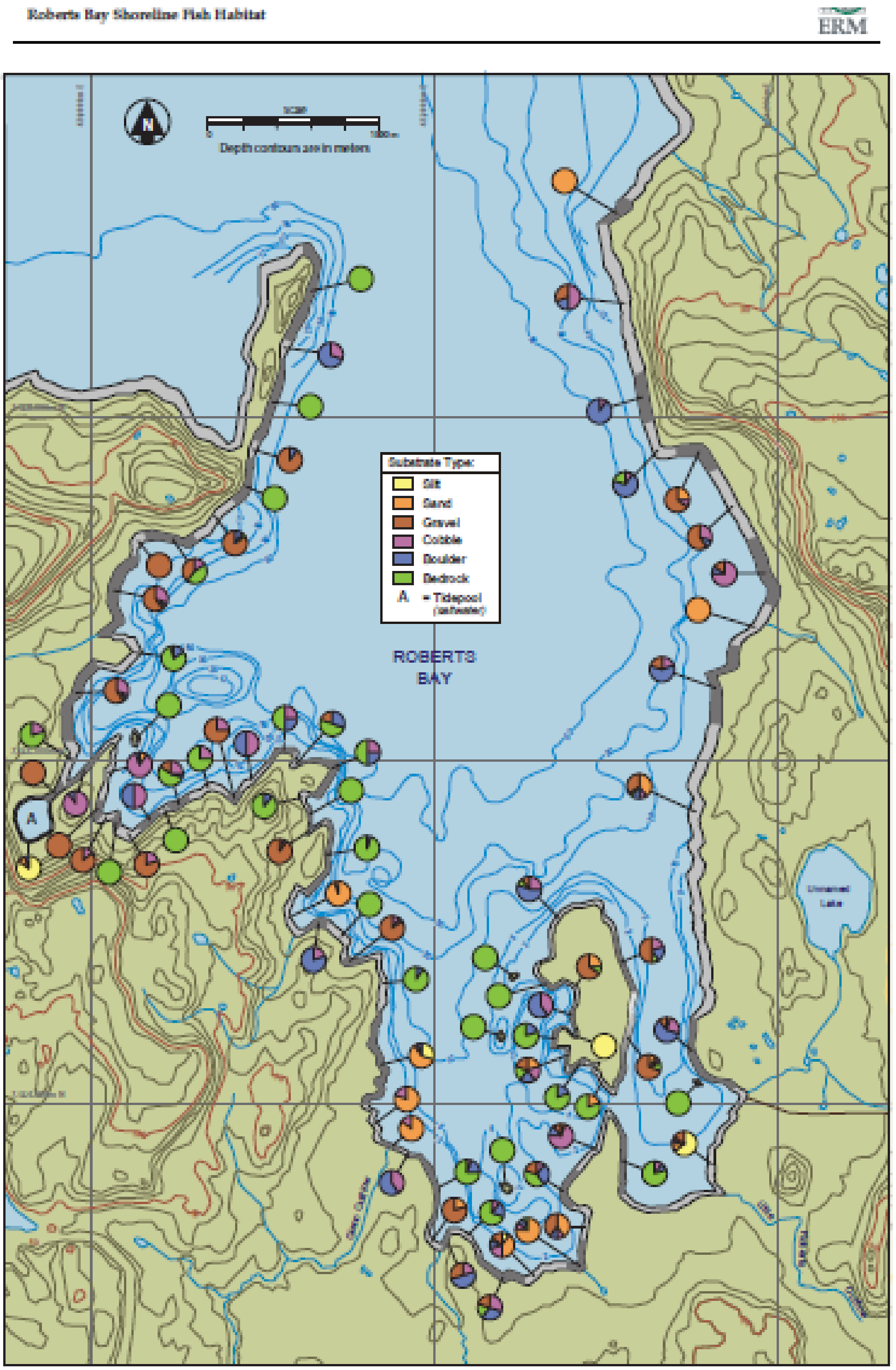

Figure 3.4. Environmental Sensitivity Mapping-Map D

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 4: Responses to Comments on Previous Plan Versions

Comment Responses and Revision References

This Plan replaces the September 2019 Spill Contingency Plan for the Hope Bay Project. Table 4.1 below outlines the comments received on previous versions of this Plan and TMAC's responses.

Table 4.1. Comments Received on Previous Versions of this Plan and TMAC's responses

Reviewer	Comment #	Comment	Recommendation	Response
INAC	1	Module A of the Spill Contingency Plan provides details on spill kit contents and aquatic environment response equipment, but the information on mobile equipment (machinery) to be used for spill response is not available.	INAC recommends that the licensee include the list of mobile equipment to be used for spill management, as well as the spill containment equipment on each piece of equipment.	Any mobile equipment present on site may be used as a resource for spill response or spill clean-up. This includes pick-ups, skid steers, excavators, loaders, vacuum trucks, haul trucks, and flatbed trucks. This has been made clear in revised text in Module A.
INAC	2	Section 2.5.1 of the spill contingency plan states that spill response kits will be available within 200 m of any areas where chemicals are stored and used. Aquatic spill response kits are available in moveable containers. The spill response kit locations are described as being easily accessible, but it is not clear if there will be adequate signage to identify them. As well, the modules at the end of the plan include pictures on which chemical storage locations are circled, but there is no indication where to find the spill kits beside them. The Guidelines for Spill Contingency Planning recommend including a plan with many features including storage locations of hazardous materials and locations of spill response kits.	INAC recommends that spill kit locations be identified on the ground and, on a site map or indicated in the pictures included in the plan. Default storage locations for the mobile aquatic response spill kits should be included so that a person consulting the plan would quickly know where to look for them.	Default spill kit locations, including the mobile aquatic response spill kits, have been now indicated on the site photographs provided in the site-specific modules.
INAC	3	The section on spill response actions (2.3) outlines actions to be taken in event of different spill scenarios. Two of the scenarios for spills in water outline actions to be taken in event of a hydrocarbon spill, but do not speak to what should be done if other materials are spilled. These are sub-sections 2.3.5, spills under ice, and mitigation of impacts to birds. Some of the materials listed as on site including sodium cyanide would not disperse in the same way as petroleum products and would require different action responses.	INAC recommends that the licensee include action responses for materials that might sink or dissolve in water for spills under ice and mitigation of impacts to birds.	Information addressing spill sunder ice of substances that sink and dissolve is now presented in Sections 2.3.6 and 2.3.7, respectively. Mitigation of impacts to birds is addressed under 2.3.10.1.

Reviewer	Comment #	Comment	Recommendation	Response
INAC	4	Table 1 of Section 1.2 includes regulations and guidelines governing the spill contingency plan. Other regulations are referenced in the text and included in Section 7 of the plan.	INAC suggests that other material to be considered might include: - Federal Transportation of Dangerous Goods Act and regulations; and - NWT Used Oil and Waste Fuel Management Regulations	Waste material generated during spill response is managed as per the Hazardous Waste Management, Non-Hazardous Waste Management Plan, and/or the Landfarm Management Plan as indicated in Section 2.4 of the Plan. TMAC's Hazardous Waste Management Plan includes consideration of/reference to the Federal Transportation of Dangerous Goods Act and regulations and NWT Used Oil and Waste Fuel Management Regulations, as well as many other materials which may apply to management and disposal of spill response wastes, such as GN's Environmental Guideline for Used Oil and Waste Fuel.
ECCC	1	Reference: Page 18 of the revised Spill Contingency Plan, EC #2 Comment: As noted in the table ECCC requested that TMAC undertake and incorporate hazardous substance identification and risk assessment into the Spill Contingency Plan in order to provide the required basis for accident scenario characterization and response planning.	It is expected that the risk assessment process will incorporate consideration of the likelihood of various spills and their potential consequences, which will determine appropriate mitigation/response strategies according to the resulting matrix rankings.	TMAC has provided further clarification of the risk assessment process to be undertaken for all work areas in the revised Plan, in Section 4.
ECCC	2	Reference: Pages 18-19 of the revised Spill Contingency Plan, EC #4 Comment: ECCC reiterates recommendation EC #4 which requests that TMAC document and provide information on worst case accident scenarios for each hazardous product stored and handled onsite.	While the TMAC has indicated that the appropriate sections of the SCP “will continue to be refined in future revisions to capture additional scenarios as operational activities evolve and corrective actions/lessons learned are developed through incident investigations” ECCC is of the opinion that by identifying worst case accident scenarios now, TMAC will be better placed to determine actual required response capacities and develop adequate preparedness and response plans.	During the 2016 revision of the Plan, and based on ECCC's recommendation # 4 cited in the 2016 Plan, TMAC identified worse case scenarios and appropriate responses and included this information in the 2016 SCP as Section 4 "Spill Response Management Issues and Contingencies". TMAC's text indicating that worst case scenarios and responses 'will continue to be refined in future' was an acknowledgement of the continual improvement process loop employed at the Hope Bay Project including the risk assessment process, and recognition that additional scenarios may be identified and added to this Plan in future as a result.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	1 (KIA-6)	The Spill Contingency Plan provides a solid outline of reporting and mitigation measures in the event of a spill. Although specific mitigation of impacts to wildlife, including birds, and sensitive habitats is outlined, there is no specific detail associated with a spill into fish habitat. It is noted that no chemicals are stored with 31 m of water, but there are no specific response actions protective of fish, as is outlined for other wildlife in the 'environmentally Sensitive Species' section. Environmental Resource Maps are provided in Module C, but the focus is on vegetation and terrestrial features.	TMAC should include additional maps and detail be provided for freshwater and marine fish habitat, so that sensitive features can be avoided, and if a spill were to occur near or in water, that the sensitivity of the habitat would be easily found and appropriate mitigation measures taken.	Fish are addressed and protected under the Plan by the management actions addressing spills to water. Fish habitat (sites which have been sampled for fish and within which fish have been found) are also indicated on the Environmental Resource Maps presented in Module C. TMAC has also included a fish habitat map of Roberts Bay in the revised Plan to allow identification of sensitive intertidal and shallow subtidal habitat for avoidance where possible.
KIA	2 (KIA-7)	The Spill Contingency Plan states in section 1.4, "In the event that a spill requires activation of the Emergency Response Plan, the Environmental Coordinator will provide guidance to the Surface Manager regarding implementing response actions according to this plan and evaluating priorities for protection of sensitive habitats/species and archeological features at risk." A decision tree for use by the Surface Manager/Incident Commander or Environmental Coordinator has not been provided for the reviewer to evaluate how sensitive habitats/species and archeological features are prioritized in the event of potential impact to multiple priority areas.	TMAC should include a decision tree outlining how various sensitive or high value locations are prioritized. This will ensure of these locations are prioritized in the event of a spill or unplanned discharge in a manner satisfactory to KIA.	A prioritization hierarchy has been proposed for the environmental sensitivities and is now included in Section 2.3.10.
KIA	3 (KIA-8)	In Section 2.3.8, the Plan states, "TMAC and previous companies operating on the Hope Bay site have conducted numerous ecological surveys to identify [environmentally sensitive habitats or archeological sites] at risk, with the focus of identifying those areas immediately surrounding Project infrastructure which are at greatest risk of impact from a spill. In the event that a spill enters the natural environment, the Environmental Coordinator will use maps identifying these sensitive areas to prioritize the protection of these resources." In the event of an unplanned spill or discharge, these sites will only become a mitigation priority after the	TMAC should ensure that the Environmental Coordinator has a-priori knowledge of high priority environmentally sensitive habitats and archeological sites and how to respond in these areas and provide all first responders with instruction on the locations of high priority environmentally sensitive habitats and archeological sites so that First Responders are immediately aware of them in the event of a spill or unplanned discharge. This would allow these locations to be	TMAC wishes to clarify that environmentally sensitive habitat maps are included in the Plan, which is available to all staff including the Environmental Coordinator. These maps identify locations of sensitive habitat, raptor nests, den sites, and fish habitat. Only archaeological site locations are kept confidential, at the requirement of the GN's Territorial Archaeologist. However, the Environmental Coordinator has ready access to archaeological site maps. of all

Reviewer	Comment #	Comment	Recommendation	Response
		Environmental Coordinator has had a chance to review the pertinent maps and provide guidance to the response team. A delay in First Responders becoming aware of these priority locations may limit the effectiveness of mitigation measures, permit more significant adverse impacts than necessary, or even damage those locations through the application of mitigation measures. We understand that, Environmental Resource Maps outlining archeological sites are kept confidential by TMAC. However, the need to keep the locations of these sites confidential must be weighed against the risk of potential spills and unplanned discharges.	prioritized and/or avoided when applying mitigation measures.	locations which may be designated high priority.
KIA	4 (KIA-9)	In Section 3.4 the Plan states, "Monitoring activities may be conducted to assess the impacts of the spill and the effectiveness of associated cleanup/remediation efforts in the event a spill cannot be completely removed." The KIA notes that spills reaching watercourses or waterbodies will eventually disperse as a result of natural hydrology such that they are "completely removed" from the environment even if impacts have occurred. The language included in the Plan does not require monitoring in the event of a spill or unplanned discharge to water nor other habitat types. The KIA's right to compensation for damages to their lands and waters makes prompt and effective monitoring important to both TMAC and the KIA in the event of a spill or unplanned discharge.	TMAC should include triggers which require monitoring activities, and provide details of the type of monitoring that will be undertaken as part of adaptive management to spills and unplanned discharges in the Plan. This discussion should be specific to the type of spill, volume, mobility of the spilled material and proximity to various habitat features. Triggered monitoring should be implemented as quickly as possible such that it would characterize the impact of a spill to the receiving environment as well as the effectiveness of mitigation.	TMAC has provided more detail on spill related monitoring in Section 3.4.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	5 (KIA-10)	TMAC specifies in Module B that the Windy Camp is "no longer occupied". TMAC further specifies that "Fuel storage at Windy Camp is limited to one tank (double-walled Tidy Tank) containing a maximum of 1240L of diesel fuel." This tank is located more than 31 m from any waterbody and has been placed in "a secondary portable berm capable of containing the full volume of this tank in the event that the double-walled system failed". However, no schedule for regular inspections of the tank or secondary containment has been included. A breach in the double-walled Tidy Tank may persist within the secondary containment for an unknown period of time placing the receiving environment and wildlife at potential risk.	TMAC should include the frequency fuel storage structures will be inspected at the Windy Camp, and increase the capacity of the secondary portable berm to 110% the total volume of the 1240L Tidy Tank.	TMAC has clarified in the revised Plan that the tank at Windy is a double-walled enviro tank (i.e. it possesses 110% secondary containment in its design and construction), and is also located inside of tertiary containment, with a capacity > 110 % of the volume of the tank. Although this tank is located at Windy camp, it is there to support Doris activities (it is the fuel supply tank for the potable water pump used to collect all potable water for Doris Camp), as such it is inspected on a regular basis as required under the Doris Water Licence (Part I Items 2 and 4).
CIRNAC	8		Section 2.4.1 of the Hope Bay Spill Contingency Plan indicates that spill response kits will be available near (within 200 m) areas where chemicals are stored and used on site, on fuel transfer vehicles, in moveable containers, and that additional kits will be added as project activities evolve and new locations of chemical storage and use are identified. Reference is made to Module B for a list of supplies in each spill kit and aquatic spill response container. This reference is incorrect – contents of spill kits and the aquatic spill response container are provided in Appendix 2: Spill Response Resources. CIRNAC recommends this error be corrected to eliminate confusion.	Corrected in this version of the Plan.

Reviewer	Comment #	Comment	Recommendation	Response
CIRNAC	9		Sections 2.3.12 and 2.2.13 of the Hope Bay Spill Contingency Plan make reference to substances that will sink or dissolve if spilled under ice, indicating that response to these substances will be decided on a case-by-case basis, with consultation with regulatory agencies and remediation specialists as necessary. CIRNAC recommends that the plan should include an indication of whether these categories of materials are present on site, what they are, as well as where and how they are stored and/or utilized.	TMAC keeps on file Safety Data Sheets (SDS) for all chemicals and materials on-site. The information provided in the SDS and by the manufacturer define what they are, as well as where and how they are stored and/or utilized. SDS are made available to all employees on site and help define spill response activities for any material, including any substances that will sink or dissolve if spilled under ice.
CIRNAC	10		Appendix 2 of the Hope Bay Project Spill Contingency Plan provides information on spill response resources including mobile equipment, spill kit contents, and aquatic environment response equipment, however no mention is made of specialized equipment and material to cleanup/handle spills, for example, the respirators/self-contained breathing apparatus, fire retardant clothing, sodium or calcium hypochlorite solution, etc. identified in Appendix 1 as required to clean up/neutralize spilled sodium cyanide. CIRNAC recommends Appendix 2 should be enhanced to include all equipment and material referenced in the plan for spill response and the Proponent ensures the equipment is available on site.	Appendix 2 in this version of the Plan has been revised to include specialized equipment required for spill response.
CIRNAC	15	Multiple references (e.g. in Section 2.2.6, 2.2.24 and 4.5.1) incorrectly state that Product Specific Spill Response Plans are provided in Module A	Ensure the proper reference (Appendix 1: Hazardous Materials and Product Specific Spill Response Plans) is used to eliminate confusion	References to appendices corrected in this version of the Plan.

Reviewer	Comment #	Comment	Recommendation	Response
CIRNAC	CIRNAC-3	In reviewing the 2017 Annual Report, CIRNAC commented that a table of key government contacts was presented in the Hope Bay Project Spill Contingency Plan which required an update. This contact information has not been updated to the recommended phone number in the 2019 revision.	CIRNAC recommends that the contact numbers for the inspector be updated. Candice Peterson is now responsible for this file. She is based out of Cambridge Bay, her phone number is 867-983-5115, and her fax number is 867-982-4307.	During the upcoming annual review and update of the Spill Contingency Plan, TMAC will update the Inspector contact information, as well as any other key government contacts, as required to ensure they are current.
CIRNAC	CIRNAC-6	Continuous monitoring and timely reporting of spills incidents is required by regulations and project Term and Condition. The Term and Condition 20 states that: "The Proponent shall ensure spill kits are at hand at the Roberts Bay oil handling facility at all times, and that appropriate containment measures are used in the event of a spill". The Term and Condition 32 requires that: "Prior to the commencement of operation the Proponent shall have a complete Environment, Health and Safety Management System in place which includes: Emergency Response and Spill Contingency Plan; Occupational Health and Safety Plan; Monitoring and Follow-up Plan; and Auditing and Continuous Improvement Plan". General comments in Section 6.2 regarding the 2017 Annual Report state: "An information summary should be included in the annual report on these minor spills such as numbers, quantities, impacted media, reasons/causes, and corrective measures implemented (both short term and long term). As one of the objectives stated in the Hope Bay Project Spill Contingency Plan is to "Implement a process to evaluate and continuously improve site spill response procedures", discussion should be provided regarding lessons learned related to spill response and improvement measures implemented." The objectives for monitoring spills and discharges are designed to prevent negative impacts to the environment (e.g., water, soil, vegetation, wildlife, air, etc.) associated with project activities, prevent injuries and health impacts to workers and other people associated with project activities; ensure adequate spill response capacity and emergency response planning is in place and ensure adequate oversight of project activities is occurring.	CIRNAC recommends that TMAC Resources Inc.: • Consider including details of all spills (minor and major/reportable) in the Annual Report. Minimum details should include numbers, quantities, material spilled, impacted media, reasons/causes, and corrective measures implemented (both short term and long term). • Identify corrective measures to address the timing for reporting of reportable spills. All reportable spills have to be reported within 24 hours as required by the Spill Contingency and Reporting regulation R-068-93 (Government of Nunavut, clauses 9(2) and 11(2)). • Consider adding the following testing and review elements to the Spill Contingency Plan to promote continuous improvement, as best management practice: • Document all spill incidents (major/reportable and minor/non-reportable) and undertake periodic review of trends and lessons learned. Analyze previous year's data of reportable and non-reportable spills to identify trends. • Plan, undertake and document an annual spill drill / simulation exercise. The incorporation of this element into	TMAC tracks all unauthorized discharges and spills on site, regardless if they are externally reportable or not and identifies any observable trends. Based on those results, root cause analysis and corrective actions are recorded, tracked and implemented. CIRNAC is welcome to review information with TMAC staff during any of their multiple annual site inspections. See Section 3 of this plan. TMAC would like to clarify that only two of the 15 spills were reported outside of the 24 hour reporting window. TMAC strives to provide adequate reporting within the 24 hour reporting period and will aim to ensure all spills are reported as per the Spill Contingency and Reporting regulation R-068-93 (Government of Nunavut, clauses 9(2) and 11(2)). An annual tabletop exercise is conducted prior to the sealift fuel transfer simulating a spill to land or water. The exercise tests TMAC's Incident Command System and the implementation of the Spill Contingency Plan, Oil Pollution Prevention Plan and the Oil Pollution Emergency Plan in response to a spill scenario at the Roberts Bay oil handling facility as required by Transport Canada. See Section 5.1 of this plan.

Reviewer	Comment #	Comment	Recommendation	Response
		In the 2018 Annual Report, 15 spills were reported to have met the reporting threshold of the Nunavut Spill Contingency Planning and Reporting Regulations and were reported to regulatory agencies. An unquantified number of spills termed minor in nature are noted. It is notable that: • The overall number of reportable spills increased from 2017 (11) to 2018 (15). • The overall number of total spills including minor spills is not reported and there is no provision of quantities, details of the 'minor' spills. • Eight of 15 reportable spills were reported one day after the spill occurred. • The total quantity of hazardous materials spilled to the environment is more than 25,000 L and is a greater volume than that of the previous year. • The March 2019 Spill Contingency Plan does not include continuous improvement management processes addressing prevention.	the existing management plan(s) will provide a mechanism to learn and improve from accidents and malfunctions. • Revise Spill Contingency Plan to include requirements for evaluation and continuous improvement.	
CIRNAC	CIRNAC-7	Sections 2.3.12 and 2.2.13 of the Hope Bay Project Spill Contingency Plan (December 2017) make reference to substances that will sink or dissolve if spilled under ice, indicating that response to these substances will be decided on a case-by-case basis, with consultation with regulatory agencies and remediation specialists as necessary. CIRNAC recommended that at a minimum, the plan should include an indication of whether these categories of materials are present on site currently, if so identify them and indicate where they are stored and how they are utilized. TMAC Resources Inc. provided a response and referred to these substances in Table 4.2 (Pg. 27) of the updated Spill Contingency Plan (March, 2019). Therefore this issue has been resolved. Appendix 2 of the Hope Bay Project Spill Contingency Plan provides information on spill response resources including mobile equipment, spill kit contents, and aquatic environment response equipment, however no mention is made of specialized equipment and material to cleanup/handle spills, for example, the respirators/self-contained breathing apparatus, fire retardant clothing, sodium or calcium hypochlorite solution, etc. identified in	CIRNAC recommends that TMAC Resources Inc.: • Correct the Format and Reference errors indicated in the table above. • Review and add new relevant documents pertaining to spills including: • "A Guide to Spill Contingency Planning and Reporting" dated 2018 June, Nunavut Department of Environment; and • Environmental Emergency Regulations, 2019 published in the Canada Gazette March 6, 2019, coming into force August 24, 2019, Environment and Climate Change Canada	TMAC agrees to update and correct the formatting and reference errors in the next annual update of the Spill Contingency Plan.

Reviewer	Comment #	Comment	Recommendation	Response
		Appendix 1 as required to clean up/neutralize spilled sodium cyanide. CIRNAC recommended that Appendix 2 should be enhanced to include all equipment and material referenced in the plan for spill response. TMAC Resources Inc. listed the specialized response equipment in the Spill Contingency Plan, March, 2019 (Pg. 13). This issue is resolved. Format and reference errors were identified for the updated Spill Contingency Plan (March, 2019): Hope Bay Project Spill Contingency Plan (March 2019) Section 1.2 Title of Table 1.1 references the Incinerator Management Plan Correct Title of Table 1.1 Table 1.1 Regulation / Guideline Include updated regulation:		
KIA	KIA-NIRB-21 KIA-NWB-3	There is a discrepancy in the spill amount-reporting threshold for "miscellaneous products, substances, or organisms" that needs to be resolved. The table of Immediately Reportable Spills (p. iv) refers to the "NU Spill Contingency Planning and Reporting Regulations", a document on the GN DOE website that was created by the GNWT for the GNWT's use in 1998. These regulations specify a 50 L or 50 kg reporting threshold. However, Section 3.3 of the Plan also implies that the Immediately Reportable Spills Table follows the current GNWT ENR "Report a spill" website, which states that this limit is ≥ 5L or 5kg. Unless there is a typo on the GNWT website, the more conservative values should be used in TMAC's Spill Contingency Plan. In the Mar 2019 Hope Bay Spill Contingency Plan, there is a table showing Immediately Reportable Spills following "Schedule B of the NU Spill Contingency Planning and Reporting Regulations". This document is available on the GN DOE website – it is a 1998 consolidation of the 1993 regulations created by the GNWT. In Schedule B of this document, the immediately reportable amount of "miscellaneous products or substances, excluding PCB mixtures" is 50 L or 50 kg, which are the values listed in the Plan. However, the Plan also references the GNWT ENR "Report a spill" website within Section 3.3 when discussing the Immediately Reportable Spills Table. On this website, the	The KIA recommends that TMAC confirm spill-reporting thresholds with the GN and GNWT, and to update the information presented in the Immediately Reportable Spills, if needed.	TMAC will investigate to determine the correct reportable quantity and include in the next update of the Spill Contingency Plan if required. Use of the GNWT ENR "Report a Spill" website confirmed with the Inspector. This plan has been updated to reflect these thresholds (Section 3.3).

Reviewer	Comment #	Comment	Recommendation	Response
		reportable quantities for spills of “miscellaneous products, substances or organisms” are ≥ 5 L or 5 kg. These values are 10x lower than those listed in the Regulations, suggesting that the Hope Bay Spill Contingency Plan, or the website itself, contains a typo. It seems more likely that the values on the website are correct, and that those in the Plan are incorrect, based on precedents seen in other projects. Note also that the cited website link in Section 3.3 is broken. The current URL is: https://www.enr.gov.nt.ca/en/services/report-spill The correct spill amount threshold for miscellaneous substances needs to be resolved with regulators. The Immediately Reportable Spills table in the Hope Bay Spill Contingency Plan should then be updated, if necessary.		
KIA	KIA-NIRB-22 KIA-NWB-4	The Plan states that a marine spill report will be submitted to a Transport Canada (TC) Marine Safety Inspector if required. There is no further information regarding these reporting requirements; and the table showing Key Government Contacts does not include the TC Inspector’s contact information. In addition, the CIRNAC Inspector’s phone number in the Key Government Contacts table is different from the number listed in the Type A/B Water License conditions within the Conformity Tables.	The KIA requests additional information about spill reporting requirements for Transport Canada, and that contact information be included in the Plan for TC’s Marine Safety Inspector. The KIA also recommends that TMAC confirm the correct contact information for the CIRNAC Inspector and update the table of Key Government Contacts, if needed.	TMAC will ensure the correct contact information for the CIRNAC inspector is up to date with key Government Contacts in the next annual update of the Spill Contingency Plan.
		Section 3.3 of the Hope Bay Spill Contingency Plan states that in the event that a spill has occurred to the marine environment, a written report will be submitted within 24 hours to the Canadian Coast Guard, and a copy of this report will be submitted to a Transport Canada Marine Safety Inspector “if required”. There are no further details regarding the situation(s) in which a TC Marine Safety Inspector will need to be notified. There is also no contact information for the TC Marine Safety Inspector within the table of Key Government Contacts on p. iii of the Plan. The Conformity Tables within Modules A, B, C, and D include conditions of the Type A and B Water Licenses that the Spill Contingency Plan is intended to address. Among these conditions is the reporting of any	TMAC’s response is partially satisfactory. They will confirm and include the correct contact information for the CIRNAC inspector in the next update of the Spill Contingency Plan. However, TMAC did not address the KIA’s comment regarding marine spills and reporting requirements to a Transport Canada Marine Safety Inspector. Request to TMAC: Please include contact information for the Marine Safety Inspector in the list of Key Government Contacts and indicate the situation(s) in which the Marine Safety Inspector needs to be	Contact information for the Marine Safety Inspector and the situation(s) in which the Inspector would be contacted are detailed in the Hope Bay Ocean Pollution Prevention Plan/Oil Pollution Emergency Plan (OPPP/OPEP). The OPPP/OPEP is the main document of reference for spill control actions in a marine environment and is directly referenced in section 2.2.8 – Spill in a Marine Environment of the Spill Contingency Plan.

Reviewer	Comment #	Comment	Recommendation	Response
		unauthorized deposits or foreseeable unauthorized depots of waste and/or discharges of effluent to "the Inspector at (867) 975-4295" (in addition to the 24-Hour NT-NU Spill Reporting Line and the KIA). However, the phone number listed in Key Government Contacts (p. iii of the Plan) for the CIRNAC Inspector is (867) 983-5115. Please confirm which phone number is correct and update the list of key contacts, if needed.	notified in the next update of the Spill Contingency Plan.	
KIA	KIA-NIRB-23 KIA-NWB-5	It is difficult to judge from the plates in Modules A and D whether TMAC is complying with their own policy of making spill kits available within 200 m of fuel and chemical storage locations. TMAC should ensure that spill kits are available as described. Section 2.4.1 of the Hope Bay Spill Contingency Plan states that spill response kits will be available near (within 200 m) any areas where chemicals are stored and used on site, including near all bulk fuel berms and smaller fuel tanks. In addition, all active construction areas where equipment is operating will have a spill kit located within 200 m. Modules A through D within the Plan describe the specific conditions of Doris, Windy, Madrid, and Boston operations relevant to spill response, including chemical storage volumes and locations, and photographs of the sites. Plate A.4 shows the Reagent Berm at Doris, and an Explosive Berm is indicated to the right, outside of the photo. It is unclear whether the spill kit located at the Reagent Berm is also intended to serve spill incidents at the Explosive Berm, and it is also unknown whether the Explosive Berm is located within 200 m of the Reagent Berm (and spill kit). Furthermore, the lack of scale, and possible forced perspective, of Plate D.1 (Boston Camp) makes it difficult for a reviewer to determine whether the spill kit in the middle-left is located within 200 m of the chemical storage locations to the farthest left of the photo. It would be useful to have updated photos or site diagrams, for all Hope Bay project locations, that encompass all infrastructure and activities and have a	The KIA recommends that updated photos or site diagrams, with appropriate scale indicators, be included in the next version of the Hope Bay Spill Contingency Plan.	TMAC will ensure updated site diagrams will be included in the next annual update of the Spill Contingency Plan. Please refer to Modules A through D of this Plan.

