Appendix E

Doris Mine Annual Water and Load Balance Assessment – 2019 Calendar Year

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Memo

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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

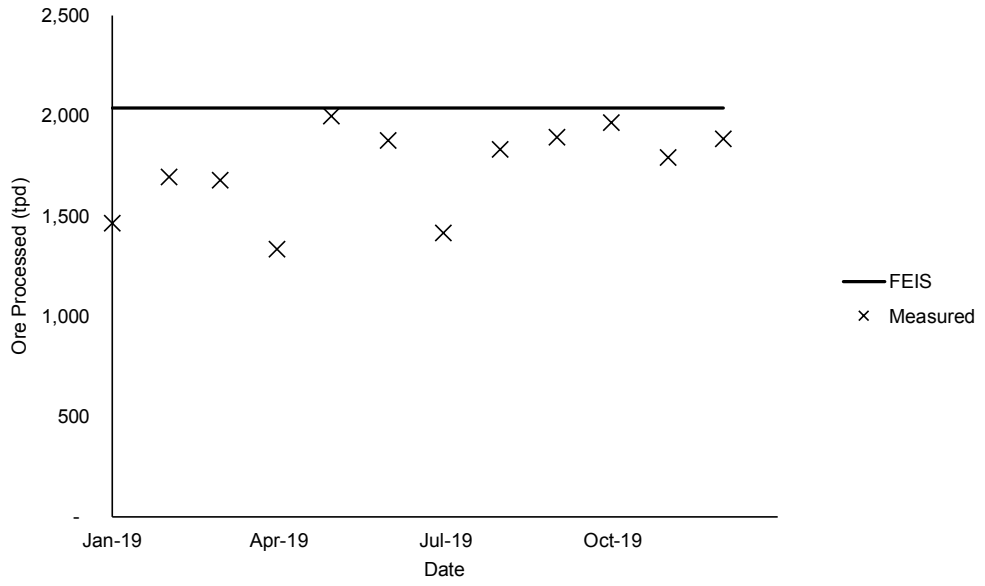

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Figure 1: FEIS Forecasted and Measured Processing Rates

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

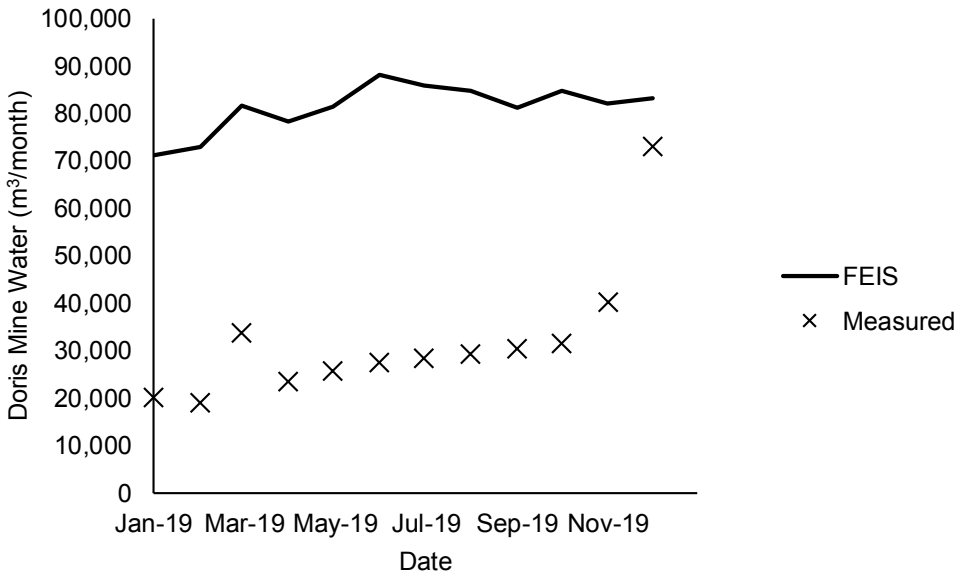

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Figure 2: FEIS Forecasted and Measured Mine Water Flows

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

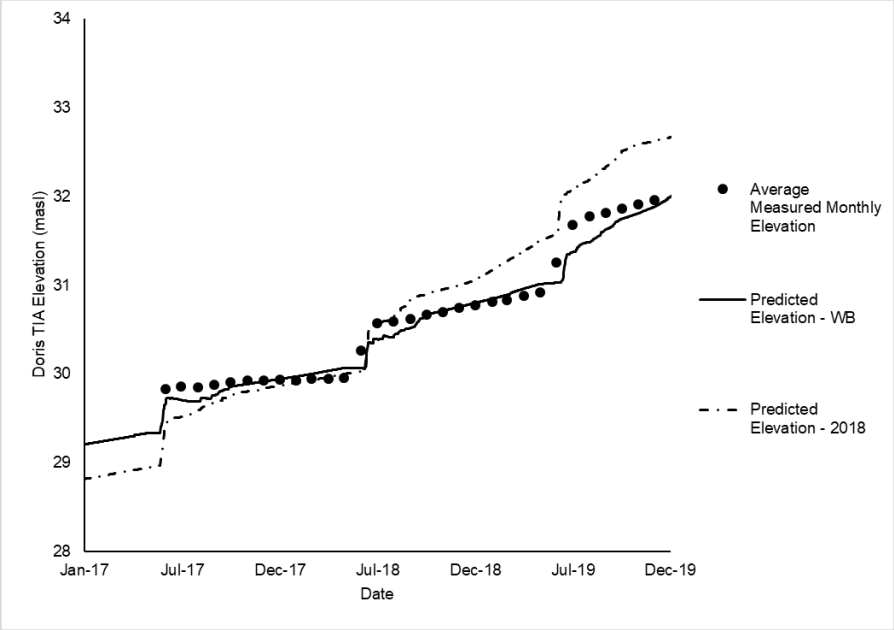

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Figure 3: Modeled and Predicted Elevations in the Doris TIA

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

Evaluated Model Input	Summary of Changes Made to the Model Input	Conclusions of Calibration
Hydrology Data	Updated to reflect 2019 measured data	Predicted elevation trends comparable to measure elevations.
Doris Process Plant process rate	Updated to reflect 2019 measured data	
Doris Mine water flows	Updated to reflect 2019 measured data	
Sedimentation control pond flows	Updated to reflect 2017 to 2019 measured data	
Total cyanide degradation update	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.	Modelled degradation for nitrogen-based parameters trending well with measured data.
Cyanate source term increased		
Ammonia degradation update		
Metals evaluation	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	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.

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

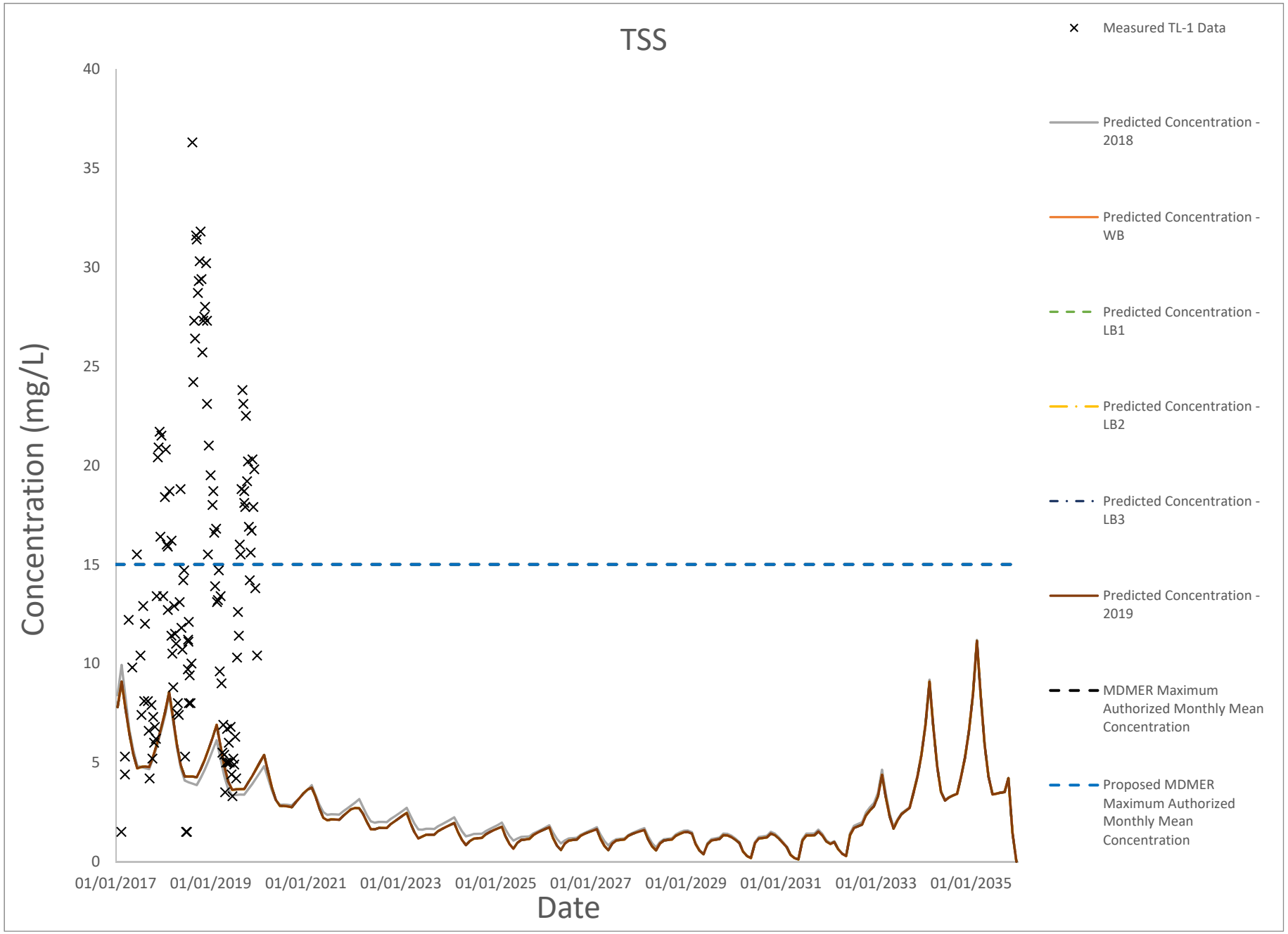
Project: **Hope Bay**
Number: **1CT022.066**
Task: **Summary of the FEIS Model Inputs**
Source: *HopeBay_FEISWLBalance_TypeA_Rev28_AJB.gsm*

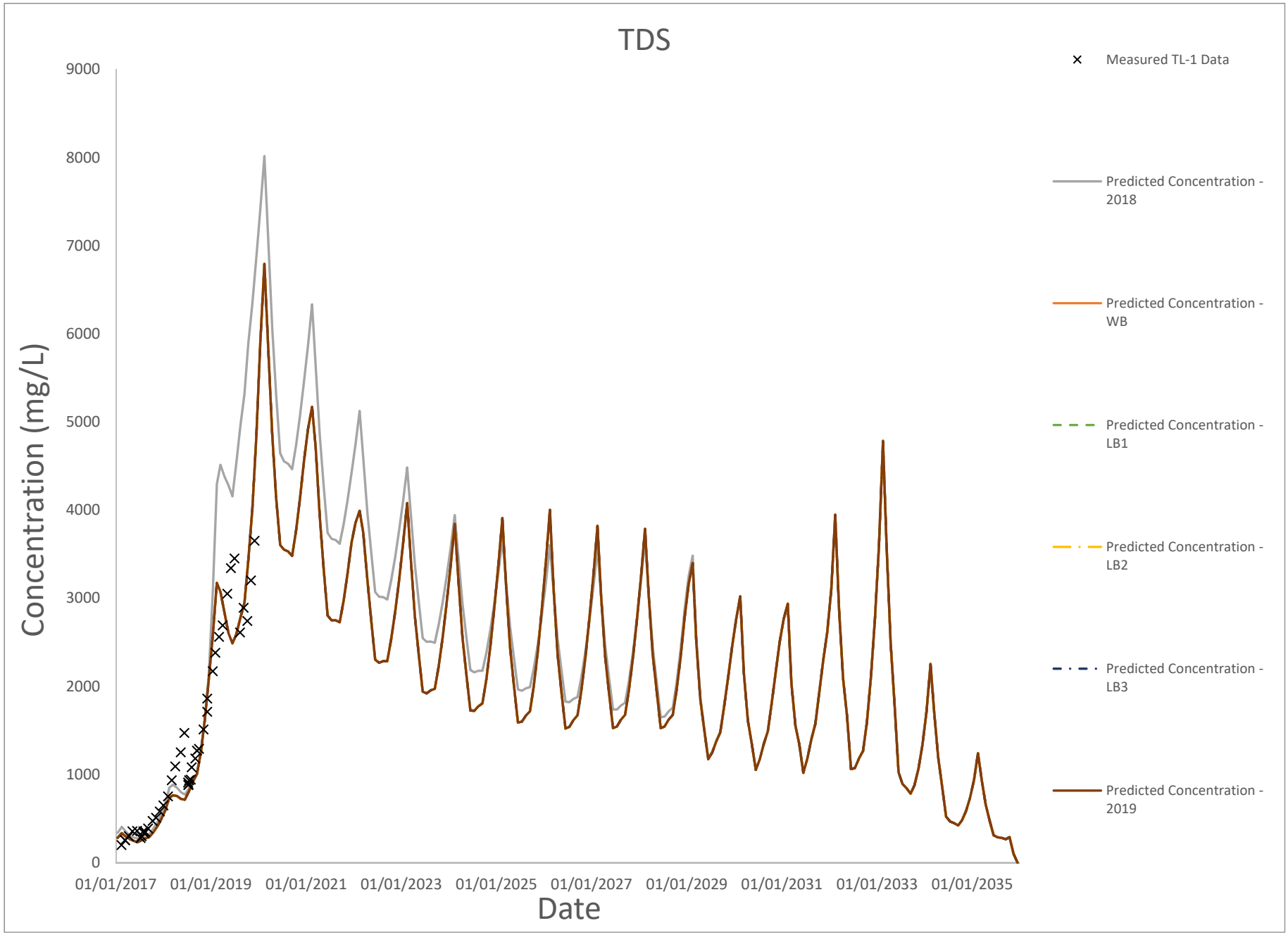
Table A1.2: Mine Water Flows By Source

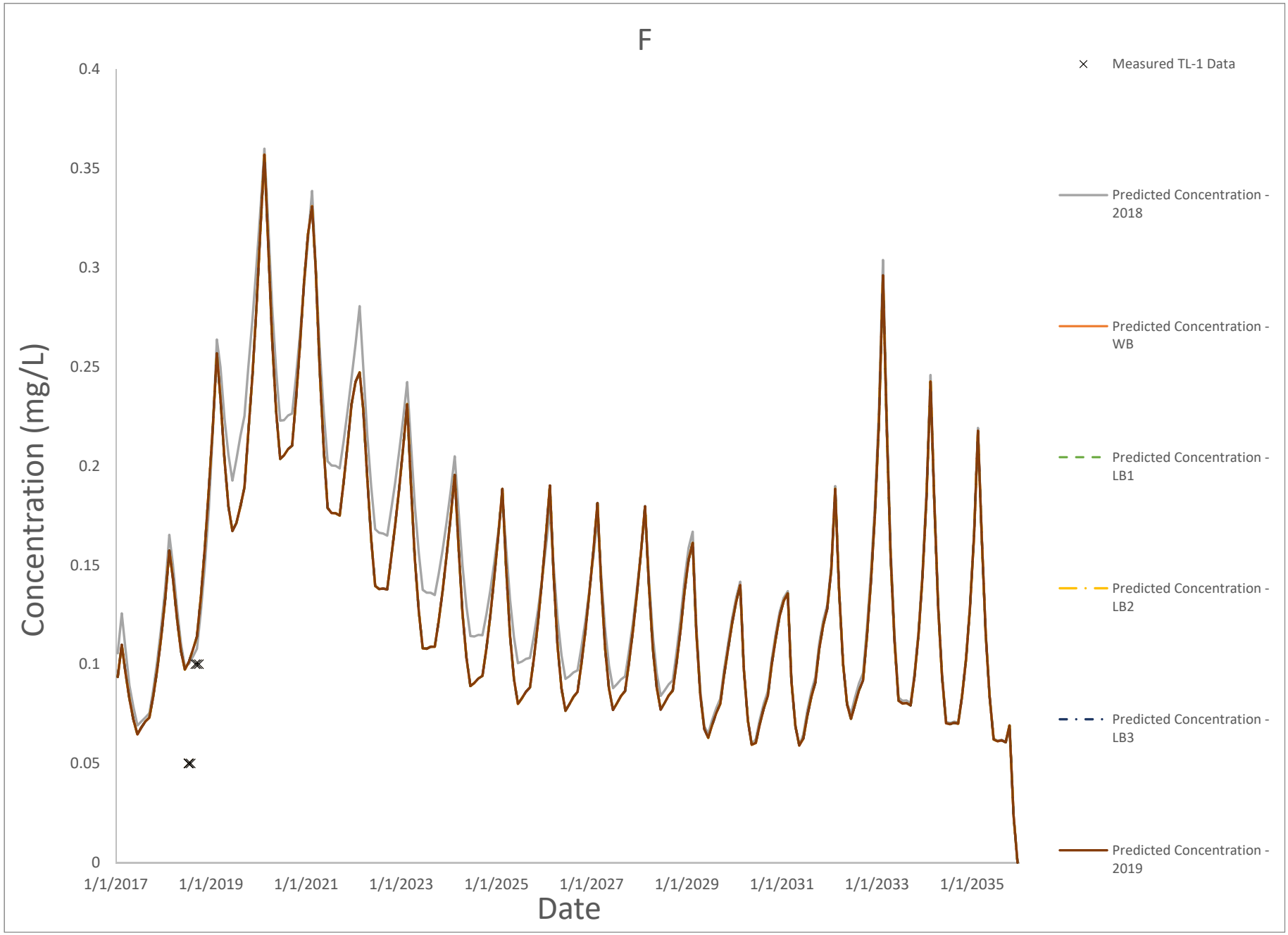
Model Date	Mine Water Flows (m^3/day)								
	Doris Mine		Madrid North Mine				Madrid South Mine		
	Flows from Bedrock	Flows from Doris Lake	Flows from Patch Lake	Flows from Imniagut Lake	Flows from Windy Lake	Flows from Bedrock	Flows from Wolverine Lake	Flows from Patch Lake	Flows from Bedrock
11/1/2030	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

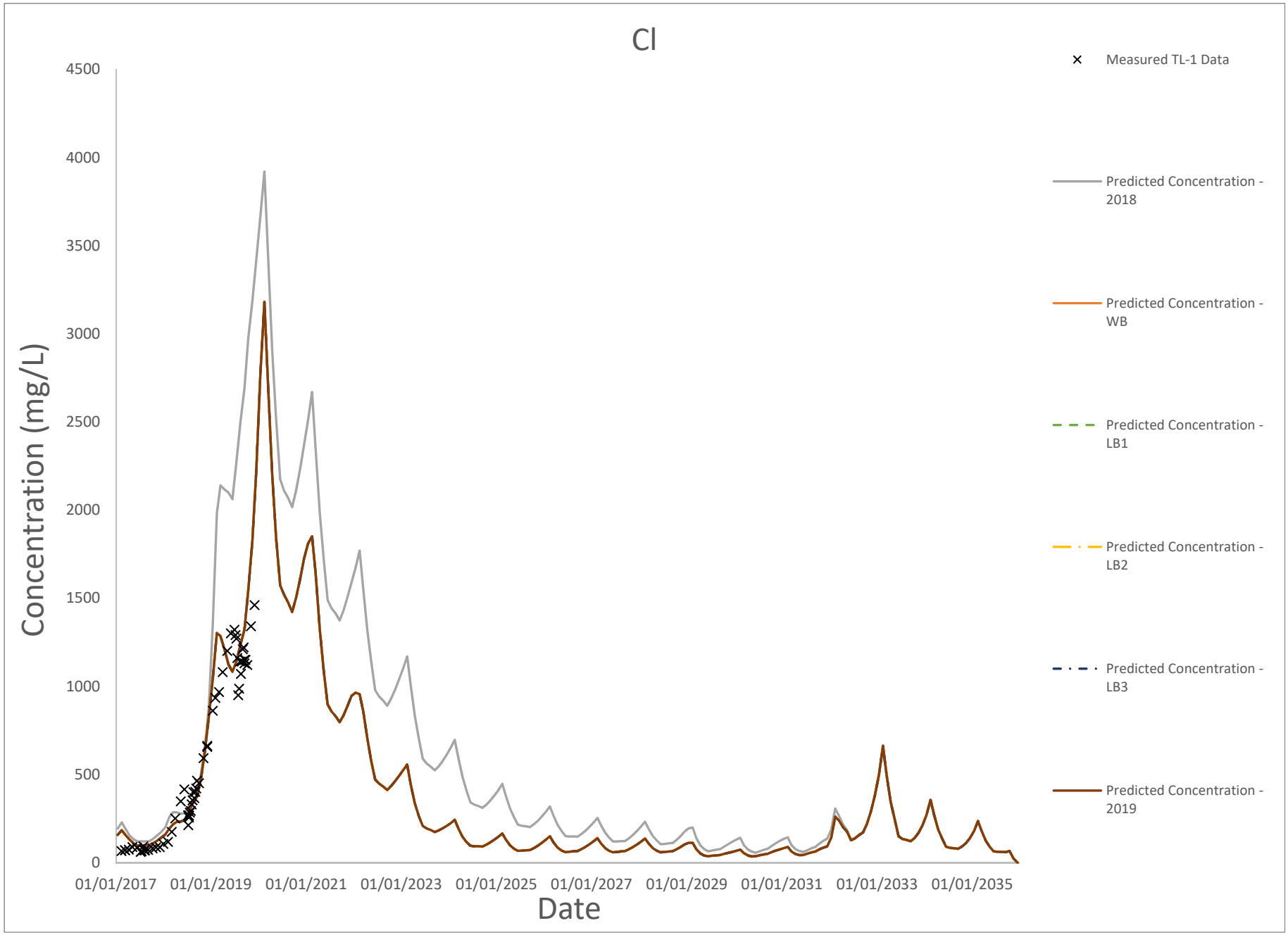
Note; Model interprets the values as constant over the next time period

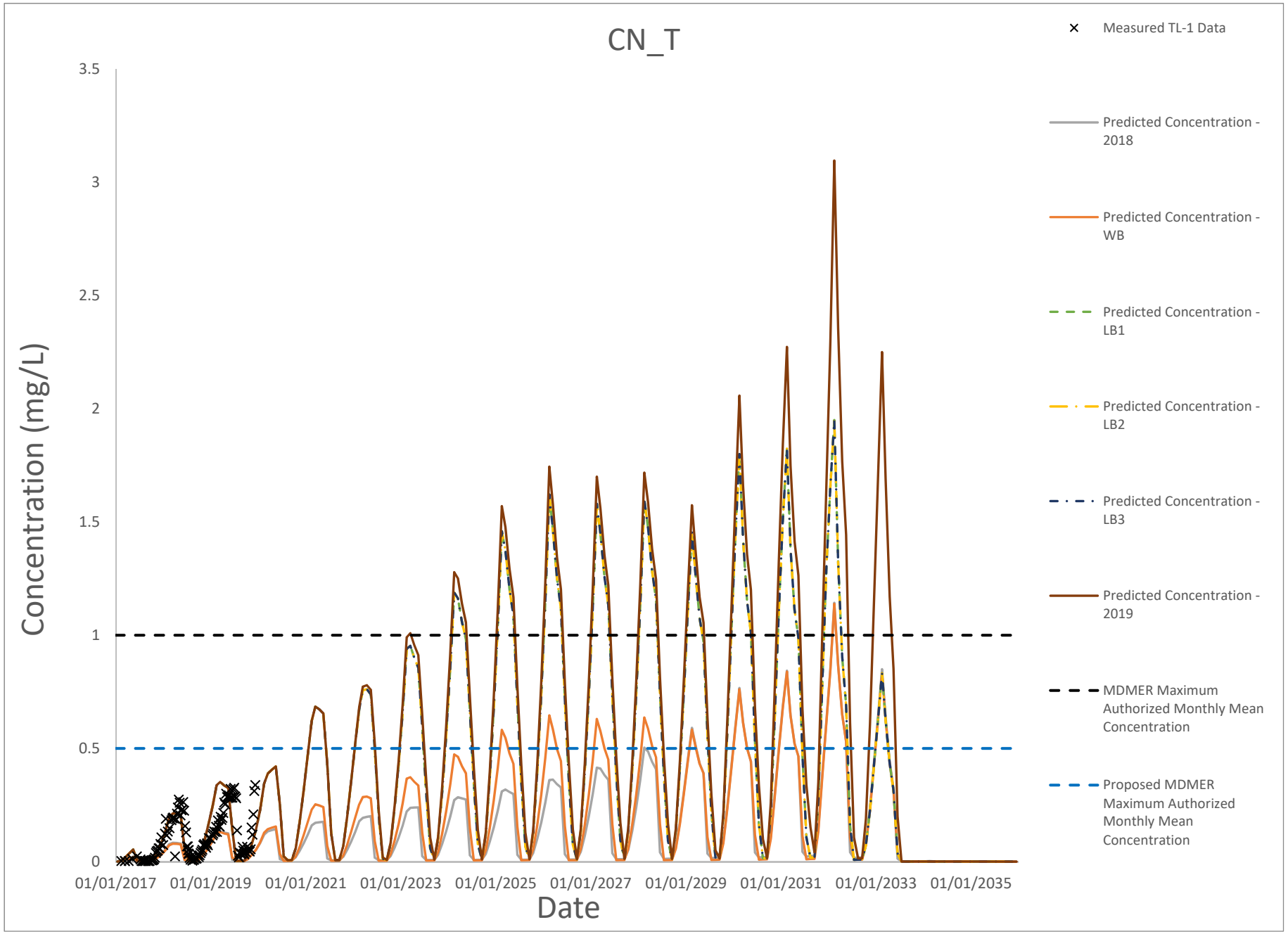
Attachment 2: Annual WLB Assessment – 2019 - PLOTS

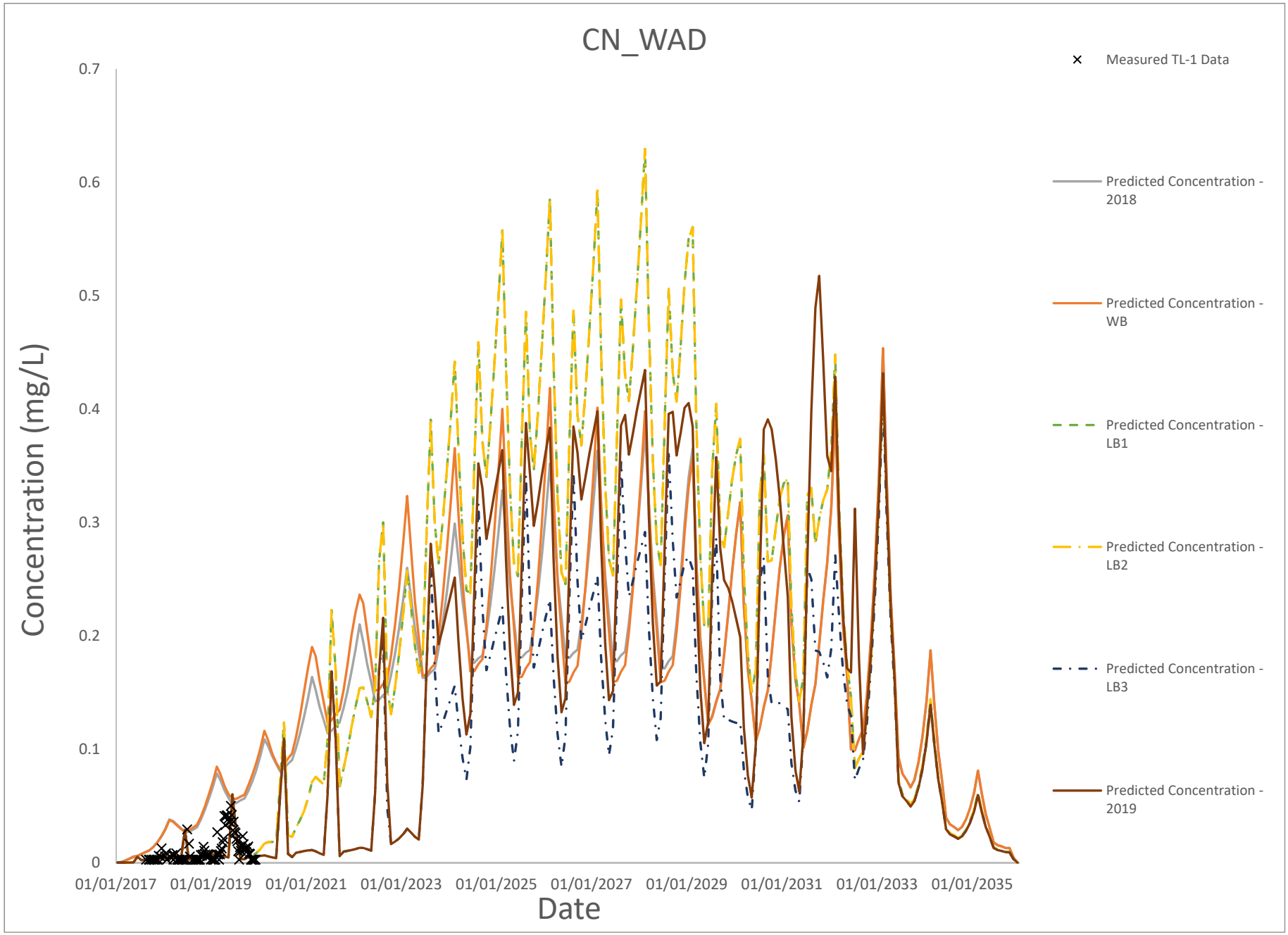

TSS
Concentration (mg/L)
Date
0
5
10
15
20
25
30
35
40
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