Reviewer	Comment #	Comment	Recommendation	Response
		scale to assess distances. These would allow for a more comprehensive review of TMAC's spill response plan.		
KIA	KIA-NIRB-24 KIA-NWB-6	The Jet-A Specific Spill Response Plan needs more information and subsequent steps for emergency response to a spill to water. Currently, the plan is limited to advising responders not to attempt to contain or remove spills, and to use booms to prevent spread. Even if TMAC staff are not responsible for cleaning up a Jet-A spill, there should be further information about who to contact for proper treatment. TMAC has developed a Product Specific Spill Response Plan for Jet-A fuel because spills of this substance could be immediately harmful to humans and/or the environment and has the potential to cause pool fires and vapour cloud explosion. Within the Jet-A plan, the instructions for spills to water include three bullet points: • Jet-A fuel floats on surface of water. • Do not attempt to contain or remove spills (high explosion potential). • Use booms to prevent spread of spill. • The subsequent generic steps regarding Jet-A fuel spills are to properly dispose of PPE and to thoroughly wash skin with soap. This is the end of the Jet-A spill response plan. Further details are needed regarding Jet-A spills to water. It is perhaps implied (though this should be clarified) that no Hope Bay Project staff within the Spill Emergency Incident Command System (Figure III, p. vii) is qualified to clean up Jet-A spills to water. If this is the case, information about who should be contacted, and who will be responsible for clean-up, should be included in the Plan.	The KIA requests that additional information regarding spills to water be included in the Jet-A Specific Spill Response Plan, such as the party(ies) responsible for cleanup/ treatment.	TMAC will provide additional information to the Aviation Fuel (Jet-A) Specific Spill Response Plan. Additional information has been provided in the Jet-A Specific Spill Response Plan with rationale for response to a spill on water. Refer to Appendix 1 of this Plan. Note, multiple spill response resources direct that attempts to recover spills of Jet-A to water should not be attempted due to volatility and explosive potential of the material, and the fact that evaporation of the product occurs within hours to days makes recovery of this product by conventional skimming methods difficult to accomplish.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	KIA-NIRB-25 KIA-NWB-7	TMAC's revisions to the Spill Contingency Plan in response to the previous KIA comment #2 are incomplete. There are ambiguities between Section 2.2.16 and the Environmental Resource Maps provided in Appendix 3, which would prevent a clear understanding of priorities in the event of a spill. In response to previous KIA review comment KIA-7, TMAC proposed a prioritization hierarchy for environmental sensitivities. (Note that there is a typo in TMAC's response on p. 24 – it should refer to Section 2.2.16 rather than 2.3.10.) The proposed hierarchy of protection will attempt to favour: 1. Waterbodies; 2. Sensitive habitat types; 3. Archaeological sites; 4. Rare plants; and 5. Active raptor nest or wildlife den. In addition, for spills in water, prioritization will attempt to avoid vegetated and finer substrate shoreline areas (sand, gravel, cobble). TMAC's proposed hierarchy is not detailed enough in comparison to the Environmental Sensitivity Maps A-C, which include rare plants, raptor nests, and wildlife dens. Are the "sensitive habitat types", indicated as the second highest priority, the other features on these maps, i.e., eskers, slopes of 40-90% (possible cliffs), or certain TEM classes? For example, would the TEM class of Dry Carex-Lichen be prioritized over others because this is important forage for caribou? Furthermore, the Environmental Resource Maps in Appendix 3 may not be at a size, scale, or resolution that is useful for emergency spill response. For example, Figure 3.1 (Map A) is very difficult to read; the need for 12 insets may indicate that larger scale maps are needed to cover the study area in sufficient detail. Map A also shows that Hope Bay is within the study area; however, only Roberts Bay was mapped for shoreline fish habitat values (Figure 3.4, Map D).	The KIA requests that the proposed prioritization hierarchy in Section 2.2.16 of the Spill Contingency Plan be revised to a level of detail that is compatible with the Environmental Sensitivity Mapping for this project. The KIA also requests that Environmental Sensitivity Maps be provided to Project personnel in a larger format and at higher resolution, such that they are useful for emergency spill response.	TMAC would like to take the opportunity to re-visit the response hierarchy to reflect operational experience. TMAC's first priority in any spill incident is to stop the source of the spill (if not already accomplished at the time discovered), then to prevent the spread and contain the spill and then to assess the best method to remove as much of the spilled substance as possible taking into consideration numerous factors including but not limited to land, water, topography, substrate depth, location and season. Safety of personnel is the paramount consideration in all efforts and workplans. Based on the review of Appendix 3 and experience to date, TMAC will re-visit the Environmental Sensitivity Mapping to account for the abiotic and biotic factors that practically guide spill response at Hope Bay. KIA will be engaged on this matter and the potential timing of the next update in the plan.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	KIA-NIRB-26 KIA-NWB-8	TMAC has made some revisions to the Spill Contingency Plan regarding spill-related monitoring. However, the wording is weak and does not reflect a commitment by TMAC to conduct monitoring activities. In response to previous KIA review comment KIA-9, TMAC responded that more details on spill related monitoring have been included in Section 3.4 of the Spill Contingency Plan. However, the revisions to Section 3.4 do not fully address the KIA's concerns. While TMAC has deleted the phrase "completely removed" and has added more information about monitoring triggers and locations for spills to water, the wording in this section still needs to be stronger. The current wording throughout Section 3.4 is that "monitoring may be triggered". TMAC should commit to conducting monitoring activities for spills that potentially have negative environmental impacts, and that are unlikely to be (completely) recovered, whether or land or in water. While monitoring for all spills may not be feasible, especially for small spills with little expected impact, TMAC could develop spill thresholds for various substances or situations for which "monitoring will be triggered".	The KIA recommends that TMAC use stronger wording within Section 3.4 of the Spill Contingency Plan, i.e. "monitoring will be triggered" rather than "monitoring may be triggered" for various spill response scenarios.	TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs deemed would be developed in consultation with the CIRNAC Inspector and the KIA.
		Without a strong commitment from TMAC to monitor the potential effects of spilled substances that cannot be recovered, there is no guarantee that monitoring will occur at all. The KIA's right to compensation for damages to their lands and waters makes prompt and effective monitoring important to both TMAC and the KIA in the event of a spill or unplanned discharge.	TMAC's response is partially satisfactory. Please see detailed KIA review comments for KIA-NWB-9 below.	Please see detailed response as part of KIA-NWB-9 below.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	KIA-NIRB-27 KIA-NWB-9	Conditions for triggering of monitoring of spills into water is unclear. TMAC states that "monitoring may be triggered in the event of spills to water of substances that dissolve or sink where substance recovery unlikely" and that "monitoring may also be triggered in the event of externally reportable spills to land for which recovery of spilled material is unlikely or may be incomplete". In Appendix 4, under Comment #4 (KIA-9), the KIA requested that "TMAC should include triggers which require monitoring activities, and provide details of the type of monitoring that will be undertaken as part of adaptive management to spills and unplanned discharges…the discussion should be specific to the type of spill, volume, mobility of the spilled material and proximity to various habitat features. Triggered monitoring should be implemented as quickly as possible".	Please remove the discretionary language in Section 3.4 to so that monitoring is required for (i) all spills to water of substances that dissolve or sink which are unlikely to be recovered and (ii) all externally reportable spills to land of substances unlikely to be fully recovered. Please specify under what conditions monitoring will be triggered for spills (i) and (ii) (e.g., type of spill, volume, mobility, proximity to sensitive environmental features), what parameters will be collected, and how soon after a spill triggered monitoring will be implemented.	TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.
		TMAC responds that it "has provided more detail on spill related monitoring in Section 3.4". We do not believe TMAC has satisfactorily responded to our original concern regarding monitoring spills. We are concerned with the use of discretionary language in the guidelines for monitoring spills under Section 3.4 ("may be triggered"). Furthermore, it is not clear what conditions will actually trigger monitoring under the two scenarios presented in this section (e.g., type of spill? volume? mobility? proximity to sensitive environmental features?). TMAC also has not indicated how soon after a spill triggered monitoring would be implemented, or what parameters will be collected.	TMAC's response is the same as for KIA-NWB-8, which is partially satisfactory. The proponent states that "where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA." As evidenced by comments KIA-NWB-8 and -9, the KIA believes that monitoring and restoration programs should be developed prior to spill events as part of spill response planning and preparedness and to show an understanding of the potential effects of spills on land and in water. These programs can then be adapted, in a timely manner, to each spill response scenario on a case-by-case basis. We appreciate that TMAC's monitoring and restoration programs will be developed in consultation with the KIA; however, we recommend that consultation about spill response and triggered monitoring occur as soon as possible.	TMAC appreciates KIA's intent to understand spill preparedness however TMAC does not feel predetermining every possible scenario, response, follow up monitoring, including parameters to be measured, and reclamation actions, is practical or effective. If TMAC were to attempt to address these requests it would result in an extremely voluminous document with thousands of iterations and combinations that account for every possible factor at Hope Bay. TMAC has explored this approach in the past and determined it would be unreasonable to maintain but more importantly, unnecessary. Including these details up front in the management plan is not the intent of the Spill Contingency Plan. The Spill Contingency Plan was developed for the efficient and effective management of activities at site by ensuring the people responsible have the information required to make informed

Reviewer	Comment #	Comment	Recommendation	Response
			KIA acknowledges that spill response varies depending on numerous factors (including type of substance, location of spill, volume, proximity to sensitive environmental features etc.), all spills need to be monitored to help determine what response is appropriate. Furthermore, in the case of spills to water and land that are unlikely to be recovered, it is paramount that monitoring be conducted to track whether these spills cause any adverse environmental effects, so that effective mitigation measures can be implemented. Consequently, the discretionary language in the guidelines for monitoring spills under Section 3.4 should be removed and replaced with wording stating that monitoring is required for all spills described under (i) and (ii) in our prior recommendation. The KIA also requests clarification about situations in which TMAC would deem it appropriate to develop appropriate monitoring and restoration programs in consultation with the CIRNAC Inspector and the KIA (e.g., compared to when it would be inappropriate to do so).	decisions that consider key factors. TMAC has evaluated this approach as being more effective than predetermined responses to a copious amount of scenarios. That said, TMAC would welcome discussing this matter further with the KIA to understand if there are opportunities for improvement that TMAC can incorporate into its approach to spill response.
KIA	KIA-NIRB-28 KIA-NWB-10	Photograph does not indicate location of spill kit at Patch Laydown Facility. Plate B.2 shows a photograph of the Patch Laydown Facility. The caption indicates that the red circle is for the fuel storage location and the yellow star is for the spill kit location. However, no red circles or yellow stars are shown on the photograph.	Please clarify whether any fuel storage and spill kit locations exist at the Patch Laydown Facility.	Fuel and chemical storage facilities have been removed from the Patch Laydown Facility. Plate B.2 been removed in this version of the Plan.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	KIA-NIRB-29 KIA-NWB-11	No mitigation measures are stated for settlement of tanks. Eight fuel tanks at the Boston site are situated on a lined fuel berm on the permafrost. TMAC indicates that there are concerns that the permafrost may degrade over time due to thin areas of the crush pad, which could cause settlement of the tanks, making them unstable and prone to tipping. TMAC states that regular monitoring of the fuel tanks for differential settlement occurs during seasonal visits, annual geotechnical inspections, and as needed. However, TMAC does not discuss what mitigation measures are in place should settlement of the tanks be detected.	Please explain what management action is taken if settlement of the fuel tanks at the Boston site is detected during routine monitoring.	If settlement of the fuel tanks at the Boston site are detected beyond an acceptable limit, TMAC will discontinue the use of the tank(s) that are effected by settlement and engage the Engineer of Record (SRK Consulting) for guidance and recommendations for correcting the settlement issue. TMAC will continue to monitor permafrost and physical stability of site infrastructure on an ongoing basis and will take a proactive approach to risks identified.

Appendix I

Hope Bay Project Incinerator Source Emissions Testing 2019

Incinerator Source Emissions Testing 2019

Final Report

December 20, 2019

Prepared for:
TMAC Resources Inc.

Prepared by:
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File No: 160930343

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Executive Summary

TMAC Resources Inc. (TMAC) retained Nunami Stantec Limited Partnership (Nunami Stantec) to conduct dioxins and furans and mercury source emissions testing on the waste incinerator currently in operation at the Hope Bay Mine/Mill site in Nunavut. The testing was conducted to assess compliance of the emissions concentrations of mercury and dioxins and furans with the standards set out in the Nunavut Water Board, Water Licence 2AM-DOH1323 Amendment No. 1, Part G-5, and the Government of Nunavut's "Environmental Guideline for the Burning and Incineration of Solid Waste", based on the Canadian Council of Ministers of the Environment (CCME) Canada Wide Standards (CWS). Particulate matter analysis was also completed concurrently with mercury testing.

The source emission testing was conducted during the period of September 15 to September 18, 2019. Source emission testing was completed with the incinerator operating under normal steady state conditions (i.e. after the primary chamber burner ignited and stabilized) for the duration of the sampling period.

The average concentration of particulate matter was 57.2 mg/Rm^3, corrected to 11% oxygen. There are no limits specified for particulate matter emissions in the "Guideline for the Burning and Incineration of Solid Waste".

The average concentration of mercury for the three tests was 0.26 µg/Rm^3, which is below the CWS/Nunavut stack limit of 20 µg/Rm^3, corrected to 11% oxygen.

The average stack concentrations of dioxins and furans was 1.27 ng TEQ/m^3 which is above the CWS/Nunavut stack limit of 0.08 ng TEQ/Rm^3 (dry, reference conditions of 25°C and 1 atm, corrected to 11% oxygen).

Based on the results of the dioxins and furans testing, it is recommended that TMAC review potential options to reduce these emissions. Options could include:

- Reviewing the incinerator emissions performance with the manufacturer,
- Ensuring manufacturer recommended operational procedures for the incinerator have been implemented and ensuring all operators are adequately trained and,
- Reviewing TMAC's waste segregation practices.

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APPENDICES

1.0 INTRODUCTION

TMAC Resources Inc. (TMAC) retained Nunami Stantec Limited Partnership (Nunami Stantec) to conduct mercury and dioxins and furans source emissions testing of one of the waste Incinerator located at the Hope Bay Mine/Mill site. The testing was conducted to assess compliance of the emissions concentrations of mercury, and dioxins and furans with the standards set out in the Nunavut Water Board, Water Licence 2AM-DOH1323 Amendment No. 1, Part G-5, and the Government of Nunavut's "Environmental Guideline for the Burning and Incineration of Solid Waste", based on the Canadian Council of Ministers of the Environment (CCME) Canada Wide Standards (CWS). Particulate matter analysis was also completed concurrently with mercury testing.

The source emission testing was conducted during the period of September 15, 2019 to September 18, 2019. The testing was conducted in accordance with the Environment and Climate Change Canada (ECCC) reference methods EPS 1/RM/2, 1/RM/3, EPS 1/RM/15, and US EPA Method 29.

The source emissions testing campaign and results are outlined in this report in five sections. A brief introduction to the report, including the scope and objectives of the project, is in Section 1. The source emissions testing locations are described in Section 2. The methodology is outlined in Section 3 and results of the source emissions testing program are in Section 4. Closing remarks are in Section 5. Supporting information, field sheets, raw data, calculations and laboratory data are provided in the Appendices.

2.0 SOURCE DESCRIPTION AND SAMPLING LOCATION DETAILS

2.1 INCINERATOR

The process parameters associated with the incinerator are provided in Table 2.1, and the parameters associated with the stacks tested are presented in Table 2.2.

Testing for dioxins and furans, particulate matter and mercury was conducted on the incinerator.

Table 2.1 Process Parameters - Incinerator

Process Parameter	Incinerator
Model ID:	CY-100-CA
Mode of operation	Batch Process 3 cycles per 24 hours @ 4-5 hrs, cool time = 8 hrs
Material feed rate & composition	150-185 kg/batch (food and paper waste)
Supplementary fuel	Diesel, liquefied petroleum gas, natural gas
Normal operating temperatures (°C)	650 (primary chamber), 1000 (secondary chamber)
Process parameters affecting emissions	waste generation and composition
Data verifying operating conditions	Mass of material processed

Table 2.2 Stack Parameters - Incinerators

Stack Parameter	Incinerator
Stack Height - Above Grade (m)	8.9
Stack / Duct Description	Vertical Circular
Stack Diameter (m)	0.508
Number of Sample Ports	2
Sample Port Configuration	2@90°
Sample Port Diameters (m)	0.10
Location Downstream from any Disturbance (m)	6
Location Upstream from any Disturbance (m)	>2
Ideal or Non-ideal	Non-ideal
Sampling Time for DF testing (min)	188
Sampling time for Hg testing (min)	120

Table 2.2 Stack Parameters - Incinerators

Stack Parameter	Incinerator
Total Number of Sample Points	24
Number of Readings per Point	2
Sample Time per Point – DF testing (min)	8
Sample Time per Point – Hg testing (min)	5
Time per Reading – DF testing (min)	4
Time per Reading – Hg testing (min)	2.5
Physical and Chemical Nature of Pollutants	Products of waste combustion and diesel combustion

3.0 STUDY METHODOLOGY

3.1 SCOPE OF WORK AND OVERVIEW OF METHODOLOGY

Nunami Stantec conducted the source emissions testing at the incinerator over the period of September 15 – September 18, 2019. Source emission testing was completed with the incinerator operating under normal steady state conditions (i.e. after the primary chamber burner ignited and stabilized) for the duration of the sampling period.

The testing was conducted in accordance with the ECCC reference methods EPS 1/RM/2 and 1/RM/3 (for dioxins and furans), US EPA Method 29 (for particulate and mercury) and EPS 1/RM/15 (combustion gases). Three replicate tests were conducted for each contaminant from each incinerator exhaust stack. The specific contaminants tested and their associated source emissions testing reference methods used in the campaign are presented in Table 3.1.

Table 3.1 Test Methods

Source	Contaminant	Reference Method	No. of Tests
Incinerator	Velocity Traverse / Flowrate, Molecular Weight, Moisture Content	EPS 1/RM/8 Methods B, C and D	3
	Oxygen (O_2)	EPS 1/RM/15	3
	Carbon Dioxide (CO_2)	EPS 1/RM/15	3
	Polychlorinated dibenzo-*para*-dioxins and Polychlorinated dibenzofurans	EPS 1/RM/2 and 1/RM/3	3
	Total Particulate Matter and Mercury (Hg)	US EPA Method 29	3

The testing methodology and specific work-task breakdown is described in the following subsections.

3.2 TASK 1 – INITIAL PREPARATION

Following award of the contract, Nunami Stantec made initial preparations for the work, including ensuring the preparation of the sampling locations and the ordering of equipment and reagents. Equipment was shipped to site in preparation for the arrival of the source testing crew.

3.3 TASK 2 – ON-SITE SOURCE EMISSIONS TESTING

Source testing was conducted while the process was under normal operation, in accordance with the applicable source testing reference methods. Three repetitions of each test method were completed.

Details of each of the source emissions testing reference methods used as part of the testing campaign are provided in the following subsections.

3.3.1 Preliminary Testing

Upon arrival at the stack sampling location, the source emissions testing equipment was set up and a preliminary survey conducted to measure the average flue gas velocity, moisture content, and flue gas composition in the stack in accordance with the ECCC Reference Method EPS 1/RM/8 Methods B, C, and D entitled “Reference Method for Source Testing: Measurement of Releases of Particulate from Stationary Sources”.

The data from the preliminary survey was used to determine the appropriate nozzle size to conduct isokinetic sampling (where the velocity of the gas entering the nozzle is equal to the gas velocity in the stack) during the source emissions testing, and in calculations for reporting emission rates and concentrations of the sampled contaminants. Verification for cyclonic or reverse flow was also conducted during the preliminary survey, according to procedures outlined in EPS 1/RM/8.

3.3.2 Dioxins and Furans

The emissions of dioxins and furans from the exhaust stacks were measured in accordance with the ECCC reference methods EPS 1/RM/2 and 1/RM/3, entitled “Method for Source Testing: Measurement of Releases Selected Semi-volatile Organic Compounds from Stationary Sources” and “Method for the Analysis of Polychlorinated Dibenzo-Para-Dioxins (PCDDs), Polychlorinated Dibenzofurans (PCDFs), and Polychlorinated Biphenyls (PCBs) in Samples from the Incineration of PCB Waste”, respectively. A schematic of the sampling train is provided in Figure 3-1.

The sampling train has several components which include: a heated sampling probe (a nozzle, glass liner, thermocouple, and pitot tube assembly); a heated sample case containing a filter; an ice box containing a condenser; an XAD-2 solid sorbent trap; a condensate trap; impinger glassware (consisting of 3 impingers); and an umbilical cord leading to the pump and control console. Its operation can be generally described as follows:

- Stack gases are drawn through the probe nozzle at or near isokinetic conditions (where the gas velocity in the nozzle is at the same velocity as the gas in the stack). The gases then flow through the inner liner of the electrically heated sampling probe.
- A pitot tube assembly is located on the probe and next to the nozzle to measure the stack gas velocity in the area of the probe nozzle. Using the differential pressure reading on the control console, the desired nozzle flowrate is determined from the differential pressure across the calibrated orifice.
- The stack gases are drawn from the probe liner through a quartz fibre filter (in the hot side of the sampling train), and then through a condenser to cool the gas prior to contacting the XAD-2 sorbent media. The gas then travels through a condensate trap prior to entering the first pre-weighed impinger (empty). The second impinger contains ethylene glycol, the third is also empty and the fourth impinger contains silica gel. The glassware is placed and operated in an ice bath to cool the gases and condense the moisture in the exhaust gas before the gas enters the umbilical cord.
- The umbilical cord carries the filtered, cooled stack gases from the sampling site to the control console. The control console contains a fibre vane vacuum pump, which is used to draw the stack gases through the sampling train. A calibrated dry gas meter measures the volume of gas sampled.

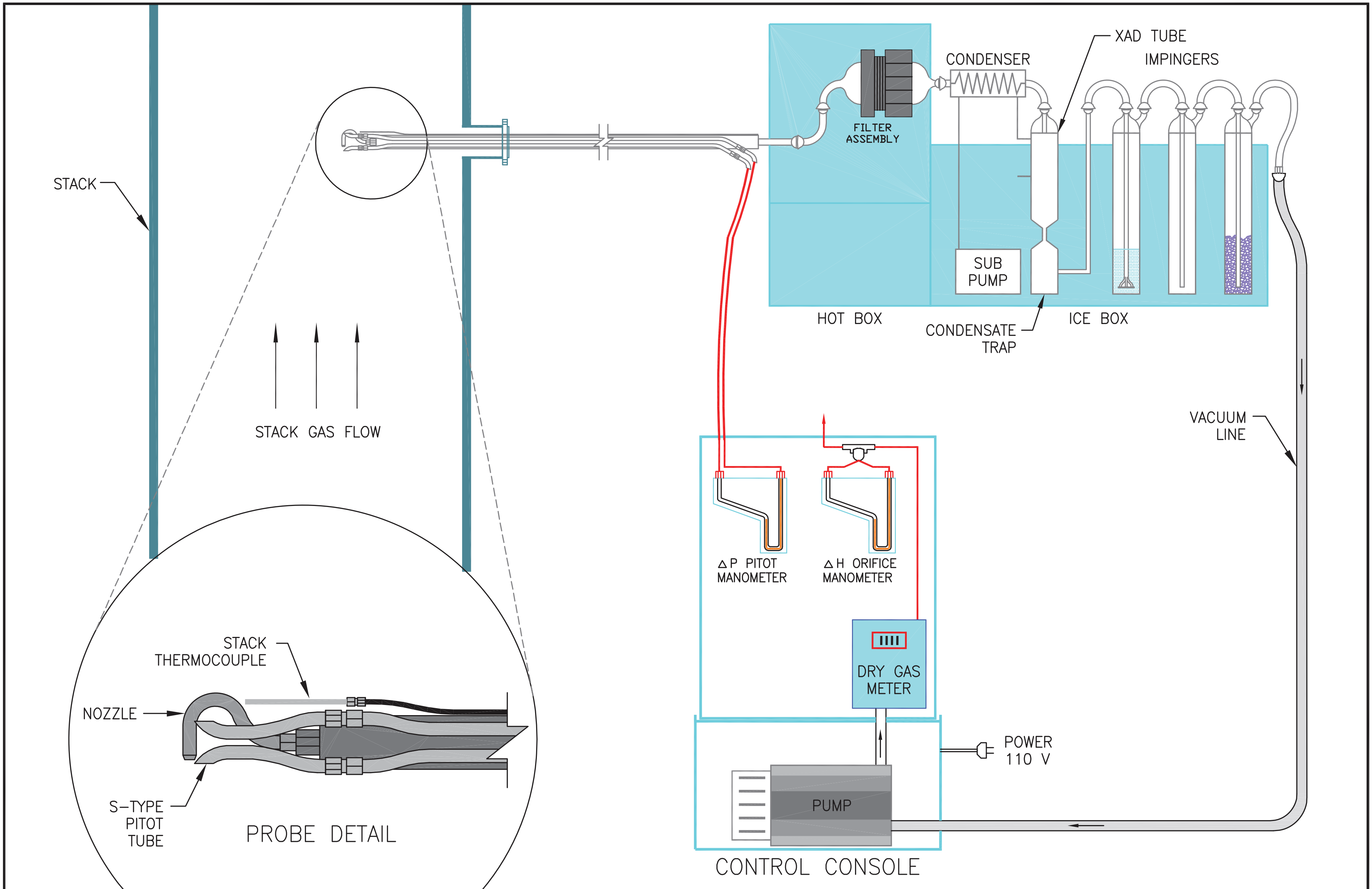
- After the completion of the test, the glassware is re-weighed and the differences in weight are used to calculate the stack gas moisture content. The glassware is rinsed with hexane and acetone, and the rinses are added to the recovered samples prior to being sent to the laboratory for analysis. Front and back half recoveries were combined for analysis.
- A field blank is also recovered onsite to take into account any dioxins and furans that may be present in the atmosphere where the leak checks are being conducted. The total volume of gas that is obtained during the leak pre- and post-leak checks is calculated, and that volume of ambient air is then samples using a fourth sampling train. This train is then recovered following the same process outlined above and sent to the lab for analysis.

The pre-cleaning and proofing of glassware, preparation of capture solutions, and post-test sample analysis was conducted by ALS Global Laboratories. The laboratory proofing report is provided in Appendix C. The test results for dioxins and furans are expressed as international total equivalent concentrations (I-TEQ).

3.3.3 Particulate Matter/Mercury Testing

Total particulate matter and mercury emissions were determined using concurrent sampling in accordance with US EPA Method 29, entitled *Determination of Metals Emissions from Stationary Sources*. The sampling train, used specifically for isokinetic sampling, is described in detail in US EPA Method 29 and EPS 1/RM/8. Seven impingers were connected in series and contained a variety of reagents to capture trace metals. A schematic of the sampling train is provided in Figure 3-2.

Following testing, the amount of particulate matter present on the filter and in the probe rinse was measured gravimetrically in the laboratory and used in the determination of total particulate matter emissions from the sources tested. The particulate matter samples captured in the probe and filter, and the impinger solutions were analyzed for mercury.



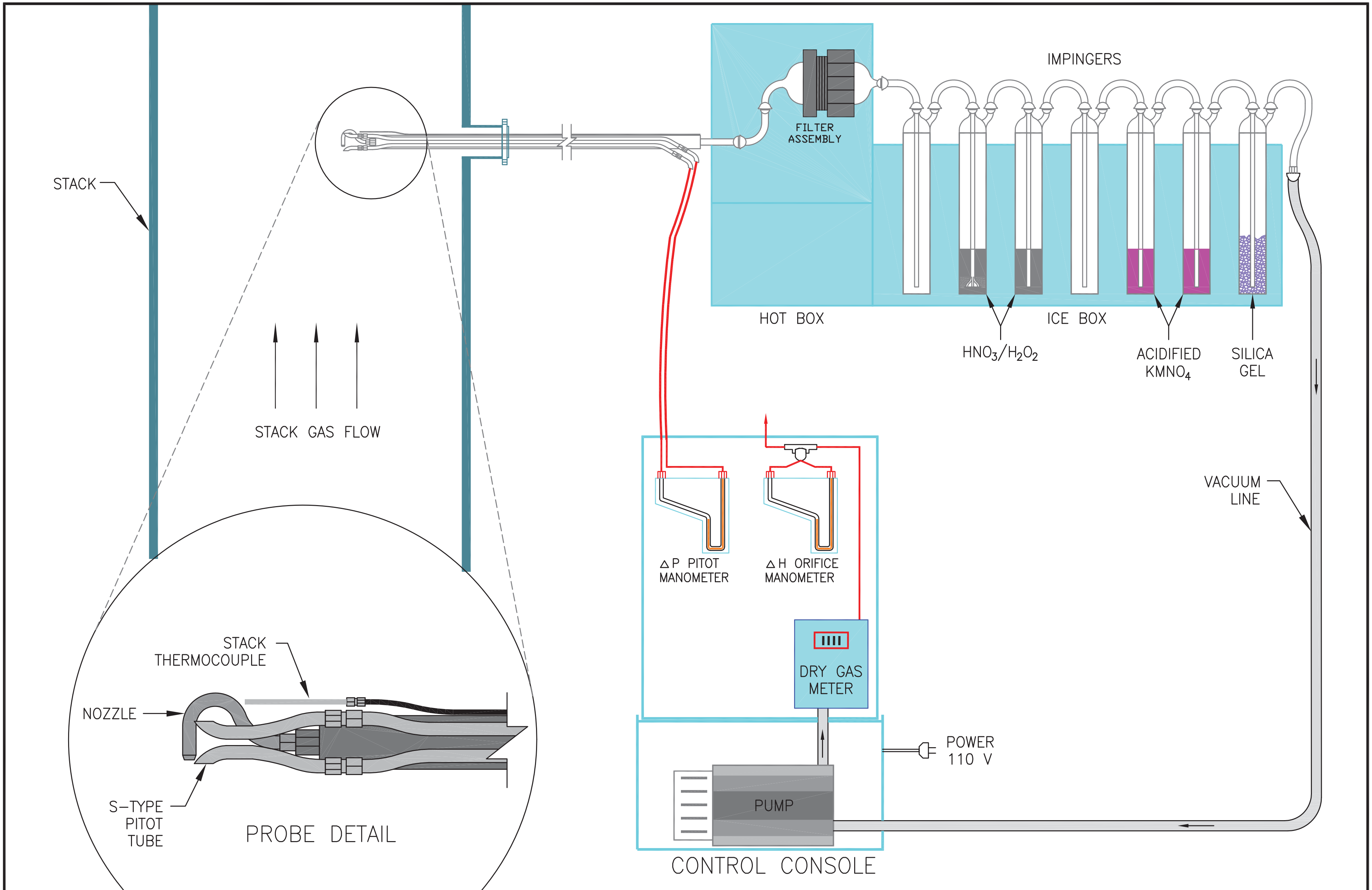
SOURCE EMISSIONS TESTING
EPS 1/RM/2 SAMPLING TRAIN

Scale: N.T.S.

Fig. No.: 3-1

Stantec

FILE: METHOD29



Stantec

SOURCE EMISSIONS TESTING
USEPA METHOD 29 SAMPLING TRAIN

Scale:	N.T.S.
Fig. No.:	3-2

3.3.4 Combustion Gas Testing

The combustion gases (O_2, CO_2) were sampled according to the ECCC reference method EPS 1/RM/15, entitled *Reference Method for the Monitoring of Gaseous Emissions from Fossil Fuel-fired Burners*. In this method, samples of flue gas are drawn through a probe, non-isokinetically, from a single point near the centre of the stack.

The combustion gases for the incinerator were analyzed using an Enerac 500 portable Gas Analyzer, manufactured by Enerac Co. This unit is equipped with electrochemical cells that are used to measure the concentrations of oxygen in accordance with EPS 1/RM/15. CO_2 is then calculated based on the oxygen concentrations and the fuel being consumed. This system is equipped with a flue gas probe that has an integrated filter trap and condensate trap and a housing unit that contains the pump and the electrochemical cells.

Calibration data for the Enerac 500 are included in Appendix A.

3.4 TASK 3 - LABORATORY ANALYSIS OF COLLECTED SAMPLES

The recoveries and analyses for dioxins and furans were performed by the ALS Global Laboratories laboratory in Burlington, Ontario, in accordance with the ECCC reference methods EPS 1/RM/2 and 1/RM/3, entitled “Method for Source Testing: Measurement of Releases Selected Semi-volatile Organic Compounds from Stationary Sources” and “Method for the Analysis of Polychlorinated Dibenzo-Para-Dioxins (PCDDs), Polychlorinated Dibenzofurans (PCDFs), and Polychlorinated Biphenyls (PCBs) in Samples from the Incineration of PCB Waste”.

The recoveries and analyses for total particulate matter and mercury were performed by the ALS Global laboratory in Burlington, Ontario, in accordance with the US EPA Method 29, entitled “Determination of Metals Emissions from Stationary Sources”.

ALS Global is accredited by the National Environmental Laboratory Accreditation Program.

Detailed laboratory reports are provided in Appendix C.

3.5 TASK 4 - DATA ANALYSIS AND EMISSION CALCULATIONS

After the source emissions testing work and the laboratory analyses were completed, the Nunami Stantec team reviewed and analyzed the data and calculated the concentrations and emission rates for the contaminants described above. The data and calculations have been subjected to quality assurance and quality control protocols to confirm their accuracy.

3.6 TASK 5 - REPORTING

Following the laboratory and data analysis, the results of the source emissions testing program described above were summarized and described in this report.

Emission concentrations are reported in ng I-TEQ/Rm^3 (calculated using the Toxic equivalency factors from the World Health Organization, 2005) for dioxins and furans, corrected to reference conditions (25°C and 101.3 kPa) and the corresponding mass emission rates are reported in pg/s. Concentrations have been corrected to 11% oxygen for comparison with the CWS/Nunavut limits.

3.7 QUALITY ASSURANCE AND QUALITY CONTROL

Throughout the source emissions testing program, quality assurance and quality control procedures were applied to confirm the collection of reliable and accurate emissions data. Quality control checks were performed at several stages during the testing program to confirm the collection of representative samples and the generation of valid results.

The Quality Control (QC) checks included the following:

- use of standardized checklists and field notebooks to confirm completeness, traceability, and comparability of the process information and samples;
- field checking of standardized forms by a second person to confirm accuracy and completeness;
- adherence to sample chain-of-custody procedures;
- testing for cyclonic or reverse flow, as well as stratified flow conditions; and
- leak checks of sampling trains.

Field equipment was calibrated according to the ECCC and US EPA protocols. These calibrations include the following:

Pitot tubes: Calibrated in a wind tunnel with probe and nozzles attached.