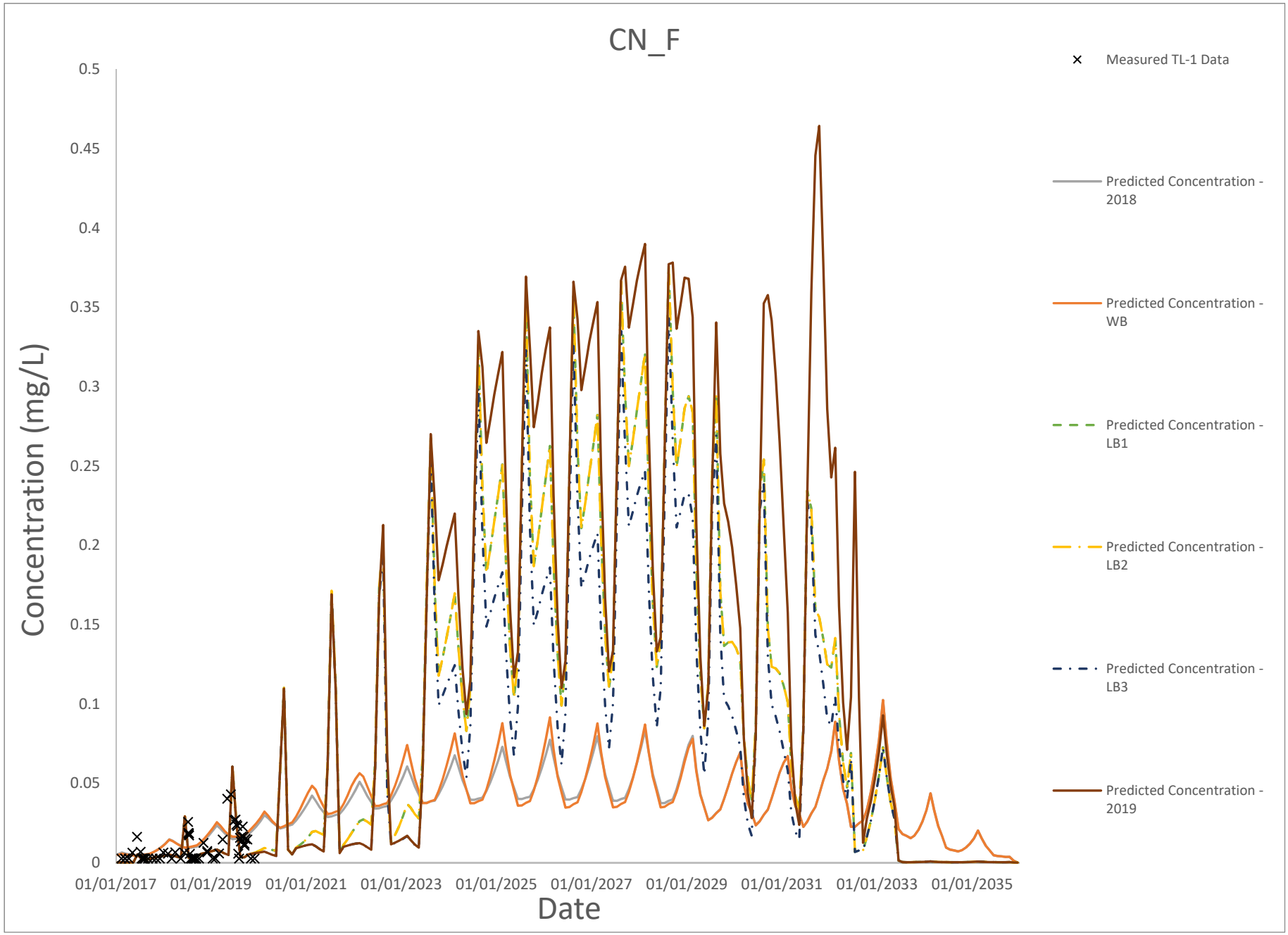

TDS
Concentration (mg/L)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

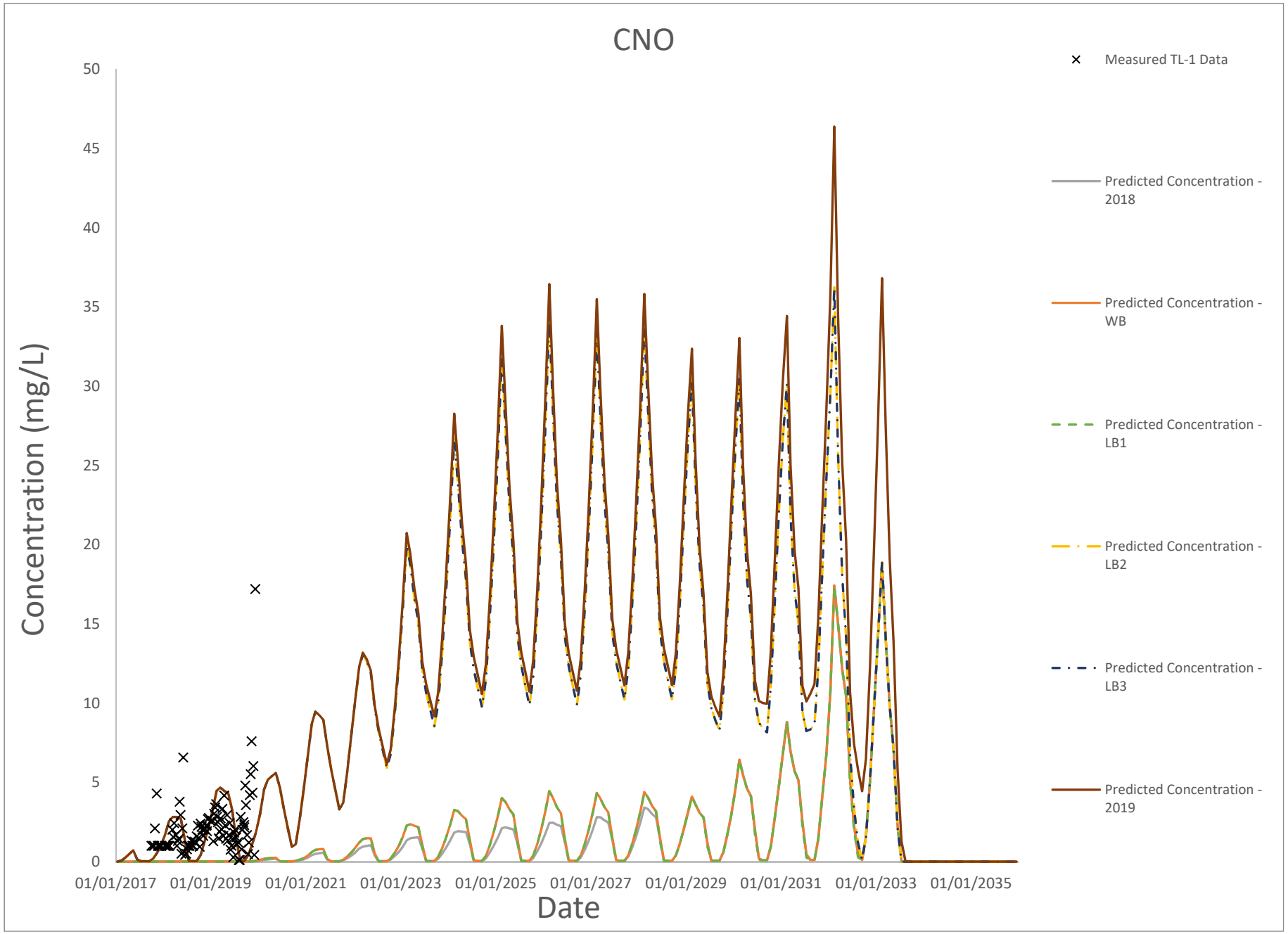

F
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

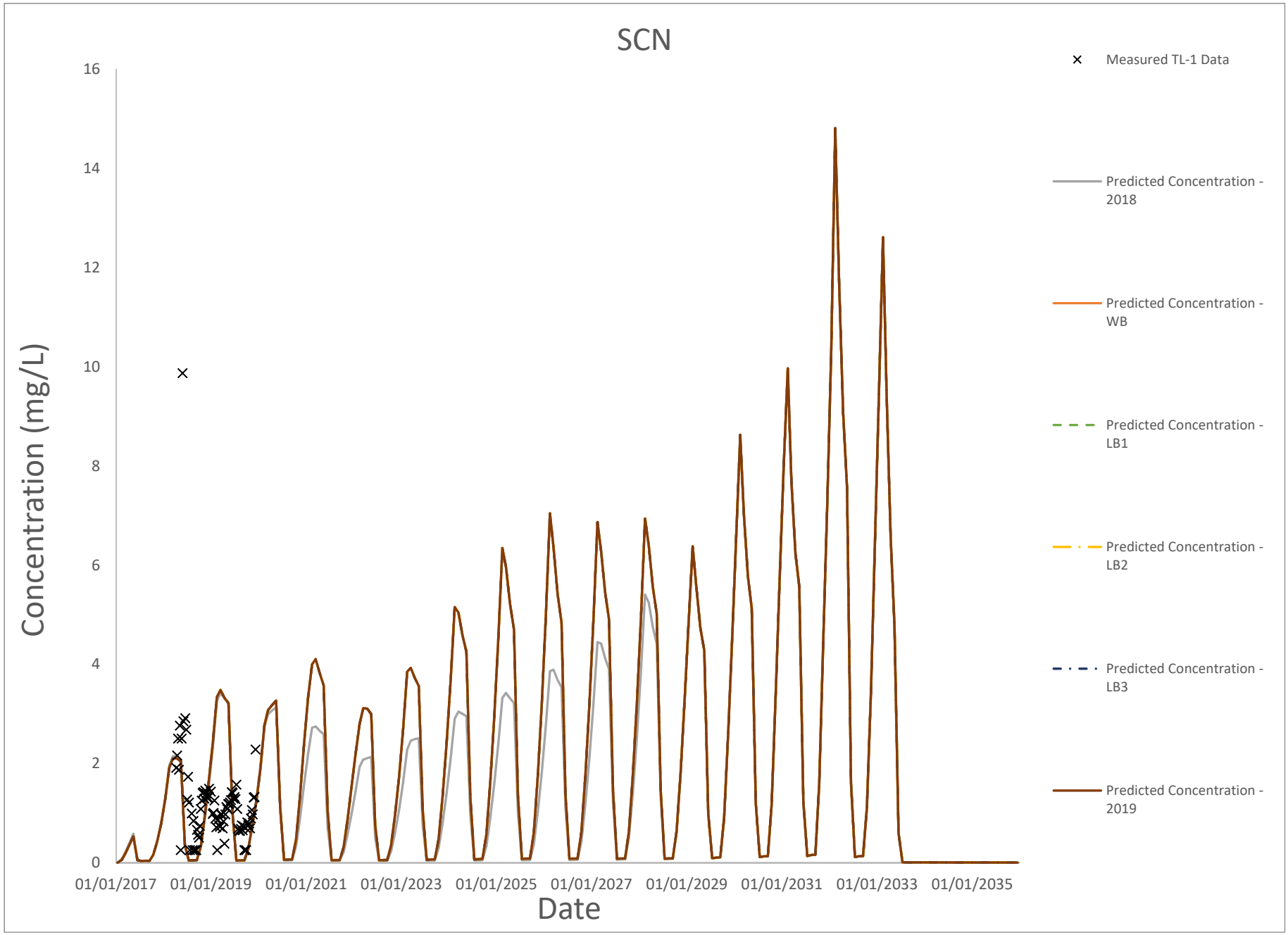

Cl
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

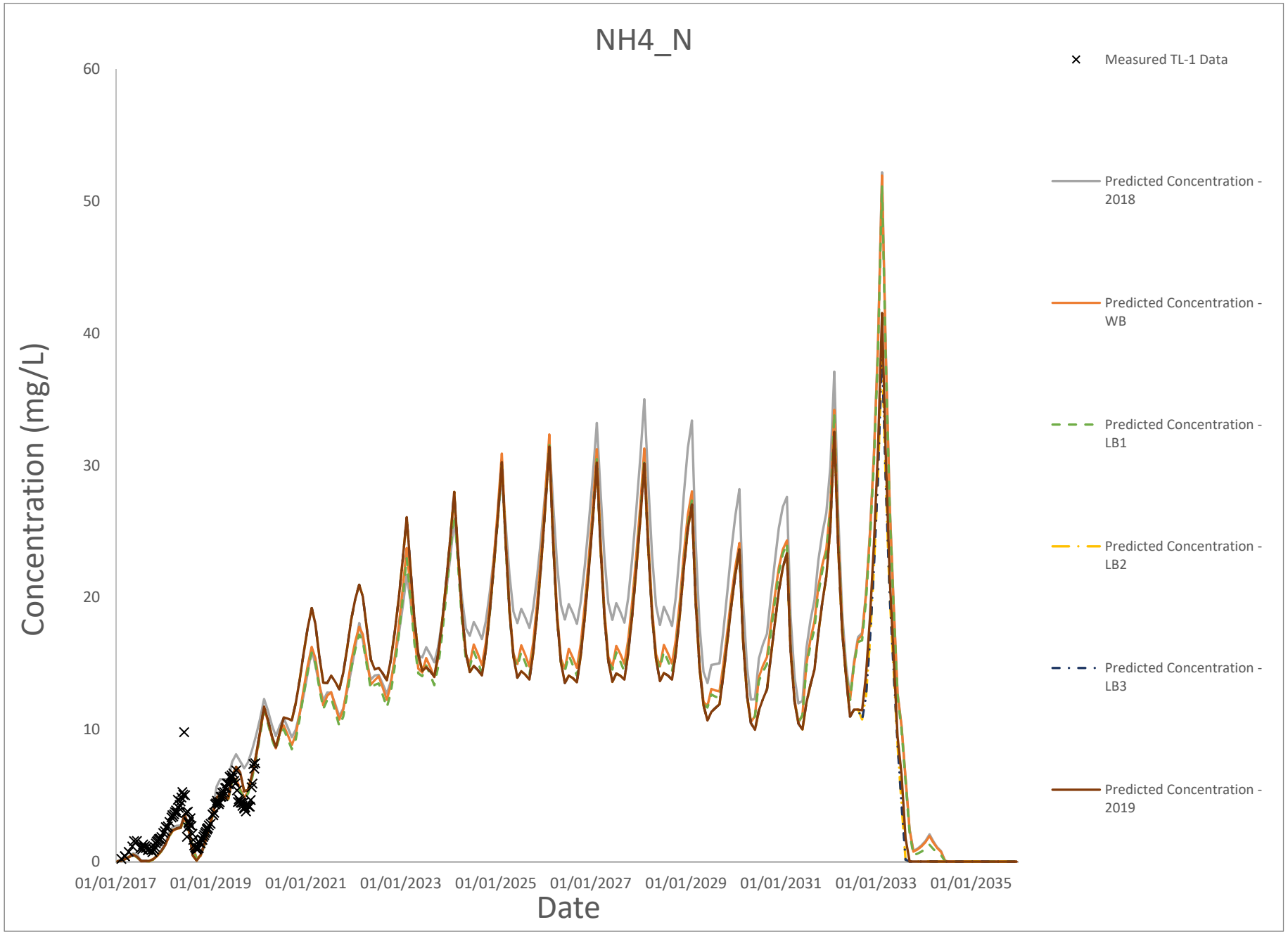

CN_T
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

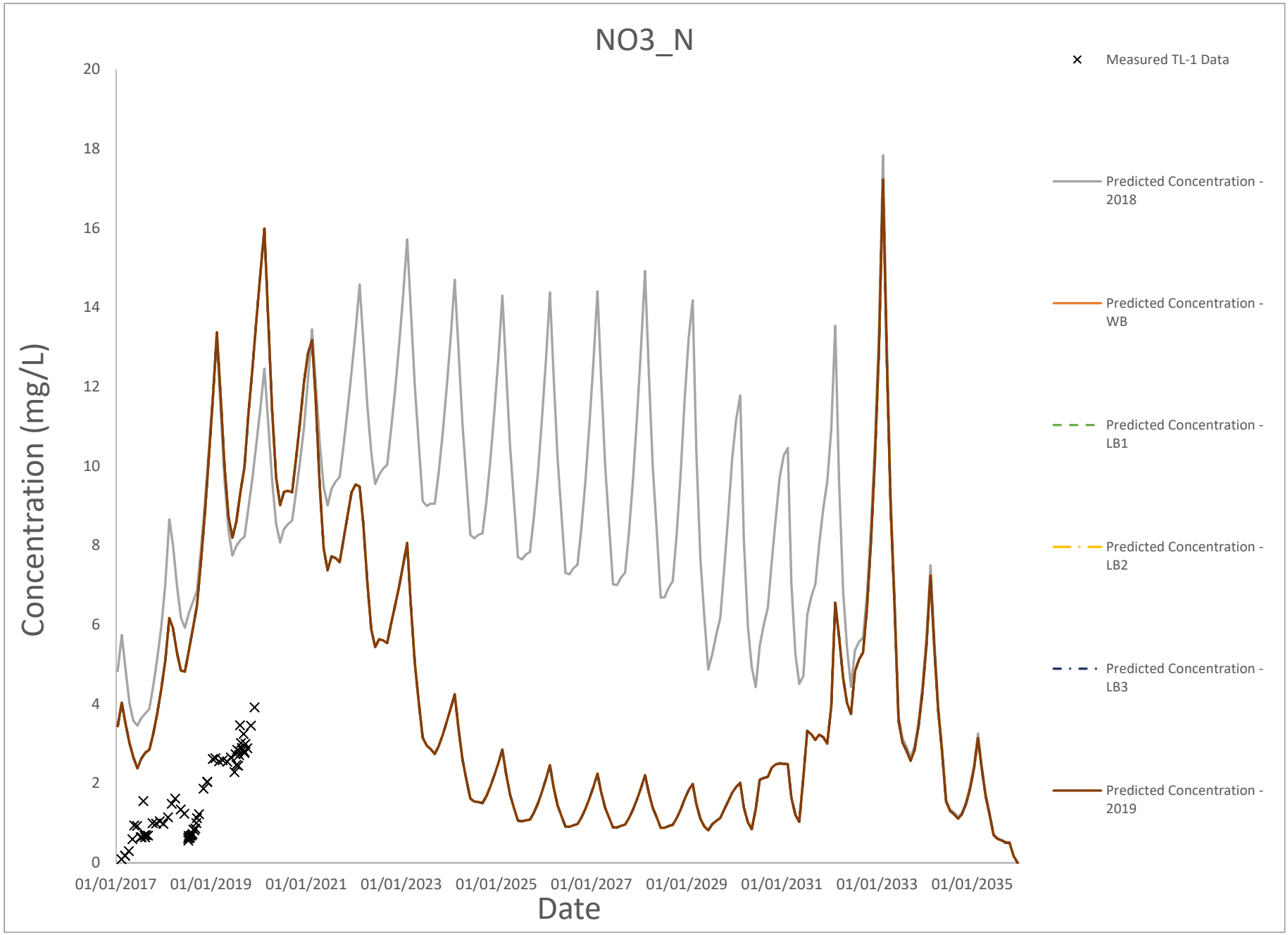

CN_WAD
Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

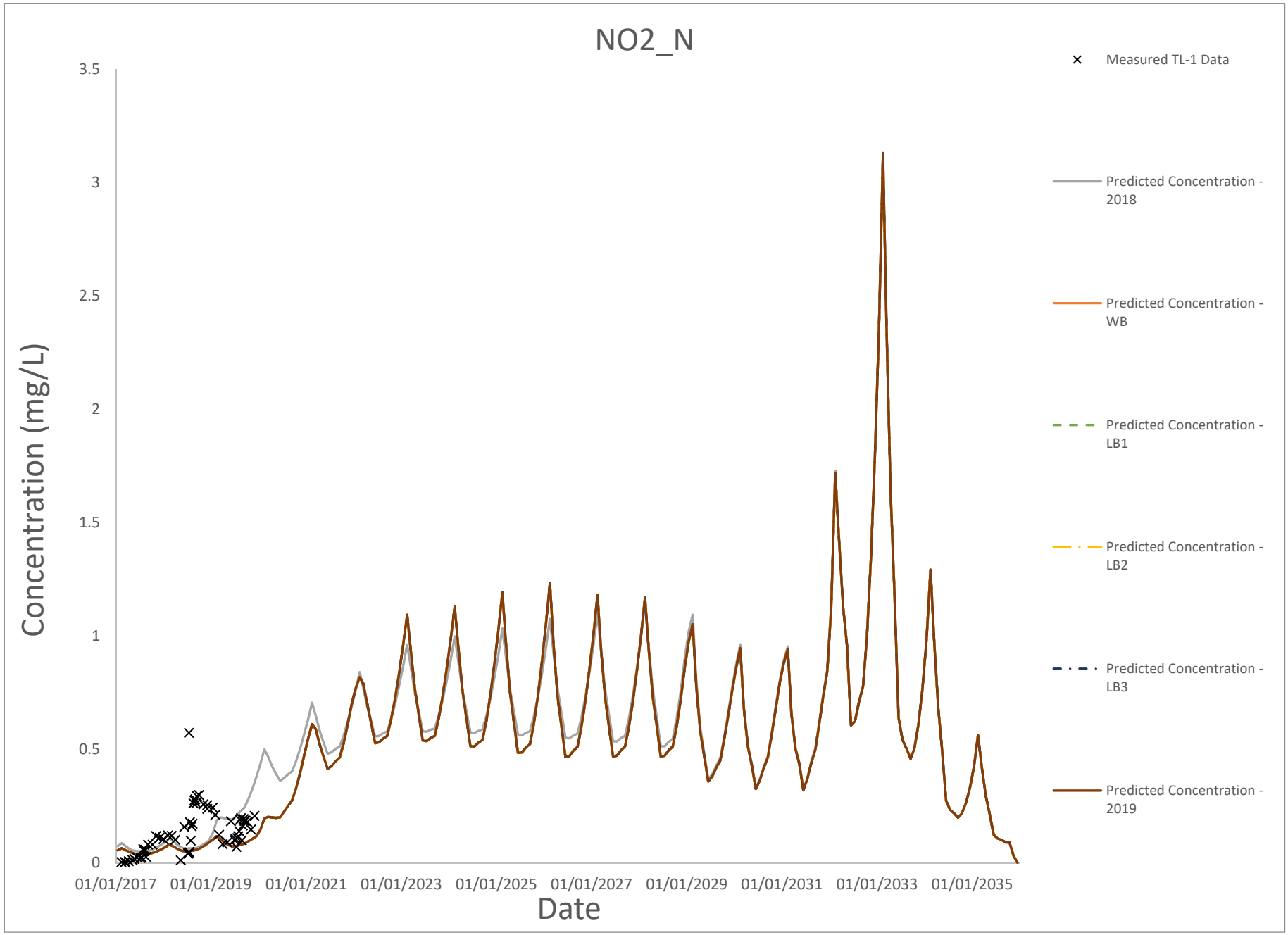

CN_F
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

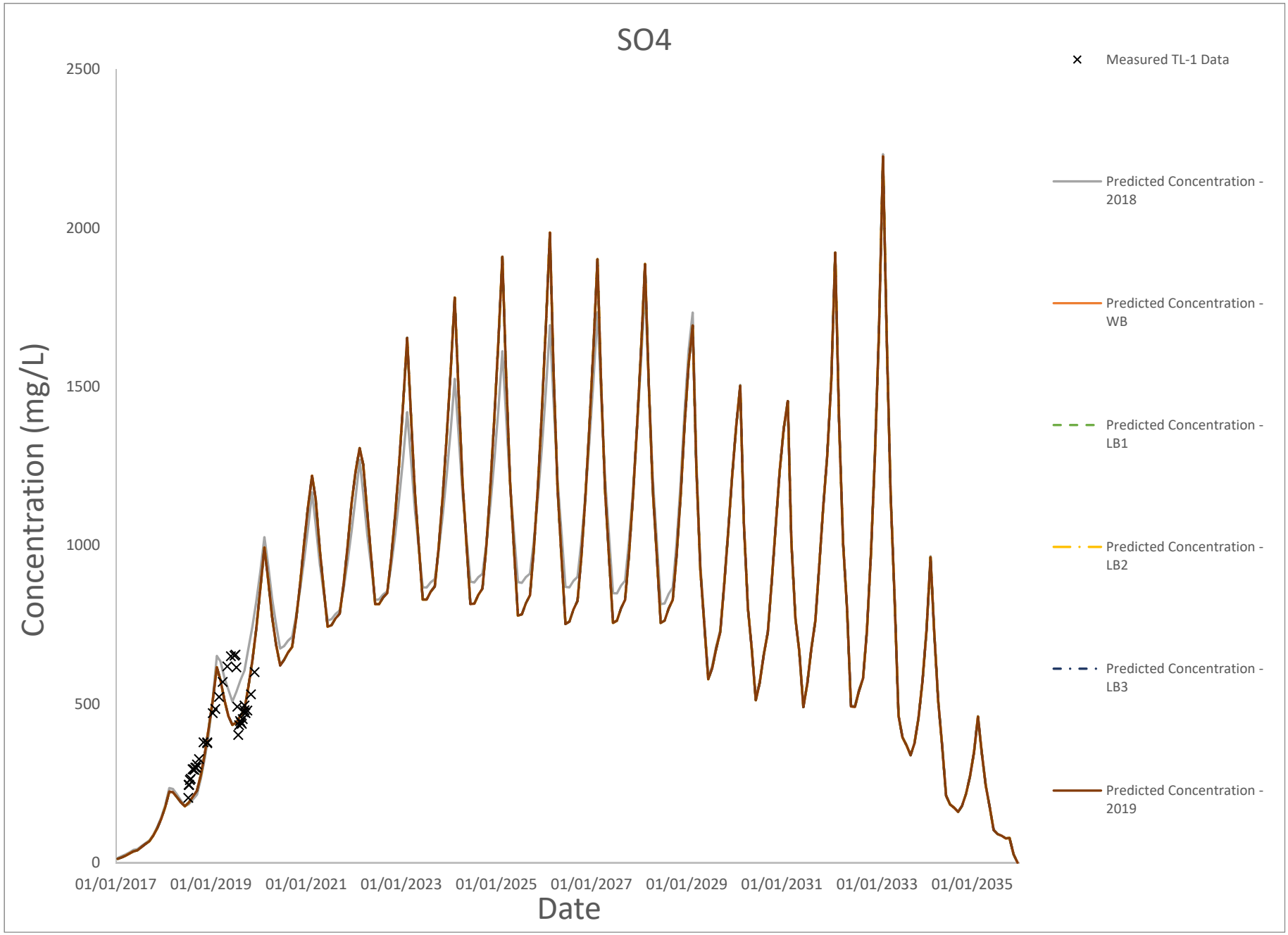

CNO
Concentration (mg/L)
Date
0
5
10
15
20
25
30
35
40
45
50
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

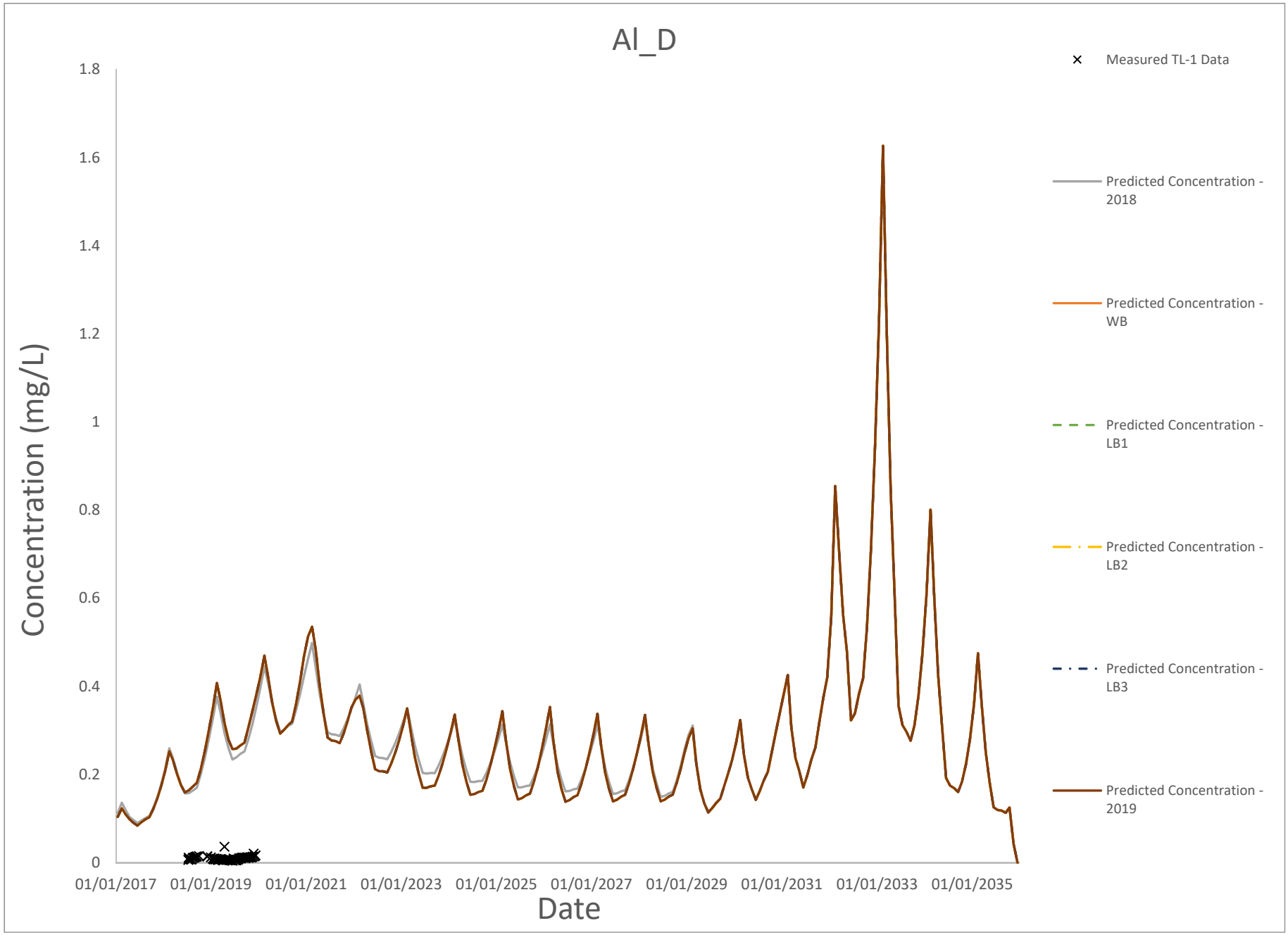

SCN
Concentration (mg/L)
Date
16
14
12
10
8
6
4
2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

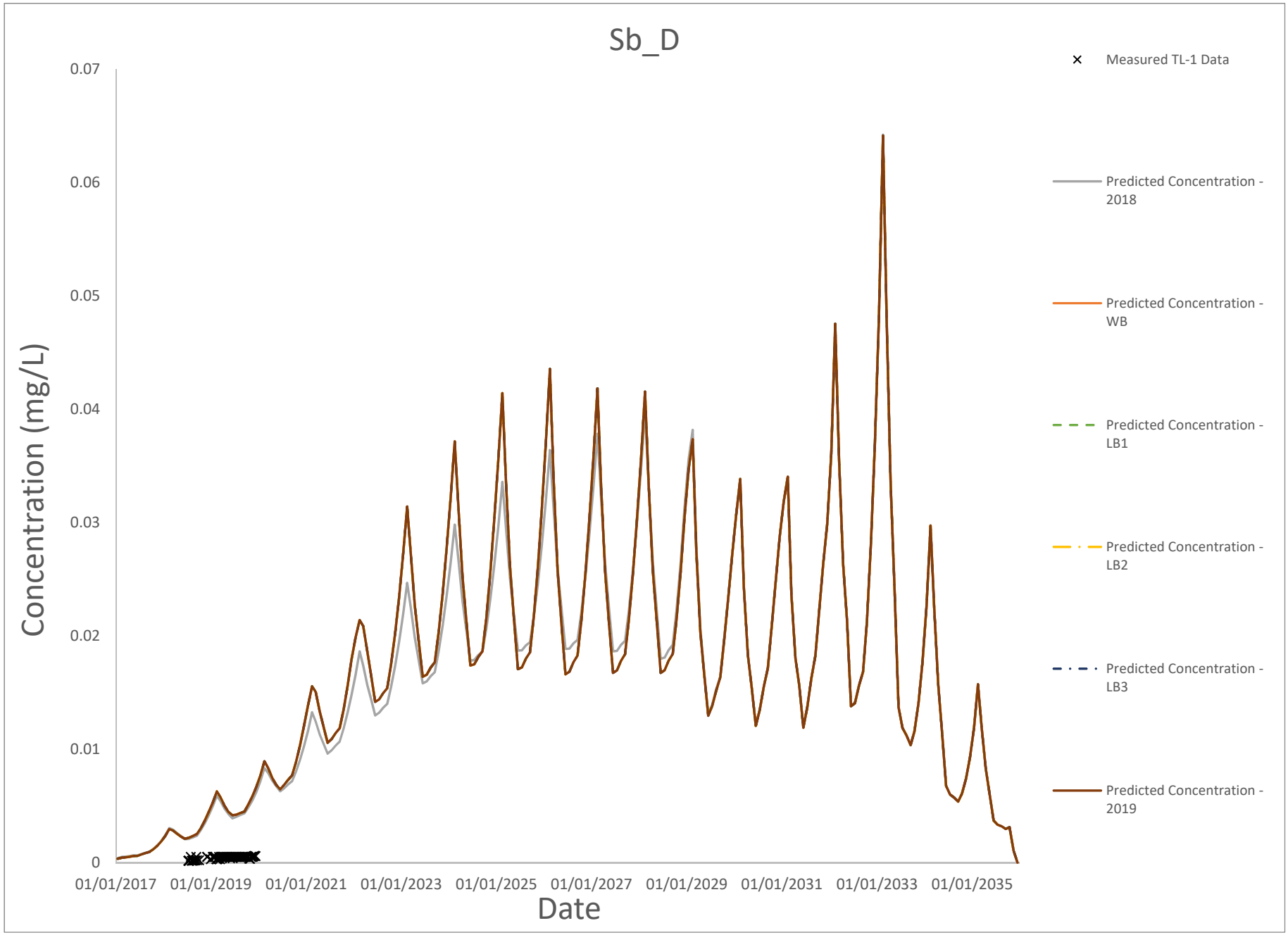

NH4_N
Concentration (mg/L)
60
50
40
30
20
10
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

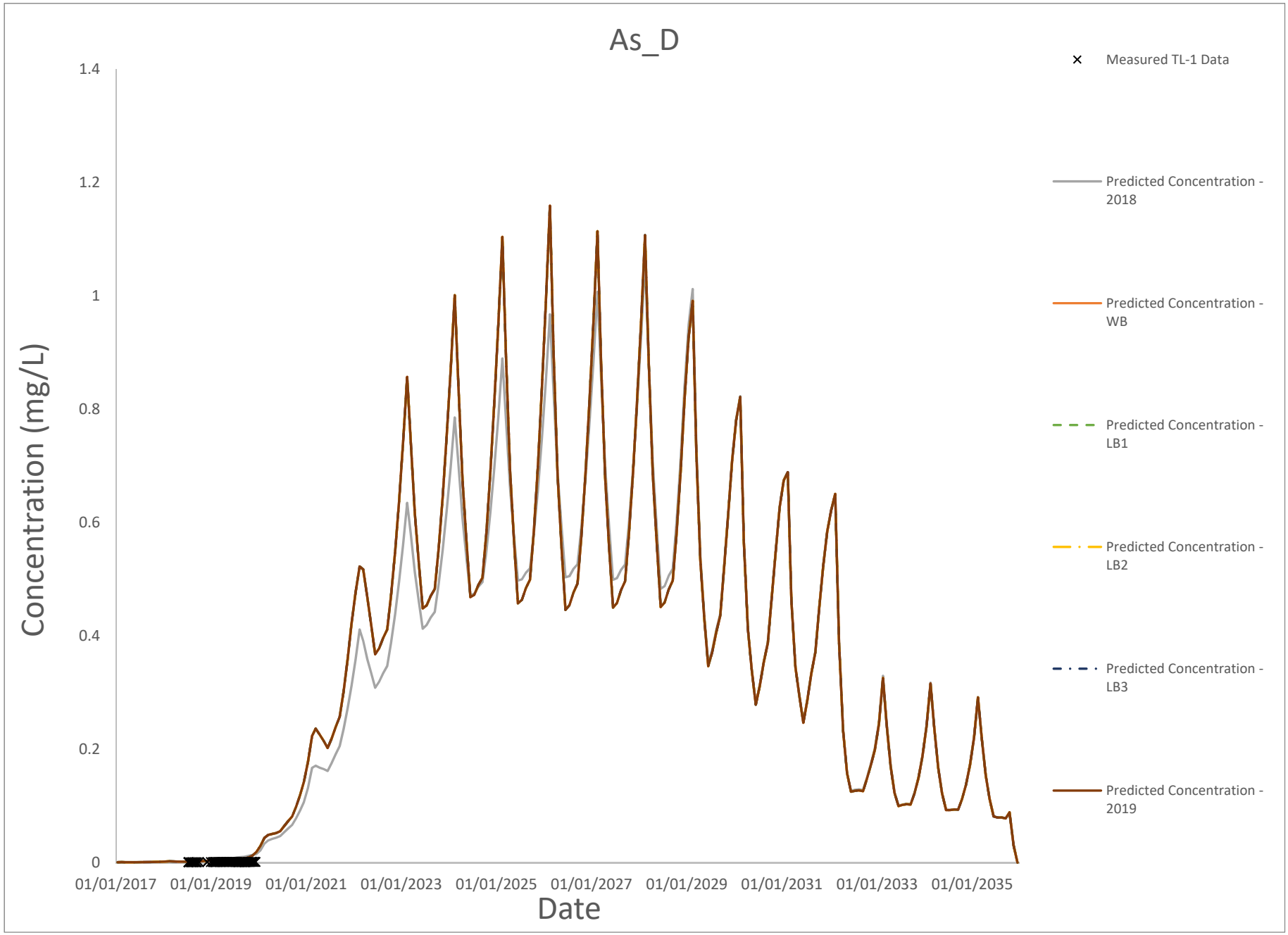

NO3_N
Concentration (mg/L)
Date
0
2
4
6
8
10
12
14
16
18
20
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