Gas meters: Calibrated using a critical orifice calibration set.

Nozzle: Four diameter measurements made using a micrometer across the sharpened edges.

Thermocouples: Calibrated using a potentiometric technique.

Gas Analyzers: Zeroed using nitrogen and calibrated against reference gases (US EPA protocol 1 calibration gases)

Calibration data for all equipment is provided in Appendix A.

Additional information may be found in the description of the reference test methods for stationary source emissions testing published by ECCC (EPS 1/RM/2, 1/RM/3, 1/RM/15) and US EPA (Method 29). Copies of these documents are available upon request from Nunami Stantec.

4.0 RESULTS AND DISCUSSION

Tables 4.1 and 4.2 present the measured stack parameters, concentrations and emission rates of particulate matter, mercury, and dioxins and furans from the incinerator.

Table 4.1 Total Particulate Matter, Mercury Source Testing Results

Parameter	Test 1	Test 2	Test 3	Average	Method Criteria/CWS Limits
Test Date	Sept 17, 2019	Sept 17, 2019	Sept 18, 2019	NA	-
Test Period	12:34 – 14:34	16:06 – 18:06	10:48 – 12:48	NA	-
Test Duration (min)	120	120	120	120	-
Stack Gas Static Pressure (kPa)	0.005	0.005	0.005	0.005	-
Volume of Gas Sampled (m^3)	1.58	1.69	1.66	1.64	-
Average Isokineticity (%)	102	103	101	102	90 - 110
Total Particulate Matter not including Impingers (mg)	97.9	101	82.7	93.9	-
Total Mass of waste combusted (kg)	191	191	161	181	-
Exhaust Gas Parameters					
Stack Gas Temperature (°C)	600	646	633	626	-
Stack Gas Moisture Content (%)	12.8	9.83	11.9	11.5	-
Stack Gas Velocity (m/s)	5.03	5.45	5.48	5.32	-
Stack Gas Flow Rate (Rm^3/s)	0.24	0.26	0.26	0.25	-
Oxygen - O_2 Concentration (%)	5.93	9.64	6.96	7.51	-
Carbon Dioxide CO_2 Concentration (%)	18.5	13.9	17.1	16.5	-
Particulate Matter (PM)					
Concentration (mg/Rm^3)	61.9	59.8	49.9	57.2	-
Concentration at 11% O_2 (mg/Rm^3)	40.9	52.6	35.4	43.0	-
Emission Rate (kg/hr)	0.05	0.06	0.05	0.05	-
Mercury (Hg)					
Concentration ($\mu g/Rm^3$)	0.33	0.31	0.39	0.35	-
Concentration at 11% O_2 ($\mu g/Rm^3$)	0.22	0.28	0.28	0.26	20
Emission Rate (kg/hr)	2.92E-07	2.91E-07	3.61E-07	3.15E-07	-

Notes:
Rm^3 Cubic meters (corrected to 25° C and 101.3 kPa).
mg/Rm^3 Milligrams per reference cubic meter.
$\mu g/Rm^3$ Micrograms per reference cubic meter
kg/hr Kilograms per hour.

The average concentration of mercury for the three tests was 0.26 µg/Rm^3, which is below the CWS/Nunavut stack limit of 20 µg/Rm^3 (corrected to 11% oxygen).

There are no limits specified for particulate matter emissions in the Nuvanut Department of the Environment's "Guideline for the Burning and Incineration of Solid Waste".

Table 4.2 Dioxins and Furans Source Testing Results

Parameter	Test 1	Test 2	Test 3	Average	Method Criteria/CWS Limits
Test Date	15-Sep-19	16-Sep-19	16-Sep-19	-	-
Test Period	10:55 – 14:05	10:00 – 12:00	14:18 – 16:18	-	-
Test Duration (min)	188	188	188	188	240
Stack Gas Static Pressure (kPa)	0.005	0.005	0.005	0.005	-
Volume of Gas Sampled (Rm^3)	2.72	1.83	2.27	2.27	3
Average Isokineticity (%)	107	99.7	99.6	102.1	90-110
Total Mass of waste combusted (kg)*	181	181	181	181	-
Stack Gas Temperature (°C)	827	811	804	814	-
Stack Gas Moisture Content (%)	15.1	12.7	10.9	12.9	-
Stack Gas Velocity (m/s)	6.84	4.70	5.65	5.73	-
Stack Gas Flow Rate (Rm^3/s)	0.25	0.18	0.23	0.22	-
Oxygen - O_2 Concentration (%)	3.73	4.76	9.87	6.12	-
Carbon Dioxide - CO_2 Concentration (%)	18.5	19.5	14.2	17.4	-
2,3,7,8-Tetra CDD (pg/TEQ pg)**	448	87.0	42.9	193	-
1,2,3,7,8-Penta CDD (pg/TEQ pg)**)	1,730	289	314	778	-
1,2,3,4,7,8-Hexa CDD (pg/TEQ pg)**	1,800	330	756	96.2	-
1,2,3,6,7,8-Hexa CDD (pg/TEQ pg)**	2,420	556	2,160	171	-
1,2,3,7,8,9-Hexa CDD (pg/TEQ pg)**	1,980	422	1,360	125	-
1,2,3,4,6,7,8-Hepta CDD (pg/TEQ pg)**	21,300	6,940	37,200	218	-
Octa CDD (pg/TEQ pg)**	28,500	12,400	95,500	13.6	-
2,3,7,8-Tetra CDF (pg/TEQ pg)**	2,310	359	249	97.3	-
1,2,3,7,8-Penta CDF (pg/TEQ pg)**	4,400	676	879	59.6	-
2,3,4,7,8-Penta CDF (pg/TEQ pg)**	5,760	1,280	2,310	935	-
1,2,3,4,7,8-Hexa CDF (pg/TEQ pg)**	5,240	1,220	2,970	314	-
1,2,3,6,7,8-Hexa CDF (pg/TEQ pg)**	5,930	1,320	4,080	378	-
2,3,4,6,7,8-Hexa CDF (pg/TEQ pg)**	4,780	2,340	11,200	611	-

Table 4.2 Dioxins and Furans Source Testing Results

Parameter	Test 1	Test 2	Test 3	Average	Method Criteria/CWS Limits
1,2,3,7,8,9-Hexa CDF (pg/TEQ pg)**	1,190	668	3,170	168	-
1,2,3,4,6,7,8-Hepta CDF (pg/TEQ pg)**	10,300	6480	28,300	150	-
1,2,3,4,7,8,9-Hepta CDF (pg/TEQ pg)**	1,680	1,470	10,300	44.8	-
Octa CDF (pg/TEQ pg)**	2,200	8,370	69,700	8.03	-
Total TEQ (pg TEQ)	6,945.01	1,656.91	4,478.33	4,360	-
Concentration uncorrected (pg TEQ/Rm^3)	2,553	907	1,972	1,811	-
Concentration corrected to 11 % O_2 (pg TEQ/Rm^3)	1,472	556	1,769	1,266	
Concentration corrected to 11 % O_2 (ng/TEQ/Rm^3)	1.47	0.56	1.77	1.27	0.08
Emission Rate (pg TEQ/s)	651	166	449	422	--

Legend:

CDD Chloro Dibenzo-p-Dioxin.
CDF Chloro Dibenzofuran.
TEF Toxic equivalency factor (2005 World Health Organization)
TEQ Tetrachlorodibenzo-para-dioxin equivalent (TEQ).
pg TEQ Picograms tetrachlorodibenzo-para-dioxin equivalent.
pg TEQ/Rm^3 Picograms tetrachlorodibenzo-para-dioxin equivalent per dry cubic meter at reference conditions.
pg TEQ/s Picograms tetrachlorodibenzo-para-dioxin equivalent per second.

*Total mass of waste combusted for September 15 and 16, 2019 was estimated by taking an average of the mass of waste combusted on September 17 and 18, 2019, as the site records for the mass of waste combusted on September 15 and 16 were not available.
**Individual test results reported in pg. Average reported in TEQ pg.

The average concentration of dioxins and furans for the three tests was 1.27 ng/TEQ/Rm^3, which is above the CWS/Nunavut stack limit of 0.08 ng TEQ/Rm^3, corrected to 11% oxygen.

The sample volumes collected were slightly below the method recommended sample size of 3 to 4 m^3, and test times were shorter than the 4-hour sample specified in the methodology. The shorter test times and lower sample volumes were required due to the relatively short batch runs of 3 hours and method dictated sample rates. Laboratory results show measurable amounts of target analytes, therefore, the lower sample volume and shorter test times is not considered to have materially affected the validity of the testing. The source testing raw data, laboratory analytical results, and detailed calculations are provided in Appendices B, C, and D, respectively.

The velocity profiles across the exhaust stack, as shown in Appendix D, were consistent between tests and did not indicate the presence of cyclonic or reverse flow.

Based on the results of the dioxins and furans testing, it is recommended that TMAC review potential options to reduce these emissions. Options could include:

- Reviewing the incinerator emissions performance with the manufacturer,
- Ensuring manufacturer recommended operational procedures for the incinerator have been implemented and ensuring all operators are adequately trained and,
- Reviewing TMAC's waste segregation practices.

5.0 CLOSING REMARKS

This report has been prepared by Nunami Stantec for the sole benefit of TMAC Resources Inc. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Nunami Stantec and TMAC Resources Inc. This report was undertaken exclusively for the purpose outlined herein and was limited to the scope and purpose specifically expressed in this report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties. Nunami Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

Nunami Stantec makes no representation or warranty with respect to this report, other than the work was undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Any information or facts provided by others and used in the preparation of this report were assumed by Nunami Stantec to be accurate. Conclusions presented in this report should not be construed as legal advice.

The source testing measurements for each stack were taken over short periods of time and the emissions results are considered representative for the conditions present at the time of testing. The information provided in this report was compiled from such on-site measurements and by applying currently accepted industry standard mitigation and prevention principles. This report represents the best professional judgment of Nunami Stantec personnel available at the time of its preparation. Nunami Stantec reserves the right to modify the contents of this report, in whole or in part, to reflect the any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

This report was prepared by Julie Reid, P.Eng., quality reviewed by Vicki Corning, P.Eng., and independently reviewed by Mike Murphy, PhD, P.Eng, on behalf of TMAC Resources Inc. If you have any questions or concerns about this report, please do not hesitate to contact the undersigned.

Respectfully Submitted,
NUNAMI STANTEC LIMITED

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APPENDIX A

Calibration Data

VALLEY ENVIRONMENTAL CALIBRATION SERVICES

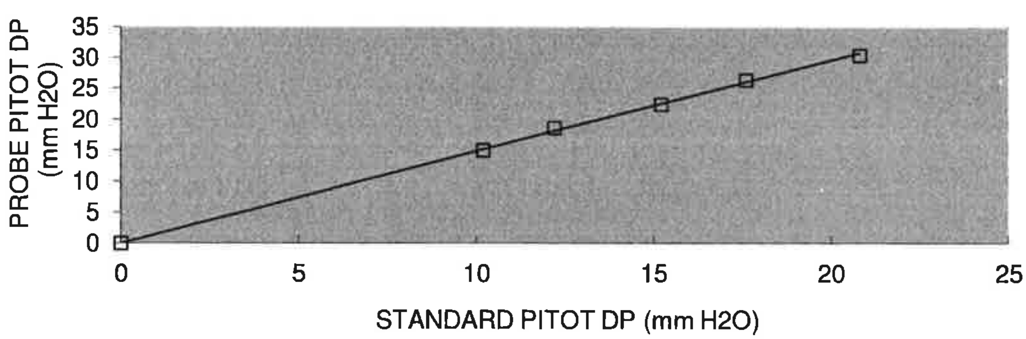
PITOT TUBE CALIBRATION REPORT

CLIENT - **Stantech**
PROBE ID - **M5-2**
NOZZLE - **#16- 0.500"**
DATE - **4-Mar-19**

FAN SPEED m/s	STANDARD PITOT (mm H2O)	PROBE PITOT (mm H2O)
0.00	0.00	0.00
13.1	10.20	15.00
14.3	12.20	18.60
16.0	15.20	22.40
17.2	17.60	26.40
18.7	20.80	30.40

PITOT FACTOR Cp = **0.821**

PITOT - **M5-2** **NOZZLE -** **#16- 0.500"**
4-Mar-19



Technician: Andrew Murphy

Signature Andrew Murphy

VALLEY ENVIRONMENTAL SERVICES
160 Pony Drive #1
Newmarket, Ontario L3Y 7B6
PH: (905) 830 0136
FAX: (905) 830 0137

Tunnel	VES
Std. Pitot Cp	0.999
Static	-0.25
Barometric	29.25
Temperature	70
Abs Static	29.23

Pre-Test Dry Gas Meter - Control Unit Calibration

Date : 1/4/2019
Barometric Pressure, Pb : 30
Model Number : 2203
Calibrated By : JJC
Job #: 121899000

Orifice Manometer Setting, deltaH (in. H2O)				Dry Gas Meter Volume, Vm (cu.ft)			Temperatures (F)				Time, theta (min)
								Dry Gas Meter			
						Total			Outlet, to	Average, tm	
1.0						5.500			66	66	10
1.5						5.403			69	69	8
2.2						5.850			70	70	7

Calculations

Orifice Manometer Setting, deltaH (in. H2O)	Dry Gas Correction Factor, gamma (Tolerance = 0.95 - 1.05, +/-1.5% of avg)	Orifice Pressure Differential (delta H@) yielding 0.75 cfm of air at 68F and 29.92 in.Hg as in. H2O (Tolerance = +/- 0.15 in.)	Orifice Coefficient Ko
1.0	0.979	1.842	0.710
1.5	0.978	1.945	0.693
2.2	0.980	1.853	0.708
Average	**0.979**	**1.880**	**0.704**

METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
2) Record barometric pressure before and after calibration procedure.
3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum total volume of 5 cubic feet.
4) Record data and information in the **GREEN** cells, YELLOW cells are calculated.

DATE:	6/24/2019	METER SERIAL #:	2203		
METER PART #:	2203	CRITICAL ORIFICE SET SERIAL #:	1463s		

	INITIAL	FINAL	AVG (P_{bar})
BAROMETRIC PRESSURE (in Hg):	29.76	29.76	29.76

IF Y VARIATION EXCEEDS 2.00%, ORIFICE SHOULD BE RECALIBRATED

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT^3) INITIAL	DGM READINGS FINAL	NET (V_m)	TEMPERATURES °F AMBIENT	DGM INLET INITIAL	DGM INLET FINAL	DGM OUTLET INITIAL	DGM OUTLET FINAL	DGM AVG	ELAPSED TIME (MIN) θ	DGM ΔH (in H_2O)	(1) V_m (STD)	(2) V_{cr} (STD)	(3) Y	Y VARIATION (%)	$\Delta H_@$
15	1	0.4164	18	179.70	185.19	5.490	69.1	65	65	65	65	65	10.00	0.95	5.5058	5.3889	0.979		1.85
	2	0.4164	18	196.19	201.70	5.510	69.6	67	68	67	68	67.5	10.00	0.95	5.4996	5.3864	0.979		1.84
	3	0.4164	18	190.69	196.19	5.50	69.4	66	67	66	67	66.5	10.00	0.95	5.5001	5.3874	0.980		1.84
																AVG =	0.979	0.05	
18	1	0.5085	18	202.10	207.69	5.590	69.6	67	69	67	69	68	8.00	1.50	5.5818	5.2622	0.943		1.95
	2	0.5085	18	207.69	212.91	5.220	69.8	69	69	69	69	69	8.00	1.50	5.2024	5.2612	1.011		1.94
	3	0.5085	18	212.91	218.31	5.40	69.8	69	70	69	70	69.5	8.00	1.50	5.3768	5.2612	0.979		1.94
																AVG =	0.978	-0.13	
23	1	0.6307	18	218.43	224.27	5.840	69.8	70	70	70	70	70	7.00	2.20	5.8194	5.7099	0.981		1.85
	2	0.6307	18	224.27	230.12	5.850	69.8	70	70	70	70	70	7.00	2.20	5.8293	5.7099	0.980		1.85
	3	0.6307	18	239.08	244.94	5.860	69.8	70	70	70	70	70	7.00	2.20	5.8393	5.7099	0.978		1.85
																AVG =	0.980	0.08	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:
The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.979

AVERAGE $\Delta H_@$ = 1.88

(1) $$Vm_{(std)} = K_1 * Vm * \frac{Pbar + (\Delta H / 13.6)}{Tm}$$

= Net volume of gas sample passed through DGM, corrected to standard conditions
K_1 = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)
T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_@ = \left(\frac{0.75\,\theta}{V_{cr}(std)}\right)^2 \Delta H \left(\frac{V_m(std)}{V_m}\right)$$

(2) $$Vcr_{(std)} = K' * \frac{Pbar * \Theta}{\sqrt{Tamb}}$$

= Volume of gas sample passed through the critical orifice, corrected to standard conditions
T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)
K' = Average K' factor from Critical Orifice Calibration

(3) $$Y = \frac{Vcr_{(std)}}{Vm_{(std)}}$$

= DGM calibration factor

THE POWER TO KNOW ENERAC™

CALIBRATION CERTIFICATE

CALIBRATION DATE 08/23/19 MODEL 500

TESTED BY RDZ SERIAL # 511458

THIS ANALYZER WAS SUCCESFULLY ZEROED IN CLEAN AIR AND SUCCESFULLY CALIBRATED USING 2% CERTIFIED ACCURACY NIST TRACEABLE SPAN GAS FOR THE MEASUREMENT OF THE FOLLOWING PARAMETERS AS NEEDED:

CALIBRATED SENSORS		CONCENTRATION		
OXYGEN	X	0.00/20.9	%	O_2 balance NITROGEN
COMBUSTIBLES	X	1.01	%	CH_4 balance NITROGEN
CARBON MONOXIDE	X	204	PPM	CO balance NITROGEN
NITRIC OXIDE	X	198	PPM	NO balance NITROGEN
NITROGEN DIOXIDE	X	104	PPM	NO_2 balance NITROGEN
SULFUR DIOXIDE	X	203	PPM	SO_2 balance NITROGEN
DRAFT	X	5.00	”	W.C.

1320 LINCOLN AVE., HOLBROOK, NY 11741
TEL: (516) 997-2100 (800) 695-3637
FAX: (516) 997-2129
www.enerac.com
EMAIL: info@enerac.com

Probe Stack Thermocouple Calibration

Calibration Date: 8-Feb-18

Calibrated By: JJC

Reference ID Fisher Scientific catalog #150414E

Stantec

Ice Bath

Thermocouple #	Reference Temp (F)	Observed Temp (F)	Percent Difference (Absolute Temp)
#1 -2' probe	32	32	0.00%
#1 -3' probe	32	32	0.00%
#1 -4' probe	32	32	0.00%
#1 -5' probe	32	32	0.00%
#1 - 6' probe	32	32	0.00%
#1 - 8'-1 probe	NA	NA	
#1 -8'-2 probe	32	32	0.00%
#1 -10'-1 probe	NA	NA	
#1 -10'-2 probe	32	32	0.00%
#6 -1848	32	32	0.00%
#7 -1848	32	32	0.00%
#6 - 2203	32	32	0.00%
#6 - 2257	32	32	0.00%
3FT Pitot - no fittings	32	32	0.00%
3FT Pitot - fittings	32	32	0.00%
5ft Pitot	32	34	-0.40%

Boiling Water

Thermocouple #	Reference Temp (F)	Observed Temp (F)	Percent Difference (Absolute Temp)
#1 -2' probe	212	210	0.30%
#1 -3' probe	212	212	0.00%
#1 -4' probe	212	212	0.00%
#1 -5' probe	212	210	0.30%
#1 - 6' probe	212	213	-0.15%
#1 - 8'-1 probe	NA	NA	
#1 -8'-2 probe	212	212	0.00%
#1 -10'-1 probe	NA	NA	
#1 -10'-2 probe	212	212	0.00%
#6 -1848	212	212	0.00%
#7 -1848	212	212	0.00%
#6 -2203	212	212	0.00%
#6 - 2257	212	212	0.00%
3FT Pitot - no fittings	212	212	0.00%
3FT Pitot - fittings	212	212	0.00%
5ft Pitot	212	212	0.00%

CAL-CHEK CANADA INC.

250 Governors Road - Dundas ON L9H 3K3
Telephone: (905) 628-4636
www.calchek.ca

Scale / Balance Certification

Date: February 12, 2019 | **Certificate Number:** S190327

Customer: Stantec Consulting Ltd.
845 Prospect Street
Fredericton, New Brunswick E3B 2T7

Room Temperature: 19.7°C

Calibration Location: 10 Timothy Drive, Hanwell - North Kingsclear Lab

Scale / Balance Manufacturer: Mettler Toledo | **Resolution:** 0.1g

Model Number: PB8001 | **Serial Number:** 1116222054

Capacity: 8,100 g | **Capacity Calibrated To:** 8,100 g

ACTUAL WEIGHT APPLIED GRAMS	SCALE READINGS AS FOUND	ERROR AS FOUND	ACTUAL WEIGHT APPLIED GRAMS	SCALE READINGS AS LEFT	ERROR AS LEFT
0.5	0.5	0.0	**0.5**	0.5	0.0
1.0	1.0	0.0	**1.0**	1.0	0.0
5.0	5.0	0.0	**5.0**	5.0	0.0
10.0	10.0	0.0	**10.0**	10.0	0.0
20.0	20.0	0.0	**20.0**	20.0	0.0
50.0	50.0	0.0	**50.0**	50.0	0.0
100.0	100.0	0.0	**100.0**	100.0	0.0
200.0	200.0	0.0	**200.0**	200.0	0.0
500.0	500.0	0.0	**500.0**	500.0	0.0
1000.0	999.9	0.1	**1000.0**	1000.0	0.0
2000.0	1999.9	0.1	**2000.0**	2000.0	0.0
4000.0	3999.7	0.3	**4000.0**	4000.0	0.0
6000.0	5999.6	0.4	**6000.0**	6000.0	0.0
8000.0	7999.4	0.6	**8000.0**	8000.0	0.0
8100.0	8099.4	0.6	**8100.0**	8100.0	0.0

The above mentioned Scale / Balance has been checked for accuracy using the following N.I.S.T. calibrated dead weights as per the CSA method.

STANDARD	CAL DATE	*TRACEABLE #*
CCC-800	15/06/16	2449326

Obtained results are within the manufacturer's stated accuracy and/or are within +/-0.01% or 1 division whichever is greater at any point of the calibrated range.

Pass/Fail statements are based on data from measurements made, procedures utilized, professional experience and the uncertainty associated with this calibration. It is the responsibility of the user of this equipment to determine if the results identified meet specific requirements for its intended application.

Calibration Technician: Mike Gambicourt

Suggested Calibration Due Date: February 2020

Authorized Signatory: Roni Newitt

Due dates appearing on the certificate of calibration and label are determined by client for administrative purposes and do not imply continued conformance to specifications.
All calibrations performed at customer location unless otherwise noted.

APPENDIX B

Field Sheets

MOISTURE FIELD DATA SHEET - DIOXINS/FURANS/SVOC's

Client: TMAC
Job No.: 1609 30343

Stantec

Plant: Incinerator
Location: Hope Bay
Test: SVOC - 1
Date: 15 Sep.
Analyst: B. Cole

Filter QZ6686

Moisture Data

	Component	Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
	Condenser	Empty	306.4	304.7	1.7
#3	Resin Trap	XAD-2	350.6	347.9	2.7
	Condensate Trap	Empty	817.5	490.1	327.4
	First Impinger	100 ml Ethylene Glycol	770.2	752.8	17.4
	Second Impinger	Empty	647.1	646.5	0.6
	Third Impinger	200g Silica Gel	918.5	911.6	6.9
			Total Weight Gain (g)		356.7
			Moisture Volume (mL)		

356.7
×0.048
= 17.1216 cu ft.

DGM Final - Initial
= 326.26 - 231.45
= 94.81 cu. ft
× 0.[illegible]
= 4.[illegible]

17.1216 / 111.9316

= 0.152965
= 15.3 %

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: T MAC
Plant: Incinerator
Location: Hope Bay
Test: SVOC-1
Date: 15 Sep
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Ko Coeff.: .704
Start : 10:55
Finish : 2:05

Barometric Pressure (in.Hg):
Static Pressure (in.H2O): 0.02
Assumed Moisture (%): 0.098 9.8%
Filter ID: Q26686
Initial Filter Weight (g):
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Ambient Temp. (F): 41

Test Traverses

Leak Checks:
Before Traverse: 231.19 → 231.45
Vacuum Pressure: -19
After Traverse:
Vacuum Pressure:

Fuel Type: diesel / garbage
Steam Load:

Combustion Gases :
O2 (%) :
CO2 (%) :
CO (ppm) :
SO2 (ppm) :
NO2 (ppm) :
NOx (ppm) :
Tamb (F) :
Tstack (F) :

250+

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0	1355	0.01		231.45			41	38	56		
	4	1355	0.02	0.42	231.92	250+	251	41	38	58		-1
	8	1382	0.02	0.42	233.26		250	41	36	56		-1
	12	1418	0.02	0.41	234.66		250	40	36	55		-1
	16	1430	0.03	0.61	236.35		250	40	37	56		-2
	20	1462	0.04	0.80	238.29		252	40	36	56		-3
	24	1488	0.04	0.79	240.20		255	41	36	57		-4
	28	1493	0.04	0.79	242.14		249	42	36	58		-5
	32	1515	0.05	0.97	244.25		253	44	36	59		-6
	36	1533	0.05	0.96	246.42		248	45	36	59		-6
	40	1550	0.06	1.15	248.80		252	46	36	59		-6
	48 44	1562	0.06	1.14	251.17		251	48	37	60		-5
	52 48	1561	0.06	1.14	253.54		250	49	37	60		-5
	56 52	1575	0.05	0.95	255.68		249	47	36	60		-5
	60 56	1580	0.05	0.94	257.76		249	45	36	59		-5
	64 60	1591	0.04	0.75	259.65		250	44	36	59		-5
	68 64	1608	0.04	0.74	261.55		251	45	36	59		-5
	72 68	1540	0.03	0.58	263.20		251	44	36	58		-6
	76 72	1547	0.03	0.57	264.82		248	42	36	58		-6
	80 76	1561	0.03	0.57	266.48		250	42	36	56		-6
	84 80	1512	0.03	0.58	268.15		249	42	36	56		-7
	88 84	1531	0.03	0.58	269.82		249	42	36	56		-7
	92 88	1524	0.03	0.58	271.48		250	42	36	56		-7
	96 92	1519	0.04	0.77	273.41		248	42	36	56		-9
	~~100~~ 96	1530	0.04	0.77	275.34		249	43	36	56		-9
	100	1518	0.04	0.77			252	44	36	57		

*52 min - Unit primary opened for stirring

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 1609 30343
Client: TMAC
Plant: Incinerator
Location: Hope Bay NU
Test: SVOC-1
Date: 15 Sep 2019
Operators: BC/KW
Gamma: 0.979
Delta H@: 1.880
Pitot Coeff.: .82
Ko Coeff.: .704
Start: 10:55
Finish: 2:05

Barometric Pressure (in.Hg):
Static Pressure (in.H2O): 0.02
Assumed Moisture (%): 9.8
Filter ID: QT 6686
Initial Filter Weight (g):
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Ambient Temp. (F):

Test Traverses

Leak Checks:
Before Traverse:
Vacuum Pressure:
After Traverse: 326.42
Vacuum Pressure: -20

Fuel Type: diesel/garbage
Steam Load:

Combustion Gases:
O2 (%):
CO2 (%):
CO (ppm):
SO2 (ppm):
NO2 (ppm):
NOx (ppm):
Tamb (F):
Tstack (F):

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	100	1518	0.04	0.77	277.29		252	44	36	57		-9
	104	1517	0.04	0.78	279.22		250	44	36	57		-9
	108	1530	0.04	0.77	281.17		252	36	35	57		-9
	112	1515	0.05	0.97	283.41		249	35	35	58		-11
	116	1508	0.05	0.98	285.56		250	42	35	58		-7
	120	1518	0.05	0.97	287.69		252	43	35	58		-8
	124	1504	0.05	0.98	289.87		251	44	36	58		-9
	128	1507	0.05	0.98	292.05		252	43	36	58		-9
	132	1520	0.05	0.97	294.20		247	43	36	58		-9
	136	1507	0.05	0.98	296.34		251	42	35	58		-10
	140	1515	0.05	0.97	298.54		252	42	35	59		-10
	144	1508	0.05	0.98	300.71		252	43	35	59		-10
	148	1514	0.05	0.97	302.93		246	43	35	59		-10
	152	1580	0.05	0.94	305.10		249	43	36	60		-7
	156	1565	0.05	0.95	307.23		251	44	36	60		-7
	160	1547	0.06	1.15	309.69		248	45	37	60		-9
	164	1545	0.06	1.15	312.05		251	45	37	60		-7
	168	1538	0.06	1.16	314.42		247	46	37	60		-8
	172	1535	0.06	1.16	316.80		251	46	37	60		-8
	176	1540	0.06	1.16	319.15		252	46	37	60		-8
	180	1535	0.06	1.16	321.52		247	46	37	60		-9
	184	1532	0.06	1.16	323.91		250	46	37	60		-9
	188	1535	0.06	1.16	326.26		249	46	38	61		-10

* 146 Unit opened for stirring
- CO shoots up temporarily after stir

MOISTURE FIELD DATA SHEET - DIOXINS/FURANS/SVOC's

Client: TMAC
Job No.: 1609 30343

Plant: Incinerator
Location: Hope Bay NU
Test: SVOC-2
Date: 16 Sep 2019
Analyst: B.Cole

Stantec

QZ 6687

Moisture Data

Component	Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	Empty	229.6	227.1	2.5
Resin Trap	XAD-2	342.2	339.4	2.8
Condensate Trap	Empty	763.4	540.9	222.5
First Impinger	100 ml Ethylene Glycol	742.5	778.3	-35.8
Second Impinger	Empty	620.0	619.8	0.2
Third Impinger	200g Silica Gel	922.2	918.1	4.1
			Total Weight Gain (g)	196.3
			Moisture Volume (mL)	

392.25
-326.60
65.65

196.3
x 0.048 = 9.4224
+ 65.65
75.0724

9.4224 / 75.0724
= 0.125511
= 12.5%

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMAC
Plant: Incinerator
Location: Hope Bay NV
Test: SVOC - 2
Date: 16 Sep 2019
Operators: BC / KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Ko Coeff.: .704
Start : 10:00
Finish :

Barometric Pressure (in.Hg):
Static Pressure (in.H2O): 0.02
Assumed Moisture (%): 15.3
Filter ID: QZ 6687
Initial Filter Weight (g):
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Ambient Temp. (F): 35

Test Traverses

Leak Checks: ✓
Before Traverse: (326.42 → 326.60)
Vacuum Pressure: -20
After Traverse:
Vacuum Pressure:

Fuel Type: diesel / garbage.
Steam Load:

Combustion Gases :
O2 (%) :
CO2 (%) :
CO (ppm) :
SO2 (ppm) :
NO2 (ppm) :
NOx (ppm) :
Tamb (F) : 35
Tstack (F) :

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				326.60							
	4	1420	0.03	0.57	328.31		252	35	33	73		-1
	8	1427	0.03	0.57	329.91		248	35	33	73		-2
	12	1464	0.03	0.56	331.56		251	36	34	73		-3
	16	1480	0.03	0.55	333.19		252	36	34	73		-4
	20	1474	0.02	0.37	334.55		251	36	34	72		-4
	24	1480	0.02	0.37	335.87		250	36	34	73		-4
	28	1475	0.02	0.37	337.20		250	37	34	72		-4
	32	1478	0.02	0.37	338.55		250	37	34	73		-5
	36	1455	0.03	0.56	340.19		249	36	34	72		-6
	40	1447	0.03	0.56	341.87		250	36	34	72		-7
	44	1455	0.02	0.37	343.32		250	37	34	72		-5
	48	1430	0.02	0.38	344.64		247	37	34	72		-6
	52	1508	0.03	0.54	346.22		252	36	34	72		-9
	56	1580	0.03	0.52	347.82		249	36	37	72		-10
	60	1584	0.03	0.52	349.42		251	37	34	72		-10
	64	1536	0.02	0.36	350.77		247	38	34	72		-9
	68	1507	0.02	0.36	352.08		248	38	34	72		-8
	72	1505	0.02	0.36	353.42		251	37	34	71		-9
	76	1494	0.02	0.37	354.78		251	37	34	72		-9
	80	1520	0.02	0.36	356.12		249	37	34	72		-9
	84	1510	0.02	0.36	357.44		248	38	34	72		-9
	88	1499	0.02	0.36	358.79		254	37	34	71		-10
	92	1503	0.02	0.36	360.17		250	37	34	71		-10
	96	1506	0.02	0.36	361.51		251	38	34	71		-10
	100	1499	0.02	0.36			249	38	34	70		

*Primary unit opened for stirring @ 44 mins.