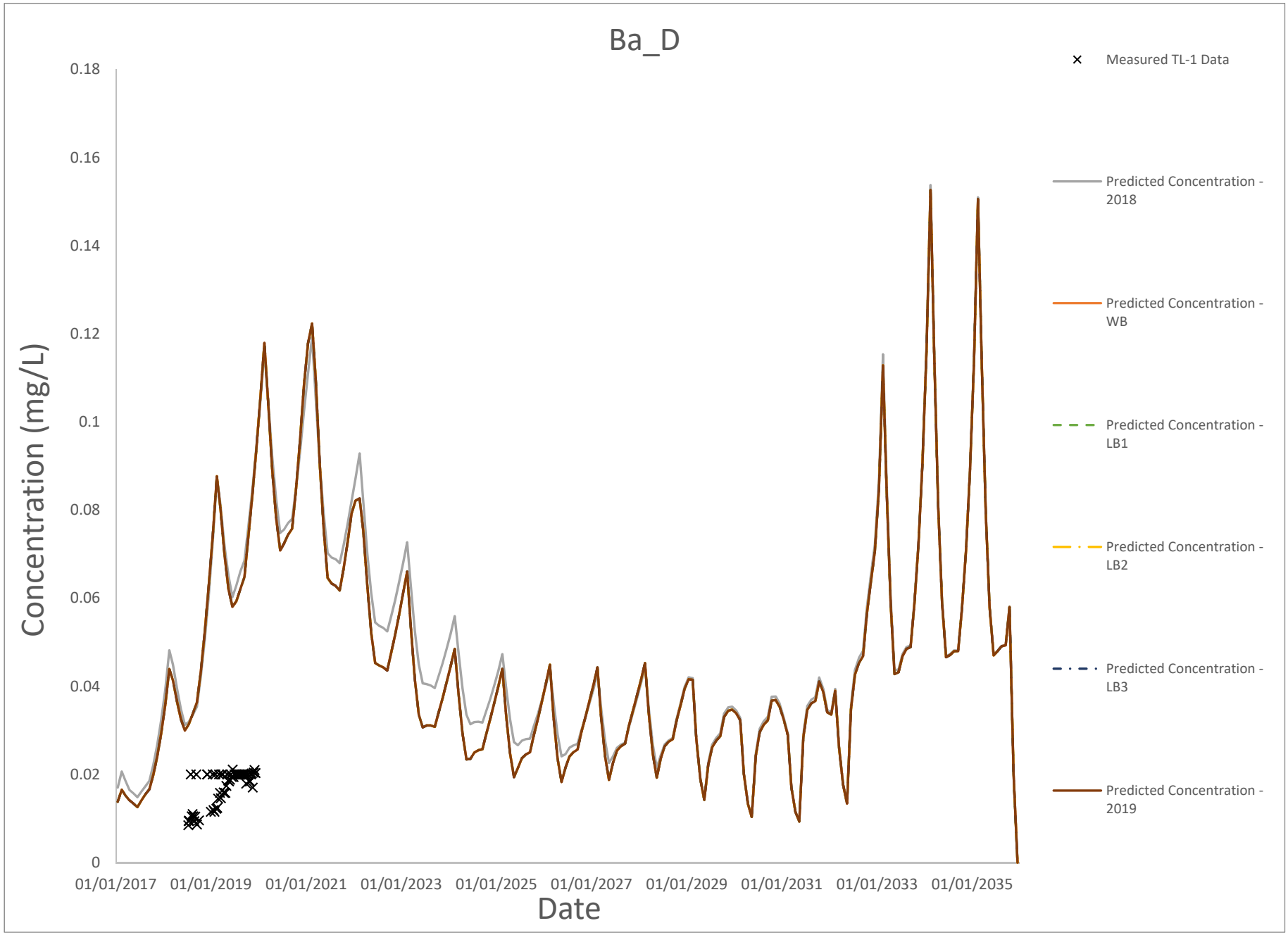

NO2_N
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

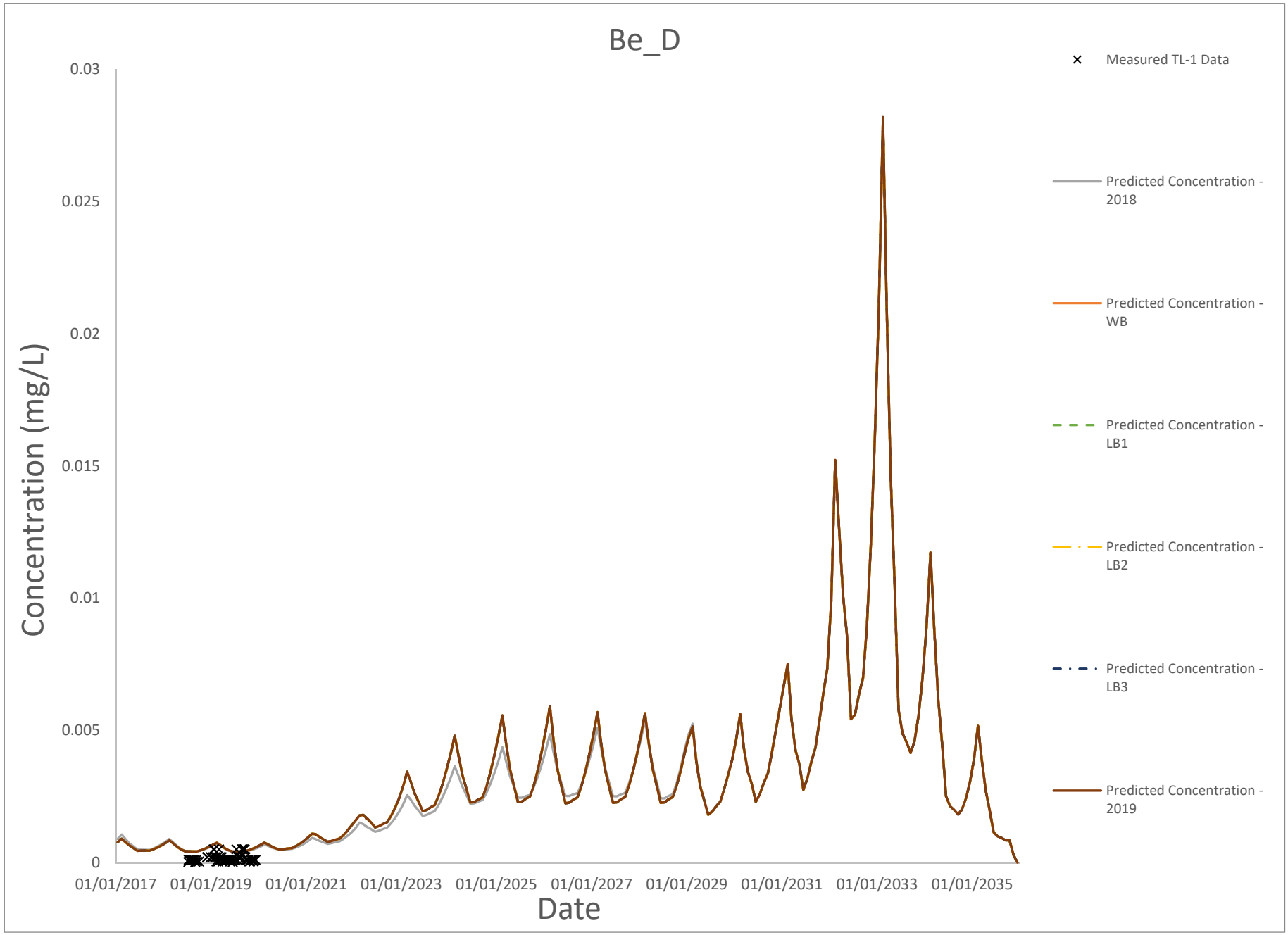

SO4
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

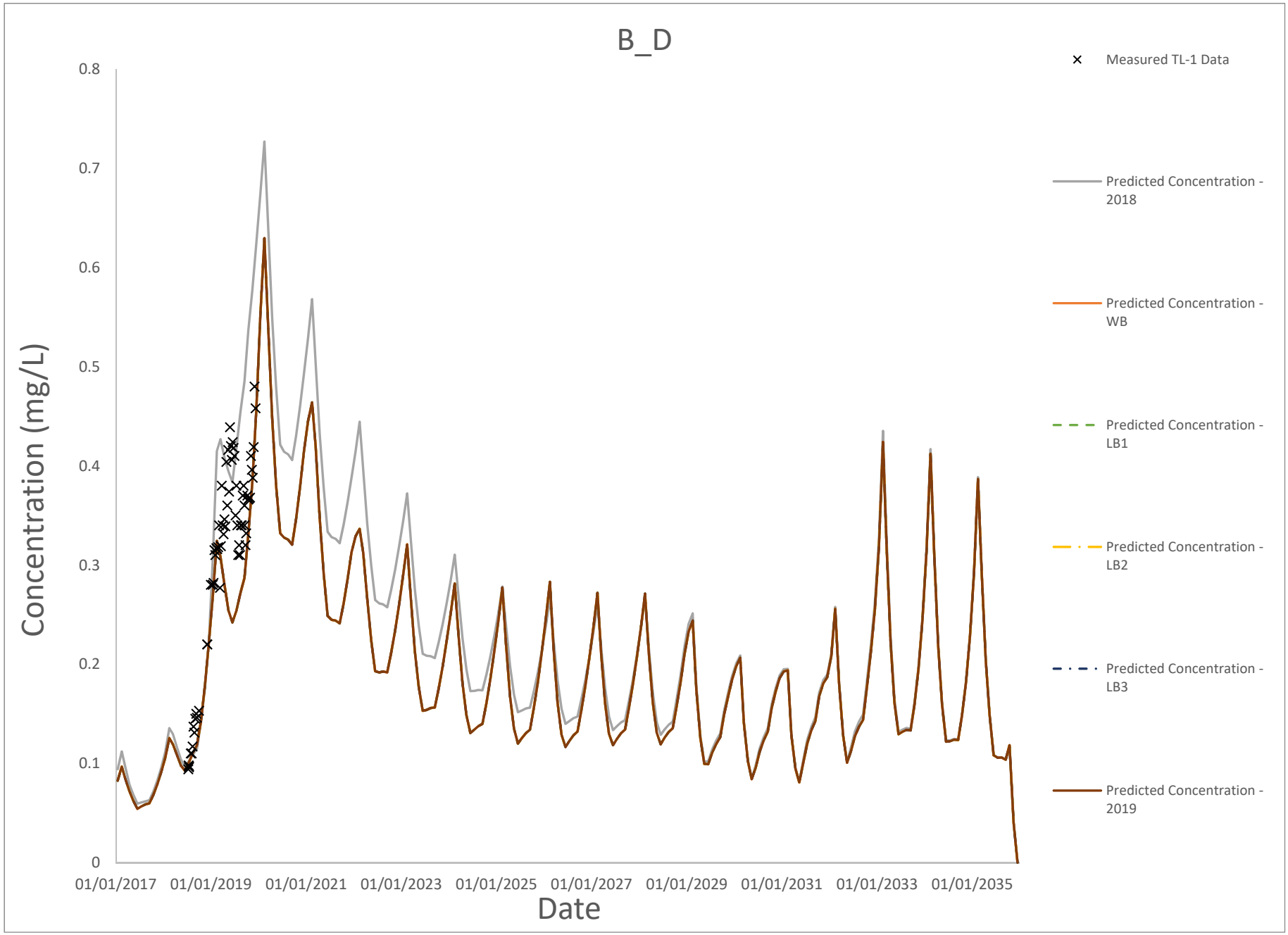

Al_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

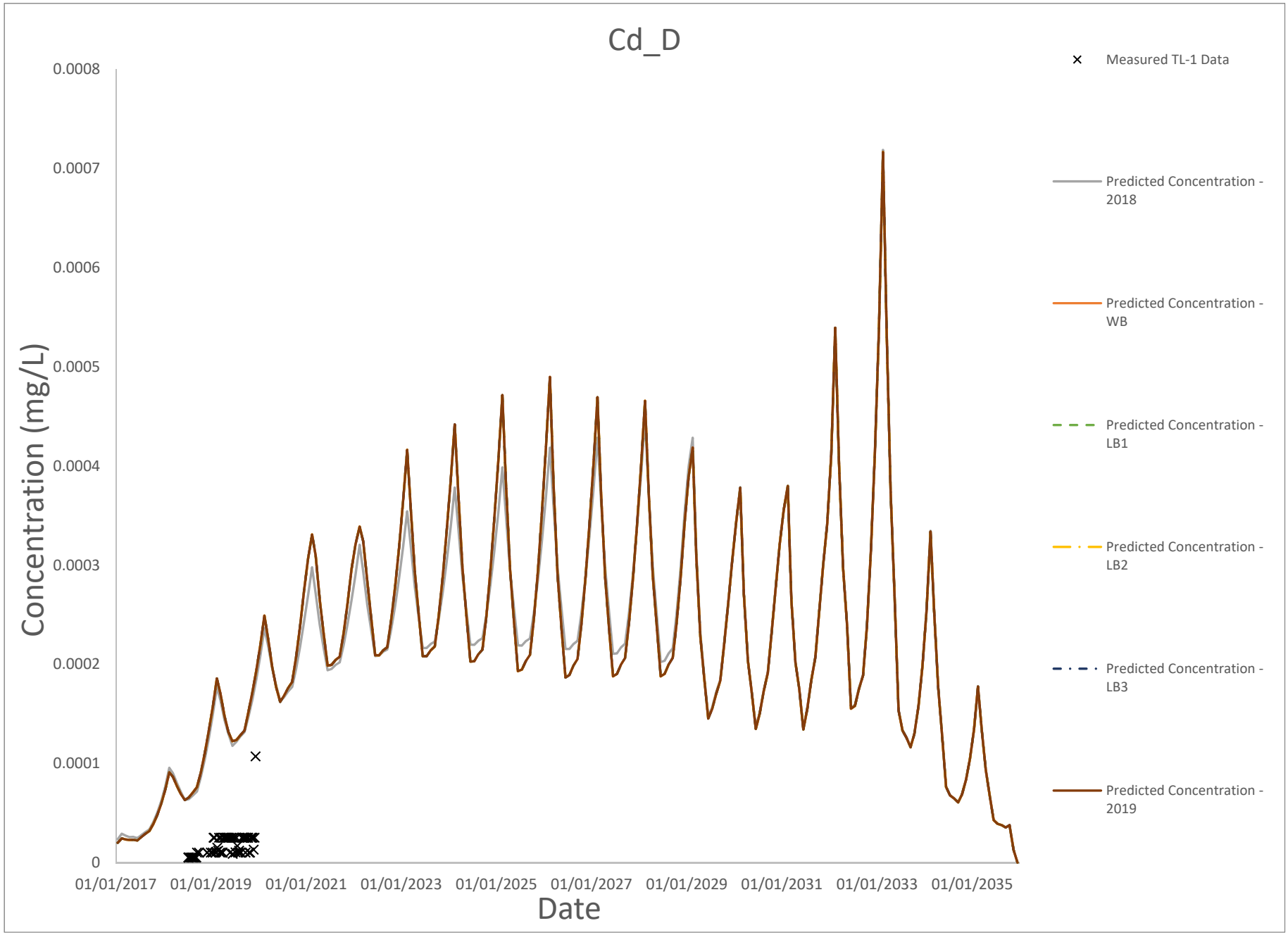

Sb_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

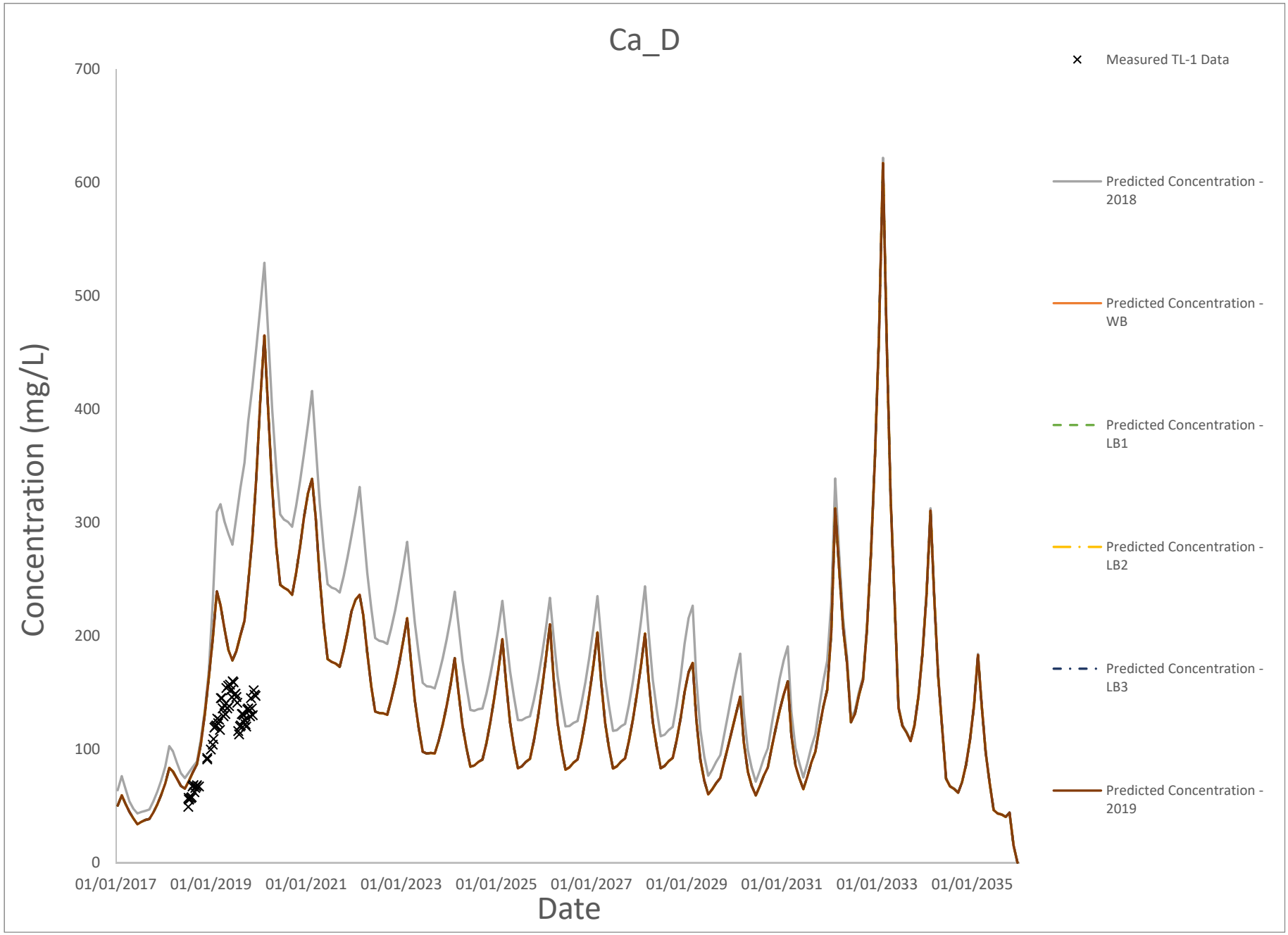

As_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

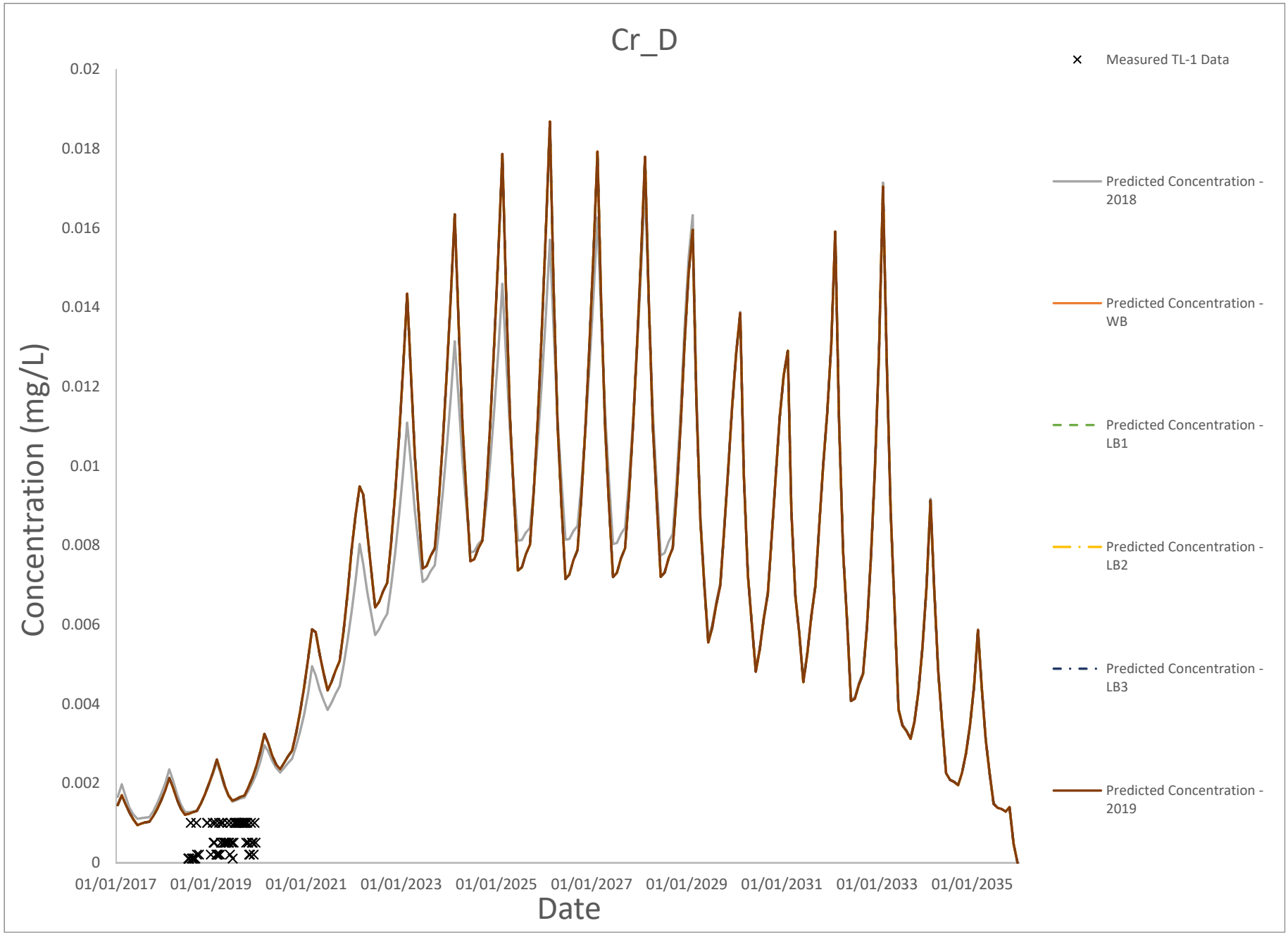

Ba_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

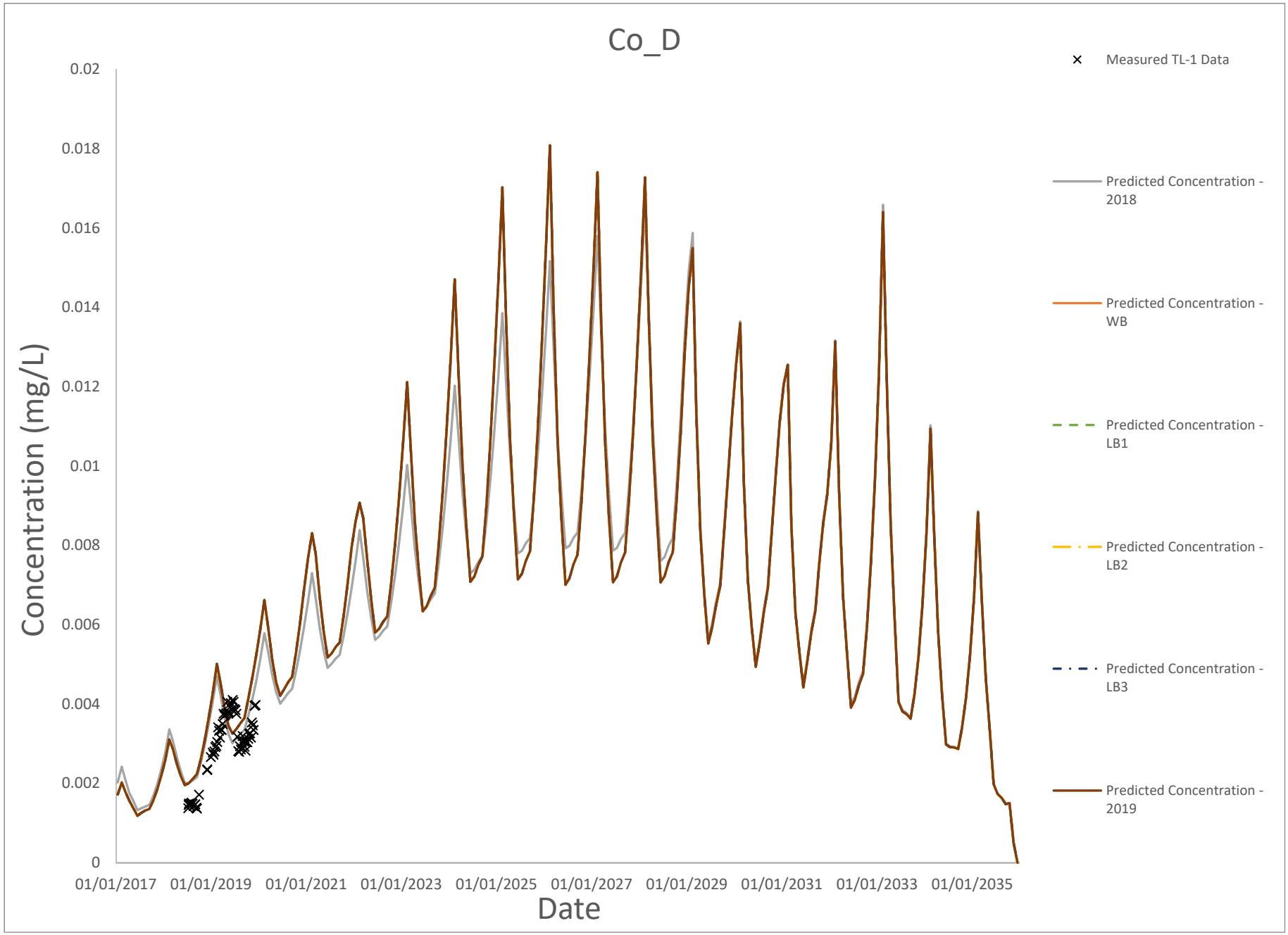

Be_D
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

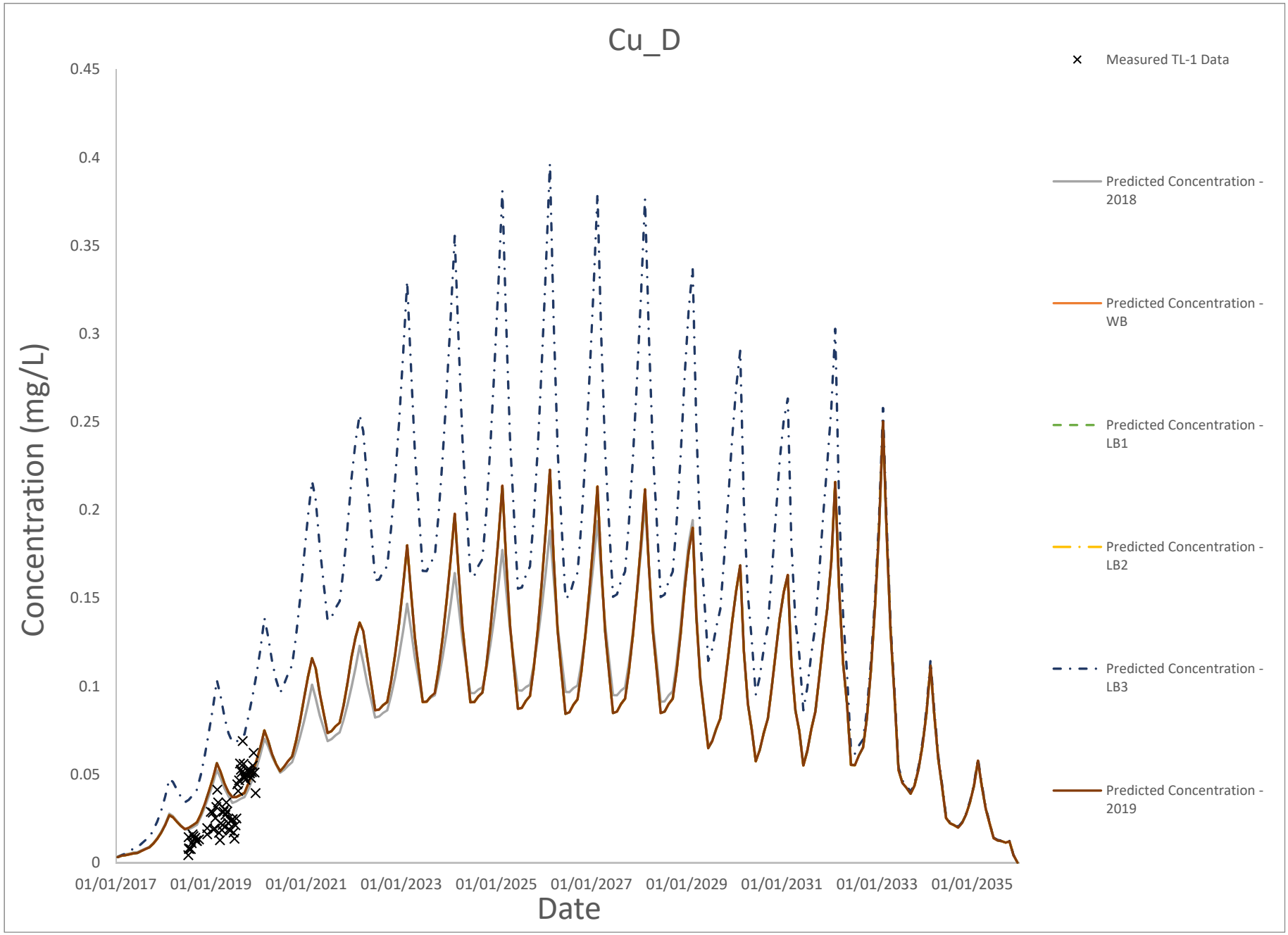

B_D
Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

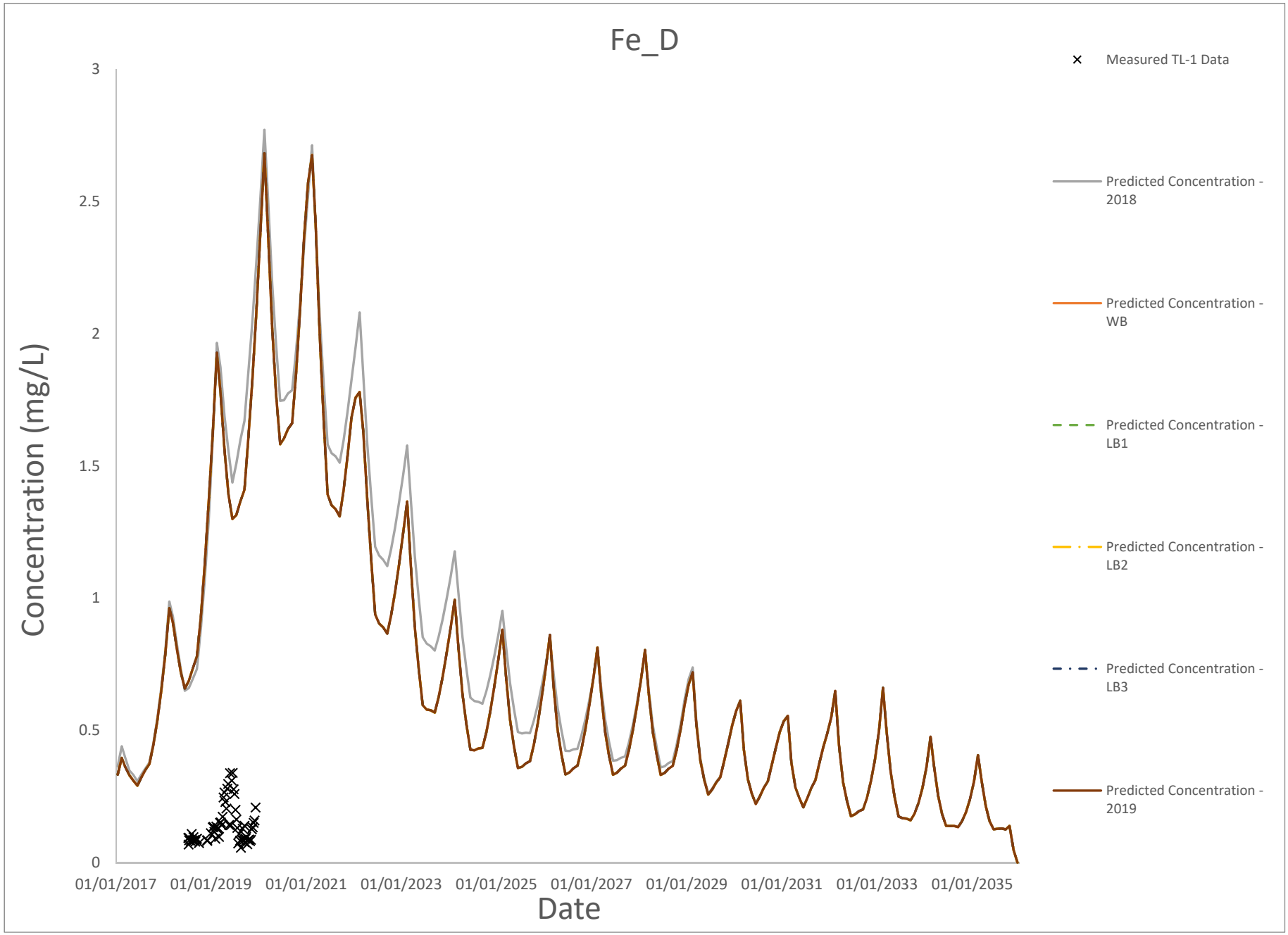

Cd_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
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

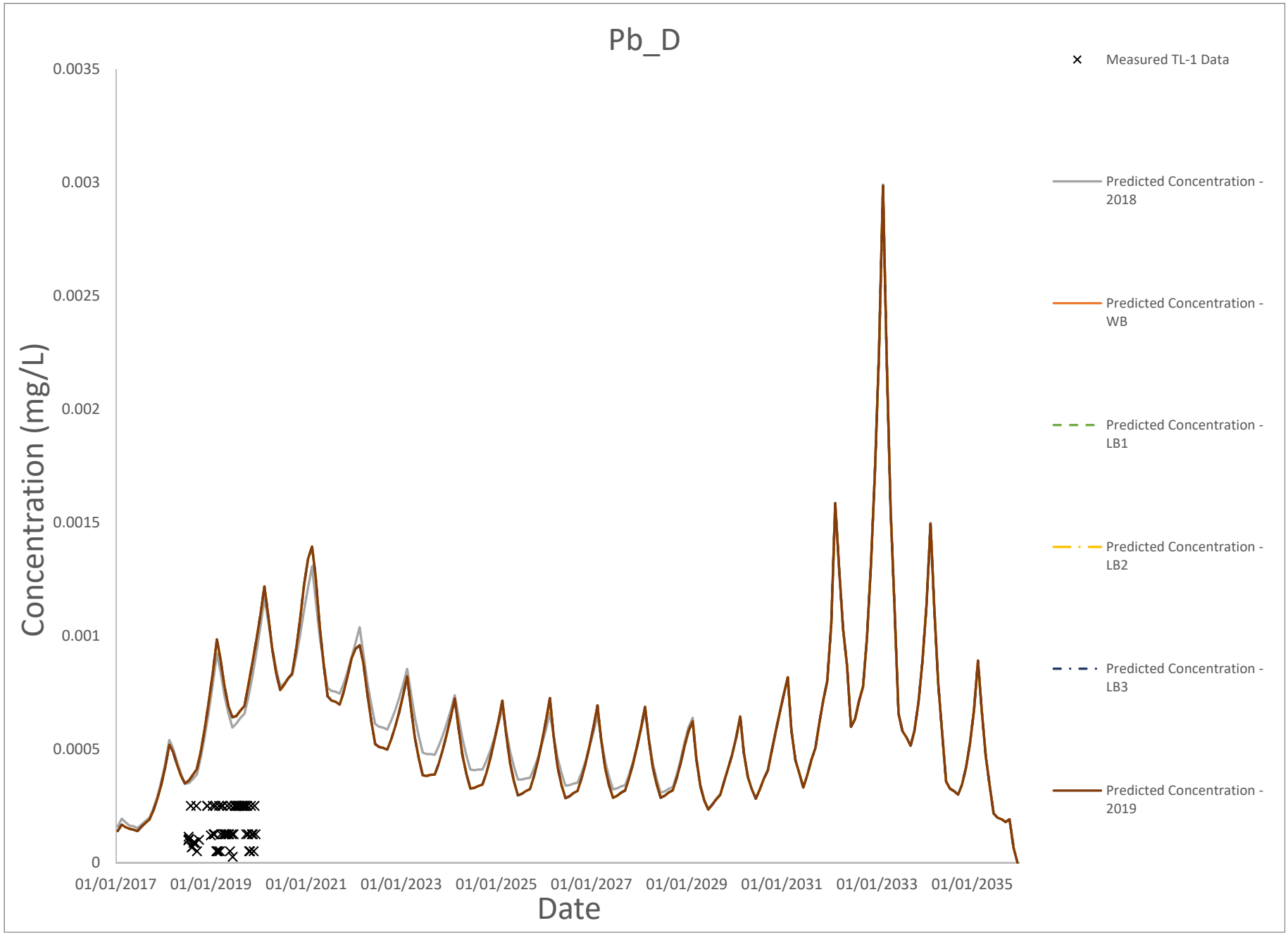

Ca_D
Concentration (mg/L)
700
600
500
400
300
200
100
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

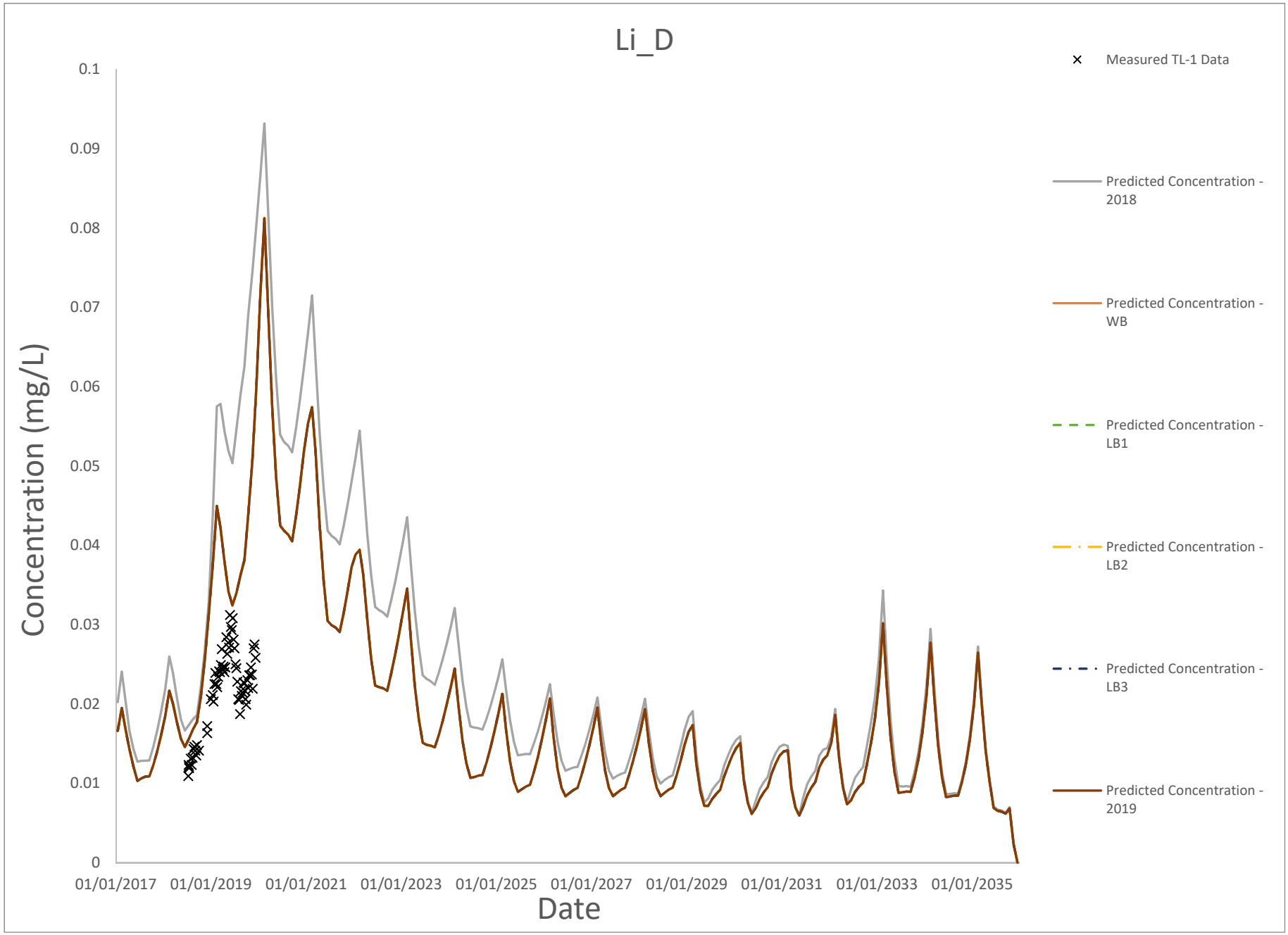

Cr_D
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

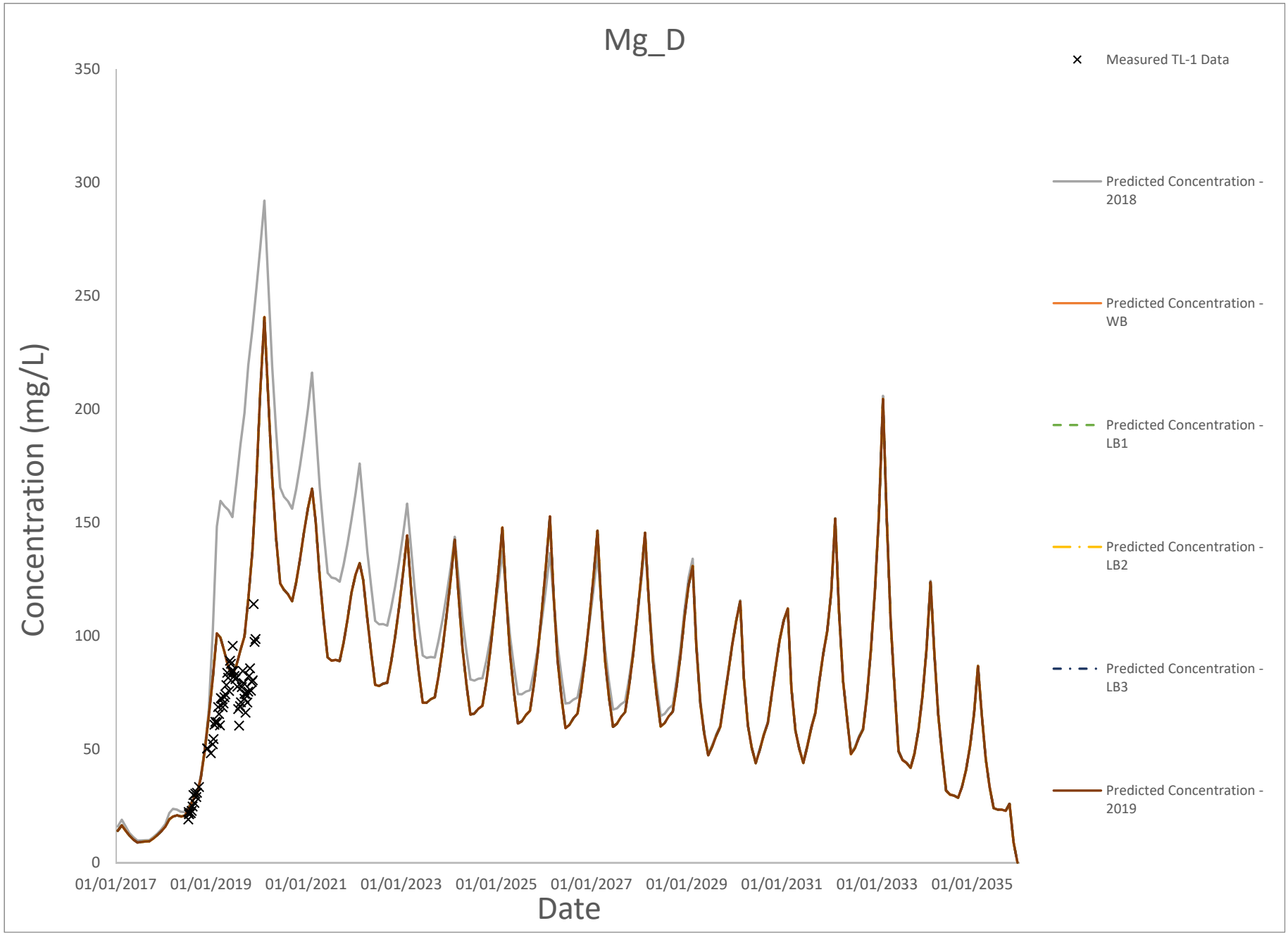

Co_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
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

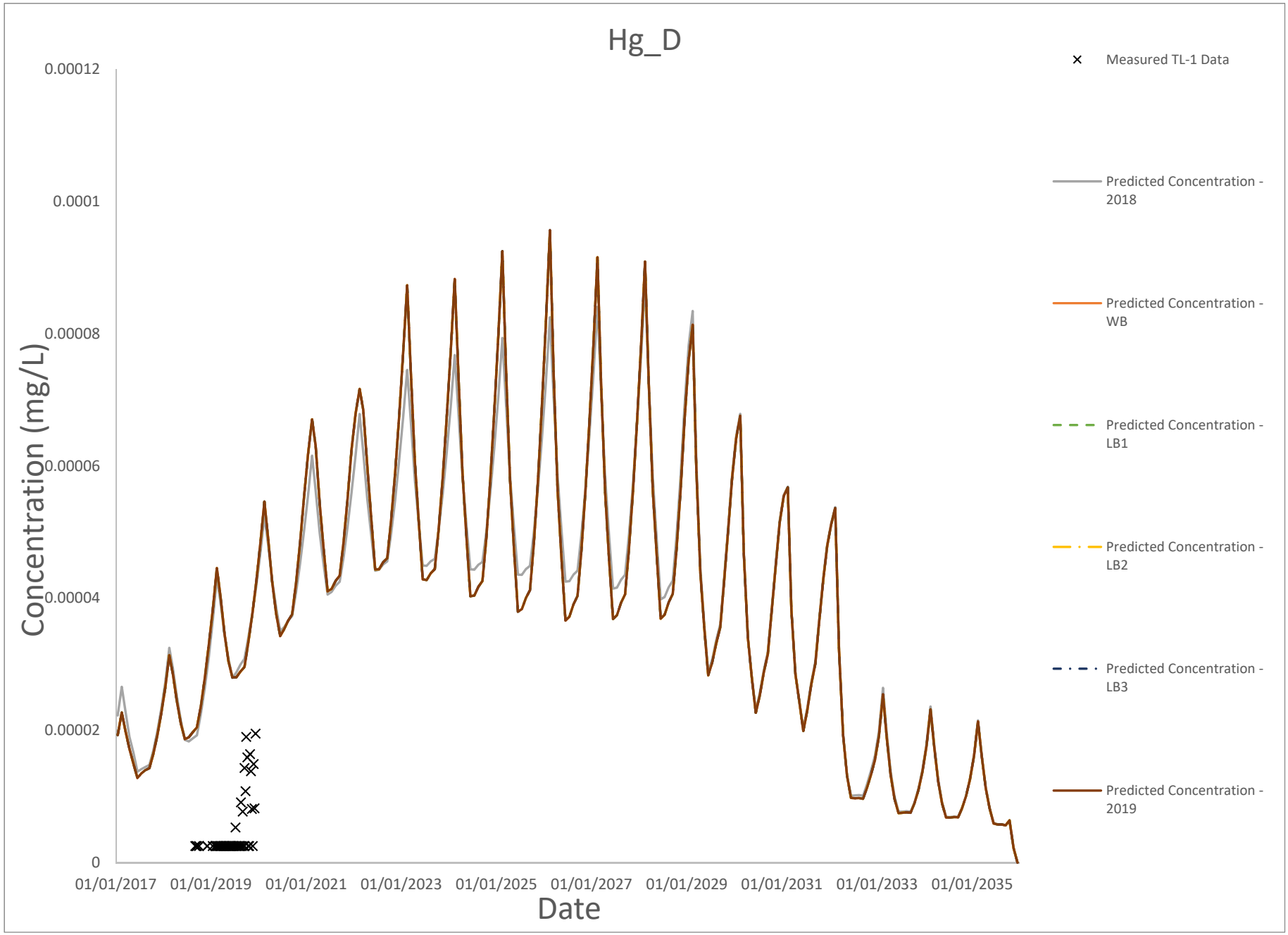

Cu_D
Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

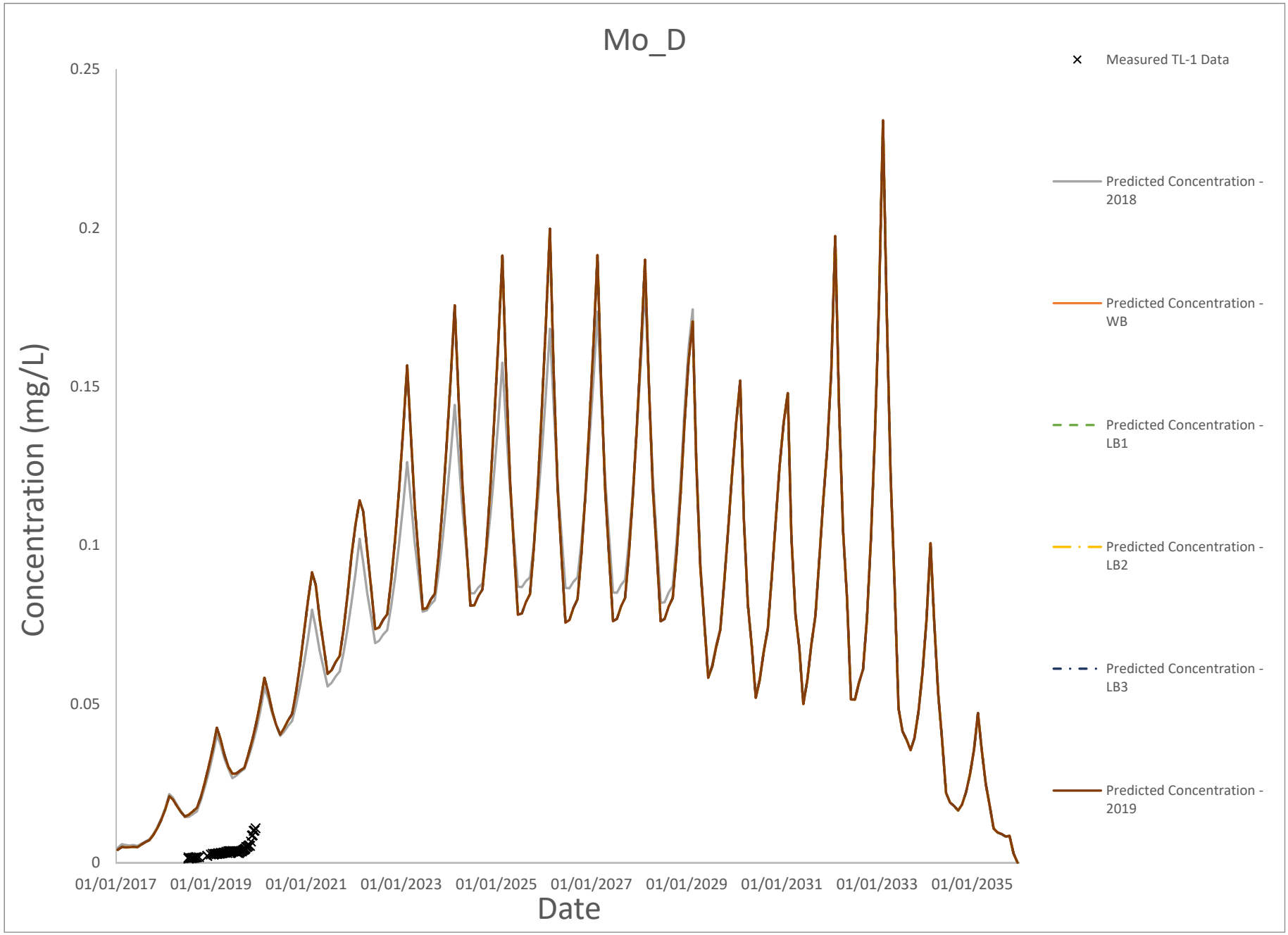

Fe_D
Concentration (mg/L)
Date
3
2.5
2
1.5
1
0.5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