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMAC
Plant: Incinerator
Location: Hope Bay NU.
Test: SVOC-2
Date: 16 Sep 2019
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Ko Coeff.: .704
Start : 10:00
Finish : 13:09

Barometric Pressure (in.Hg):
Static Pressure (in.H2O): 0.02
Assumed Moisture (%): 15.3
Filter ID: QZ 6687
Initial Filter Weight (g):
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): .536
Ambient Temp. (F):

Test Traverses

Leak Checks:
Before Traverse:
Vacuum Pressure:
After Traverse: 392.48
Vacuum Pressure: -20

Fuel Type: diesel/garbage
Steam Load:

Combustion Gases :
O2 (%) :
CO2 (%) :
CO (ppm) :
SO2 (ppm) :
NO2 (ppm) :
NOx (ppm) :
Tamb (F) :
Tstack (F) :

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	100	1499	0.02	0.36	362.85		249	38	34	70		-10
	104	1470	0.02	0.37	364.21		251	37	34	70		-10
	108	1499	0.02	0.36	365.56		249	38	34	70		-10
	112	1485	0.02	0.36	366.91		249	38	35	69		-10
	116	1475	0.02	0.37	368.25		249	38	34	68		-11
	120	1488	0.02	0.36	369.60		252	37	34	68		-11
	124	1482	0.02	0.36	370.95		250	37	34	68		-12
	128	1490	0.02	0.36	372.28		249	37	34	67		-12
	132	1480	0.02	0.36	373.60		251	36	34	67		-12
	136	1498	0.02	0.36	374.94		249	37	34	67		-12
	140	1490	0.02	0.36	376.27		249	37	34	67		-12
	144	1504	0.02	0.36	377.60		249	36	34	67		-12
	148	1495	0.02	0.36	378.94		249	37	34	67		-12
	152	1502	0.02	0.36	380.28		251	37	34	67		-13
	156	1480	0.02	0.36	381.60		249	37	34	66		-13
	160	1494	0.02	0.36	382.94		248	37	34	66		-13
	164	1505	0.02	0.36	384.27		249	37	34	66		-13
	168	1500	0.02	0.36	385.59		252	37	34	66		-13
	172	1500	0.02	0.36	386.92		247	37	34	66		-13
	176	1490	0.02	0.36	388.26		249	37	34	66		-14
	180	1500	0.02	0.36	389.58		248	37	34	66		-14
	184	1510	0.02	0.36	390.91		251	37	34	66		-14
	188	1500	0.02	0.36	392.25		247	37	35	66		

MOISTURE FIELD DATA SHEET - DIOXINS/FURANS/SVOC's

Stantec

Client: TMAC
Job No.: 160930343

Plant: Incinerator
Location: Hope Bay
Test: SVOC-3
Date: Sept 16/19
Analyst: B.C. / K.W.

QZ6688

Moisture Data

Component	Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	Empty	264.1	262.1	2.0
Resin Trap	XAD-2	338.6	341.4	-2.8
Condensate Trap	Empty	692.8	504.8	188.0
First Impinger	100 ml Ethylene Glycol	741.1	727.4	13.7
Second Impinger	Empty	634.3	634.3	0
Third Impinger	200g Silica Gel	925.3	922.2	3.1
			Total Weight Gain (g)	206.8
			Moisture Volume (mL)	206.8

473.00
-392.78
80.22

206.8 x0.048 = 9.9264

80.22 + 9.9264 = 90.1464

9.9264 / 90.1464 = 0.110114

= 11.0 %

SOURCE TESTING FIELD DATA SHEET

Job No.: 16030343
Client: TMAC
Plant: Incinerator
Location: Hope Bay
Test: SVOC-3
Date: 16 Sep.
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Ko Coeff.: .704
Start : 2:18 pm
Finish :

Barometric Pressure (in.Hg):
Static Pressure (in.H2O): 0.02
Assumed Moisture (%): 12.5
Filter ID: QZ 6688
Initial Filter Weight (g):
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): .536
Ambient Temp. (F): 40

Test Traverses

Leak Checks:
Before Traverse: 1/-20
Vacuum Pressure: 392.78 - 392.48
After Traverse:
Vacuum Pressure:

Fuel Type: diesel/garbage
Steam Load:

Combustion Gases :
O2 (%) :
CO2 (%) :
CO (ppm) :
SO2 (ppm) :
NO2 (ppm) :
NOx (ppm) :
Tamb (F) :
Tstack (F) :

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				392.78							
	4	1650	0.04	0.70	394.57	252	252	38	35	59		-2
	8	1560	0.04	0.73	396.44		248	37	35	60		-3
	12	1538	0.04	0.74	398.30		250	36	35	60		-4
	16	1480	0.04	0.76	400.20		254	37	35	61		-5
	20	1430	0.04	0.78	402.14		251	37	34	61		-5
	24	1460	0.04	0.77	404.06		249	36	35	62		-5
	28	1400	0.03	0.60	405.77		244	37	34	62		-5
	32	1480	0.03	0.57	407.44		249	37	34	62		-5
	36	1495	0.03	0.57	409.08		247	37	34	63		-5
	40	1450	0.03	0.58	410.71		250	37	34	64		-5
	44	1495	0.03	0.57	412.41		249	37	34	64		-6
	48	1480	0.03	0.57	414.07		250	37	34	64		-6
	52	1510	0.02	0.38	415.45		248	38	34	63		-5
	56	1520	0.02	0.37	416.81		249	37	34	63		-5
	60	1460	0.03	0.58	418.42		250	37	34	64		-17
	64	1520	0.03	0.56	420.05		252	37	34	64		-8
	68	1470	0.03	0.58	421.69		250	37	34	65		-8
	72	1520	0.02	0.37	423.14		257	38	34	65		-7
	76	1500	0.03	0.57	424.79		251	38	35	65		-9
	80	1590	0.03	0.54	426.40		246	38	34	65		-9
	84	1470	0.02	0.38	427.82		247	38	34	65		-8
	88	1510	0.02	0.38	429.19		250	38	34	65		-7
	92	1515	0.02	0.38	430.56		248	38	35	65		-7
	96	1510	0.02	0.38	431.89		250	38	35	65		
	100	1490	0.03	0.57			250	38	35	65		

* primary unit opened @ 55 mins for stirring

1/2

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMAC
Plant: Incinerator
Location: Hope Bay
Test: SVOC - 3
Date: 16 Sep 2019
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Ko Coeff.: .704
Start :
Finish :

Barometric Pressure (in.Hg):
Static Pressure (in.H2O):
Assumed Moisture (%): 12.5
Filter ID:
Initial Filter Weight (g):
Stack Dia. (in.):
Probe Length (ft):
Nozzle ID (in.):
Ambient Temp. (F):

Test Traverses

Leak Checks:
Before Traverse:
Vacuum Pressure:
After Traverse: 473.25
Vacuum Pressure: -20

Fuel Type:
Steam Load:

Combustion Gases :
O2 (%) :
CO2 (%) :
CO (ppm) :
SO2 (ppm) :
NO2 (ppm) :
NOx (ppm) :
Tamb (F) :
Tstack (F) :

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	XAD-2 Inlet Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	100	1490	.03	0.57	433.51		250	38	35	65		-10
	104	1450	0.03	0.58	435.20		252	38	35	66		-10
	108	1520	0.03	0.56	436.86		250	38	35	65		-11
	112	1535	0.03	0.56	438.53		249	38	35	66		-11
	116	1530	0.03	0.56	440.17		250	39	35	66		-11
	120	1530	0.03	0.56	441.83		249	39	35	66		-11
	124	1520	0.03	0.56	443.47		249	39	35	66		-11
	128	1505	0.03	0.57	445.15		251	40	36	66		-11
	132	1500	0.03	0.57	446.82		249	39	36	66		-12
	136	1460	0.03	0.58	448.53		251	37	35	66		-12
	140	1400	0.03	0.60	450.18		251	36	34	66		-12
	144	1475	0.03	0.58	451.81		248	37	34	66		-12
	148	1400	0.04	0.80	453.68		244	37	34	66		-14
	152	1440	0.04	0.78	455.58		253	36	34	66		-15
	156	1460	0.03	0.58	457.29		243	37	34	66		-13
	160	1390	0.04	0.80	459.20		249	37	34	66		-15
	164	1300	0.04	0.85	461.21		252	37	34	66		-16
	168	1370	0.04	0.81	463.22		253	37	34	67		-16
	172	1420	0.04	0.79	465.20		247	37	34	66		-15
	176	1375	0.04	0.81	467.20		252	37	35	67		-15
	180	1470	0.04	0.77	469.17		250	37	35	67		-15
	184	1480	0.04	0.77	471.10		254	37	35	67		-15
	188	1515	0.04	0.75	473.00		246	38	35	67		

* Primary unit opened @ 137 for stirring

MOISTURE FIELD DATA SHEET - DIOXINS/FURANS/SVOC's

Stantec

Client: TMAC
Job No.: 1609 30343

Plant: Incinerator
Location: Hope Bay NV
Test: SVOC-4 - Blank train
Date: 17 Sep 2019
Analyst: BC/KW

filter
QZ 6689

Moisture Data

Component	Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	Empty	273.3	271.9	
Resin Trap	XAD-2	346.0	347.5	
Condensate Trap	Empty	496.4	496.4	
First Impinger	100 ml Ethylene Glycol	732.9	732.4	
Second Impinger	Empty	666.2	666.1	
Third Impinger	200g Silica Gel	926.5	924.7	
		Total Weight Gain (g)		
		Moisture Volume (mL)		

1.38 cu. ft

Leak Check ✓ - 20

473.70
+ 1.38
475.08 ✓

Combustion Gases, TMac Incinerator Hope Bay Nu.
B Cole 17 Sep '19 Enerac 1609 30343.

Time	O_2	CO_2	CO	SO_2	NO_x	NO	NO_2
1:04	~~6.0~~ 5.0	19.2	0	0	115	115	0
1:09	5.5	19.4	0	0	102	102	0
1:14	6.1	18.2	0	0	107	107	0
1:19	6.2	19.0	0	0	107	107	0
1:24	6.2	18.3	0	0	116	116	0
1:29	6.5	17.3	0	0	109	109	0
1:34	6.0	18.1	0	0	110	110	0

Combustion Gases - TMAC Incinerator Hope Bay

BC/KW 17 Sep '19 Enerac 1609 303 43

Time	O_2	CO_2	CO	SO_2	NO_x	NO	NO_2
4:25	10.1	12.4	0	0	76	76	0
4:30	9.4	15.9	0	0	85	85	0
4:35	8.2	15.5	0	0	90	90	0
4:40	10.6	12.7	0	0	91	91	0
4:45	11.1	11.6	0	0	94	94	0
4:50	9.9	13.5	0	0	93	93	0
4:55	8.2	15.5	0	0	95	95	0

Combustion Gases - TMac Incinerator Hope Bay

BC/KW 18 Sep 2019 Enerac 160930343

Time	O_2	CO_2	CO	SO_2	NO_x	NO	NO_2
11:05	5.1	19.4	0	0	47	47	0
11:10	5.2	19.3	0	0	58	58	0
11:15	8.8	14.9	0	0	60	60	0
11:20	8.3	15.6	0	0	65	65	0
11:25	6.4	17.8	0	0	72	72	0
11:30	8.2	15.6	0	0	78	73	5
11:35	6.7	17.4	0	0	82	76	6

Combustion Gases, T-Mac Incinerator SVOC-3

16 Sep BC/KW 160930343 Enerac

	O_2	CO_2	CO	SO_2	NO_x	NO_2	No
2:43	10.9	14.4	0	0	106	106	0
2:50	10.6	14.7	0	0	111	111	0
2:55	8.5	15.2	0	0	119	119	0
3:00	9.4	13.3	0	0	111	111	0
3:05	8.9	14.4	0	0	112	112	0
3:10	10.9	13.3	0	0	116	116	0

Combustion Gases,
T-MAC Hope Bay Incinerator

16 Sep. 2019
B. Cole / K. Wood
Enercc

Time	O_2 (%)	CO_2	CO	SO_2	NO_x	NO	NO_2
10:48	1.4	24.2	501	19	200	200	0
10:53	1.7	23.6	9	7	222	222	
10:58	3.2	20.8	6	8	186	186	
11:03	7.0	18.8	6	9	133	133	
11:08	6.0	16.6	3	10	145	145	
11:13	6.7	17.6	5	10	150	150	
11:20	7.3	15.2	5	11	133	133	

SVOC-1

Combustion Gases

Time	O_2 %	CO_2 %	SO_2	CO	NO_x	NO	NO_2
11:30	2.2	18.2	6	4	219	219	0
11:35	2.1	18.3	9	1	230	230	0
11:40	3.0	18.8	351	over (2000+)	159	159	0
11:45	2.5	18.5	33	1337	122	122	0
11:50	3.3	18.8	35	174	188	188	0
11:55	6.4	14.5	36	69	132	132	0
12:00	6.6	14.9	36	46	126	126	0
1:00	8.8	16.6	14	12	125		
1:10	9.9	15.3	12	10	151	151	0
1:15	6.6	17.5	11	9	131		
1:23 (stir)	13.7	8.8	7	10	125		

MOISTURE FIELD DATA SHEET - METALS

Client: TMAC
Job No.: 160930343

Plant: Incinerator
Location: Hope Bay NU.
Test: Metals-2
Date: Sept 18/19
Analyst: BC/KW

Stantec

filter
QZ6110

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	866.0	736.3	129.7
2	50 ml 10% HNO_3 50 ml 20% H_2O_2	750.9	727.7	23.2
3	50 ml 10% HNO_3 50 ml 20% H_2O_2	733.8	730.8	3
4	Blank	612.3	612.0	0.3
5	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	766.8	766.5	0.3
6	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	755.3	755.3	0
7	200g Silica Gel	973.7	964.9	8.8
		Total Weight Gain (g)		165.3
		Moisture Volume (mL)		

652.68
-593.50
59.18 ft²

165.3 x0.048 = 7.9344 / 67.1144 = 0.118222 = 11.8%

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMac
Plant: Incinerator
Location: Hope Bay Nu.
Test: Metals 3
Date: 18 Sep 2019
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start : 10:48
Finish :

Static Pressure (in.H2O): 0.02
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K': 72.02

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				593.50						
	2.5	1115	0.03	0.72	594.66	250	250	35	64		-1
	5	1160	0.03	0.70	595.81		250	35	64		-1
	7.5	1160	0.03	0.70	596.95		251	35	64		-1
	10	1165	0.03	0.70	598.09		252	36	64		-1
	12.5	1100	0.03	0.73	599.25		252	35	64		-1
	15	1120	0.03	0.72	600.40		251	35	64		-1
	17.5	1090	0.03	0.73	601.54		250	35	64		-1
	20	1140	0.03	0.71	602.69		249	35	65		-1
	22.5	1070	0.03	0.74	603.86		250	35	65		-1
	25	1080	0.03	0.74	605.04		250	35	64		-1
	27.5	1100	0.04	0.97	606.41		250	35	65		-1
	30	1140	0.04	0.95	607.72		251	35	65		-1
	32.5	1130	0.03	0.71	608.89		250	35	65		-1
	35	1200	0.03	0.68	610.05		250	35	65		-1
	37.5	1200	0.04	0.91	611.33		249	35	65		-1
	40	1220	0.04	0.90	612.65		249	35	65		-1
	42.5	1100	0.04	0.97	613.99		250	35	65		-1
	45	1230	0.03	0.67	615.13		249	35	65		-1
	47.5	1210	0.03	0.68	616.26		250	36	65		-1
	50	1220	0.03	0.68	617.36		250	36	65		-1
	52.5	1100	0.03	0.73	618.54		250	36	65		-1
	55	1240	0.03	0.67	619.67		251	36	66		-1
	57.5	1200	0.03	0.68	620.80		250	36	66		-1
	60	1230	0.03	0.67			251	36	66		

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMac
Plant: Incinerator
Location: Hope Bay
Test: Metals 3
Date: 18 Sep 2019
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start : 10:48
Finish :

Static Pressure (in.H2O): 0.02
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K': 72.02

Traverse Point	Time (min) (60+)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				621.93						-1
	2.5	1160	0.04	0.94	623.26		250	36	66		-2
	5	1240	0.04	0.89	624.55		250	36	66		-2
	7.5	1130	0.04	0.95	625.84		249	36	66		-2
	10	1130	0.03	0.71	627.10		250	35	65		-1
	12.5	1180	0.03	0.69	628.16		250	35	65		-1
	15	1140	0.03	0.71	629.29		250	35	65		-1
	17.5	1140	0.03	0.71	630.43		249	35	66		-1
	20	1160	0.03	0.70	631.57		250	35	66		-1
	22.5	1175	0.03	0.70	632.70		251	35	66		-1
	25	1130	0.03	0.71	633.85		251	35	66		-1
	27.5	1180	0.04	0.92	635.18		249	35	66		-2
	30	1170	0.04	0.93	636.48		250	35	65		-2
	32.5	1170	0.04	0.93	637.80		251	35	66		-2
	35	1165	0.04	0.93	639.11		251	35	66		-2
	37.5	1200	0.04	0.91	640.43		250	35	66		-2
	40	1200	0.04	0.91	641.71		249	35	66		-2
*	42.5	1240	0.04	0.89	643.03		250	35	66		-2
	45	1240	0.04	0.89	644.31		250	35	66		-2
	47.5	1210	0.06	1.36	645.89		248	35	66		-3
	50	1225	0.05	1.13	647.33		250	36	67		-2
	52.5	1210	0.05	1.14	648.78		252	36	67		-3
	55	1250	0.04	0.89	650.07		250	36	67		-2
	57.5	1270	0.04	0.88	651.36		250	37	67		-2
	60	1200	0.04	0.91	652.68		250	37	67		-2

*unit opened for raking @ 1:41

2/2

MOISTURE FIELD DATA SHEET - METALS

Client: TMAC
Job No.: 160930343
Plant: Incinerator
Location: Hope Bay Nu.
Test: Metals - 2
Date: 17 Sep 2019
Analyst: BC/KW

Stantec

Filter
QZ6117

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	835.9	741.8	94.1
2	50 ml 10% HNO_3 50 ml 20% H_2O_2	754.7	728.5	26.2
3	50 ml 10% HNO_3 50 ml 20% H_2O_2	735.7	731.3	4.4
4	Blank	611.4	611.0	0.4
5	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	763.9	763.3	0.6
6	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	757.2	756.5	~~0.5~~ 0.7
7	200g Silica Gel	965.6	956.4	9.2
			Total Weight Gain (g)	144.8
			Moisture Volume (mL)	

593.16
− 532.30
60.86

1448 x 0.048
= 6.9504

6.9504 / 67.8104 = 0.102497
= 10.2% Moisture

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: T-Mac
Plant: Incinerator
Location: Hope Bay
Test: Metals-2
Date: 17 Sep 2019
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start : 4:06
Finish :

Static Pressure (in.H2O): 0.02
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): .(536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K': 70.71

Traverse Point	Time (min) (60 +)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				561.82						-4
	2.5	1175	0.04	0.91	563.13		250	36	68		-4
	5	1190	0.04	0.91	564.44		249	36	68		-4
	7.5	1190	0.04	0.91	565.73		250	36	68		-4
	10	1210	0.04	0.90	567.05		250	36	69		-5
	12.5	1190	0.04	0.91	568.35		251	36	69		-5
	15	1200	0.04	0.90	569.66		250	36	69		-5
	17.5	1195	0.04	0.90	570.95		250	37	69		-5
	20	1200	0.04	0.90	572.26		250	37	69		-5
	22.5	1200	0.04	0.90	573.56		250	37	69		-5
	25	1190	0.04	0.91	574.88		250	37	69		-5
	27.5	1200	0.04	0.90	576.19		250	38	69		-5
	30	1180	0.05	1.14	577.65		250	38	69		-6
	32.5	1230	0.04	0.89	578.94		251	38	69		-5
	35	1230	0.04	0.89	580.22		251	38	69		-5
	37.5	1230	0.04	0.89	581.51		249	39	69		-6
	40	1230	0.04	0.89	*582.71 *		250	39	70		-6
	42.5	1230	0.04	0.89	584.08		250	39	70		-6
	45	1250	0.04	0.89	585.38		250	39	70		-6
	47.5	1230	0.04	0.89	586.68		250	39	70		-6
	50	1230	0.04	0.89	587.98		249	39	70		-7
	52.5	1230	0.04	0.89	589.28		250	39	70		-7
	55	1230	0.04	0.89	590.57		250	39	70		-7
	57.5	1220	0.04	0.89	591.87		250	39	70		-7
	60	1220	0.04	0.89	593.16		250	39	70		-7

*Unit opened for raking @ 1:27 mins.

SOURCE TESTING FIELD DATA SHEET

Job No.: 160930343
Client: TMac
Plant: Incinerator
Location: Hope Bay
Test: Metals-2
Date: 17 Sep/19
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start : 4:06
Finish :

Static Pressure (in.H2O): 0.02
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): .(536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K' : 70.71

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F)		Pump Vacuum (in.Hg)
									In	Out	
	0				532.30						
	2.5	1200	0.03	0.67	533.43		225	46	66		-1
	5	1230	0.03	0.66	534.55		234	41	66		-1
	7.5	1250	0.03	0.65	535.66		248	43	65		-1
	10	1240	0.03	0.66	536.77		253	41	66		-1
	12.5	1150	0.03	0.69	537.91		252	39	66		-1
	15	1150	0.03	0.69	539.03		251	37	65		-1
	17.5	1150	0.03	0.69	540.16		251	36	65		-1
	20	1150	0.03	0.69	541.29		250	36	65		-2
	22.5	1150	0.03	0.69	542.43		251	34	66		-2
	25	1160	0.03	0.69	543.56		251	34	66		-2
	27.5	1190	0.04	0.90	544.86		250	35	66		-3
	30	1170	0.04	0.91	546.18		250	35	66		-3
	32.5	1190	0.04	0.90	547.47		251	36	66		-3
	35	1165	0.04	0.92	548.77		250	36	66		-3
	37.5	1165	0.04	0.92	550.07		249	36	66		-4
	40	1170	0.04	0.91	551.36		250	36	67		-4
	42.5	1160	0.04	0.92	552.68		250	36	67		-4
	45	1160	0.04	0.92	553.98		250	36	67		-4
	47.5	1170	0.04	0.91	555.29		250	36	67		-4
	50	1165	0.04	0.92	556.59		250	36	67		-4
	52.5	1180	0.04	0.91	557.91		250	36	68		-4
	55	1160	0.04	0.92	559.20		250	36	68		-4
	57.5	1190	0.04	0.91	560.51		250	36	68		-4
	60	1170	0.04	0.92			249	36	68		

MOISTURE FIELD DATA SHEET - METALS

Client: TMAC
Job No.: 160930343

Plant: Incinerator
Location: Hope Bay NU
Test: Metals - 1
Date: 17 Sep 2019
Analyst: BC / KW

Stantec

Filter.
QZ6690

Moisture Data

Impinger No.	Impinger Contents	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	100 mL H2O	862.4	740.6	121.8
2	50 ml 10% HNO_3 50 ml 20% H_2O_2	747.8	722.8	25.0
3	50 ml 10% HNO_3 50 ml 20% H_2O_2	731.6	727.4	4.2
4	Blank	607.5	607.0	0.5
5	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	769.3	760.3	9.0
6	50 ml 8% $KMnO_4$ 50 ml 20% H_2SO_4	754.2	753.7	0.5
7	200g Silica Gel	956.5	946.0	10.5
		Total Weight Gain (g)		171.5
		Moisture Volume (mL)		

531.90
- 475.40
56.5 ft²

171.5
× 0.048
8.232

8.232 / 64.732 = 0.12717 = 12.7%

SOURCE TESTING FIELD DATA SHEET

Job No.: 1609 30343
Client: T Mac
Plant: Incinerator
Location: Hope Bay
Test: Metals 1
Date: 17 Sep 19
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start : 12:34
Finish : 2:34

Static Pressure (in.H2O):
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K' : 70.71

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	60 +										-8
	0				504.19						-8
	2.5	1120	0.03	0.71	505.36		268	35	67		-8
	5	1100	0.03	0.72	506.55		266	36	67		-8
	7.5	1105	0.03	0.71	507.70		261	37	67		-8
	10	1120	0.03	0.71	508.85		257	37	67		-8
	12.5	1120	0.03	0.71	510.02		252	36	67		-8
	15	1120	0.03	0.71	511.19		248	36	67		-8
	17.5	1120	0.03	0.71	512.33		245	36	67		-9
	20	1120	0.03	0.71	513.48		246	36	67		-9
	22.5	1120	0.03	0.71	514.65		249	36	68		-9
	25	1130	0.03	0.70	515.80		254	36	67		-9
	27.5	1130	0.03	0.70	516.94		260	36	67		-9
	30	1130	0.03	0.70	518.09		265	36	67		-10
	32.5	1120	0.03	0.71	519.25		267	36	68		-10
	35	1130	0.03	0.70	520.42		268	36	68		-10
	37.5	1170	0.03	0.69	521.56		266	36	68		-10
	40	1140	0.03	0.70	522.70		263	36	68		-10
	42.5	1150	0.03	0.70	523.85		258	36	68		-10
	45	1140	0.03	0.70	525.00		255	36	68		-10
	47.5	1160	0.03	0.69	526.16		249	36	68		-10
	50	1150	0.03	0.70	527.30		246	36	69		-10
	52.5	1150	0.03	0.70	528.45		245	36	69		-10
	55	1160	0.03	0.69	529.60		247	36	69		-10
	57.5	1150	0.03	0.70	530.75		252	36	69		-10
	60	1140	0.03	0.70	531.90		259	36	69		-11

SOURCE TESTING FIELD DATA SHEET

Job No.: 1609 30343
Client: T McC
Plant: Incinerator
Location: Hope Bay Nu
Test: Metals L1
Date: 17 Sep '19
Operators: BC/KW
Gamma: .979
Delta H@: 1.880
Pitot Coeff.: .821
Start: 12:34
Finish:

Static Pressure (in.H2O): 0.02
Port Length (in): 6
Stack Dia. (in.): 20
Probe Length (ft): 2
Nozzle ID (in.): (.536)
Console S/N: 2203

Pre-Test Leak Check: ✓
Vacuum Pressure: -20
Post-Test Leak Check:
Vacuum Pressure:

K': 70.71

Traverse Point	Time (min)	Stack Gas Temp., Ts (F)	Velocity Head, dP (in.H2O)	Orifice dH (in.H2O)	Gas Meter Volume (cu.ft)	Probe Temp. (F)	Oven Temp. (F)	Impinger Outlet Temp. (F)	Gas Meter Temp. (F) In	Gas Meter Temp. (F) Out	Pump Vacuum (in.Hg)
	0				475.40		242	35	65		-1
	2.5	1180	0.03	0.71	476.56		237	35	65		-1
	5	1090	0.03	0.72	477.71		238	35	65		-2
	7.5	1040	0.03	0.74	478.90		245	36	65		-2
	10	1080	0.03	0.72	480.06		250	35	65		-3
	12.5	1070	0.03	0.73	481.23		269	35	65		-4
	15	1050	0.03	0.74	482.43		275	35	65		-4
	17.5	1090	0.03	0.72	483.57		280	35	65		-4
	20	1070	0.03	0.73	484.77		280	35	66		-5
	22.5	1100	0.03	0.72	485.94		278	35	66		-5
	25	1070	0.03	0.73	487.12		273	35	66		-5
	27.5	1070	0.03	0.73	488.32		270	35	66		-5
	30	1070	0.03	0.73	489.49		263	35	66		-6
	32.5	1060	0.03	0.73	490.67		258	35	66		-6
	35	1080	0.03	0.72	491.82		255	35	66		-7
	37.5	1060	0.03	0.73	493.02		249	35	66		-7
	40	1090	0.03	0.72	494.19		247	35	66		-7
	42.5	1080	0.03	0.72	495.36		246	35	66		-7
	45	1110	0.03	0.71	496.54		248	35	66		-9
	47.5	1100	0.04	0.95	497.85		253	35	67		-9
	50	1160	0.04	0.92	499.17		259	35	67		-9
	52.5	1120	0.04	0.94	500.53		264	35	67		-9
	55	1140	0.04	0.93	501.84		268	35	67		-8
	57.5	1130	0.03	0.70	503.04		269	35	67		-8
	60	1130	0.03	0.70							

APPENDIX C

Lab Analysis

1435 Norjohn Court, Unit 1, Burlington ON, L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Claire Kocharakkal	**Client Name:**	Stantec Consulting, Ltd.
ALS Project ID:	25282	**Client Address:**	845 Prospect Street
ALS WO#:	L2355428		Fredricton, NB E3B 2T7
Date of Report	18-Oct-19		Canada
Date of Sample Receipt	27-Sep-19	**Client Contact:**	Tristan Blair-Hicks
		Client Project ID:	160930343 TASK 519.006 HOPE BAY

COMMENTS:

Sample Particulate Analysis via Gravimetric USEPA Method 5 (PE/TP 11-Oct-19)

REPORT FLAGS:

J - The value is uncertain and below what can be reliably identified as positive with a ≥99% confidence limit (i.e. below the laboratory determined MDL).