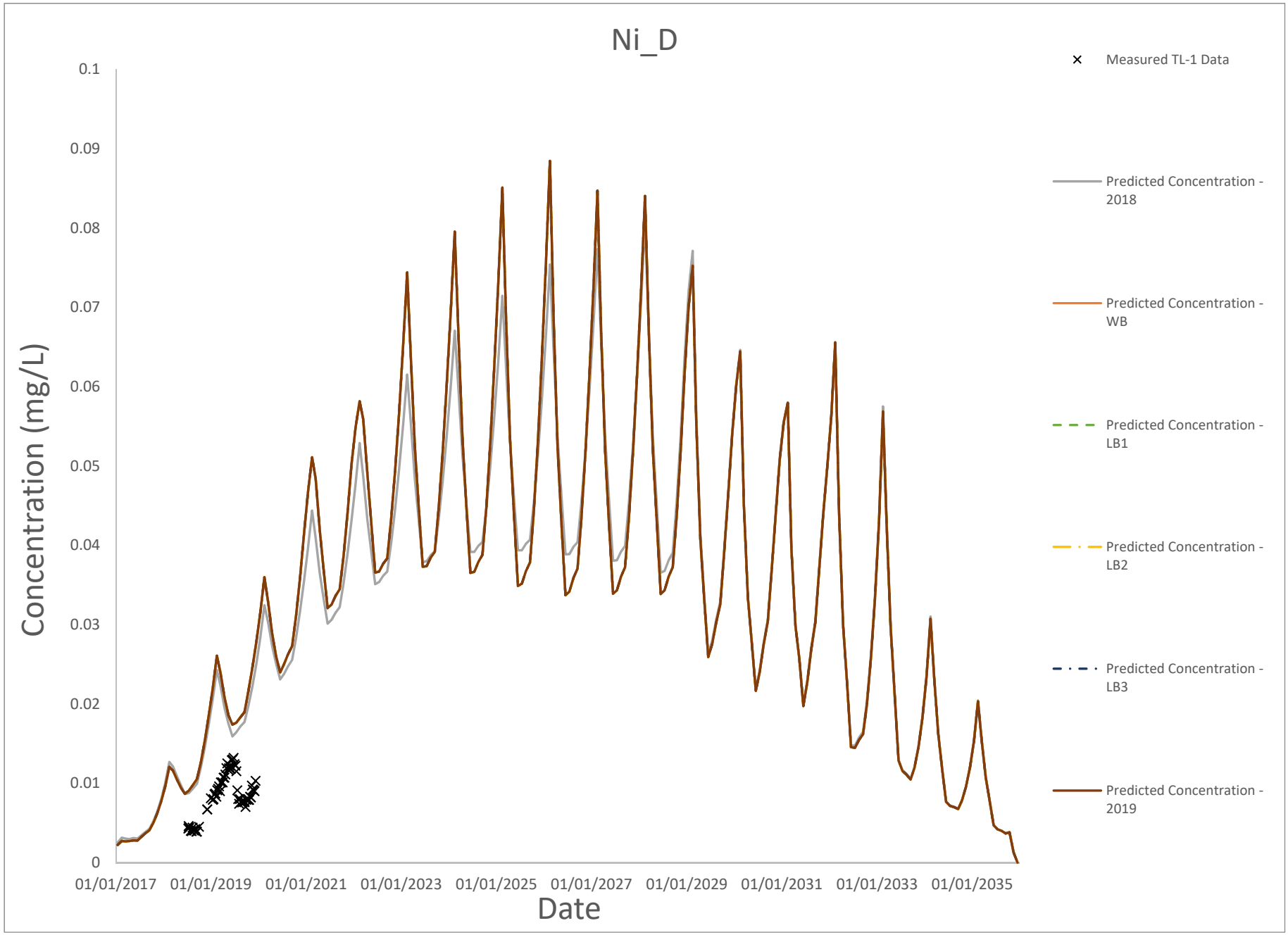

Pb_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

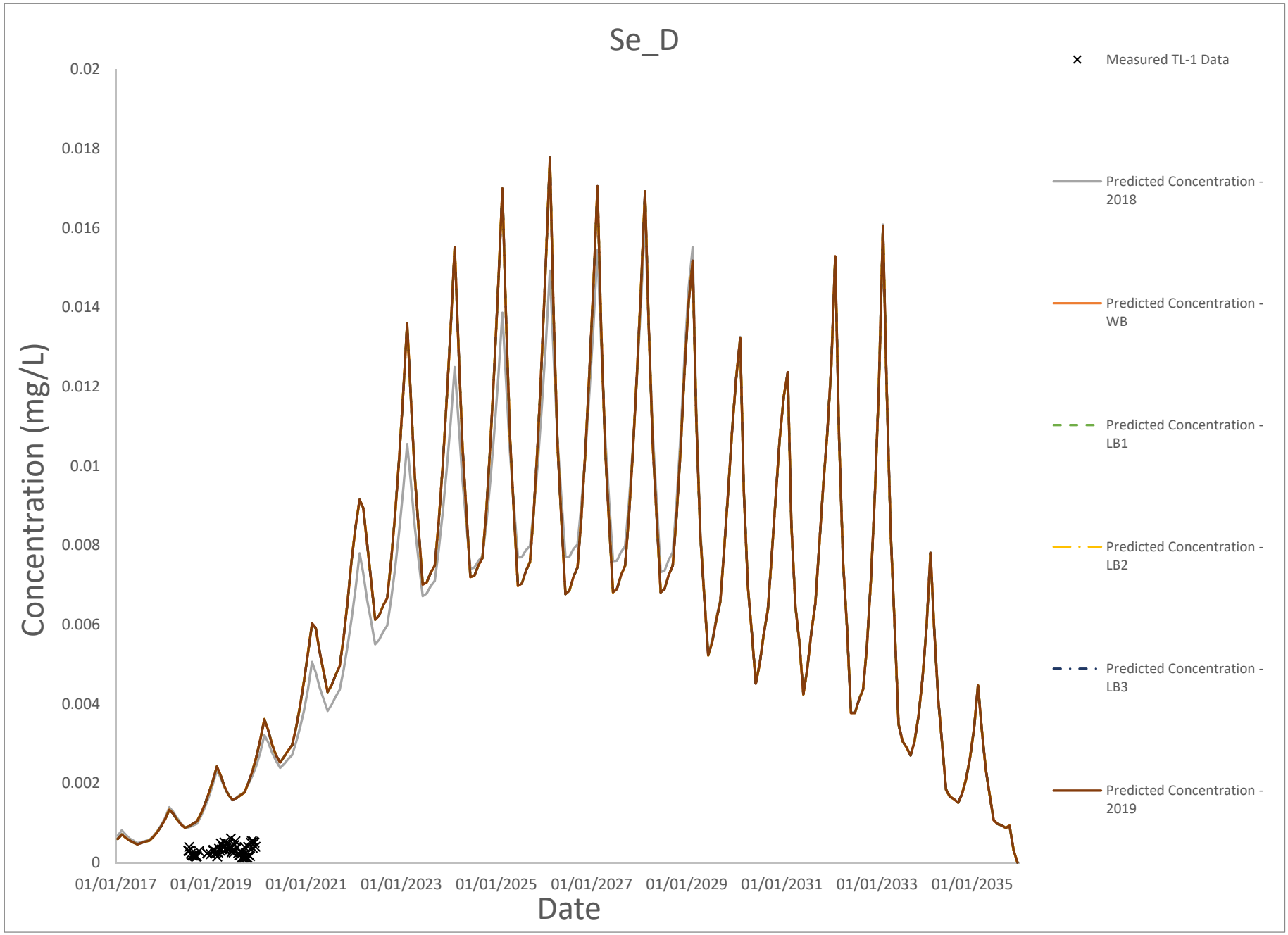

Li_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

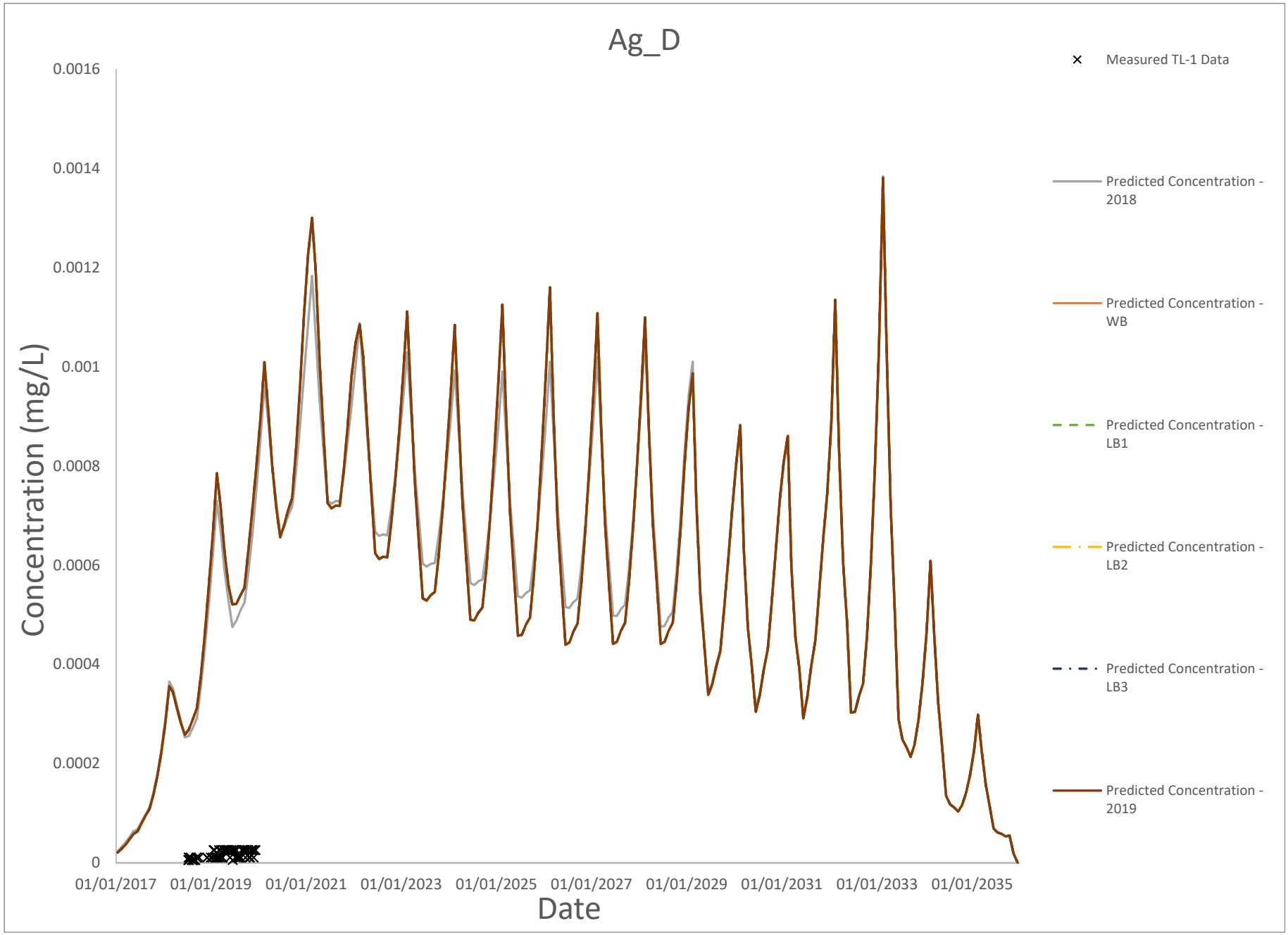

Mg_D
Concentration (mg/L)
350
300
250
200
150
100
50
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

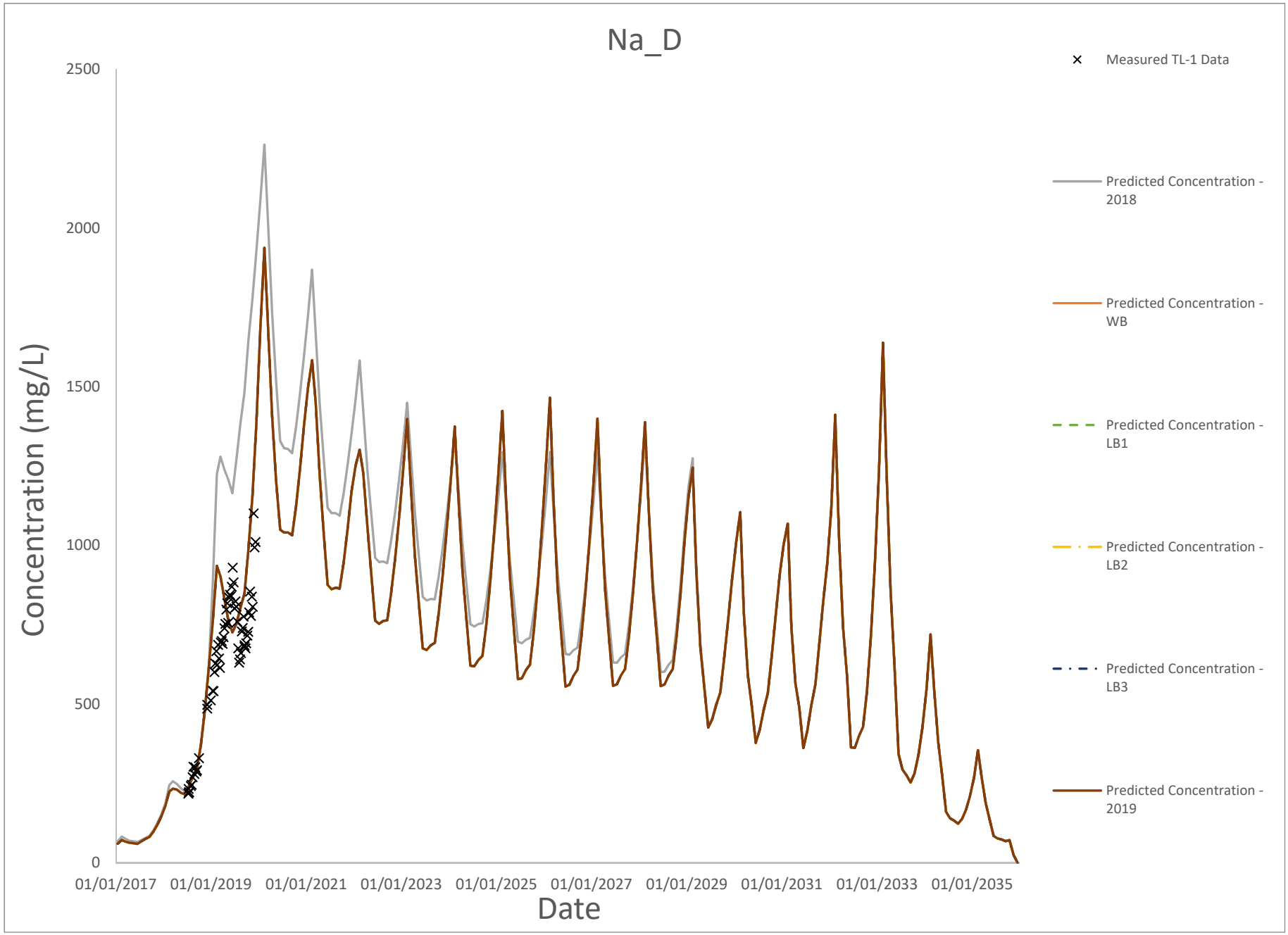

Hg_D
Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

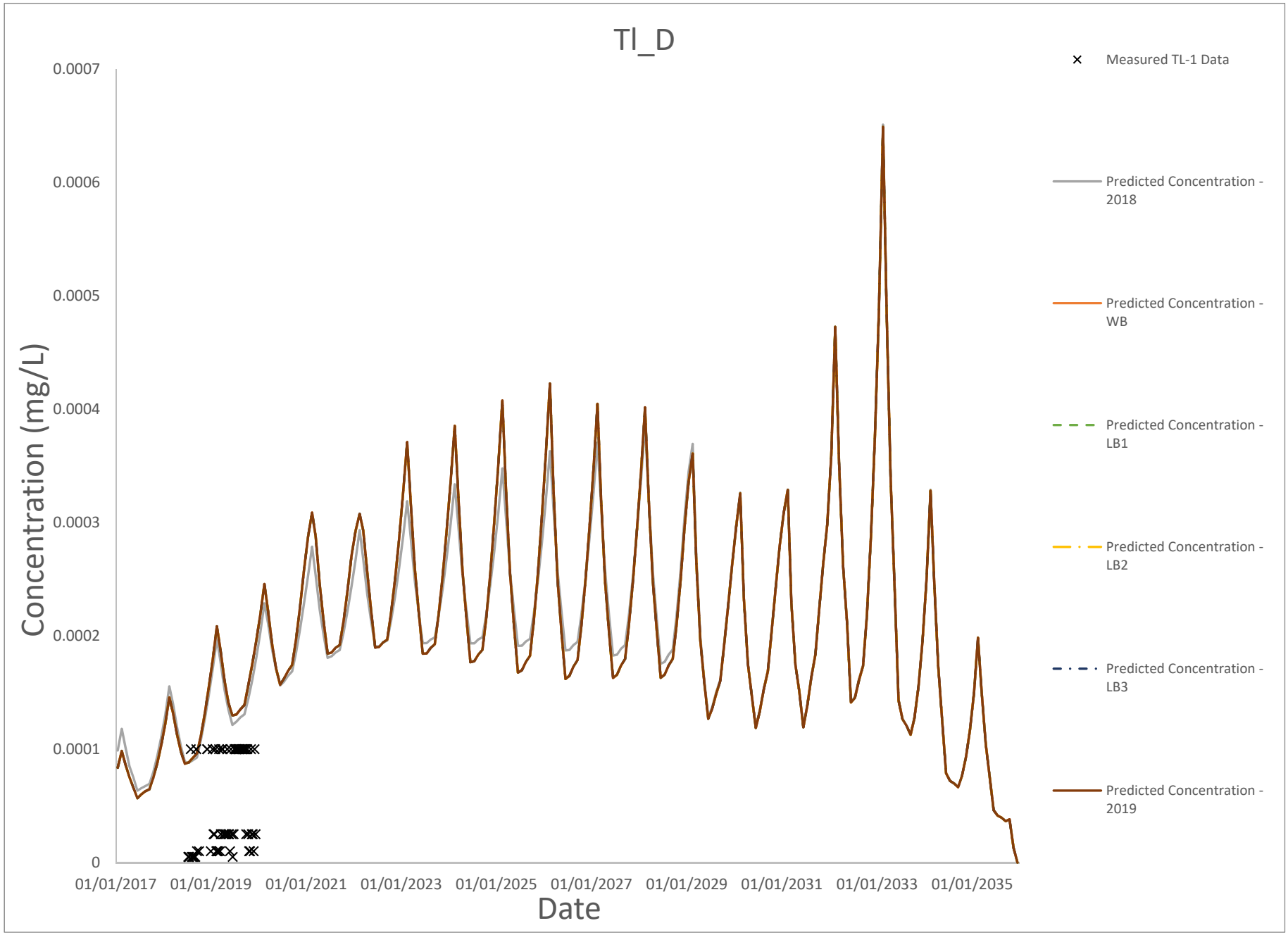

Mo_D
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

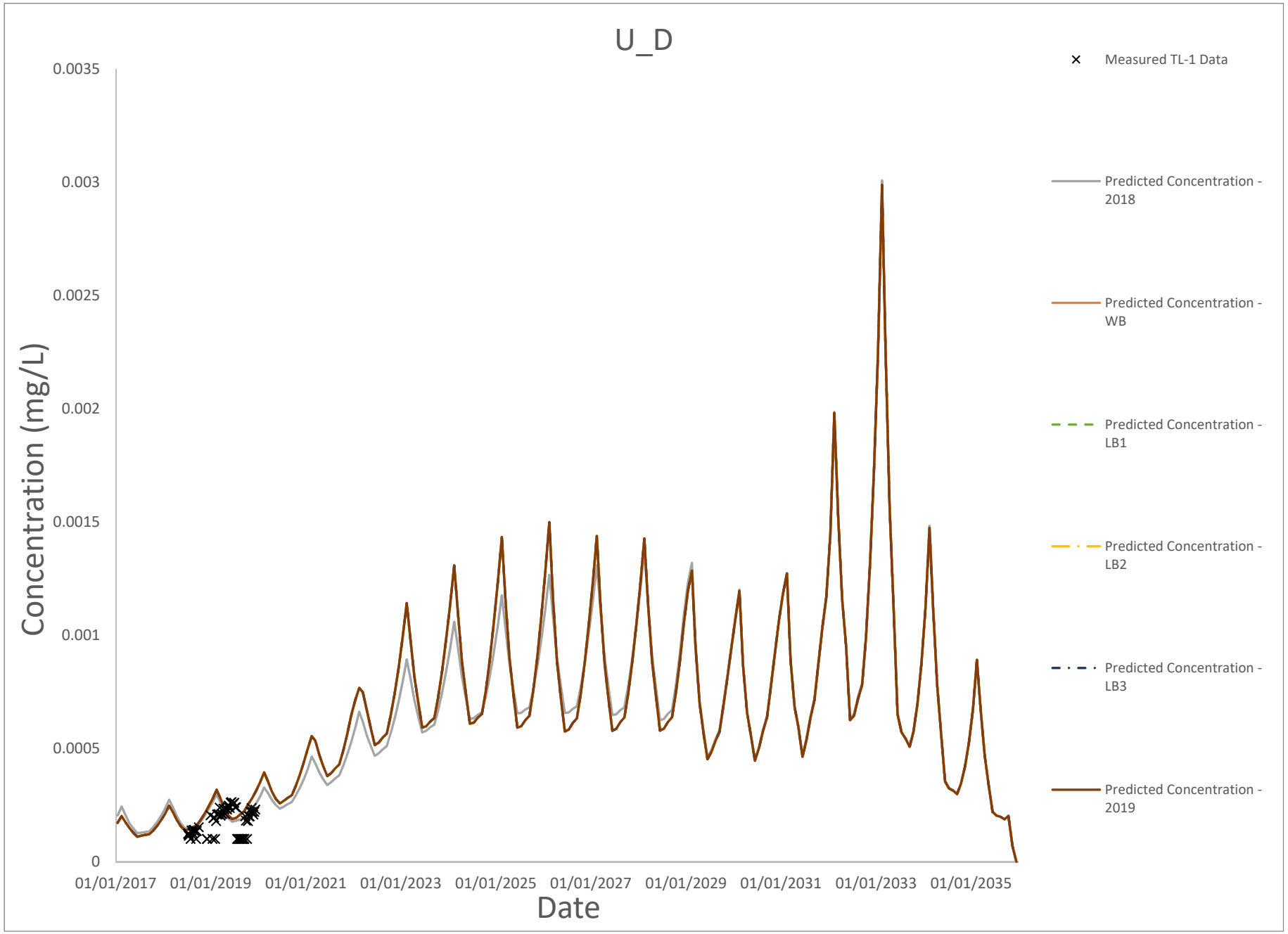

Ni_D
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

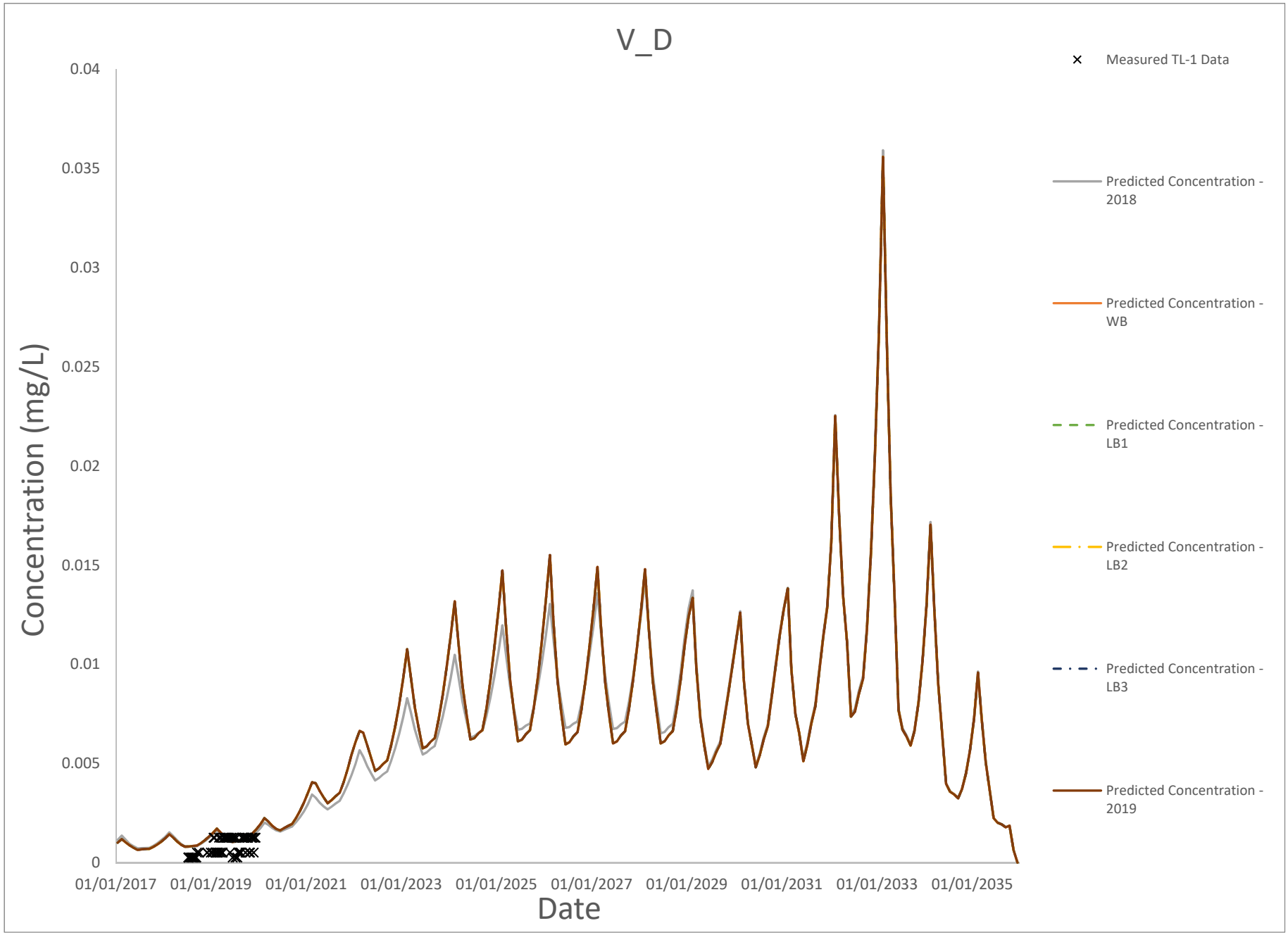

Se_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
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