LCB = Laboratory Control Blank

CVS = Continuing Verification Standard Sample (limits: ±2 in the last decimal)

LOR = Limit of Reporting

Certified by: ______________________

Claire Kocharakkal
Project Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name		METALS-1 (TS1 THRU TS5C)		METALS-2 (TS1 THRU TS5C)	METALS-3 (TS1 THRU TS5C)	METALS-BLANK (TS7 THRU TS12)		MB	
ALS Sample ID		L2355428-1		L2355428-2	L2355428-3	L2355428-4		L2355428-MB	
Matrix		Stack		Stack	Stack	Stack		n/a	
Analysis type		Sample		Sample	Sample	Sample		Sample	
Sampling Date/Time		17-Sep-19		17-Sep-19	18-Sep-19	17-Sep-19		n/a	
Date of Receipt		27-Sep-19		27-Sep-19	27-Sep-19	27-Sep-19		n/a	
PM via Gravimetric Analysis	**LOR**								
Method 5	**mg**	**mg**		**mg**	**mg**	**mg**		**mg**	
Filter Particulate Matter	0.8	62.0		68.5	57.1	<0.1		<0.1	
Acetone Particulate Matter	0.4	35.9		32.6	25.6	0.2	**J**	0.4	**J**
	g	**g**		**g**	**g**	**g**		**g**	
Acetone Mass	0.02	63.0		73.2	67.1	74.6		31.8	

ALS Environmental
1435 Norjohn Court, Unit 1, Burlington ON, L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Claire Kocharakkal	**Client Name:**	Stantec Consulting Ltd.
ALS Project ID:	25282	**Client Address:**	845 Prospect Street
ALS WO#:	L2355428		Fredericton, NB E3B 2T7
Date of Report	18-Oct-19		Canada
Date of Sample Receipt	27-Sep-19	**Client Contact:**	Tristan Blair-Hicks
		Client Project ID:	160930343 TASK 519.006 HOPE BAY

COMMENTS:

Sample Preparation via USEPA Method 29 (AB 07,17-OCT-2019)
Mercury Analysis via CVAA using Method USEPA 7470A (AB 08,17-OCT-2019)

LOR = Limit of Reporting
LCB = Laboratory Control Blank (limits: <LOR)
LCS = Laboratory Control Sample (limits: hivol, solids: 85-115%, stack: 90-110%)
MS = Matrix Spike Sample (limits: 75-125%)
RPD = Relative Percent Difference (limits: <20%)
CCV/CVS = Calibration Verification Standard (limits: 85-115%)

Certified by: ______________________
Claire Kocharakkal
Project Manager

ALS Environmental

Sample Analysis Summary Report

Sample Name		METALS-1 (TS1 THRU TS5C)	METALS-2 (TS1 THRU TS5C)	METALS-3 (TS1 THRU TS5C)	METALS-BLANK (TS7 THRU TS12)
ALS Sample ID		L2355428-1	L2355428-2	L2355428-3	L2355428-4
Matrix		Stack	Stack	Stack	Stack
Analysis type		Sample	Sample	Sample	Sample
Sampling Date/Time		17-Sep-19	17-Sep-19	18-Sep-19	17-Sep-19
Date of Receipt		27-Sep-19	27-Sep-19	27-Sep-19	27-Sep-19
Mercury via CVAA	**LOR**				
Method 29	**ug**	**ug**	**ug**	**ug**	**ug**
Analytical Fraction 1B	0.015	<0.015	<0.015	0.0549	0.167
Analytical Fraction 2B	0.050	0.340	0.354	0.435	<0.1
Analytical Fraction 3A	0.005	<0.01	<0.0095	<0.0097	<0.01
Analytical Fraction 3B	0.025	<0.025	0.0270	0.0216	<0.0125
Analytical Fraction 3C	0.25	0.138	<0.125	<0.125	<0.125

ALS Environmental

Sample QC Summary Report

Sample Name		**LCB**	**LCS**	**LCS**	**LCSD**	**LCSD**
ALS Sample ID		LCB	LCS	LCS	LCSD	LCSD
Analysis type		Method Blank	Blank Spike	Blank Spike	Blank Spike Dup	Blank Spike Dup
Sampling Date/Time		N/A	N/A	N/A	N/A	N/A
Date of Receipt		N/A	N/A	N/A	N/A	N/A
Mercury via CVAA	**LOR**					
Method 29	**ug**	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Analytical Fraction 1B	0.015	<0.015	0.291	97%	0.292	97%
Analytical Fraction 2B	0.050	<0.1	1.87	94%	1.92	96%
Analytical Fraction 3A	0.005	<0.01	0.197	98%	0.197	98%
Analytical Fraction 3B	0.025	<0.025	0.465	91%	0.461	90%
Analytical Fraction 3C	0.25	<0.125	2.45	97%	2.46	97%

ALS Environmental

Sample QC Summary Report

Sample Name		METALS-1 (TS1 THRU TS5C)	METALS-1 (TS1 THRU TS5C)	METALS-1 (TS1 THRU TS5C)	METALS-1 (TS1 THRU TS5C)	METALS-1 (TS1 THRU TS5C)	METALS-1 (TS1 THRU TS5C)
ALS Sample ID		L2355428-1	L2355428-1DUP	L2355428-1MS	L2355428-1MS	L2355428-1MSD	L2355428-1MSD
Matrix		Stack	Stack	Stack	Stack	Stack	Stack
Analysis type		Sample	Duplicate	Matrix Spike	Matrix Spike	Matrix Spike Dup	Matrix Spike Dup
Sampling Date/Time		17-Sep-19	17-Sep-19	17-Sep-19	17-Sep-19	17-Sep-19	17-Sep-19
Date of Receipt		27-Sep-19	27-Sep-19	27-Sep-19	27-Sep-19	27-Sep-19	27-Sep-19
Mercury via CVAA	**LOR**						
Method 29	**ug**	**ug**	**ug**	**ug**	**% Rec**	**ug**	**% Rec**
Analytical Fraction 1B	0.015	<0.015	<0.015	0.309	102%	0.306	101%
Analytical Fraction 2B	0.050	0.340	0.378	5.56	97%	5.35	93%
Analytical Fraction 3A	0.005	<0.01	<0.01	0.193	96%	0.193	95%
Analytical Fraction 3B	0.025	<0.025	<0.025	0.444	87%	0.435	85%
Analytical Fraction 3C	0.250	0.138	0.125	2.50	95%	2.48	94%

1435 Norjohn Court, Unit 1, Burlington, ON, Canada L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Claire Kocharakkal	**Client Name:**	Stantec Consulting Ltd
ALS Project ID:	25282	**Client Address:**	845 Prospect Street
ALS WO#:	L2355437		Fredericton, NB E3B 2T7
Date of Report	24-Oct-19		Canada
Date of Sample Receipt	27-Sep-19	**Client Contact:**	Tristan Blair-Hicks
		Client Project ID:	160930343 TASK 519.006 HOPE BAY

COMMENTS: **PCDD/F by EPA M23**

Certified by:

Steve Kennedy
Technical Supervisor

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	SVOC-1 (TS1 THRU TS6)	SVOC-2 (TS1 THRU TS6)	SVOC-3 (TS1 THRU TS6)	SVOC-BLANK (TS1 THRU TS6)	TRIP BLANK (TS7 THRU TS10)
ALS Sample ID	L2355437-1	L2355437-2	L2355437-3	L2355437-4	L2355437-5
Sample Size	1	1	1	1	1
Sample size units	Train	Train	Train	Train	Train
Percent Moisture	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Stack	Stack	Stack	Stack	Stack
Sampling Date	15-Sep-19	16-Sep-19	16-Sep-19	17-Sep-19	17-Sep-19
Extraction Date	8-Oct-19	8-Oct-19	8-Oct-19	8-Oct-19	8-Oct-19
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	448	87.0	42.9	<0.83	<1.6
1,2,3,7,8-PeCDD	1730	289	314	0.840	<0.89
1,2,3,4,7,8-HxCDD	1800	330	756	<2.0	<1.2
1,2,3,6,7,8-HxCDD	2420	556	2160	2.73	<1.1
1,2,3,7,8,9-HxCDD	1980	422	1360	1.92	<1.1
1,2,3,4,6,7,8-HpCDD	21300	6940	37200	22.1	<2.6
OCDD	28500	12400	95500	62.2	16.6
2,3,7,8-TCDF	2310	359	249	<1.2	<1.2
1,2,3,7,8-PeCDF	4400	676	879	1.97	<1.1
2,3,4,7,8-PeCDF	5760	1280	2310	2.32	<0.55
1,2,3,4,7,8-HxCDF	5240	1220	2970	2.69	<0.75
1,2,3,6,7,8-HxCDF	5930	1320	4080	3.08	<0.70
2,3,4,6,7,8-HxCDF	4780	2340	11200	<5.0	<0.75
1,2,3,7,8,9-HxCDF	1190	668	3170	3.00	<0.94
1,2,3,4,6,7,8-HpCDF	10300	6480	28300	18.2	<0.77
1,2,3,4,7,8,9-HpCDF	1680	1470	10300	3.28	<0.91
OCDF	2200	8370	69700	24.1	<3.0
Field Spike Standards	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
37Cl4-2,3,7,8-TCDD	87	92	91	92	NS
13C12-1,2,3,4,7,8-HxCDD	94	92	94	92	NS
13C12-2,3,4,7,8-PeCDF	99	105	97	97	NS
13C12-1,2,3,4,7,8-HxCDF	95	98	94	94	NS
13C12-1,2,3,4,7,8,9-HpCDF	86	91	86	91	NS
Extraction Standards					
13C12-2,3,7,8-TCDD	71	75	63	82	54
13C12-1,2,3,7,8-PeCDD	78	80	56	69	64
13C12-1,2,3,6,7,8-HxCDD	75	79	54	69	60
13C12-1,2,3,4,6,7,8-HpCDD	79	78	61	68	64
13C12-OCDD	75	75	61	70	59
13C12-2,3,7,8-TCDF	81	84	63	79	59
13C12-1,2,3,7,8-PeCDF	82	83	61	76	62
13C12-1,2,3,6,7,8-HxCDF	86	87	62	79	62
13C12-1,2,3,4,6,7,8-HpCDF	81	83	63	74	66
Cleanup Standard					
13C12-1,2,3,7,8,9-HxCDF	75	71	61	64	64
Homologue Group Totals	**pg**	**pg**	**pg**	**pg**	**pg**
Total-TCDD	11900	2020	1350	<0.83	<1.6
Total-PeCDD	21200	3390	5760	7.84	<0.89
Total-HxCDD	31700	6670	24100	11.3	<1.2
Total-HpCDD	41800	13500	68800	43.1	<1.1
Total-TCDF	81500	13000	15600	8.49	<1.2
Total-PeCDF	83300	14600	30000	19.0	<0.61
Total-HxCDF	52300	16500	51700	22.9	1.08
Total-HpCDF	18400	15100	80400	35.8	<0.91
Toxic Equivalency - (WHO 2005)					
Lower Bound PCDD/F TEQ (WHO 2005)	6950	1660	4480	3.40	0.00498
Mid Point PCDD/F TEQ (WHO 2005)	6950	1660	4480	4.63	1.83
Upper Bound PCDD/F TEQ (WHO 2005)	6950	1660	4480	5.05	3.51

ALS Life Sciences

Quality Control Summary Report

Sample Name	Method Blank	Method Blank	Laboratory Control Sample
ALS Sample ID	WG3174994-1	WG3174994-4	WG3174994-2
Sample Size	1	1	1
Sample size units	Train	Train	n/a
Percent Moisture	n/a	n/a	n/a
Sample Matrix	MEDIA	REAGENT	QC
Sampling Date	n/a	n/a	n/a
Extraction Date	8-Oct-19	8-Oct-19	8-Oct-19
Target Analytes	**pg**	**pg**	**% Rec**
2,3,7,8-TCDD	<0.69	<0.79	100
1,2,3,7,8-PeCDD	1.22	<0.42	107
1,2,3,4,7,8-HxCDD	<0.73	<0.79	103
1,2,3,6,7,8-HxCDD	<0.72	<0.72	103
1,2,3,7,8,9-HxCDD	2.06	<0.75	106
1,2,3,4,6,7,8-HpCDD	3.00	<1.9	102
OCDD	17.0	<11	98
2,3,7,8-TCDF	<0.47	<0.50	98
1,2,3,7,8-PeCDF	1.37	<1.1	110
2,3,4,7,8-PeCDF	<0.30	<0.38	96
1,2,3,4,7,8-HxCDF	<0.67	<0.57	107
1,2,3,6,7,8-HxCDF	<0.55	<0.53	104
2,3,4,6,7,8-HxCDF	<0.74	<0.57	102
1,2,3,7,8,9-HxCDF	<0.97	<1.7	100
1,2,3,4,6,7,8-HpCDF	<1.3	1.41	102
1,2,3,4,7,8,9-HpCDF	<1.9	<0.46	100
OCDF	<3.4	2.08	95
Field Spike Standards	**% Rec**	**% Rec**	**% Rec**
37Cl4-2,3,7,8-TCDD	NS	NS	NS
13C12-1,2,3,4,7,8-HxCDD	NS	NS	NS
13C12-2,3,4,7,8-PeCDF	NS	NS	NS
13C12-1,2,3,4,7,8-HxCDF	NS	NS	NS
13C12-1,2,3,4,7,8,9-HpCDF	NS	NS	NS
Extraction Standards			
13C12-2,3,7,8-TCDD	75	66	55
13C12-1,2,3,7,8-PeCDD	70	69	54
13C12-1,2,3,6,7,8-HxCDD	71	65	61
13C12-1,2,3,4,6,7,8-HpCDD	73	69	62
13C12-OCDD	85	66	60
13C12-2,3,7,8-TCDF	77	71	64
13C12-1,2,3,7,8-PeCDF	73	72	57
13C12-1,2,3,6,7,8-HxCDF	78	72	67
13C12-1,2,3,4,6,7,8-HpCDF	82	71	69
Cleanup Standard			
13C12-1,2,3,7,8,9-HxCDF	79	74	71
Homologue Group Totals	**pg**	**pg**	
Total-TCDD	<0.69	<0.79	
Total-PeCDD	1.22	<0.42	
Total-HxCDD	2.06	<0.79	
Total-HpCDD	4.84	<0.74	
Total-TCDF	<0.47	<0.50	
Total-PeCDF	1.37	<0.42	
Total-HxCDF	<0.65	<0.65	
Total-HpCDF	<0.38	1.41	
Toxic Equivalency - (WHO 2005)			
Lower Bound PCDD/F TEQ (WHO 2005)	1.50	0.0147	
Mid Point PCDD/F TEQ (WHO 2005)	2.35	1.13	
Upper Bound PCDD/F TEQ (WHO 2005)	2.80	2.01	

ALS Life Sciences

Sample Analysis Report

Sample Name	**SVOC-1 (TS1 THRU TS6)**	Sampling Date	15-Sep-19		
ALS Sample ID	L2355437-1	Extraction Date	8-Oct-19		Approved:
Analysis Method	EPA M23	Sample Size	1	Train	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Stack	Split Ratio	2		22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A23
Run Date	19-Oct-19 21:34
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	27.96	448	1.5			20
1,2,3,7,8-PeCDD	1	32.06	1730	2.3			100
1,2,3,4,7,8-HxCDD	0.1	34.10	1800	5.2			100
1,2,3,6,7,8-HxCDD	0.1	34.15	2420	4.8			100
1,2,3,7,8,9-HxCDD	0.1	34.27	1980	5.0			100
1,2,3,4,6,7,8-HpCDD	0.01	35.75	21300	5.1			100
OCDD	0.0003	37.24	28500	3.2			200
2,3,7,8-TCDF	0.1	27.04	2310	1.5			20
1,2,3,7,8-PeCDF	0.03	31.13	4400	410			100
2,3,4,7,8-PeCDF	0.3	31.85	5760	370			100
1,2,3,4,7,8-HxCDF	0.1	33.61	5240	6.0			100
1,2,3,6,7,8-HxCDF	0.1	33.68	5930	5.5			100
2,3,4,6,7,8-HxCDF	0.1	34.00	4780	5.9			100
1,2,3,7,8,9-HxCDF	0.1	34.44	1190	6.8			100
1,2,3,4,6,7,8-HpCDF	0.01	35.19	10300	2.8			100
1,2,3,4,7,8,9-HpCDF	0.01	36.00	1680	3.4			100
OCDF	0.0003	37.33	2200	1.4			200

Field Spike Standards	**pg**		**% Rec**	**Limits**
37Cl4-2,3,7,8-TCDD	400	27.96	87	70-130
13C12-1,2,3,4,7,8-HxCDD	4000	34.09	94	70-130
13C12-2,3,4,7,8-PeCDF	4000	31.84	99	70-130
13C12-1,2,3,4,7,8-HxCDF	4000	33.60	95	70-130
13C12-1,2,3,4,7,8,9-HpCDF	4000	35.99	86	70-130
Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.93	71	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	78	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.14	75	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.74	79	25-130
13C12-OCDD	8000	37.23	75	25-130
13C12-2,3,7,8-TCDF	4000	27.02	81	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	82	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.67	86	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.18	81	25-130
Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	75	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**	
Total-TCDD	17	11900	1.5	20
Total-PeCDD	9	21200	2.3	100
Total-HxCDD	8	31700	5.2	100
Total-HpCDD	2	41800	5.1	100
Total-TCDF	26	81500	1.5	20
Total-PeCDF	22	83300	410	100
Total-HxCDF	14	52300	6.8	100
Total-HpCDF	4	18400	3.4	100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	6950
Mid Point PCDD/F TEQ (WHO 2005)	6950
Upper Bound PCDD/F TEQ (WHO 2005)	6950

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency

LQL Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**SVOC-2 (TS1 THRU TS6)**	Sampling Date	16-Sep-19		
ALS Sample ID	L2355437-2	Extraction Date	8-Oct-19		Approved:
Analysis Method	EPA M23	Sample Size	1	Train	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Stack	Split Ratio	2		22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A24
Run Date	19-Oct-19 22:17
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	27.96	87.0	1.4			20
1,2,3,7,8-PeCDD	1	32.06	289	1.1			100
1,2,3,4,7,8-HxCDD	0.1	34.10	330	3.4			100
1,2,3,6,7,8-HxCDD	0.1	34.15	556	3.1			100
1,2,3,7,8,9-HxCDD	0.1	34.28	422	3.2			100
1,2,3,4,6,7,8-HpCDD	0.01	35.75	6940	3.3			100
OCDD	0.0003	37.24	12400	2.3			200
2,3,7,8-TCDF	0.1	27.04	359	1.1			20
1,2,3,7,8-PeCDF	0.03	31.13	676	3.0			100
2,3,4,7,8-PeCDF	0.3	31.85	1280	2.7			100
1,2,3,4,7,8-HxCDF	0.1	33.61	1220	2.7			100
1,2,3,6,7,8-HxCDF	0.1	33.68	1320	2.5			100
2,3,4,6,7,8-HxCDF	0.1	34.01	2340	2.7			100
1,2,3,7,8,9-HxCDF	0.1	34.44	668	3.1			100
1,2,3,4,6,7,8-HpCDF	0.01	35.19	6480	2.6			100
1,2,3,4,7,8,9-HpCDF	0.01	36.00	1470	3.0			100
OCDF	0.0003	37.33	8370	1.8			200

Field Spike Standards	**pg**		**% Rec**	**Limits**
37Cl4-2,3,7,8-TCDD	400	27.96	92	70-130
13C12-1,2,3,4,7,8-HxCDD	4000	34.09	92	70-130
13C12-2,3,4,7,8-PeCDF	4000	31.84	105	70-130
13C12-1,2,3,4,7,8-HxCDF	4000	33.60	98	70-130
13C12-1,2,3,4,7,8,9-HpCDF	4000	35.99	91	70-130
Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.93	75	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	80	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.14	79	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.75	78	25-130
13C12-OCDD	8000	37.23	75	25-130
13C12-2,3,7,8-TCDF	4000	27.02	84	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	83	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.67	87	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.19	83	25-130
Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	71	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**	**LQL**
Total-TCDD	14	2020	1.4	20
Total-PeCDD	9	3390	1.1	100
Total-HxCDD	7	6670	3.4	100
Total-HpCDD	2	13500	3.3	100
Total-TCDF	25	13000	1.1	20
Total-PeCDF	20	14600	3.0	100
Total-HxCDF	15	16500	3.1	100
Total-HpCDF	4	15100	3.0	100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	1660
Mid Point PCDD/F TEQ (WHO 2005)	1660
Upper Bound PCDD/F TEQ (WHO 2005)	1660

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalenc

LQL Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**SVOC-3 (TS1 THRU TS6)**	Sampling Date	16-Sep-19	
ALS Sample ID	L2355437-3	Extraction Date	8-Oct-19	Approved:
Analysis Method	EPA M23	Sample Size	1 Train	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Stack	Split Ratio	2	22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A25
Run Date	19-Oct-19 22:59
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	27.98	42.9	1.4			20
1,2,3,7,8-PeCDD	1	32.06	314	2.4			100
1,2,3,4,7,8-HxCDD	0.1	34.10	756	7.6			100
1,2,3,6,7,8-HxCDD	0.1	34.15	2160	6.9			100
1,2,3,7,8,9-HxCDD	0.1	34.28	1360	7.2			100
1,2,3,4,6,7,8-HpCDD	0.01	35.76	37200	12			100
OCDD	0.0003	37.25	95500	5.0			200
2,3,7,8-TCDF	0.1	27.05	249	1.1			20
1,2,3,7,8-PeCDF	0.03	31.13	879	4.5			100
2,3,4,7,8-PeCDF	0.3	31.85	2310	4.1			100
1,2,3,4,7,8-HxCDF	0.1	33.62	2970	12			100
1,2,3,6,7,8-HxCDF	0.1	33.69	4080	11			100
2,3,4,6,7,8-HxCDF	0.1	34.01	11200	12			100
1,2,3,7,8,9-HxCDF	0.1	34.45	3170	14			100
1,2,3,4,6,7,8-HpCDF	0.01	35.20	28300	6.2			100
1,2,3,4,7,8,9-HpCDF	0.01	36.00	10300	7.3			100
OCDF	0.0003	37.34	69700	5.5			200

Field Spike Standards	**pg**		**% Rec**	**Limits**
37Cl4-2,3,7,8-TCDD	400	27.98	91	70-130
13C12-1,2,3,4,7,8-HxCDD	4000	34.10	94	70-130
13C12-2,3,4,7,8-PeCDF	4000	31.84	97	70-130
13C12-1,2,3,4,7,8-HxCDF	4000	33.60	94	70-130
13C12-1,2,3,4,7,8,9-HpCDF	4000	36.00	86	70-130
Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.95	63	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	56	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.15	54	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.75	61	25-130
13C12-OCDD	8000	37.24	61	25-130
13C12-2,3,7,8-TCDF	4000	27.02	63	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	61	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.68	62	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.19	63	25-130
Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	61	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**	**LQL**
Total-TCDD	15	1350	1.4	20
Total-PeCDD	9	5760	2.4	100
Total-HxCDD	8	24100	7.6	100
Total-HpCDD	2	68800	12	100
Total-TCDF	26	15600	1.1	20
Total-PeCDF	24	30000	4.5	100
Total-HxCDF	15	51700	14	100
Total-HpCDF	4	80400	7.3	100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	4480
Mid Point PCDD/F TEQ (WHO 2005)	4480
Upper Bound PCDD/F TEQ (WHO 2005)	4480

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalenc

LQL Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**SVOC-BLANK (TS1 THRU TS6)**	Sampling Date	17-Sep-19		
ALS Sample ID	L2355437-4	Extraction Date	8-Oct-19		Approved:
Analysis Method	EPA M23	Sample Size	1	Train	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Stack	Split Ratio	2		22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A21
Run Date	19-Oct-19 20:10
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<0.83	0.83	U		20
1,2,3,7,8-PeCDD	1	32.07	0.840	0.57	M,J,B		100
1,2,3,4,7,8-HxCDD	0.1	34.10	<2.0	1.3	M,J,R	2.0	100
1,2,3,6,7,8-HxCDD	0.1	34.15	2.73	1.2	M,J		100
1,2,3,7,8,9-HxCDD	0.1	34.27	1.92	1.2	M,J,B		100
1,2,3,4,6,7,8-HpCDD	0.01	35.75	22.1	0.85	J,B		100
OCDD	0.0003	37.24	62.2	0.70	J,B		200
2,3,7,8-TCDF	0.1	26.99	<1.2	0.75	M,J,R	1.2	20
1,2,3,7,8-PeCDF	0.03	31.12	1.97	0.70	M,J,B		100
2,3,4,7,8-PeCDF	0.3	31.84	2.32	0.63	M,J		100
1,2,3,4,7,8-HxCDF	0.1	33.60	2.69	0.72	J		100
1,2,3,6,7,8-HxCDF	0.1	33.68	3.08	0.67	J		100
2,3,4,6,7,8-HxCDF	0.1	34.01	<5.0	0.71	M,J,R	5.0	100
1,2,3,7,8,9-HxCDF	0.1	34.43	3.00	0.82	J		100
1,2,3,4,6,7,8-HpCDF	0.01	35.19	18.2	0.40	J		100
1,2,3,4,7,8,9-HpCDF	0.01	36.00	3.28	0.48	J		100
OCDF	0.0003	37.33	24.1	0.45	J		200

Field Spike Standards	**pg**		**% Rec**	**Limits**
37Cl4-2,3,7,8-TCDD	400	27.96	92	70-130
13C12-1,2,3,4,7,8-HxCDD	4000	34.09	92	70-130
13C12-2,3,4,7,8-PeCDF	4000	31.84	97	70-130
13C12-1,2,3,4,7,8-HxCDF	4000	33.60	94	70-130
13C12-1,2,3,4,7,8,9-HpCDF	4000	35.99	91	70-130
Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.95	82	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	69	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.14	69	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.74	68	25-130
13C12-OCDD	8000	37.23	70	25-130
13C12-2,3,7,8-TCDF	4000	27.02	79	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	76	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.67	79	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.18	74	25-130
Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	64	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		**LQL**
Total-TCDD	0	<0.83	0.83	U	20
Total-PeCDD	3	7.84	0.57		100
Total-HxCDD	3	11.3	1.3		100
Total-HpCDD	2	43.1	0.85		100
Total-TCDF	4	8.49	0.75		20
Total-PeCDF	6	19.0	0.70		100
Total-HxCDF	6	22.9	0.82		100
Total-HpCDF	4	35.8	0.48		100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	3.40
Mid Point PCDD/F TEQ (WHO 2005)	4.63
Upper Bound PCDD/F TEQ (WHO 2005)	5.05

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**TRIP BLANK (TS7 THRU TS10)**	Sampling Date	17-Sep-19		
ALS Sample ID	L2355437-5	Extraction Date	8-Oct-19		Approved:
Analysis Method	EPA M23	Sample Size	1	Train	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Stack	Split Ratio	2		22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A22
Run Date	19-Oct-19 20:52
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.6	1.6	U		20
1,2,3,7,8-PeCDD	1	NotFnd	<0.89	0.89	U		100
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.2	1.2	U		100
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.1	1.1	U		100
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.1	1.1	U		100
1,2,3,4,6,7,8-HpCDD	0.01	35.75	<2.6	1.1	M,J,R	2.6	100
OCDD	0.0003	37.23	16.6	0.98	M,J,B		200
2,3,7,8-TCDF	0.1	NotFnd	<1.2	1.2	U		20
1,2,3,7,8-PeCDF	0.03	31.14	<1.1	0.61	M,J,R	1.1	100
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.55	0.55	U		100
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.75	0.75	U		100
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.70	0.70	U		100
2,3,4,6,7,8-HxCDF	0.1	34.00	<0.75	0.75	M,U	0.60	100
1,2,3,7,8,9-HxCDF	0.1	34.41	<0.94	0.86	M,J,R	0.94	100
1,2,3,4,6,7,8-HpCDF	0.01	NotFnd	<0.77	0.77	U		100
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<0.91	0.91	U		100
OCDF	0.0003	37.33	<3.0	0.84	M,J,R	3.0	200

Field Spike Standards	**% Rec**
37Cl4-2,3,7,8-TCDD	NS
13C12-1,2,3,4,7,8-HxCDD	NS
13C12-2,3,4,7,8-PeCDF	NS
13C12-1,2,3,4,7,8-HxCDF	NS
13C12-1,2,3,4,7,8,9-HpCDF	NS

Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.96	54	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	64	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.14	60	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.74	64	25-130
13C12-OCDD	8000	37.23	59	25-130
13C12-2,3,7,8-TCDF	4000	27.04	59	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	62	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.67	62	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.18	66	25-130

Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	64	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0	<1.6	1.6	U	20
Total-PeCDD	0	<0.89	0.89	U	100
Total-HxCDD	0	<1.2	1.2	U	100
Total-HpCDD	0	<1.1	1.1	U	100
Total-TCDF	0	<1.2	1.2	U	20
Total-PeCDF	0	<0.61	0.61	U	100
Total-HxCDF	1	1.08	0.86		100
Total-HpCDF	0	<0.91	0.91	U	100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.00498
Mid Point PCDD/F TEQ (WHO 2005)	1.83
Upper Bound PCDD/F TEQ (WHO 2005)	3.51

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure
NS	Indicates that this standard was not spiked to sample

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3174994-1	Extraction Date	8-Oct-19	Approved:
Analysis Method	EPA M23	Sample Size	1 Train	*T.Patterson*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	MEDIA	Split Ratio	2	22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A19
Run Date	19-Oct-19 18:46
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<0.69	0.69	U		20
1,2,3,7,8-PeCDD	1	32.05	1.22	0.60	M,J		100
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.73	0.73	U		100
1,2,3,6,7,8-HxCDD	0.1	34.14	<0.72	0.67	M,J,R	0.72	100
1,2,3,7,8,9-HxCDD	0.1	34.26	2.06	0.69	M,J		100
1,2,3,4,6,7,8-HpCDD	0.01	35.74	3.00	1.4	M,J		100
OCDD	0.0003	37.23	17.0	0.63	J		200
2,3,7,8-TCDF	0.1	NotFnd	<0.47	0.47	U		20
1,2,3,7,8-PeCDF	0.03	31.12	1.37	0.33	M,J		100
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.30	0.30	U		100
1,2,3,4,7,8-HxCDF	0.1	33.61	<0.67	0.57	M,J,R	0.67	100
1,2,3,6,7,8-HxCDF	0.1	33.68	<0.55	0.53	M,J,R	0.55	100
2,3,4,6,7,8-HxCDF	0.1	33.99	<0.74	0.57	M,J,R	0.74	100
1,2,3,7,8,9-HxCDF	0.1	34.41	<0.97	0.65	M,J,R	0.97	100
1,2,3,4,6,7,8-HpCDF	0.01	35.18	<1.3	0.32	M,J,R	1.3	100
1,2,3,4,7,8,9-HpCDF	0.01	35.99	<1.9	0.38	M,J,R	1.9	100
OCDF	0.0003	37.32	<3.4	0.44	M,J,R	3.4	200
Field Spike Standards			**% Rec**				
37Cl4-2,3,7,8-TCDD			NS				
13C12-1,2,3,4,7,8-HxCDD			NS				
13C12-2,3,4,7,8-PeCDF			NS				
13C12-1,2,3,4,7,8-HxCDF			NS				
13C12-1,2,3,4,7,8,9-HpCDF			NS				
Extraction Standards							
13C12-2,3,7,8-TCDD	4000	27.93	75	40-130			
13C12-1,2,3,7,8-PeCDD	4000	32.04	70	40-130			
13C12-1,2,3,6,7,8-HxCDD	4000	34.13	71	40-130			
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.73	73	25-130			
13C12-OCDD	8000	37.22	85	25-130			
13C12-2,3,7,8-TCDF	4000	27.01	77	40-130			
13C12-1,2,3,7,8-PeCDF	4000	31.10	73	40-130			
13C12-1,2,3,6,7,8-HxCDF	4000	33.66	78	40-130			
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.17	82	25-130			
Cleanup Standard	**pg**						
13C12-1,2,3,7,8,9-HxCDF	4000	34.40	79	40-130			

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0	<0.69	0.69	U	20
Total-PeCDD	1	1.22	0.60		100
Total-HxCDD	1	2.06	0.73		100
Total-HpCDD	2	4.84	1.4		100
Total-TCDF	0	<0.47	0.47	U	20
Total-PeCDF	1	1.37	0.33		100
Total-HxCDF	0	<0.65	0.65	U	100
Total-HpCDF	0	<0.38	0.38	U	100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	1.50
Mid Point PCDD/F TEQ (WHO 2005)	2.35
Upper Bound PCDD/F TEQ (WHO 2005)	2.80

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure
NS	Indicates that this standard was not spiked to sample

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a
ALS Sample ID	WG3174994-4	Extraction Date	8-Oct-19
Analysis Method	EPA M23	Sample Size	1 Train
Analysis Type	Blank	Percent Moisture	n/a
Sample Matrix	REAGENT	Split Ratio	2

Approved:
T.Patterson
--e-signature--
22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A20
Run Date	19-Oct-19 19:28
Final Volume	20 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<0.79	0.79	U		20
1,2,3,7,8-PeCDD	1	NotFnd	<0.42	0.42	U		100
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.79	0.79	U		100
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.72	0.72	U		100
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.75	0.75	U		100
1,2,3,4,6,7,8-HpCDD	0.01	35.75	<1.9	0.74	M,J,R	1.9	100
OCDD	0.0003	37.24	<11	0.50	M,J,R	11	200
2,3,7,8-TCDF	0.1	NotFnd	<0.50	0.50	U		20
1,2,3,7,8-PeCDF	0.03	31.13	<1.1	0.42	M,J,R	1.1	100
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.38	0.38	U		100
1,2,3,4,7,8-HxCDF	0.1	33.60	<0.57	0.57	M,U		100
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.53	0.53	U		100
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.57	0.57	U		100
1,2,3,7,8,9-HxCDF	0.1	34.43	<1.7	0.65	M,J,R	1.7	100
1,2,3,4,6,7,8-HpCDF	0.01	35.19	1.41	0.39	M,J		100
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<0.46	0.46	U		100
OCDF	0.0003	37.33	2.08	0.63	M,J		200

Field Spike Standards	**% Rec**
37Cl4-2,3,7,8-TCDD	NS
13C12-1,2,3,4,7,8-HxCDD	NS
13C12-2,3,4,7,8-PeCDF	NS
13C12-1,2,3,4,7,8-HxCDF	NS
13C12-1,2,3,4,7,8,9-HpCDF	NS

Extraction Standards				
13C12-2,3,7,8-TCDD	4000	27.95	66	40-130
13C12-1,2,3,7,8-PeCDD	4000	32.05	69	40-130
13C12-1,2,3,6,7,8-HxCDD	4000	34.15	65	40-130
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.75	69	25-130
13C12-OCDD	8000	37.23	66	25-130
13C12-2,3,7,8-TCDF	4000	27.02	71	40-130
13C12-1,2,3,7,8-PeCDF	4000	31.12	72	40-130
13C12-1,2,3,6,7,8-HxCDF	4000	33.67	72	40-130
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.19	71	25-130

Cleanup Standard	**pg**			
13C12-1,2,3,7,8,9-HxCDF	4000	34.41	74	40-130

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0	<0.79	0.79	U	20
Total-PeCDD	0	<0.42	0.42	U	100
Total-HxCDD	0	<0.79	0.79	U	100
Total-HpCDD	0	<0.74	0.74	U	100
Total-TCDF	0	<0.50	0.50	U	20
Total-PeCDF	0	<0.42	0.42	U	100
Total-HxCDF	0	<0.65	0.65	U	100
Total-HpCDF	1	1.41	0.46		100

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0147
Mid Point PCDD/F TEQ (WHO 2005)	1.13
Upper Bound PCDD/F TEQ (WHO 2005)	2.01

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalenc
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure
NS	Indicates that this standard was not spiked to sample

ALS Life Sciences

Laboratory Control Sample Analysis Report

Sample Name	**Laboratory Control Sample**	Sampling Date	n/a	
ALS Sample ID	WG3174994-2	Extraction Date	8-Oct-19	Approved:
Analysis Method	EPA M23	Sample Size	1 n/a	*T.Patterson*
Analysis Type	LCS	Percent Moisture	n/a	--e-signature--
Sample Matrix	QC	Split Ratio	2	22-Oct-2019

Run Information	**Run 1**
Filename	7-191019A16
Run Date	19-Oct-19 16:40
Final Volume	20 uL
Dilution Factor	1
Analysis Units	%
Instrument - Column	HRMS-7 DB5MSUST470134H

Target Analytes	**pg**	**Ret. Time**	**% Rec**	**Limits**	**Flags**
2,3,7,8-TCDD	400	27.95	100	70-130	
1,2,3,7,8-PeCDD	2000	32.05	107	70-130	
1,2,3,4,7,8-HxCDD	2000	34.08	103	70-130	
1,2,3,6,7,8-HxCDD	2000	34.13	103	70-130	
1,2,3,7,8,9-HxCDD	2000	34.26	106	70-130	
1,2,3,4,6,7,8-HpCDD	2000	35.74	102	70-130	
OCDD	4000	37.22	98	70-130	
2,3,7,8-TCDF	400	27.04	98	70-130	
1,2,3,7,8-PeCDF	2000	31.12	110	70-130	
2,3,4,7,8-PeCDF	2000	31.84	96	70-130	
1,2,3,4,7,8-HxCDF	2000	33.60	107	70-130	
1,2,3,6,7,8-HxCDF	2000	33.66	104	70-130	
2,3,4,6,7,8-HxCDF	2000	33.99	102	70-130	
1,2,3,7,8,9-HxCDF	2000	34.41	100	70-130	
1,2,3,4,6,7,8-HpCDF	2000	35.18	102	70-130	
1,2,3,4,7,8,9-HpCDF	2000	35.99	100	70-130	
OCDF	4000	37.31	95	70-130	
Field Spike Standards			**% Rec**		
37Cl4-2,3,7,8-TCDD			NS		
13C12-1,2,3,4,7,8-HxCDD			NS		
13C12-2,3,4,7,8-PeCDF			NS		
13C12-1,2,3,4,7,8-HxCDF			NS		
13C12-1,2,3,4,7,8,9-HpCDF			NS		
Extraction Standards					
13C12-2,3,7,8-TCDD	4000	27.93	55	40-130	
13C12-1,2,3,7,8-PeCDD	4000	32.04	54	40-130	
13C12-1,2,3,6,7,8-HxCDD	4000	34.13	61	40-130	
13C12-1,2,3,4,6,7,8-HpCDD	4000	35.73	62	25-130	
13C12-OCDD	8000	37.22	60	25-130	
13C12-2,3,7,8-TCDF	4000	27.01	64	40-130	
13C12-1,2,3,7,8-PeCDF	4000	31.10	57	40-130	
13C12-1,2,3,6,7,8-HxCDF	4000	33.66	67	40-130	
13C12-1,2,3,4,6,7,8-HpCDF	4000	35.17	69	25-130	
Cleanup Standard	**pg**				
13C12-1,2,3,7,8,9-HxCDF	4000	34.40	71	40-130	

NS Indicates that this standard was not spiked to sample

APPENDIX D

Calculated Data

GAS CALCULATIONS

Client: TMAC
Plant: Incinerator
Location: Hope Bay Nunavut

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
Gas 1	4.8	19.5	76.4	10.6	167.0
Gas 2	3.7	17.4	518.7	72.3	168.0
Gas 3	9.9	14.2	0.0	0.0	112.5

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	1.4	24.2	501	19	200
5	1.7	23.6	9	7	222
10	3.2	20.8	6	8	186
15	7	18.8	6	9	133
20	6	16.6	3	10	145
25	6.7	17.6	5	10	150
30	7.3	15.2	5	11	133

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	2.2	18.2	4	6	219
5	2.1	18.3	1	9	230
10	3	18.8	2000	351	159
15	2.5	18.5	1337	33	122
20	3.3	18.8	174	35	188
25	6.4	14.5	69	36	132
30	6.6	14.9	46	36	126

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	10.9	14.4	0	0	106
5	10.6	14.7	0	0	111
10	8.5	15.2	0	0	119
15	9.4	13.3	0	0	111
20	8.9	14.4	0	0	112
25	10.9	13.3	0	0	116
30					

GAS CALCULATIONS
TMAC
Incinerator
Hope Bay Nunavut

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Corresponding PM Test							n/a
Dry Stack Gas Flow Rate	Qs	dscfm	(Entered from PM Test Data)				n/a
		dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	0.00	0.00	0.00	n/a
Stack Gas Oxygen Content	Co2	%	Measurement from Flue Gas Analyzer	4.8	3.7	9.9	6.1
Stack Gas Carbon Dioxide Content	Cco2	%	Measurement from Flue Gas Analyzer	19.5	17.4	14.2	17.1
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	10.6	72.3	0.0	27.62
Uncorrected @ STP	Cso2	mg/dscm	Cso2 (mg/dscm) = Cso2 (ppm) x 2.62	27.70	189.39	0.00	72.36
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	0.00	0.00	0.00	0.00
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/dscm	Cso2 (11% O2) = Cso2 (mg/dscm) x (20.9-11) / (20.9-Co2)	16.99	109.19	0.00	42.06
Corrected to 3% O2	Cso2	mg/dscm	Cso2 (3% O2) = Cso2 (mg/dscm) x (20.9-3) / (20.9-Co2)	30.71	197.42	0.00	76.05
Corrected to 12% CO2	Cso2	mg/dscm	Cso2 (12% CO2) = Cso2 (mg/dscm) x (12/Cco2)	17.01	130.40	0.00	49.14
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	167.0	168.0	112.5	149.17
Uncorrected @ STP	Cnox	mg/dscm	Cnox (mg/dscm) = Cnox (ppm) x 1.882	314.29	316.18	211.73	280.73
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	0.00	0.00	0.00	0.00
NOx Concentration							
Corrected to 11% O2	Cnox	mg/dscm	Cnox (11% O2) = Cnox (mg/dscm) x (20.9-11) / (20.9-Co2)	192.75	182.29	189.98	188.34
Corrected to 3% O2	Cnox	mg/dscm	Cnox (3% O2) = Cnox (mg/dscm) x (20.9-3) / (20.9-Co2)	348.50	329.59	343.49	340.53
Corrected to 12% CO2	Cnox	mg/dscm	Cnox (12% CO2) = Cnox (mg/dscm) x (12/Cco2)	192.99	217.69	178.71	196.47
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	76.4	518.7	0.0	198.38
Uncorrected @ STP	Cco	mg/dscm	Cco (mg/dscm) = Cco (ppm) x 1.145	87.51	593.93	0.00	227.15
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	0.00	0.00	0.00	0.00
CO Concentration							
Corrected to 11% O2	Cco	mg/dscm	Cco (11% O2) = Cco (mg/dscm) x (20.9-11) / (20.9-Co2)	53.67	342.42	0.00	132.03
Corrected to 3% O2	Cco	mg/dscm	Cco (3% O2) = Cco (mg/dscm) x (20.9-3) / (20.9-Co2)	97.04	619.13	0.00	238.72
Corrected to 12% CO2	Cco	mg/dscm	Cco (12% CO2) = Cco (mg/dscm) x (12/Cco2)	53.73	408.93	0.00	154.22

Legend:
sq.ft - square feet
sq.m - square metres
Pi - 3.142
R - degrees Rankin
ppm - parts per million
in.Hg - inches of mercury
cu.ft - cubic feet
cu.m - cubic metres
STP - standard temperature and pressure (25 C and 101.3 kPa)
dscms - dry standard cubic metres per second
dscfm - dry standard cubic feet per minute
mg/dscm - miligrams per dry standard cubic metre
g/s - grams per second
NOx - as NO2
acfm - actual cubic feet per minute

STACK TESTING RESULTS
GAS CALCULATIONS
TMAC
Incinerator
Hope Bay Nunavut

Parameter	Test 1	Test 2	Test 3	Average	Limits
Oxygen - O2 (%)	4.76	3.73	9.87	6.12	-
Carbon Dioxide - CO2 (%)	19.5	17.4	14.2	17.1	-
Sulphur Dioxide - SO2					
SO2 Measured Concentration (ppm)	10.6	72.3	0.0	27.6	-
Uncorrected at STP (mg/dscm)	27.7	189.4	0.0	72.4	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Nitrogen Oxides - NOx					
NOx Measured Concentration (ppm)	167.0	168.0	112.5	149.2	-
Uncorrected at STP (mg/dscm)	314.3	316.2	211.7	280.7	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Carbon Monoxide - CO					
CO Measured Concentration (ppm)	76.4	518.7	0.0	198.4	-
Uncorrected at STP (mg/dscm)	87.5	593.9	0.0	227.1	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-

Legend:

C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2
ND - non-detectable

GAS CALCULATIONS

Client: TMAC
Plant: Incinterator
Location: Hope Bay, Nunavut

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
Gas 1	5.9	18.5	0.0	0.0	109.4
Gas 2	9.6	13.9	0.0	0.0	89.1
Gas 3	7.0	17.1	0.0	0.0	66.0

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	5	19.2	0	0	115
5	5.5	19.4	0	0	102
10	6.1	18.2	0	0	107
15	6.2	19	0	0	107
20	6.2	18.3	0	0	116
25	6.5	17.3	0	0	109
30	6	18.1	0	0	110

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	10.1	12.4	0	0	76
5	9.4	15.9	0	0	85
10	8.2	15.5	0	0	90
15	10.6	12.7	0	0	91
20	11.1	11.6	0	0	94
25	9.9	13.5	0	0	93
30	8.2	15.5	0	0	95

	O_2 (%)	CO_2 (%)	CO (ppm)	SO_2 (ppm)	NO_X (ppm)
0	5.1	19.4	0	0	47
5	5.2	19.3	0	0	58
10	8.8	14.9	0	0	60
15	8.3	15.6	0	0	65
20	6.4	17.8	0	0	72
25	8.2	15.6	0	0	78
30	6.7	17.4	0	0	82

GAS CALCULATIONS
TMAC
Incinterator
Hope Bay, Nunavut

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Corresponding PM Test							n/a
Dry Stack Gas Flow Rate	Qs	dscfm	(Entered from PM Test Data)				n/a
		dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	0.00	0.00	0.00	n/a
Stack Gas Oxygen Content	Co2	%	Measurement from Flue Gas Analyzer	5.9	9.6	7.0	7.5
Stack Gas Carbon Dioxide Content	Cco2	%	Measurement from Flue Gas Analyzer	18.5	13.9	17.1	16.5
Sulphur Dioxide - SO2							
SO2 Measured Concentration	Cso2	ppm	Measurement from Flue Gas Analyzer	0.0	0.0	0.0	0.00
Uncorrected @ STP	Cso2	mg/dscm	Cso2 (mg/dscm) = Cso2 (ppm) x 2.62	0.00	0.00	0.00	0.00
SO2 Emission Rate	ERso2	g/s	ERso2 = Cso2/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERso2 (kg/hr) = 3.6 x ERso2 (g/s)	0.00	0.00	0.00	0.00
SO2 Concentration							
Corrected to 11% O2	Cso2	mg/dscm	Cso2 (11% O2) = Cso2 (mg/dscm) x (20.9-11) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 3% O2	Cso2	mg/dscm	Cso2 (3% O2) = Cso2 (mg/dscm) x (20.9-3) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 12% CO2	Cso2	mg/dscm	Cso2 (12% CO2) = Cso2 (mg/dscm) x (12/Cco2)	0.00	0.00	0.00	0.00
Nitrogen Oxides - NOx							
NOx Measured Concentration	Cnox	ppm	Measurement from Flue Gas Analyzer	109.4	89.1	66.0	88.19
Uncorrected @ STP	Cnox	mg/dscm	Cnox (mg/dscm) = Cnox (ppm) x 1.882	205.94	167.77	124.21	165.97
NOx Emission Rate	ERnox	g/s	ERnox = Cnox/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERnox (kg/hr) = 3.6 x ERnox (g/s)	0.00	0.00	0.00	0.00
NOx Concentration							
Corrected to 11% O2	Cnox	mg/dscm	Cnox (11% O2) = Cnox (mg/dscm) x (20.9-11) / (20.9-Co2)	136.18	147.54	88.20	123.97
Corrected to 3% O2	Cnox	mg/dscm	Cnox (3% O2) = Cnox (mg/dscm) x (20.9-3) / (20.9-Co2)	246.23	266.77	159.46	224.15
Corrected to 12% CO2	Cnox	mg/dscm	Cnox (12% CO2) = Cnox (mg/dscm) x (12/Cco2)	133.59	145.13	86.95	121.89
Carbon Monoxide - CO							
CO Measured Concentration	Cco	ppm	Measurement from Flue Gas Analyzer	0.0	0.0	0.0	0.00
Uncorrected @ STP	Cco	mg/dscm	Cco (mg/dscm) = Cco (ppm) x 1.145	0.00	0.00	0.00	0.00
CO Emission Rate	ERco	g/s	ERco = Cco/1000 x Qs	0.00	0.00	0.00	0.00
		kg/hr	ERco (kg/hr) = 3.6 x ERco (g/s)	0.00	0.00	0.00	0.00
CO Concentration							
Corrected to 11% O2	Cco	mg/dscm	Cco (11% O2) = Cco (mg/dscm) x (20.9-11) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 3% O2	Cco	mg/dscm	Cco (3% O2) = Cco (mg/dscm) x (20.9-3) / (20.9-Co2)	0.00	0.00	0.00	0.00
Corrected to 12% CO2	Cco	mg/dscm	Cco (12% CO2) = Cco (mg/dscm) x (12/Cco2)	0.00	0.00	0.00	0.00

Legend:

sq.ft - square feet
sq.m - square metres
Pi - 3.142
R - degrees Rankin
ppm - parts per million

in.Hg - inches of mercury
cu.ft - cubic feet
cu.m - cubic metres
STP - standard temperature and pressure (25 C and 101.3 kPa)
dscms - dry standard cubic metres per second
dscfm - dry standard cubic feet per minute

mg/dscm - miligrams per dry standard cubic metre
g/s - grams per second
NOx - as NO2
acfm - actual cubic feet per minute

STACK TESTING RESULTS
GAS CALCULATIONS
TMAC
Incinterator
Hope Bay, Nunavut

Parameter	Test 1	Test 2	Test 3	Average	Limits
Oxygen - O2 (%)	5.93	9.64	6.96	7.51	-
Carbon Dioxide - CO2 (%)	18.5	13.9	17.1	16.5	-
Sulphur Dioxide - SO2					
SO2 Measured Concentration (ppm)	0.0	0.0	0.0	0.0	-
Uncorrected at STP (mg/dscm)	0.0	0.0	0.0	0.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Nitrogen Oxides - NOx					
NOx Measured Concentration (ppm)	109.4	89.1	66.0	88.2	-
Uncorrected at STP (mg/dscm)	205.9	167.8	124.2	166.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-
Carbon Monoxide - CO					
CO Measured Concentration (ppm)	0.0	0.0	0.0	0.0	-
Uncorrected at STP (mg/dscm)	0.0	0.0	0.0	0.0	-
Emission Rate (kg/hr)	0.00	0.00	0.00	0.00	-

Legend:
C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2
ND - non-detectable

Raw Data for: TMAC Resources

Client:	TMAC
Job Number:	160930343
Plant:	Incinerator
Location:	Hope Bay, NU
Test:	M-1
Date:	17-Sep-19
Personnel:	BC/KW
Test Start:	12:34 PM
Test Finish:	2:34 PM

	Particulate Matter
Collected from Filter (mg):	62.00
Collected from Probe Wash (mg):	35.90
Total Collected (mg):	97.90

Impinger No.	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
1	862.4	740.6	121.8
2	747.8	722.8	25.0
3	731.6	727.4	4.2
4	607.5	607.0	0.5
5	769.3	760.3	9.0
6	754.2	753.7	0.5
7	956.5	946.0	10.5
		Moisture Volume (mL)	171.5

Parameters

Barometric Pressure, Pbar (in. Hg)	29.60	O2, (%)	5.9	Stack Diameter, (in.)	18
Stack Static Pressure, Pstatic (in. H2O)	0.02	CO2, (%)	18.5	Stack Area, (sq. ft.)	1.77
Ambient Temp, (°F)	45	N2, (%)	75.6	Probe Length, (in)	24
H2O Volume Collected, Vw (mL)	171.5			Nozzle Diameter, (in.)	0.536
Total # Sampling Points,	24			Pitot Coefficient, (Cp)	0.821
Sampling Time per Point, (min)	5			Gamma, meter constant	0.979
Readings Taken Every __ mins	2.5				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						475.40	
Traverse 1	1	2.5	1100	0.03	0.71	476.56	65
		5	1090	0.03	0.72	477.71	65
	2	7.5	1040	0.03	0.74	478.90	65
		10	1080	0.03	0.72	480.06	65
	3	12.5	1070	0.03	0.73	481.23	65
		15	1050	0.03	0.74	482.43	65
	4	17.5	1090	0.03	0.72	483.57	65
		20	1070	0.03	0.73	484.77	65
	5	22.5	1100	0.03	0.72	485.94	66
		25	1070	0.03	0.73	487.12	66
	6	27.5	1070	0.03	0.73	488.32	66
		30	1070	0.03	0.73	489.49	66
	7	32.5	1060	0.03	0.73	490.67	66
		35	1080	0.03	0.72	491.82	66
	8	37.5	1060	0.03	0.73	493.02	66
		40	1090	0.03	0.72	494.19	66
	9	42.5	1080	0.03	0.72	495.36	66
		45	1110	0.03	0.71	496.54	66
	10	47.5	1100	0.04	0.95	497.85	66
		50	1160	0.04	0.92	499.17	67
	11	52.5	1120	0.04	0.94	500.53	67
		55	1140	0.04	0.93	501.84	67
	12	57.5	1130	0.03	0.70	503.04	67
		60	1130	0.03	0.70	504.19	67
						504.19	
Traverse 2	1	62.5	1120	0.03	0.71	505.36	67
		65	1100	0.03	0.72	506.55	67
	2	67.5	1105	0.03	0.71	507.70	67
		70	1120	0.03	0.71	508.85	67
	3	72.5	1120	0.03	0.71	510.02	67
		75	1120	0.03	0.71	511.19	67
	4	77.5	1120	0.03	0.71	512.33	67
		80	1120	0.03	0.71	513.48	67
	5	82.5	1120	0.03	0.71	514.65	68
		85	1130	0.03	0.70	515.80	67
	6	87.5	1130	0.03	0.70	516.94	67
		90	1130	0.03	0.70	518.09	67
	7	92.5	1120	0.03	0.71	519.25	68
		95	1130	0.03	0.70	520.42	68
	8	97.5	1170	0.03	0.69	521.56	68
		100	1140	0.03	0.70	522.70	68
	9	102.5	1150	0.03	0.70	523.85	68
		105	1140	0.03	0.70	525.00	68
	10	107.5	1160	0.03	0.69	526.16	68
		110	1150	0.03	0.70	527.30	69
	11	112.5	1150	0.03	0.70	528.45	69
		115	1160	0.03	0.69	529.60	69
	12	117.5	1150	0.03	0.70	530.75	69
		120	1140	0.03	0.70	531.90	69

Calculations for: **TMAC Resources**
Test #1

Client: TMAC
Job Number: 160930343

Plant: Incinerator
Location: Hope Bay, NU
Test: M-1
Date: 17-Sep-19
Personnel: BC/KW

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.60
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.20
Volume of Water Vapour Collected, Vwc (cu.ft)	8.232
Stack Gas Moisture Content (% as decimal)	0.128
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.50

Isokineticity Checks

Check range	**Within Criteria**
Check average	**Within Criteria**

0

	Traverse Point	**Time (min)**	**Stack Gas Temp, Ts (R)**	**S-type Pitot, delta P (in. H2O)**	**Orifice delta H (in. H2O)**	**Stack Gas Velocity, Us (ft/s)**	**Meter Press., Pm (in. Hg)**	**Gas Meter Avg. Temp, Tm (R)**	**Gas Meter Volume, Vm (cu. ft.)**	**Vol. @ Ref., Vmc (cu. ft.)**	**Isokinetics I (%)**
Traverse 1	**1**	2.5	1560	0.03	0.71	16.22	29.65	525	1.160	1.151	101.76
		5	1550	0.03	0.72	16.17	29.65	525	1.150	1.141	100.56
	2	7.5	1500	0.03	0.74	15.90	29.65	525	1.190	1.181	102.37
		10	1540	0.03	0.72	16.11	29.65	525	1.160	1.151	101.11
	3	12.5	1530	0.03	0.73	16.06	29.65	525	1.170	1.161	101.65
		15	1510	0.03	0.74	15.96	29.65	525	1.200	1.191	103.57
	4	17.5	1550	0.03	0.72	16.17	29.65	525	1.140	1.131	99.68
		20	1530	0.03	0.73	16.06	29.65	525	1.200	1.191	104.25
	5	22.5	1560	0.03	0.72	16.22	29.65	526	1.170	1.159	102.44
		25	1530	0.03	0.73	16.06	29.65	526	1.180	1.169	102.32
	6	27.5	1530	0.03	0.73	16.06	29.65	526	1.200	1.189	104.06
		30	1530	0.03	0.73	16.06	29.65	526	1.170	1.159	101.45
	7	32.5	1520	0.03	0.73	16.01	29.65	526	1.180	1.169	101.99
		35	1540	0.03	0.72	16.11	29.65	526	1.150	1.139	100.04
	8	37.5	1520	0.03	0.73	16.01	29.65	526	1.200	1.189	103.72
		40	1550	0.03	0.72	16.17	29.65	526	1.170	1.159	102.11
	9	42.5	1540	0.03	0.72	16.11	29.65	526	1.170	1.159	101.78
		45	1570	0.03	0.71	16.27	29.65	526	1.180	1.169	103.65
	10	47.5	1560	0.04	0.95	18.73	29.67	526	1.310	1.298	99.39
		50	1620	0.04	0.92	19.08	29.67	527	1.320	1.306	101.86
	11	52.5	1580	0.04	0.94	18.85	29.67	527	1.360	1.345	103.64
		55	1600	0.04	0.93	18.96	29.67	527	1.310	1.296	100.46
	12	57.5	1590	0.03	0.70	16.37	29.65	527	1.200	1.186	105.87
		60	1590	0.03	0.70	16.37	29.65	527	1.150	1.137	101.46
Traverse 2	**1**	62.5	1580	0.03	0.71	16.32	29.65	527	1.170	1.157	102.90
		65	1560	0.03	0.72	16.22	29.65	527	1.190	1.177	103.99
	2	67.5	1565	0.03	0.71	16.24	29.65	527	1.150	1.137	100.66
		70	1580	0.03	0.71	16.32	29.65	527	1.150	1.137	101.14
	3	72.5	1580	0.03	0.71	16.32	29.65	527	1.170	1.157	102.90
		75	1580	0.03	0.71	16.32	29.65	527	1.170	1.157	102.90
	4	77.5	1580	0.03	0.71	16.32	29.65	527	1.140	1.127	100.26
		80	1580	0.03	0.71	16.32	29.65	527	1.150	1.137	101.14
	5	82.5	1580	0.03	0.71	16.32	29.65	528	1.170	1.155	102.70
		85	1590	0.03	0.70	16.37	29.65	527	1.150	1.137	101.46
	6	87.5	1590	0.03	0.70	16.37	29.65	527	1.140	1.127	100.58
		90	1590	0.03	0.70	16.37	29.65	527	1.150	1.137	101.46
	7	92.5	1580	0.03	0.71	16.32	29.65	528	1.160	1.145	101.83
		95	1590	0.03	0.70	16.37	29.65	528	1.170	1.155	103.03
	8	97.5	1630	0.03	0.69	16.58	29.65	528	1.140	1.125	101.64
		100	1600	0.03	0.70	16.42	29.65	528	1.140	1.125	100.70
	9	102.5	1610	0.03	0.70	16.48	29.65	528	1.150	1.135	101.90
		105	1600	0.03	0.70	16.42	29.65	528	1.150	1.135	101.58
	10	107.5	1620	0.03	0.69	16.53	29.65	528	1.160	1.145	103.10
		110	1610	0.03	0.70	16.48	29.65	529	1.140	1.123	100.82
	11	112.5	1610	0.03	0.70	16.48	29.65	529	1.150	1.133	101.71
		115	1620	0.03	0.69	16.53	29.65	529	1.150	1.133	102.02
	12	117.5	1610	0.03	0.70	16.48	29.65	529	1.150	1.133	101.71
		120	1600	0.03	0.70	16.42	29.65	529	1.150	1.133	101.39
		Total	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Total**	**Total**	**Average**
		120	1,572	0.03	0.73	16.49	29.65	527	56.500	55.883	101.97

Raw Data for: TMAC Resources
Test #2

Client:	TMAC
Job Number:	160930343
	Incinerator
Plant:	Incinerator
Location:	Hope Bay, NU
Test:	M-2
Date:	17-Sep-19
Personnel:	BC / KW
Test Start:	4:06 PM
Test Finish:	6:06 PM

	Particulate Matter
Collected from Filter (mg):	68.50
Collected from Probe Wash (mg):	32.60
Total Collected (mg):	101.10

Impinger No.	Final Weight	Tare Weight	Weight of Moisture (g)
1	835.9	741.8	94.1
2	754.7	728.5	26.2
3	735.7	731.3	4.4
4	611.4	611.0	0.4
5	763.9	763.3	0.6
6	757.2	756.5	0.7
7	965.6	956.4	9.2
		Moisture Volume (mL)	135.6

Parameters

Barometric Pressure, Pbar (in. Hg)	29.40	**O2, (%)**	9.6	**Stack Diameter, (in.)**	18
Stack Static Pressure, Pstatic (in. H2O)	0.02	**CO2, (%)**	13.9	**Stack Area, (sq. ft.)**	1.76715
Ambient Temp, (°F)	27	**N2, (%)**	90.4	**Probe Length, (in.)**	24
H2O Volume Collected, Vw (mL)	135.6			**Nozzle Diameter, (in.)**	0.536
Total # Sampling Points,	24			**Pitot Coefficient, (Cp)**	0.821
Sampling Time per Point, (min)	5			**Gamma, meter constant**	0.979
Readings Taken Every __ mins	2.5				

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						532.30	
Traverse 1	**1**	2.5	1200	0.03	0.67	533.43	66
		5	1230	0.03	0.66	534.55	66
	2	7.5	1250	0.03	0.65	535.66	65
		10	1240	0.03	0.66	536.77	66
	3	12.5	1150	0.03	0.69	537.91	66
		15	1150	0.03	0.69	539.03	65
	4	17.5	1150	0.03	0.69	540.16	65
		20	1150	0.03	0.69	541.29	65
	5	22.5	1150	0.03	0.69	542.43	66
		25	1160	0.03	0.69	543.56	66
	6	27.5	1190	0.04	0.90	544.86	66
		30	1170	0.04	0.91	546.18	66
	7	32.5	1190	0.04	0.90	547.47	66
		35	1165	0.04	0.92	548.77	66
	8	37.5	1165	0.04	0.92	550.07	66
		40	1170	0.04	0.91	551.36	67
	9	42.5	1160	0.04	0.92	552.68	67
		45	1160	0.04	0.92	553.98	67
	10	47.5	1170	0.04	0.91	555.29	67
		50	1165	0.04	0.92	556.59	67
	11	52.5	1180	0.04	0.91	557.91	68
		55	1160	0.04	0.92	559.20	68
	12	57.5	1190	0.04	0.91	560.51	68
		60	1170	0.04	0.92	561.82	68
						561.82	
Traverse 2	**1**	62.5	1175	0.04	0.91	563.13	68
		65	1190	0.04	0.91	564.44	68
	2	67.5	1190	0.04	0.91	565.73	68
		70	1210	0.04	0.90	567.05	69
	3	72.5	1190	0.04	0.91	568.35	69
		75	1200	0.04	0.90	569.66	69
	4	77.5	1195	0.04	0.90	570.95	69
		80	1200	0.04	0.90	572.26	69
	5	82.5	1200	0.04	0.90	573.56	69
		85	1190	0.04	0.91	574.88	69
	6	87.5	1200	0.04	0.90	576.19	69
		90	1180	0.05	1.14	577.65	69
	7	92.5	1230	0.04	0.89	578.94	69
		95	1230	0.04	0.89	580.22	69
	8	97.5	1230	0.04	0.89	581.51	69
		100	1230	0.04	0.89	582.71	70
	9	102.5	1230	0.04	0.89	584.08	70
		105	1250	0.04	0.89	585.38	70
	10	107.5	1230	0.04	0.89	586.68	70
		110	1230	0.04	0.89	587.98	70
	11	112.5	1230	0.04	0.89	589.28	70
		115	1230	0.04	0.89	590.57	70
	12	117.5	1220	0.04	0.89	591.87	70
		120	1220	0.04	0.89	593.16	70

Calculations for: TMAC Resources

Test #2

Client: TMAC
Job Number: 160930343

Plant: Incinerator
Location: Hope Bay, NU
Test: M-2
Date: 17-Sep-19
Personnel: BC / KW

Calculated Parameters		**Isokineticity Checks**	
Stack Gas Pressure, Ps (in.Hg)	29.40	**Check range**	**Within Criteria**
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	34.49	**Check average**	**Within Criteria**
Volume of Water Vapour Collected, Vwc (cu.ft)	6.509		
Stack Gas Moisture Content (% as decimal)	0.098		
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	32.87		

0

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	**1**	2.5	1660	0.03	0.67	15.90	29.45	526	1.130	1.112	103.77
		5	1690	0.03	0.66	16.05	29.45	526	1.120	1.102	103.77
	2	7.5	1710	0.03	0.65	16.14	29.45	525	1.110	1.094	103.65
		10	1700	0.03	0.66	16.09	29.45	526	1.110	1.092	103.15
	3	12.5	1610	0.03	0.69	15.66	29.45	526	1.140	1.122	103.10
		15	1610	0.03	0.69	15.66	29.45	525	1.120	1.104	101.49
	4	17.5	1610	0.03	0.69	15.66	29.45	525	1.130	1.114	102.39
		20	1610	0.03	0.69	15.66	29.45	525	1.130	1.114	102.39
	5	22.5	1610	0.03	0.69	15.66	29.45	526	1.140	1.122	103.10
		25	1620	0.03	0.69	15.71	29.45	526	1.130	1.112	102.52
	6	27.5	1650	0.04	0.90	18.31	29.47	526	1.300	1.280	103.13
		30	1630	0.04	0.91	18.20	29.47	526	1.320	1.299	104.09
	7	32.5	1650	0.04	0.90	18.31	29.47	526	1.290	1.270	102.34
		35	1625	0.04	0.92	18.17	29.47	526	1.300	1.280	102.35
	8	37.5	1625	0.04	0.92	18.17	29.47	526	1.300	1.280	102.35
		40	1630	0.04	0.91	18.20	29.47	527	1.290	1.267	101.53
	9	42.5	1620	0.04	0.92	18.14	29.47	527	1.320	1.297	103.57
		45	1620	0.04	0.92	18.14	29.47	527	1.300	1.277	102.00
	10	47.5	1630	0.04	0.91	18.20	29.47	527	1.310	1.287	103.10
		50	1625	0.04	0.92	18.17	29.47	527	1.300	1.277	102.16
	11	52.5	1640	0.04	0.91	18.25	29.47	528	1.320	1.294	104.01
		55	1620	0.04	0.92	18.14	29.47	528	1.290	1.265	101.03
	12	57.5	1650	0.04	0.91	18.31	29.47	528	1.310	1.285	103.53
		60	1630	0.04	0.92	18.20	29.47	528	1.310	1.285	102.91
Traverse 2	**1**	62.5	1635	0.04	0.91	18.22	29.47	528	1.310	1.285	103.06
		65	1650	0.04	0.91	18.31	29.47	528	1.310	1.285	103.53
	2	67.5	1650	0.04	0.91	18.31	29.47	528	1.290	1.265	101.95
		70	1670	0.04	0.90	18.42	29.47	529	1.320	1.292	104.75
	3	72.5	1650	0.04	0.91	18.31	29.47	529	1.300	1.272	102.55
		75	1660	0.04	0.90	18.36	29.47	529	1.310	1.282	103.81
	4	77.5	1655	0.04	0.90	18.34	29.47	529	1.290	1.263	103.49
		80	1660	0.04	0.90	18.36	29.47	529	1.310	1.282	102.07
	5	82.5	1660	0.04	0.90	18.36	29.47	529	1.300	1.272	103.65
		85	1650	0.04	0.91	18.31	29.47	529	1.320	1.292	102.55
	6	87.5	1660	0.04	0.90	18.36	29.47	529	1.310	1.282	104.44
		90	1640	0.05	1.14	20.41	29.48	529	1.460	1.430	92.15
	7	92.5	1690	0.04	0.89	18.53	29.47	529	1.290	1.263	116.63
		95	1690	0.04	0.89	18.53	29.47	529	1.280	1.253	102.98
	8	97.5	1690	0.04	0.89	18.53	29.47	529	1.290	1.263	102.18
		100	1690	0.04	0.89	18.53	29.47	530	1.200	1.172	102.98
	9	102.5	1690	0.04	0.89	18.53	29.47	530	1.370	1.338	95.62
		105	1710	0.04	0.89	18.64	29.47	530	1.300	1.270	109.81
	10	107.5	1690	0.04	0.89	18.53	29.47	530	1.300	1.270	103.59
		110	1690	0.04	0.89	18.53	29.47	530	1.300	1.270	103.58
	11	112.5	1690	0.04	0.89	18.53	29.47	530	1.300	1.270	103.58
		115	1690	0.04	0.89	18.53	29.47	530	1.290	1.260	103.58
	12	117.5	1680	0.04	0.89	18.47	29.47	530	1.300	1.270	102.48
		120	1680	0.04	0.89	18.47	29.47	530	1.290	1.260	103.28
		Total	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Total**	**Total**	**Average**
		120	1,654	0.04	0.86	17.87	29.46	528	60.860	59.688	103.04

Raw Data for: TMAC Resources
Test #3

Client:	TMAC
Job Number:	160930343
	Incinerator
Plant:	Incinerator
Location:	Hope Bay, NU
Test:	M-3
Date:	18-Sep-19
Personnel:	TBH, JJC
Test Start:	10:48 AM
Test Finish:	12:48 PM

	Particulate Matter
Collected from Filter (mg):	57.10
Collected from Probe Wash (mg):	25.60
Total Collected (mg):	82.70

Impinger No.	Final Weight	Tare Weight	Weight of Moisture (g)
1	866.0	736.3	129.7
2	750.9	727.7	23.2
3	733.8	730.8	3.0
4	612.3	612.0	0.3
5	766.8	766.5	0.3
6	755.3	755.3	0.0
7	973.7	964.9	8.8
		Moisture Volume (mL)	165.3

Parameters

Barometric Pressure, Pbar (in. Hg)	29.50
Stack Static Pressure, Pstatic (in. H2O)	0.02
Ambient Temp, (°F)	47
H2O Volume Collected, Vw (mL)	165.3
Total # Sampling Points,	24
Sampling Time per Point, (min)	5
Readings Taken Every __ mins	2.5

O2, (%)	7.0
CO2, (%)	17.1
N2, (%)	75.9

Stack Diameter, (in.)	18
Stack Area, (sq. ft.)	1.77
Probe Length, (in.)	24
Nozzle Diameter, (in.)	0.536
Pitot Coefficient, (Cp)	0.821
Gamma, meter constant	0.979

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						593.50	
Traverse 1	**1**	2.5	1115	0.03	0.72	594.66	64
		5	1160	0.03	0.70	595.81	64
	2	7.5	1160	0.03	0.70	596.95	64
		10	1165	0.03	0.70	598.09	64
	3	12.5	1100	0.03	0.73	599.25	64
		15	1120	0.03	0.72	600.40	64
	4	17.5	1090	0.03	0.73	601.54	64
		20	1140	0.03	0.71	602.69	65
	5	22.5	1070	0.03	0.74	603.86	65
		25	1080	0.03	0.74	605.04	64
	6	27.5	1100	0.04	0.97	606.41	65
		30	1140	0.04	0.95	607.72	65
	7	32.5	1130	0.03	0.71	608.89	65
		35	1200	0.03	0.68	610.05	65
	8	37.5	1200	0.04	0.91	611.33	65
		40	1220	0.04	0.90	612.65	65
	9	42.5	1100	0.04	0.97	613.99	65
		45	1230	0.03	0.67	615.13	65
	10	47.5	1210	0.03	0.68	616.26	65
		50	1220	0.03	0.68	617.36	65
	11	52.5	1100	0.03	0.73	618.54	65
		55	1240	0.03	0.67	619.67	66
	12	57.5	1200	0.03	0.68	620.80	66
		60	1230	0.03	0.67	621.93	66
						621.93	
Traverse 2	**1**	62.5	1160	0.04	0.94	623.26	66
		65	1240	0.04	0.89	624.55	66
	2	67.5	1130	0.04	0.95	625.84	66
		70	1130	0.03	0.71	627.10	65
	3	72.5	1180	0.03	0.69	628.16	65
		75	1140	0.03	0.71	629.29	65
	4	77.5	1140	0.03	0.71	630.43	66
		80	1160	0.03	0.70	631.57	66
	5	82.5	1175	0.03	0.70	632.70	66
		85	1130	0.03	0.71	633.85	66
	6	87.5	1180	0.04	0.92	635.18	66
		90	1170	0.04	0.93	636.48	65
	7	92.5	1170	0.04	0.93	637.80	66
		95	1165	0.04	0.93	639.11	66
	8	97.5	1200	0.04	0.91	640.43	66
		100	1200	0.04	0.91	641.71	66
	9	102.5	1240	0.04	0.89	643.03	66
		105	1240	0.04	0.89	644.31	66
	10	107.5	1210	0.06	1.36	645.89	66
		110	1225	0.05	1.13	647.33	67
	11	112.5	1210	0.05	1.14	648.78	67
		115	1250	0.04	0.89	650.07	67
	12	117.5	1270	0.04	0.88	651.36	67
		120	1200	0.04	0.91	652.68	67

	T (deg C)	T (deg F)
10:00	8.7	47.7
11:00	7.9	46.2
12:00	8.4	47.1

Calculations for: TMAC Resources
Test #3

Client: TMAC
Job Number: 160930343

Plant: Incinerator
Location: Hope Bay, NU
Test: M-3
Date: 18-Sep-19
Personnel: TBH, JJC

Calculated Parameters		Isokineticity Checks	
Stack Gas Pressure, Ps (in.Hg)	29.50	**Check range**	**Within Criteria**
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.02	**Check average**	**Within Criteria**
Volume of Water Vapour Collected, Vwc (cu.ft)	7.934		
Stack Gas Moisture Content (% as decimal)	0.119		
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.47		

0

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	**1**	2.5	1575	0.03	0.72	16.33	29.55	524	1.160	1.150	101.17
		5	1620	0.03	0.70	16.56	29.55	524	1.150	1.140	101.71
	2	7.5	1620	0.03	0.70	16.56	29.55	524	1.140	1.130	100.83
		10	1625	0.03	0.70	16.59	29.55	524	1.140	1.130	100.98
	3	12.5	1560	0.03	0.73	16.25	29.55	524	1.160	1.150	100.69
		15	1580	0.03	0.72	16.36	29.55	524	1.150	1.140	100.45
	4	17.5	1550	0.03	0.73	16.20	29.55	524	1.140	1.130	98.63
		20	1600	0.03	0.71	16.46	29.55	525	1.150	1.137	100.89
	5	22.5	1530	0.03	0.74	16.10	29.55	525	1.170	1.157	100.38
		25	1540	0.03	0.74	16.15	29.55	524	1.180	1.169	101.76
	6	27.5	1560	0.04	0.97	18.77	29.57	525	1.370	1.356	102.85
		30	1600	0.04	0.95	19.01	29.57	525	1.310	1.296	99.59
	7	32.5	1590	0.03	0.71	16.41	29.55	525	1.170	1.157	102.33
		35	1660	0.03	0.68	16.77	29.55	525	1.160	1.147	103.65
	8	37.5	1660	0.04	0.91	19.36	29.57	525	1.280	1.267	99.11
		40	1680	0.04	0.90	19.48	29.57	525	1.320	1.306	102.82
	9	42.5	1560	0.04	0.97	18.77	29.57	525	1.340	1.326	100.60
		45	1690	0.03	0.67	16.92	29.55	525	1.140	1.127	102.78
	10	47.5	1670	0.03	0.68	16.82	29.55	525	1.130	1.118	101.28
		50	1680	0.03	0.68	16.87	29.55	525	1.100	1.088	98.88
	11	52.5	1560	0.03	0.73	16.25	29.55	525	1.180	1.167	102.23
		55	1700	0.03	0.67	16.97	29.55	526	1.130	1.115	101.98
	12	57.5	1660	0.03	0.68	16.77	29.55	526	1.130	1.115	100.78
		60	1690	0.03	0.67	16.92	29.55	526	1.130	1.115	101.68
Traverse 2	**1**	62.5	1620	0.04	0.94	19.13	29.57	526	1.330	1.314	101.54
		65	1700	0.04	0.89	19.59	29.57	526	1.290	1.274	100.88
	2	67.5	1590	0.04	0.95	18.95	29.57	526	1.290	1.274	97.58
		70	1590	0.03	0.71	16.41	29.55	525	1.260	1.246	110.20
	3	72.5	1640	0.03	0.69	16.67	29.55	525	1.060	1.048	94.15
		75	1600	0.03	0.71	16.46	29.55	525	1.130	1.118	99.14
	4	77.5	1600	0.03	0.71	16.46	29.55	526	1.140	1.125	99.82
		80	1620	0.03	0.70	16.56	29.55	526	1.140	1.125	100.44
	5	82.5	1635	0.03	0.70	16.64	29.55	526	1.130	1.115	100.02
		85	1590	0.03	0.71	16.41	29.55	526	1.150	1.135	100.39
	6	87.5	1640	0.04	0.92	19.24	29.57	526	1.330	1.314	102.17
		90	1630	0.04	0.93	19.19	29.57	525	1.300	1.286	99.75
	7	92.5	1630	0.04	0.93	19.19	29.57	526	1.320	1.304	101.09
		95	1625	0.04	0.93	19.16	29.57	526	1.310	1.294	100.17
	8	97.5	1660	0.04	0.91	19.36	29.57	526	1.320	1.304	102.01
		100	1660	0.04	0.91	19.36	29.57	526	1.280	1.264	98.92
	9	102.5	1700	0.04	0.89	19.59	29.57	526	1.320	1.304	103.23
		105	1700	0.04	0.89	19.59	29.57	526	1.280	1.264	100.10
	10	107.5	1670	0.06	1.36	23.78	29.60	526	1.580	1.562	100.11
		110	1685	0.05	1.13	21.81	29.58	527	1.440	1.420	100.15
	11	112.5	1670	0.05	1.14	21.71	29.58	527	1.450	1.430	100.39
		115	1710	0.04	0.89	19.65	29.57	527	1.290	1.272	100.99
	12	117.5	1730	0.04	0.88	19.77	29.56	527	1.290	1.272	101.57
		120	1660	0.04	0.91	19.36	29.57	527	1.320	1.301	101.82
		Total	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Total**	**Total**	**Average**
		120	1,632	0.04	0.82	17.99	29.56	525	59.180	58.500	100.93

Stack: Hope Bay, NU
Operating Conditions: Normal
Stack Height above Grade: X.xx m
Stack Diameter: 0.46 m

Reference Temperature, Tref (F):	77
(R):	537
(K):	298
Reference Pressure, Pref (in.Hg):	29.92
(Bar):	1.0

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	-	-	M-1	M-2	M-3	-
Date	-	-	17-Sep-19	17-Sep-19	18-Sep-19	n/a
Start Time	-	-	12:34 PM	4:06 PM	10:48 AM	n/a
End Time	-	-	2:34 PM	6:06 PM	12:48 PM	n/a
Total Sampling Time	-	min	120	120	120	120
Stack Diameter	D	in.	18	18	18	18
Average Stack Gas Temperature	Ts	F	1112	1194	1172	1159
Average Dry Gas Meter Temperature	Tm	F	67	68	65	67
Barometric Pressure	Pbar	in.Hg	29.60	29.40	29.50	29.50
Stack Static Pressure	Pstatic	in.H2O	0.02	0.02	0.02	0.02
Avgerage Pressure Drop (Head)	dP	in.H2O	0.03	0.04	0.04	0.03
Avgerage deltaH Orifice	dH	in.H2O	0.73	0.86	0.82	0.80
Average Meter Temperature	Tm	F	67	68	65	67
Gas Sample Volume	Vm	cu.ft	56.500	60.860	59.180	58.85
Average Isokinetics	I	%	102.0	103.0	100.9	102.0
Nozzle Diameter	Dn	in.	0.536	0.536	0.536	0.536
Pitot Coefficient	Cp	-	0.821	0.821	0.821	0.821
Gamma, meter constant	y	-	0.979	0.979	0.979	0.979
Reference Temperature	Tref	R	537	537	537	537
Reference Pressure	Pref	in.Hg	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	Co2	%	5.9	9.6	7.0	7.5
Stack Gas Carbon Dioxide Content	Cco2	%	18.5	13.9	17.1	16.5
Stack Gas Nitrogen Content	Cn2	%	75.6	90.4	75.9	80.6
Volume of Water Collected	Vw	mL	171.5	135.6	165.3	157.5
Particulate Collected from Filter	-	mg	62	69	57	63
Particulate Collected from Probe Wash	-	mg	36	33	26	31
Total Particulate Collected	Mp	mg	98	101	83	94

Legend:
F - degrees Fahrenheit
K - degrees Kelvin
Bar - bars
in.Hg - inches of mercury
in. - inches
in.H2O - inches of water
cu.ft - cubic feet
R - degrees Rankin
NOx - as NO2

CALCULATIONS
TMAC
Incinerator
Stack: Hope Bay, NU
Operating Conditions: Normal
Stack Height above Grade: X.xx m
Stack Diameter: 0.46 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	**As**	**sq.ft**	**As = Pi x ((D/12)^2)/ 4**	1.77	1.77	1.77	1.77
		sq.m	**As (sq.m) = As (sq.ft) x 0.0929**	0.16	0.16	0.16	0.16
Barometric Pressure	**Pbar**	**kPa**	**Pbar (kPa) = Pbar (in.Hg) x 3.386**	100.2	99.5	99.9	99.9
Stack Static Pressure	**Pstatic**	**kPa**	**Pstatic (kPa) = Pstatic (in.H2O) x 0.249**	0.005	0.005	0.005	0.005
Avg. Stack Temperature	**Ts**	**R**	**Ts (R) = Ts (F) + 460**	1572	1654	1632	1619
Avg. Meter Temperature	**Tm**	**R**	**Tm (R) = Tm (F) + 460**	527	528	525	527
Nozzle Diameter	**Dn**	**mm**	**Dn (mm) = Dn (in.) x 25.4**	14	14	14	14
Gas Meter Pressure	**Pm**	**in.Hg**	**Pm = Pbar + (dH / 13.6)**	29.65	29.46	29.56	29.56
Sample Volume at STP	**Vmc**	**cu.ft**	**Vmc = Tref / Pref x (Vm x Pm x y) / Tm**	55.881	59.694	58.503	58.026
		cu.m	**Vmc (cu.m) = 0.02832 x Vmc (cu.ft)**	1.58	1.69	1.66	1.64
Volume of Water Vapour	**Vwc**	**cu.ft**	**Vwc = 0.0480 x Vw**	8.232	6.509	7.934	7.558
Water Fraction	**Bwo**	**-**	**Bwo = Vwc / (Vwc + Vmc)**	0.128	0.098	0.119	0.115
Molecular Weight, Dry	**Md**	**lb/lb-mol**	**Md = 0.44 (Cco2) + 0.32 (Co2) + 0.28 (Cn2)**	31.20	34.49	31.02	32.24
Molecular Weight, Wet	**Ms**	**lb/lb-mol**	**Ms = Md (1 - Bwo) + (18 x Bwo)**	29.50	32.87	29.47	30.61
Stack Pressure	**Ps**	**in.Hg**	**Ps = Pbar + (Pstatic / 13.6)**	29.60	29.40	29.50	29.50
Stack Gas Velocity	**Us**	**ft/s**	**Us = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5**	16.49	17.87	17.99	17.45
		m/s	**Us (m/s) = 0.3048 x Us (ft/s)**	5.03	5.45	5.48	5.32
Actual Stack Gas Flow Rate	**Q**	**acfm**	**Q = 60 x Us x As**	1,748	1,894	1,908	1,850
Dry Stack Gas Flow Rate	**Qs**	**dscfm**	**Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)**	515	545	545	535
		dscms	**Qs (dscms) = 0.000472 x Qs (dscfm)**	0.24	0.26	0.26	0.25
Particulate Concentration	**Cs**	**mg/dscm**	**Cs = Mp / Vmc**	61.862	59.804	49.916	57.194
Particulate Emission Rate	**ERp**	**g/s**	**ERp = Cs/1000 x Qs**	0.015	0.015	0.013	0.014
		kg/hr	**ERp (kg/hr) = 3.6 x ERp (g/s)**	0.05	0.06	0.05	0.05
Particulate Concentration			**Correction factor to 11% O2**	0.661	0.879	0.710	
Corrected to 11% O2	**Cs**	**mg/dscm**	**Cs (11% O2) = Cs x (20.9-11) / (20.9-Co2)**	41	53	35	43
Corrected to 3% O2	**Cs**	**mg/dscm**	**Cs (3% O2) = Cs x (20.9-3) / (20.9-Co2)**	74	95	64	78
Corrected to 12% CO2	**Cs**	**mg/dscm**	**Cs (12% CO2) = Cs x (12/Cco2)**	40	52	35	42

Legend:
sq.ft - square feet
sq.m - square metres
Pi - 3.142
R - degrees Rankin
in.Hg - inches of mercury
acfm - actual cubic feet per minute
dscfm - dry standard cubic feet per minute
dscms - dry standard cubic metres per second
ppm - parts per million
mg/dscm - miligrams per dry standard cubic metre
g/s - grams per second
NOx - as NO2
cu.ft - cubic feet
cu.m - cubic metres
STP - standard temperature and pressure
(25 C and 101.s kPa)

SUMMARY OF METAL EMISSIONS- TMAC Incinerator Exhaust Stack 2017

	TEST1	TEST2	TEST3
vol dry gas meter dscm	1.58	1.69	1.66
volumetric flow dry stack gas dscm/s	0.24	0.26	0.26
O2 correction factor	0.66	0.88	0.71

	Test 1			**Test 2**			**Test 3**			**Average**		
	mg/dscm at STP	mg/dscm at 11% O2	emission rate (kg/hr)	mg/dscm at STP	mg/dscm at 11% O2	emission rate (kg/hr)	mg/dscm at STP	mg/dscm at 11% O2	emission rate (kg/hr)	mg/dscm at STP	mg/dscm at 11% O2	emission rate (kg/hr)
Total Mercury (Hg)	3.34E-04	2.21E-04	2.92E-07	3.14E-04	2.76E-04	2.91E-07	3.90E-04	2.77E-04	3.61E-07	3.46E-04	2.58E-04	3.15E-07

PRELIMINARY STACK TESTING RESULTS

TMAC

Incinerator

Stack: Hope Bay, NU

Operating Conditions: Normal

Stack Height above Grade: X.xx m

Stack Diameter: 0.46 m

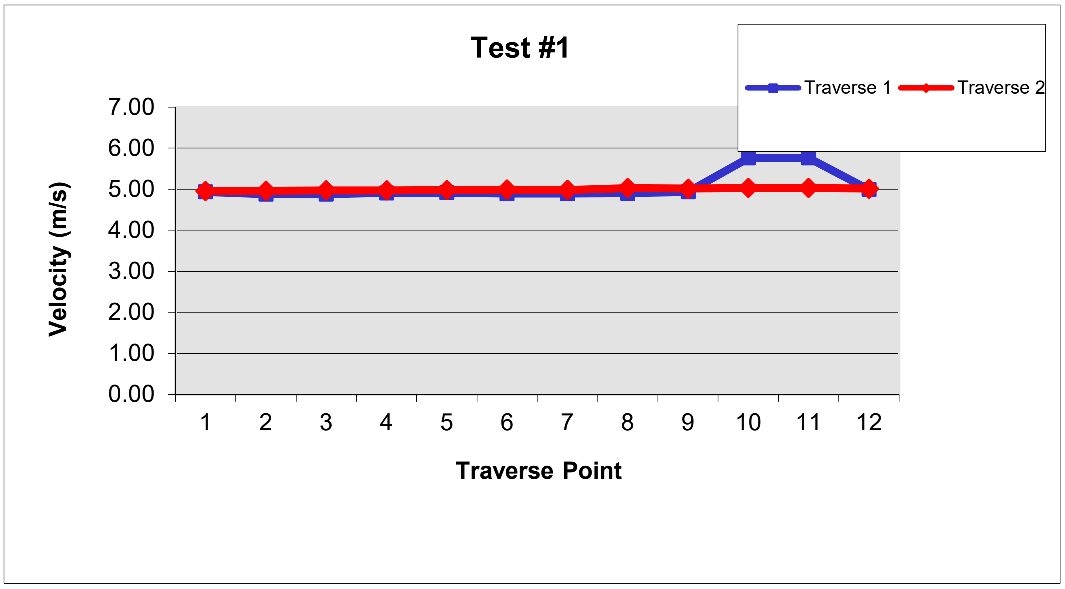
Parameter	Test 1	Test 2	Test 3	Average
Test ID	M-1	M-2	M-3	
Test Date	17-Sep-19	17-Sep-19	18-Sep-19	
Stack Gas Temperature (C)	600	646	633	626
Moisture Content (%)	12.84	9.8	11.9	11.5
Velocity (m/s)	5.03	5.45	5.48	5.32
Volumetric Flow (dscms)	0.24	0.26	0.26	0.25
Oxygen - O2 (%)	5.93	9.64	6.96	7.51
Carbon Dioxide - CO2 (%)	18.50	13.87	17.14	16.50
Particulate Matter - PM				
Particulate Concentration (mg/dscm)	62	60	50	57
Corrected to 11% O2 (mg/dscm)	40.9	52.6	35.4	43.0
Corrected to 11% O2 (ug/dscm)	0.04	0.05	0.04	0.04
Emission Rate (g/s)	0.02	0.02	0.01	0.01

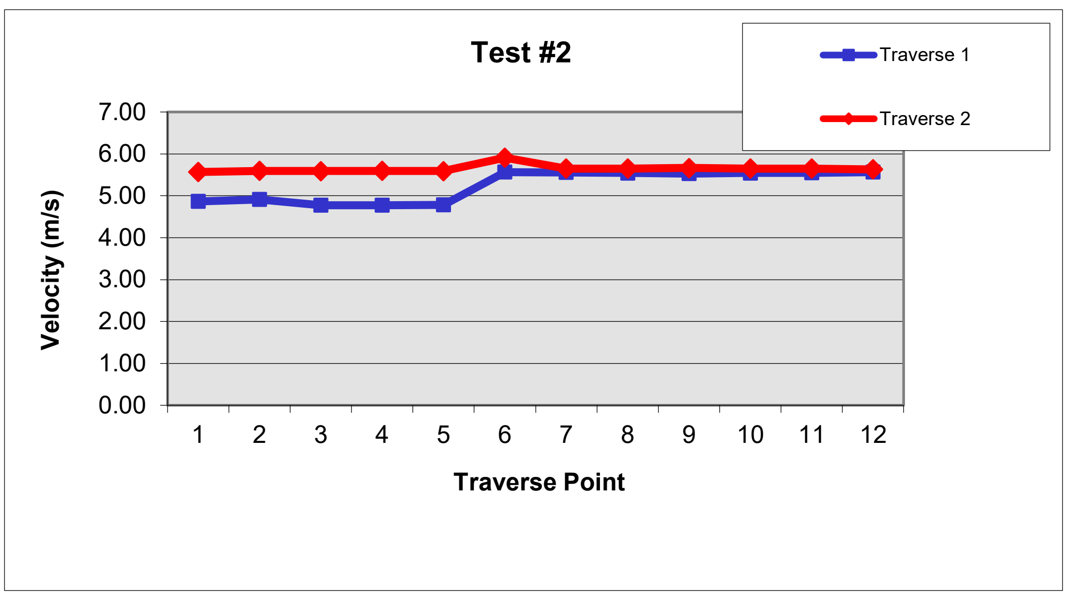
Legend: C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2

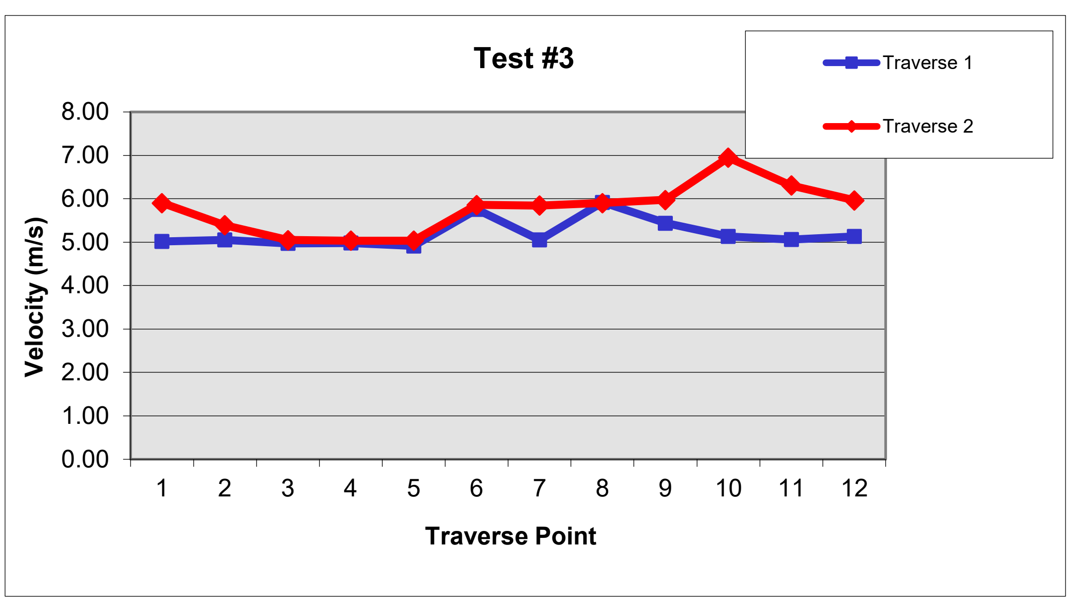
Parameter	Test 1	Test 2	Test 3	Average
Test Duration (min)	120	120	120	120
Stack Gas Static Pressure (kPa)	0.005	0.005	0.005	0.005
Volume of Gas Sampled (Rm^3)	1.58	1.69	1.66	1.64
Average Isokineticity (%)	102.0	103.0	100.9	102.0
Total Particulate Matter not including Impingers (mg)	97.90	101.10	82.70	93.90
Exhaust Gas Parameters				
Stack Gas Temperature (°C)	600	646	633	626
Stack Gas Moisture Content (%)	12.84	9.83	11.94	11.54
Stack Gas Velocity (m/s)	5.03	5.45	5.48	5.32
Stack Gas Flow Rate (Rm^3/s)	0.24	0.26	0.26	0.25
Oxygen - O_2 Concentration (%)	5.93	9.64	6.96	7.51
Carbon Dioxide - CO_2 Concentration (%)	18.5	13.9	17.1	16.5
Particulate Matter (PM)[+] Concentration (mg/Rm^3)	61.9	59.8	49.9	57.2
Emission Rate (kg/hr)	0.05	0.06	0.05	0.05
Mercury (Hg) Concentration (ug/Rm^3)	0.33	0.31	0.39	0.35
Concentration (ug/Rm^3) @ 11%	0.22	0.28	0.28	0.26
Emission Rate (kg/hr)	2.92E-07	2.91E-07	3.61E-07	3.15E-07

TMAC **Job No. 160930343**
Incinerator

Stack Gas Velocity Profiles
Hope Bay, NU
Particulate and Metals Testing







Raw Data for: New Incinerator DF Testing

Client:	TMAC
Job Number:	160930343
Plant:	incinerator
Location:	Hope Bay
Test:	SVOC-1
Date:	15-Sep-19
Personnel:	BC
Test Start:	10:55 AM
Test Finish:	2:05 PM

	Dioxins and Furans
Collected from Front Half Rinse (pg TEQ):	
Collected from Back half rinse (pg TEQ):	
Total Collected (pg TEQ):	6945.010

Impinger No.	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	306.4	304.7	1.7
Resin Trap	350.6	347.9	2.7
Condensate trap	817.5	490.1	327.4
1	770.2	752.8	17.4
2	647.1	646.5	0.6
3	918.5	911.6	6.9
		Moisture Volume (mL)	356.7

Parameters

Barometric Pressure, Pbar (in. Hg)	29.50	O2, (%)	3.7
Stack Static Pressure, Pstatic (in. H2O)	0.02	CO2, (%)	18.5
Ambient Temp, (°F)	41	N2, (%)	77.8
H2O Volume Collected, Vw (mL)	356.7		
Total # Sampling Points,	24		
Sampling Time per Point, (min)	8		
Readings Taken Every __ mins	4		

Stack Diameter, (in.)	18
Stack Area, (sq. ft.)	1.77
Probe Length, (in.)	24
Nozzle Diameter, (in.)	0.536
Pitot Coefficient, (Cp)	0.821
Gamma, meter constant	0.979

	T (deg C)	T	P (kPa)	P
11:00		7.5		100.12
12:00		7.6		100.1
1:00		7.3		100.07
2:00		7.5		100.06

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						230.45	
Traverse 1	1	4	1355	0.02	0.42	231.92	58
		8	1382	0.02	0.42	233.26	56
	2	12	1418	0.02	0.41	234.66	55
		16	1430	0.03	0.61	236.35	56
	3	20	1462	0.04	0.80	238.29	56
		24	1488	0.04	0.79	240.20	57
	4	28	1493	0.04	0.79	242.14	58
		32	1515	0.05	0.97	244.25	59
	5	36	1533	0.05	0.96	246.42	59
		40	1550	0.06	1.15	248.80	59
	6	44	1562	0.06	1.14	251.17	60
		48	1561	0.06	1.14	253.54	60
	7	52	1575	0.05	0.95	255.68	60
		56	1580	0.05	0.94	257.76	59
	8	60	1591	0.04	0.75	259.65	59
		64	1608	0.04	0.74	261.55	59
	9	68	1540	0.03	0.58	263.20	58
		72	1547	0.03	0.57	264.82	58
	10	76	1561	0.03	0.57	266.48	56
		80	1512	0.03	0.58	268.15	56
	11	84	1531	0.03	0.58	269.82	56
		88	1524	0.03	0.58	271.48	56
	12	92	1519	0.04	0.77	273.41	56
		96	1530	0.04	0.77	275.34	56
Traverse 2	1	100	1518	0.04	0.77	277.29	57
		104	1517	0.04	0.78	279.22	57
	2	108	1530	0.04	0.77	281.17	57
		112	1515	0.05	0.97	283.41	58
	3	116	1508	0.05	0.98	285.56	58
		120	1518	0.05	0.97	287.69	58
	4	124	1504	0.05	0.98	289.87	58
		128	1507	0.05	0.98	292.05	58
	5	132	1520	0.05	0.97	294.20	58
		136	1507	0.05	0.98	296.34	58
	6	140	1515	0.05	0.97	298.54	59
		144	1508	0.05	0.98	300.71	59
	7	148	1514	0.05	0.97	302.93	59
		152	1580	0.05	0.94	305.10	60
	8	156	1565	0.05	0.95	307.23	60
		160	1547	0.06	1.15	309.69	60
	9	164	1545	0.06	1.15	312.05	60
		168	1538	0.06	1.16	314.42	60
	10	172	1535	0.06	1.16	316.80	60
		176	1540	0.06	1.16	319.15	60
	11	180	1535	0.06	1.16	321.52	60
		184	1532	0.06	1.16	323.91	60
	12	188	1535	0.06	1.16	326.26	61

Calculations for: New Incinerator DF Testing 0

Client: TMAC
Job Number: 160930343

Plant: incinerator
Location: Hope Bay
Test: SVOC-1
Date: 15-Sep-19
Personnel: BC

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.50
Stack Gas Pressure, Ps (KPa)	99.90
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.11
Volume of Water Vapour Collected, Vwc (cu.ft)	17.122
Stack Gas Moisture Content (% as decimal)	0.151
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.13

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	**1**	4	1815	0.02	0.42	14.40	29.53	518	1.470	1.473	109.85
		8	1842	0.02	0.42	14.51	29.53	516	1.340	1.347	101.27
	2	12	1878	0.02	0.41	14.65	29.53	515	1.400	1.411	107.04
		16	1890	0.03	0.61	18.00	29.54	516	1.690	1.700	105.68
	3	20	1922	0.04	0.80	20.96	29.56	516	1.940	1.953	106.00
		24	1948	0.04	0.79	21.10	29.56	517	1.910	1.919	104.86
	4	28	1953	0.04	0.79	21.12	29.56	518	1.940	1.945	106.43
		32	1975	0.05	0.97	23.75	29.57	519	2.110	2.112	103.97
	5	36	1993	0.05	0.96	23.86	29.57	519	2.170	2.172	107.41
		40	2010	0.06	1.15	26.25	29.58	519	2.380	2.384	108.05
	6	44	2022	0.06	1.14	26.32	29.58	520	2.370	2.369	107.70
		48	2021	0.06	1.14	26.32	29.58	520	2.370	2.369	107.68
	7	52	2035	0.05	0.95	24.11	29.57	520	2.140	2.138	106.82
		56	2040	0.05	0.94	24.14	29.57	519	2.080	2.082	104.15
	8	60	2051	0.04	0.75	21.65	29.56	519	1.890	1.891	106.05
		64	2068	0.04	0.74	21.74	29.55	519	1.900	1.901	107.05
	9	68	2000	0.03	0.58	18.51	29.54	518	1.650	1.653	105.72
		72	2007	0.03	0.57	18.54	29.54	518	1.620	1.623	103.98
	10	76	2021	0.03	0.57	18.61	29.54	516	1.660	1.670	107.33
		80	1972	0.03	0.58	18.38	29.54	516	1.670	1.680	106.67
	11	84	1991	0.03	0.58	18.47	29.54	516	1.670	1.680	107.18
		88	1984	0.03	0.58	18.44	29.54	516	1.660	1.670	106.35
	12	92	1979	0.04	0.77	21.26	29.56	516	1.930	1.942	107.00
		96	1990	0.04	0.77	21.32	29.56	516	1.930	1.942	107.29
Traverse 2	**1**	100	1978	0.04	0.77	21.26	29.56	517	1.950	1.959	107.87
		104	1977	0.04	0.78	21.25	29.56	517	1.930	1.939	106.74
	2	108	1990	0.04	0.77	21.32	29.56	517	1.950	1.959	108.19
		112	1975	0.05	0.97	23.75	29.57	518	2.240	2.247	110.59
	3	116	1968	0.05	0.98	23.71	29.57	518	2.150	2.157	105.96
		120	1978	0.05	0.97	23.77	29.57	518	2.130	2.137	105.24
	4	124	1964	0.05	0.98	23.68	29.57	518	2.180	2.187	107.33
		128	1967	0.05	0.98	23.70	29.57	518	2.180	2.187	107.41
	5	132	1980	0.05	0.97	23.78	29.57	518	2.150	2.157	106.28
		136	1967	0.05	0.98	23.70	29.57	518	2.140	2.147	105.44
	6	140	1975	0.05	0.97	23.75	29.57	519	2.200	2.203	108.40
		144	1968	0.05	0.98	23.71	29.57	519	2.170	2.173	106.74
	7	148	1974	0.05	0.97	23.74	29.57	519	2.220	2.223	109.36
		152	2040	0.05	0.94	24.14	29.57	520	2.170	2.168	108.45
	8	156	2025	0.05	0.95	24.05	29.57	520	2.130	2.128	106.06
		160	2007	0.06	1.15	26.23	29.58	520	2.460	2.459	111.38
	9	164	2005	0.06	1.15	26.21	29.58	520	2.360	2.359	106.80
		168	1998	0.06	1.16	26.17	29.59	520	2.370	2.369	107.07
	10	172	1995	0.06	1.16	26.15	29.59	520	2.380	2.379	107.44
		176	2000	0.06	1.16	26.18	29.58	520	2.350	2.349	106.22
	11	180	1995	0.06	1.16	26.15	29.59	520	2.370	2.369	106.99
		184	1992	0.06	1.16	26.13	29.59	520	2.390	2.389	107.81
	12	188	1995	0.06	1.16	26.15	29.59	521	2.350	2.345	105.88
		Total	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Total**	**Total**	**Average**
		188	1,981	0.05	0.88	22.45	29.56	518	95.810	96.016	106.83

Raw Data for: New Incinerator DF Testing Test #2

Client:	TMAC
Job Number:	160930343
Plant:	incinerator
Location:	Hope Bay
Test:	SVOC-2
Date:	16-Sep-19
Personnel:	BC
Test Start:	10:00 AM
Test Finish:	12:00 PM

	Dioxins and Furans
Collected from Front Half Rinse (pg TEQ):	
Collected from Back half rinse (pg TEQ):	
Total Collected (pg TEQ):	1656.91

Impinger No.	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	229.6	227.1	2.5
Resin Trap	342.2	339.4	2.8
Condensate trap	763.4	540.9	222.5
1	742.5	778.3	-35.8
2	620.0	619.8	0.2
3	922.2	918.1	4.1
		Moisture Volume (mL)	196.3

Parameters

Barometric Pressure, Pbar (in. Hg)	29.60
Stack Static Pressure, Pstatic (in. H2O)	0.02
Ambient Temp, (°F)	35
H2O Volume Collected, Vw (mL)	196.3
Total # Sampling Points,	24
Sampling Time per Point, (min)	8
Readings Taken Every __ mins	4.0

O2, (%)	4.76
CO2, (%)	19.54
N2, (%)	75.70

Stack Diameter, (in.)	18
Stack Area, (sq. ft.)	1.77
Probe Length, (in.)	24
Nozzle Diameter, (in.)	0.536
Pitot Coefficient, (Cp)	0.821
Gamma, meter constant	0.979

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						326.60	
Traverse 1	1	4	1420	0.03	0.57	328.31	73
		8	1427	0.03	0.57	329.91	73
	2	12	1464	0.03	0.56	331.56	73
		16	1480	0.03	0.55	333.19	73
	3	20	1474	0.02	0.37	334.55	72
		24	1480	0.02	0.37	335.87	73
	4	28	1475	0.02	0.37	337.20	72
		32	1478	0.02	0.37	338.55	73
	5	36	1455	0.03	0.56	340.19	72
		40	1447	0.03	0.56	341.87	72
	6	44	1455	0.02	0.37	343.32	72
		48	1430	0.02	0.38	344.64	72
	7	52	1508	0.03	0.54	346.22	72
		56	1580	0.03	0.52	347.82	72
	8	60	1584	0.03	0.52	349.42	72
		64	1536	0.02	0.36	350.77	72
	9	68	1507	0.02	0.36	352.08	72
		72	1505	0.02	0.36	353.42	71
	10	76	1494	0.02	0.37	354.78	72
		80	1520	0.02	0.36	356.12	72
	11	84	1510	0.02	0.36	357.44	72
		88	1499	0.02	0.36	358.79	71
	12	92	1503	0.02	0.36	360.17	71
		96	1506	0.02	0.36	361.51	71
						361.51	
Traverse 2	1	100.0	1499	0.02	0.36	362.85	70
		104.0	1470	0.02	0.37	364.21	70
	2	108.0	1499	0.02	0.36	365.56	70
		112.0	1485	0.02	0.36	366.91	69
	3	116.0	1475	0.02	0.37	368.25	68
		120.0	1488	0.02	0.36	369.60	68
	4	124.0	1482	0.02	0.36	370.95	68
		128.0	1490	0.02	0.36	372.28	67
	5	132.0	1480	0.02	0.36	373.60	67
		136.0	1498	0.02	0.36	374.94	67
	6	140.0	1490	0.02	0.36	376.27	67
		144.0	1504	0.02	0.36	377.60	67
	7	148.0	1495	0.02	0.36	378.94	67
		152.0	1502	0.02	0.36	380.28	67
	8	156.0	1480	0.02	0.36	381.60	66
		160.0	1494	0.02	0.36	382.94	66
	9	164.0	1505	0.02	0.36	384.27	66
		168.0	1500	0.02	0.36	385.59	66
	10	172.0	1500	0.02	0.36	386.92	66
		176.0	1490	0.02	0.36	388.26	66
	11	180.0	1500	0.02	0.36	389.58	66
		184.0	1510	0.02	0.36	390.91	66
	12	188.0	1500	0.02	0.36	392.25	66

Calculations for: New Incinerator DF Testing Test #2

Client: TMAC
Job Number: 160930343

Plant: incinerator
Location: Hope Bay
Test: SVOC-2
Date: 16-Sep-19
Personnel: BC

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.60
Stack Gas Pressure, Ps (KPa)	100.24
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	31.32
Volume of Water Vapour Collected, Vwc (cu.ft)	9.422
Stack Gas Moisture Content (% as decimal)	0.127
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.62

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Meter Press., Pm (in. Hg)	Gas Meter Avg. Temp, Tm (R)	Gas Meter Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	**1**	4	1880	0.03	0.57	17.77	29.64	533	1.710	1.671	101.43
		8	1887	0.03	0.57	17.80	29.64	533	1.600	1.563	95.08
	2	12	1924	0.03	0.56	17.97	29.64	533	1.650	1.612	99.01
		16	1940	0.03	0.55	18.05	29.64	533	1.630	1.593	98.21
	3	20	1934	0.02	0.37	14.71	29.63	532	1.360	1.331	100.35
		24	1940	0.02	0.37	14.74	29.63	533	1.320	1.289	97.36
	4	28	1935	0.02	0.37	14.72	29.63	532	1.330	1.301	98.16
		32	1938	0.02	0.37	14.73	29.63	533	1.350	1.319	99.53
	5	36	1915	0.03	0.56	17.93	29.64	532	1.640	1.606	98.36
		40	1907	0.03	0.56	17.90	29.64	532	1.680	1.645	100.55
	6	44	1915	0.02	0.37	14.64	29.63	532	1.450	1.419	106.46
		48	1890	0.02	0.38	14.55	29.63	532	1.320	1.292	96.28
	7	52	1968	0.03	0.54	18.18	29.64	532	1.580	1.547	96.06
		56	2040	0.03	0.52	18.51	29.64	532	1.600	1.566	99.04
	8	60	2044	0.03	0.52	18.53	29.64	532	1.600	1.566	99.13
		64	1996	0.02	0.36	14.95	29.63	532	1.350	1.321	101.19
	9	68	1967	0.02	0.36	14.84	29.63	532	1.310	1.282	97.48
		72	1965	0.02	0.36	14.83	29.63	531	1.340	1.314	99.85
	10	76	1954	0.02	0.37	14.79	29.63	532	1.360	1.331	100.86
		80	1980	0.02	0.36	14.89	29.63	532	1.340	1.311	100.04
	11	84	1970	0.02	0.36	14.85	29.63	532	1.320	1.292	98.30
		88	1959	0.02	0.36	14.81	29.63	531	1.350	1.323	100.44
	12	92	1963	0.02	0.36	14.82	29.63	531	1.380	1.353	102.78
		96	1966	0.02	0.36	14.84	29.63	531	1.340	1.314	99.87
Traverse 2	**1**	100	1959	0.02	0.36	14.81	29.63	530	1.340	1.316	99.88
		104	1930	0.02	0.37	14.70	29.63	530	1.360	1.336	100.62
	2	108	1959	0.02	0.36	14.81	29.63	530	1.350	1.326	100.63
		112	1945	0.02	0.36	14.76	29.63	529	1.350	1.328	100.46
	3	116	1935	0.02	0.37	14.72	29.63	528	1.340	1.321	99.65
		120	1948	0.02	0.36	14.77	29.63	528	1.350	1.331	100.73
	4	124	1942	0.02	0.36	14.74	29.63	528	1.350	1.331	100.57
		128	1950	0.02	0.36	14.78	29.63	527	1.330	1.314	99.47
	5	132	1940	0.02	0.36	14.74	29.63	527	1.320	1.304	98.47
		136	1958	0.02	0.36	14.81	29.63	527	1.340	1.324	100.43
	6	140	1950	0.02	0.36	14.78	29.63	527	1.330	1.314	99.47
		144	1964	0.02	0.36	14.83	29.63	527	1.330	1.314	99.83
	7	148	1955	0.02	0.36	14.79	29.63	527	1.340	1.324	100.35
		152	1962	0.02	0.36	14.82	29.63	527	1.340	1.324	100.53
	8	156	1940	0.02	0.36	14.74	29.63	526	1.320	1.306	98.66
		160	1954	0.02	0.36	14.79	29.63	526	1.340	1.326	100.51
	9	164	1965	0.02	0.36	14.83	29.63	526	1.330	1.316	100.04
		168	1960	0.02	0.36	14.81	29.63	526	1.320	1.306	99.16
	10	172	1960	0.02	0.36	14.81	29.63	526	1.330	1.316	99.92
		176	1950	0.02	0.36	14.78	29.63	526	1.340	1.326	100.41
	11	180	1960	0.02	0.36	14.81	29.63	526	1.320	1.306	99.16
		184	1970	0.02	0.36	14.85	29.63	526	1.330	1.316	100.17
	12	188	1960	0.02	0.36	14.81	29.63	526	1.340	1.326	100.67
		Total	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Total**	**Total**	**Average**
		188	1,951	0.02	0.40	15.41	29.63	530	65.650	64.512	99.69

Raw Data for: New Incinerator DF Testing Test #3

Client:	TMAC
Job Number:	160930343
Plant:	incinerator
Location:	Hope Bay
Test:	SVOC-3
Date:	16-Sep-19
Personnel:	BC
Test Start:	2:18 PM
Test Finish:	4:18 PM

	Dioxins and Furans
Collected from Front Half Rinse (pg TEQ):	
Collected from Back half rinse (pg TEQ):	
Total Collected (pg TEQ):	4478.330

Impinger No.	Final Weight (g)	Tare Weight (g)	Weight of Moisture (g)
Condenser	264.1	262.1	2.0
Resin Trap	338.6	341.4	-2.8
Condensate trap	692.8	504.8	188.0
1	741.1	727.4	13.7
2	634.3	634.3	0.0
3	925.3	922.2	3.1
		Moisture Volume (mL)	204.0

Parameters

Barometric Pressure, Pbar (in. Hg)	29.80	**O2, (%)**	9.9
Stack Static Pressure, Pstatic (in. H2O)	0.02	**CO2, (%)**	14.2
Ambient Temp, (°F)	40	**N2, (%)**	75.9
H2O Volume Collected, Vw (mL)	204.0		
Total # Sampling Points,	24		
Sampling Time per Point, (min)	8		
Readings Taken Every __ mins	4		

Stack Diameter, (in.)	18
Stack Area, (sq. ft.)	1.77
Probe Length, (in.)	24
Nozzle Diameter, (in.)	0.536
Pitot Coefficient, (Cp)	0.821
Gamma, meter constant	0.979

	Traverse Point	Time (min)	Stack Gas Temp, Ts (°F)	S-type Pitot delta P (in. H2O)	Orifice delta H (in. H2O)	Gas Meter Volume (cu. ft.)	Gas Meter Temp (°F)
						392.78	
Traverse 1	**1**	4	1650	0.04	0.70	394.57	59
		8	1560	0.04	0.73	396.44	60
	2	12	1538	0.04	0.74	398.30	60
		16	1480	0.04	0.76	400.20	61
	3	20	1430	0.04	0.78	402.14	61
		24	1460	0.04	0.77	404.06	62
	4	28	1400	0.03	0.60	405.77	62
		32	1480	0.03	0.57	407.44	62
	5	36	1495	0.03	0.57	409.08	63
		40	1450	0.03	0.58	410.71	64
	6	44	1495	0.03	0.57	412.41	64
		48	1480	0.03	0.57	414.07	64
	7	52	1510	0.02	0.38	415.45	63
		56	1520	0.02	0.37	416.81	63
	8	60	1460	0.03	0.58	418.42	64
		64	1520	0.03	0.56	420.05	64
	9	68	1470	0.03	0.58	421.69	65
		72	1520	0.02	0.37	423.14	65
	10	76	1500	0.03	0.57	424.79	65
		80	1590	0.03	0.54	426.40	65
	11	84	1470	0.02	0.38	427.82	65
		88	1510	0.02	0.38	429.19	65
	12	92	1515	0.02	0.38	430.56	65
		96	1510	0.02	0.38	431.89	65
Traverse 2	**1**	100	1490	0.03	0.57	433.51	65
		104	1450	0.03	0.58	435.20	66
	2	108	1520	0.03	0.56	436.86	65
		112	1535	0.03	0.56	438.53	66
	3	116	1530	0.03	0.56	440.17	66
		120	1530	0.03	0.56	441.83	66
	4	124	1520	0.03	0.56	443.47	66
		128	1505	0.03	0.57	445.15	66
	5	132	1500	0.03	0.57	446.82	66
		136	1460	0.03	0.58	448.53	66
	6	140	1400	0.03	0.60	450.18	66
		144	1475	0.03	0.58	451.81	66
	7	148	1400	0.04	0.80	453.68	66
		152	1440	0.04	0.78	455.58	66
	8	156	1460	0.03	0.58	457.29	66
		160	1390	0.04	0.80	459.20	66
	9	164	1300	0.04	0.85	461.21	66
		168	1370	0.04	0.81	463.22	67
	10	172	1420	0.04	0.79	465.20	66
		176	1375	0.04	0.81	467.20	67
	11	180	1470	0.04	0.77	469.17	67
		184	1480	0.04	0.77	471.10	67
	12	188	1515	0.04	0.75	473.00	67

	T (deg C)	T (deg F)	P (kPa)	P (inHg)
2:00	8.7	47.7	101.01	29.8
3:00	9.3	48.7	101.04	29.83
4:00	9.2	48.6	101.05	29.84

Calculations for: New Incinerator DF Testing Test #3
Test #3

Client: TMAC
Job Number: 160930343

Plant: incinerator
Location: Hope Bay
Test: SVOC-3
Date: 43724
Personnel: BC

Calculated Parameters

Stack Gas Pressure, Ps (in.Hg)	29.80
Stack Gas Pressure, Ps (KPa)	100.92
Stack Gas Molecular Weight, Dry Basis, Md (lb/lb-mole)	30.67
Volume of Water Vapour Collected, Vwc (cu.ft)	9.792
Stack Gas Moisture Content (% as decimal)	0.109
Stack Gas Molecular Weight, Wet Basis, Ms (lb/lb-mole)	29.29

	Traverse Point	Time (min)	Stack Gas Temp, Ts (R)	S-type Pitot, delta P (in. H2O)	Orifice delta H (in. H2O)	Stack Gas Velocity, Us (ft/s)	Gas Meter Meter Press., Pm (in. Hg)	Avg. Temp, Tm (R)	Volume, Vm (cu. ft.)	Vol. @ Ref., Vmc (cu. ft.)	Isokinetics I (%)
Traverse 1	1	4	2110	0.04	0.70	21.78	29.85	519	1.790	1.809	97.76
		8	2020	0.04	0.73	21.31	29.85	520	1.870	1.886	99.75
	2	12	1998	0.04	0.74	21.20	29.85	520	1.860	1.876	98.67
		16	1940	0.04	0.76	20.89	29.86	521	1.900	1.913	99.14
	3	20	1890	0.04	0.78	20.62	29.86	521	1.940	1.953	99.92
		24	1920	0.04	0.77	20.78	29.86	522	1.920	1.930	99.47
	4	28	1860	0.03	0.60	17.71	29.84	522	1.710	1.718	100.64
		32	1940	0.03	0.57	18.09	29.84	522	1.670	1.678	100.38
	5	36	1955	0.03	0.57	18.16	29.84	523	1.640	1.644	98.76
		40	1910	0.03	0.58	17.95	29.84	524	1.630	1.631	96.84
	6	44	1955	0.03	0.57	18.16	29.84	524	1.700	1.701	102.18
		48	1940	0.03	0.57	18.09	29.84	524	1.660	1.661	99.39
	7	52	1970	0.02	0.38	14.88	29.83	523	1.380	1.383	102.12
		56	1980	0.02	0.37	14.92	29.83	523	1.360	1.363	100.90
	8	60	1920	0.03	0.58	18.00	29.84	524	1.610	1.611	95.90
		64	1980	0.03	0.56	18.27	29.84	524	1.630	1.631	98.60
	9	68	1930	0.03	0.58	18.04	29.84	525	1.640	1.638	97.76
		72	1980	0.02	0.37	14.92	29.83	525	1.450	1.448	107.17
	10	76	1960	0.03	0.57	18.18	29.84	525	1.650	1.648	99.11
		80	2050	0.03	0.54	18.60	29.84	525	1.610	1.608	98.90
	11	84	1930	0.02	0.38	14.73	29.83	525	1.420	1.418	103.62
		88	1970	0.02	0.38	14.88	29.83	525	1.370	1.368	101.00
	12	92	1975	0.02	0.38	14.90	29.83	525	1.370	1.368	101.13
		96	1970	0.02	0.38	14.88	29.83	525	1.330	1.328	98.05
Traverse 2	1	100	1950	0.03	0.57	18.14	29.84	525	1.620	1.618	97.06
		104	1910	0.03	0.58	17.95	29.84	526	1.690	1.685	100.03
	2	108	1980	0.03	0.56	18.27	29.84	525	1.660	1.658	100.22
		112	1995	0.03	0.56	18.34	29.84	526	1.670	1.665	101.01
	3	116	1990	0.03	0.56	18.32	29.84	526	1.640	1.635	99.07
		120	1990	0.03	0.56	18.32	29.84	526	1.660	1.655	100.28
	4	124	1980	0.03	0.56	18.27	29.84	526	1.640	1.635	98.82
		128	1965	0.03	0.57	18.21	29.84	526	1.680	1.675	100.85
	5	132	1960	0.03	0.57	18.18	29.84	526	1.670	1.665	100.12
		136	1920	0.03	0.58	18.00	29.84	526	1.710	1.705	101.47
	6	140	1860	0.03	0.60	17.71	29.84	526	1.650	1.645	96.38
		144	1935	0.03	0.58	18.07	29.84	526	1.630	1.625	97.10
	7	148	1860	0.04	0.80	20.45	29.86	526	1.870	1.865	94.64
		152	1900	0.04	0.78	20.67	29.86	526	1.900	1.895	97.18
	8	156	1920	0.03	0.58	18.00	29.84	526	1.710	1.705	101.47
		160	1850	0.04	0.80	20.40	29.86	526	1.910	1.905	96.40
	9	164	1760	0.04	0.85	19.90	29.86	526	2.010	2.005	98.96
		168	1830	0.04	0.81	20.29	29.86	527	2.010	2.001	100.71
	10	172	1880	0.04	0.79	20.56	29.86	526	1.980	1.975	100.74
		176	1835	0.04	0.81	20.31	29.86	527	2.000	1.991	100.35
	11	180	1930	0.04	0.77	20.83	29.86	527	1.970	1.961	101.36
		184	1940	0.04	0.77	20.89	29.86	527	1.930	1.921	99.56
	12	188	1975	0.04	0.75	21.08	29.86	527	1.900	1.891	98.89
		Total	Average	Average	Average	Average	Average	Average	Total	Total	Average
		188	1,940	0.03	0.61	18.53	29.85	525	80.220	80.190	99.57

DATA ENTRY

TMAC

incinerator

Fuel: municipal waste
Operating Conditions: Normal
Emission Control: dual chamber incinerator
Stack Height above Grade: XXX m
Stack Diameter: 0.46 m

Reference Temperature, Tref (F):	77
(R):	537
(K):	298
Reference Pressure, Pref (in.Hg):	29.92
(Bar):	1.0

Parameter	Symbol	Units	Test 1	Test 2	Test 3	Average
Test ID	**-**	**-**	SVOC-1	SVOC-2	SVOC-3	-
Date	**-**	**-**	15-Sep-19	16-Sep-19	16-Sep-19	n/a
Start Time	**-**	**-**	10:55 AM	10:00 AM	2:18 PM	n/a
End Time	**-**	**-**	2:05 PM	12:00 PM	4:18 PM	n/a
Total Sampling Time	**-**	**min**	188	188	188	188
Stack Diameter	**D**	**in.**	18	18	18	18
Average Stack Gas Temperature	**Ts**	**F**	1521	1491	1480	1497
Average Dry Gas Meter Temperature	**Tm**	**F**	58	70	65	64
Barometric Pressure	**Pbar**	**in.Hg**	29.50	29.60	29.80	29.63
Stack Static Pressure	**Pstatic**	**in.H2O**	0.02	0.02	0.02	0.02
Avgerage Pressure Drop (Head)	**dP**	**in.H2O**	0.05	0.02	0.03	0.03
Avgerage deltaH Orifice	**dH**	**in.H2O**	0.88	0.40	0.61	0.63
Average Meter Temperature	**Tm**	**F**	58	70	65	64
Gas Sample Volume	**Vm**	**cu.ft**	95.810	65.650	80.220	80.56
Average Isokinetics	**I**	**%**	106.8	99.7	99.6	102.0
Nozzle Diameter	**Dn**	**in.**	0.536	0.536	0.536	0.536
Pitot Coefficient	**Cp**	**-**	0.821	0.821	0.821	0.821
Gamma, meter constant	**y**	**-**	0.979	0.979	0.979	0.979
Reference Temperature	**Tref**	**R**	537	537	537	537
Reference Pressure	**Pref**	**in.Hg**	29.92	29.92	29.92	29.92
Stack Gas Oxygen Content	**Co2**	**%**	3.7	4.8	9.9	6.1
Stack Gas Carbon Dioxide Content	**Cco2**	**%**	18.5	19.5	14.2	17.4
Stack Gas Nitrogen Content	**Cn2**	**%**	77.8	75.7	75.9	76.5
Volume of Water Collected	**Vw**	**mL**	356.7	196.3	204.0	252.3
Dioxins and Furans Collected In Front Half	**-**	**pg TEQ**	0.000	0.000	0.000	0.0000
Doxins and Furans Collected In Back Half	**-**	**pg TEQ**	0.000	0.000	0.000	0.0000
Total Dioxins and Furans Collected	**Mhg**	**pg TEQ**	6945.010	1656.911	4478.330	4360.0837

Legend:

F - degrees Fahrenheit	in.H2O - inches of water
K - degrees Kelvin	cu.ft - cubic feet
Bar - bars	R - degrees Rankin
in.Hg - inches of mercury	NOx - as NO2
in. - inches	

#DIV/0!

CALCULATIONS

TMAC

incinerator

Fuel: municipal waste
Operating Conditions: Normal
Emission Control: dual chamber incinerator
Stack Height above Grade: XXX m
Stack Diameter: 0.46 m

Variable	Symbol	Units	Calculation	Test 1	Test 2	Test 3	Average
Stack Area	As	sq.ft	As = Pi x ((D/12)^2)/ 4	1.77	1.77	1.77	1.77
		sq.m	As (sq.m) = As (sq.ft) x 0.0929	0.16	0.16	0.16	0.16
Barometric Pressure	Pbar	kPa	Pbar (kPa) = Pbar (in.Hg) x 3.386	99.9	100.2	100.9	100.3
Stack Static Pressure	Pstatic	kPa	Pstatic (kPa) = Pstatic (in.H2O) x 0.249	0.00	0.00	0.00	0.00
Avg. Stack Temperature	Ts	R	Ts (R) = Ts (F) + 460	1981	1951	1940	1957
Avg. Stack Temperature	Ts	R	Ts (C) = (Ts (R) - 492) x 5/9	827	811	804	814
Avg. Meter Temperature	Tm	R	Tm (R) = Tm (F) + 460	518	530	525	524
Nozzle Diameter	Dn	mm	Dn (mm) = Dn (in.) x 25.4	14	14	14	14
Gas Meter Pressure	Pm	in.Hg	Pm = Pbar + (dH / 13.6)	29.56	29.63	29.85	29.68
Sample Volume at STP	Vmc	cu.ft	Vmc = Tref / Pref x (Vm x Pm x y) / Tm	96.039	64.524	80.188	80.250
		cu.m	Vmc (cu.m) = 0.02832 x Vmc (cu.ft)	2.720	1.827	2.271	2.273
Volume of Water Vapour	Vwc	cu.ft	Vwc = 0.0480 x Vw	17.122	9.422	9.792	12.112
Water Fraction	Bwo	-	Bwo = Vwc / (Vwc + Vmc)	0.151	0.127	0.109	0.129
Molecular Weight, Dry	Md	lb/lb-mol	Md = 0.44 (Cco2) + 0.32 (Co2) + 0.28 (Cn2)	31.11	31.32	30.67	31.03
Molecular Weight, Wet	Ms	lb/lb-mol	Ms = Md (1 - Bwo) + (18 x Bwo)	29.13	29.62	29.29	29.35
Stack Pressure	Ps	in.Hg	Ps = Pbar + (Pstatic / 13.6)	29.50	29.60	29.80	29.63
Stack Gas Velocity	Us	ft/s	Us = 85.33 x Cp x ((dP x Ts)/(Ps x Ms))^0.5	22.45	15.41	18.53	18.80
		m/s	Us (m/s) = 0.3048 x Us (ft/s)	6.84	4.70	5.65	5.73
Actual Stack Gas Flow Rate	Q	acfm	Q = 60 x Us x As	2,380	1,634	1,965	1,993
Dry Stack Gas Flow Rate	Qs	dscfm	Qs = Q x (1-Bwo) x (Tref/Ts) x (Ps/Pref)	540	388	483	470
		dscms	Qs (dscms) = 0.000472 x Qs (dscfm)	0.25	0.18	0.23	0.22
Dioxin and Furan Concentration Uncorrected @ STP	Chg	pg/dscm	Chg = Mhg / Vmc	2553.47	906.74	1972.04	1810.75
Dioxin and Furan Emission Rate	Erhg	pg/s	ERhg = Chg/1x10^9 x Qs	650.64	166.20	449.50	422.11
		kg/hr	ERhg(kg/hr) = 3.6x10^{-9} x ERh (g/s)	0.00	0.00	0.00	0.00
Dioxin and Furan Concentration			Correction factor to 11% O2	0.58	0.61	0.90	
Corrected to 11% O2	Chg	pg/dscm	Chg (11% O2) = Chg (mg/dscm) x (20.9-11) / (20.9-Co2)	1472.17	556.08	1769.47	1265.91
Corrected to 3% O2	Chg	pg/dscm	Chg (3% O2) = Chg (mg/dscm) x (20.9-3) / (20.9-Co2)	2661.81	1005.44	3199.35	2288.87
Corrected to 12% CO2	Chg	pg/dscm	Chg (12% CO2) = Chg (mg/dscm) x (12/Cco2)	1656.30	556.77	1664.56	1292.54

Legend:

sq.ft - square feet
sq.m - square metres
Pi - 3.142
R - degrees Rankin
in.Hg - inches of mercury
g/s - grams per second
acfm - actual cubic feet per minute
dscfm - dry standard cubic feet per minute
dscms - dry standard cubic metres per second
ppm - parts per million
mg/dscm - miligrams per dry standard cubic metre
ug - mircograms
cu.ft - cubic feet
cu.m - cubic metres
STP - standard temperature and pressure
(25 C and 101. kPa)
NOx - as NO2
pg - picograms

OFFICIAL STACK TESTING RESULTS

TMAC

incinerator

Fuel: municipal waste

Operating Conditions: Normal

Emission Control: dual chamber incinerator

Stack Height above Grade: XXX m

Stack Diameter: 0.46 m

Parameter	Test 1	Test 2	Test 3	Average	
Test ID	SVOC-1	SVOC-2	SVOC-3		
Test Date	15-Sep-19	16-Sep-19	16-Sep-19		
Stack Gas Temperature (C)	827	811	804	814	
Moisture Content (%)	15.1	12.7	10.9	12.9	
Velocity (m/s)	6.84	4.70	5.65	5.73	
Volumetric Flow (dscms)	0.25	0.18	0.23	0.22	
Oxygen - O2 (%)	3.73	4.76	9.87	6.12	
Carbon Dioxide - CO2 (%)	18.5	19.5	14.2	17.4	
Dioxins and Furans (TCDD Equivalent)					
Dioxin and Furan Concentration (pg TEQ/dscm)	2,553	907	1,972	1,811	
Corrected to 11% O2 (pg TEQ/dscm)	1,472	556	1,769	1,266	
Corrected to 11% O2 (ng TEQ/dscm)	1.47	0.56	1.77	1.27	0.08
Emission Rate (pg TEQ/s)	651	166	449	422	
Emission Rate (ng Teq/s)	0.65	0.17	0.45	0.42	

Legend:
C - degrees Celsius
m/s - metres per second
dscms - dry standard cubic metres per second
ppm - parts per million
STP - standard temperature and pressure (25 C and 101.3 kPa)
mg/dscm - miligrams per dry standard cubic metre
NOx - as NO2

TMAC | Job No. 160930343
incinerator

Stack Gas Velocity Profiles
Hope Bay
SVOCs / Dioxins & Furans Testing