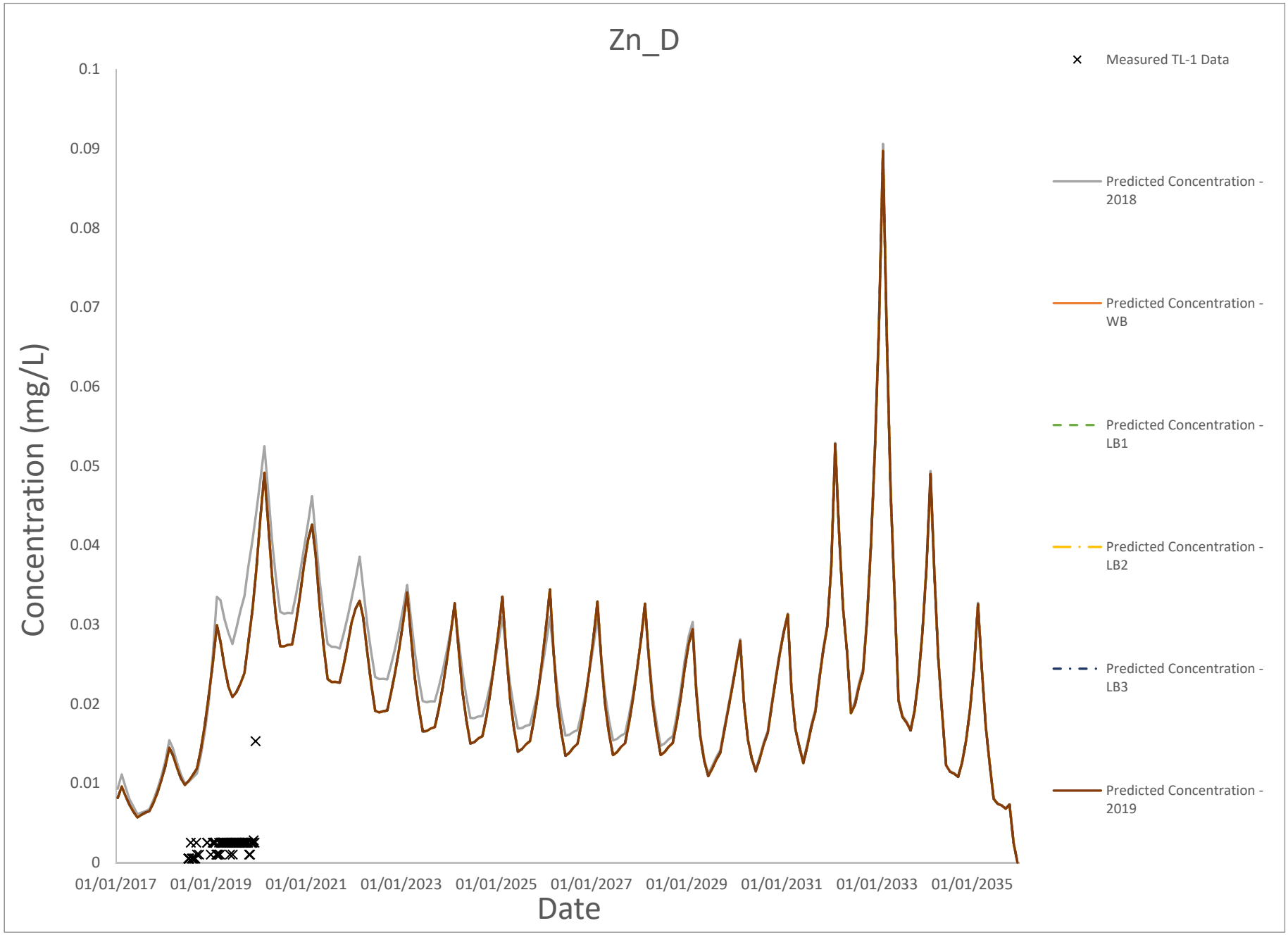

Ag_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
01/01/2017
01/01/2019
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

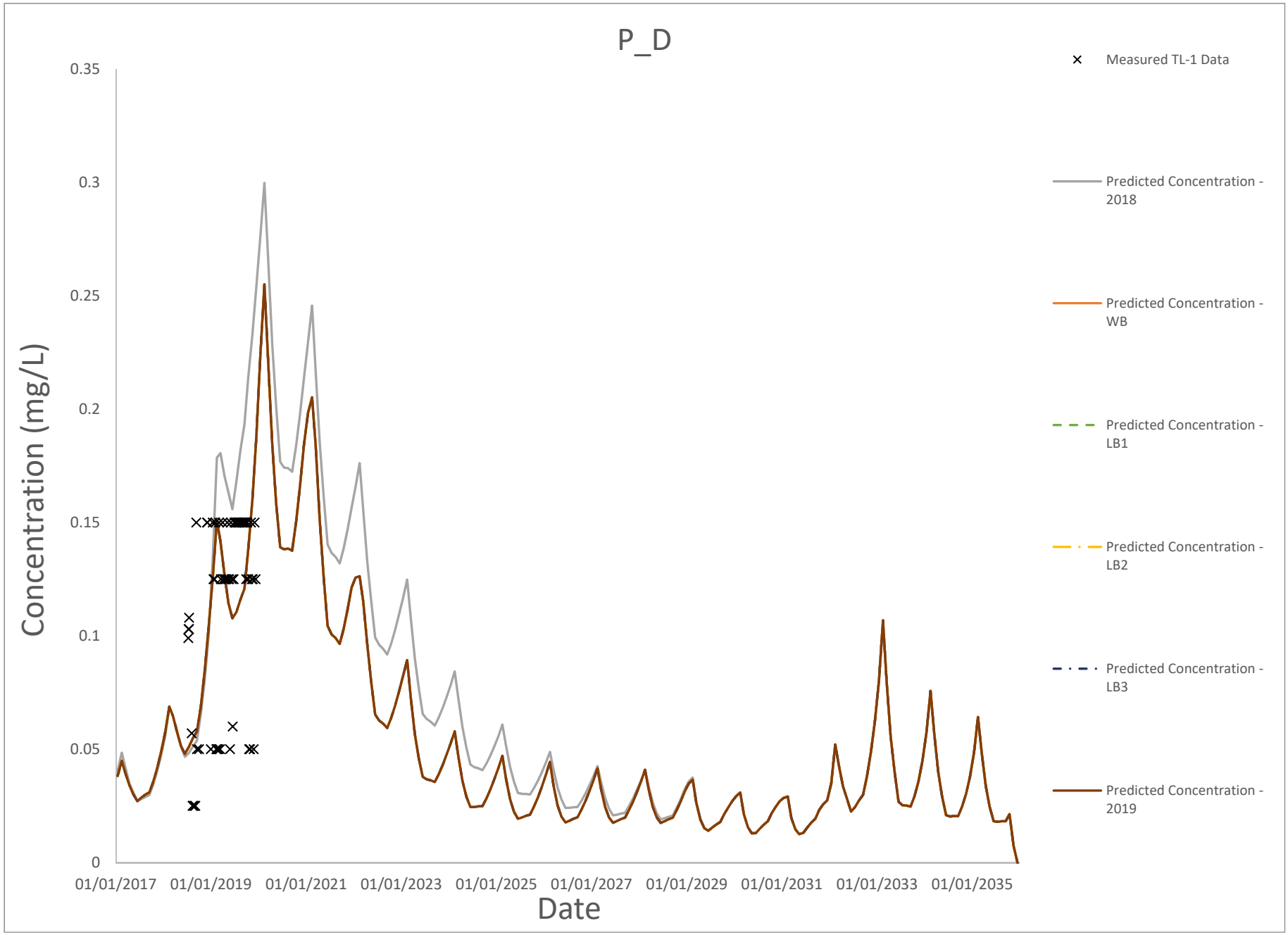

Na_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

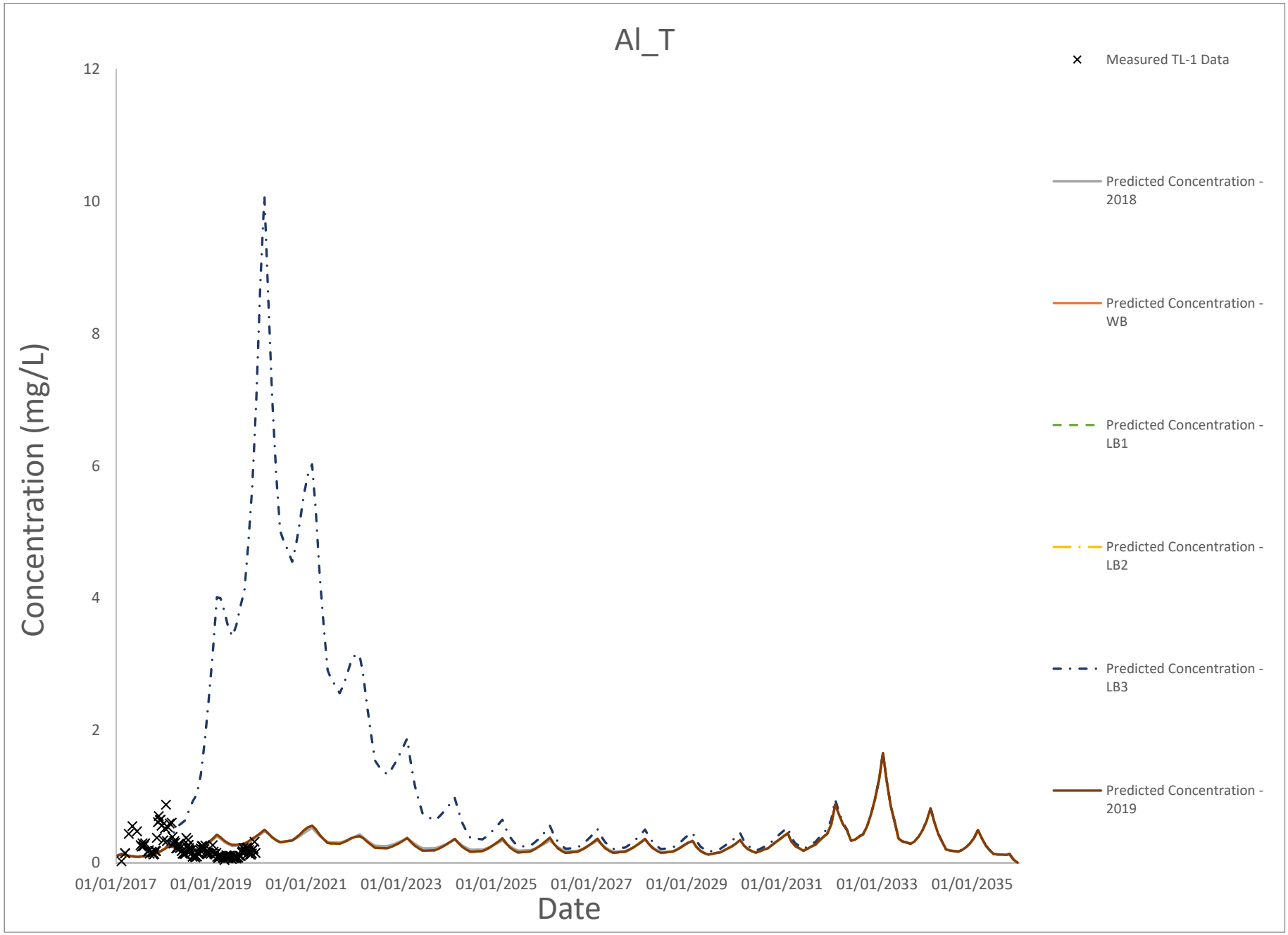

Tl_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

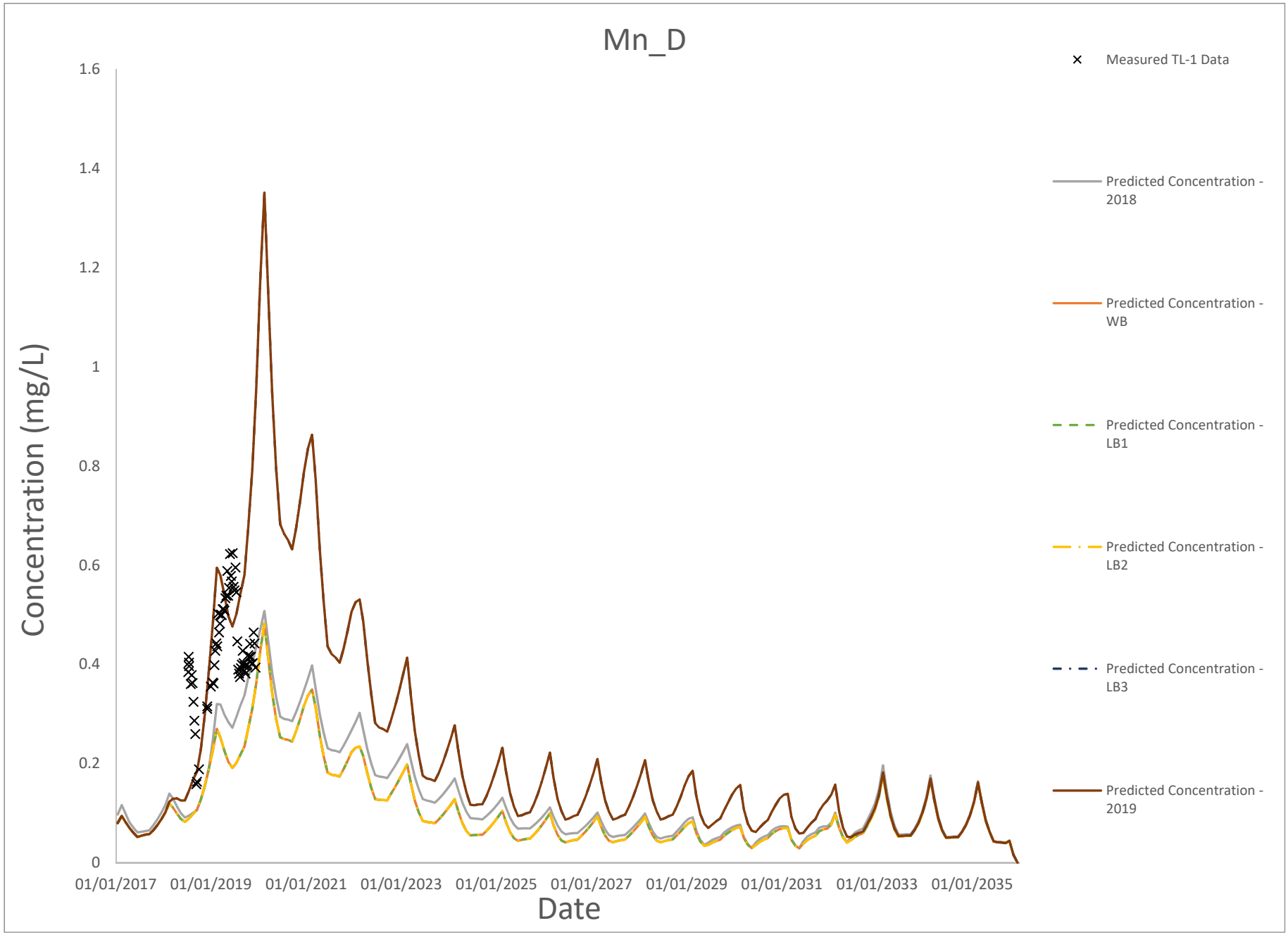

U_D
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

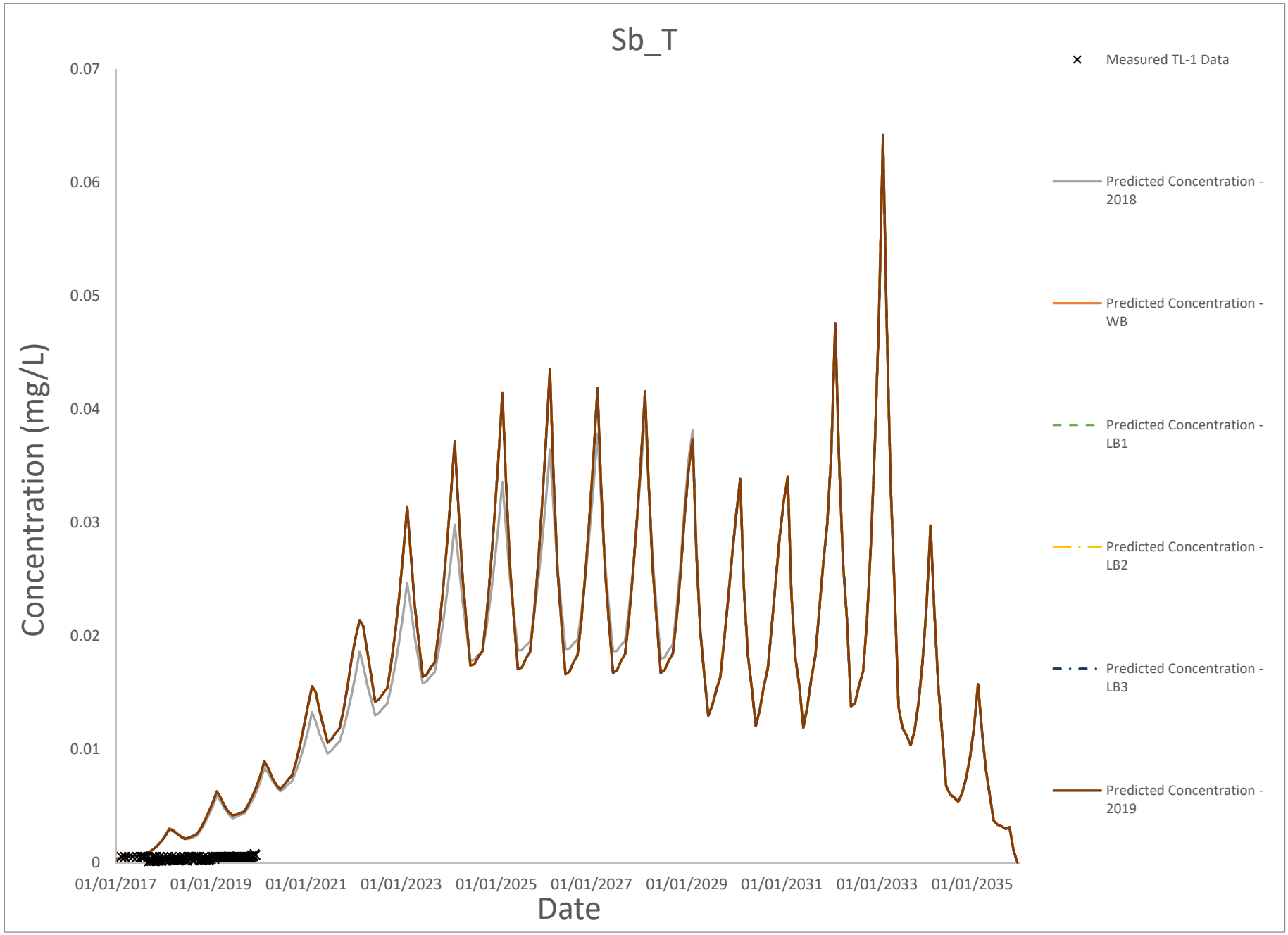

V_D
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

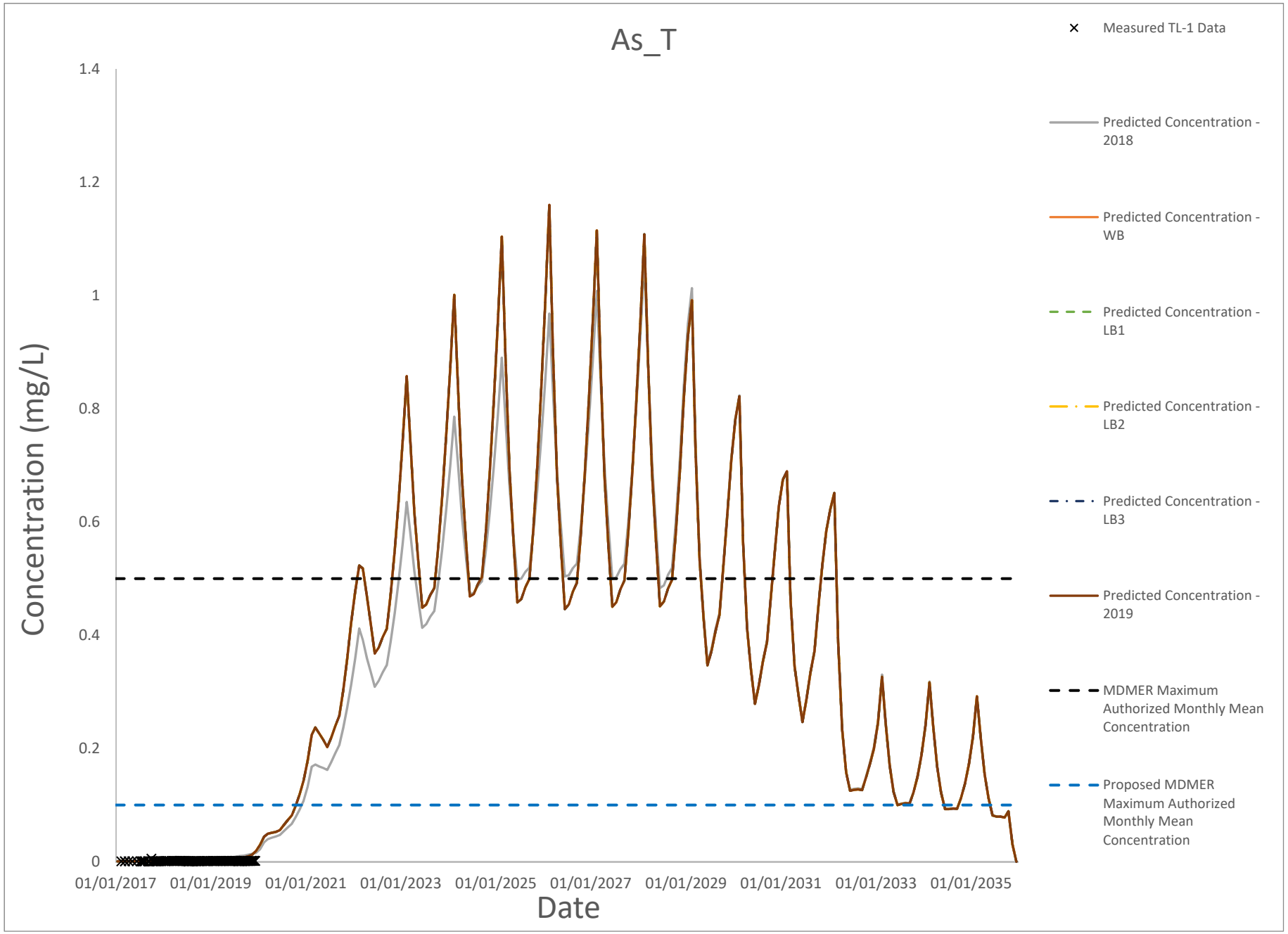

Zn_D
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

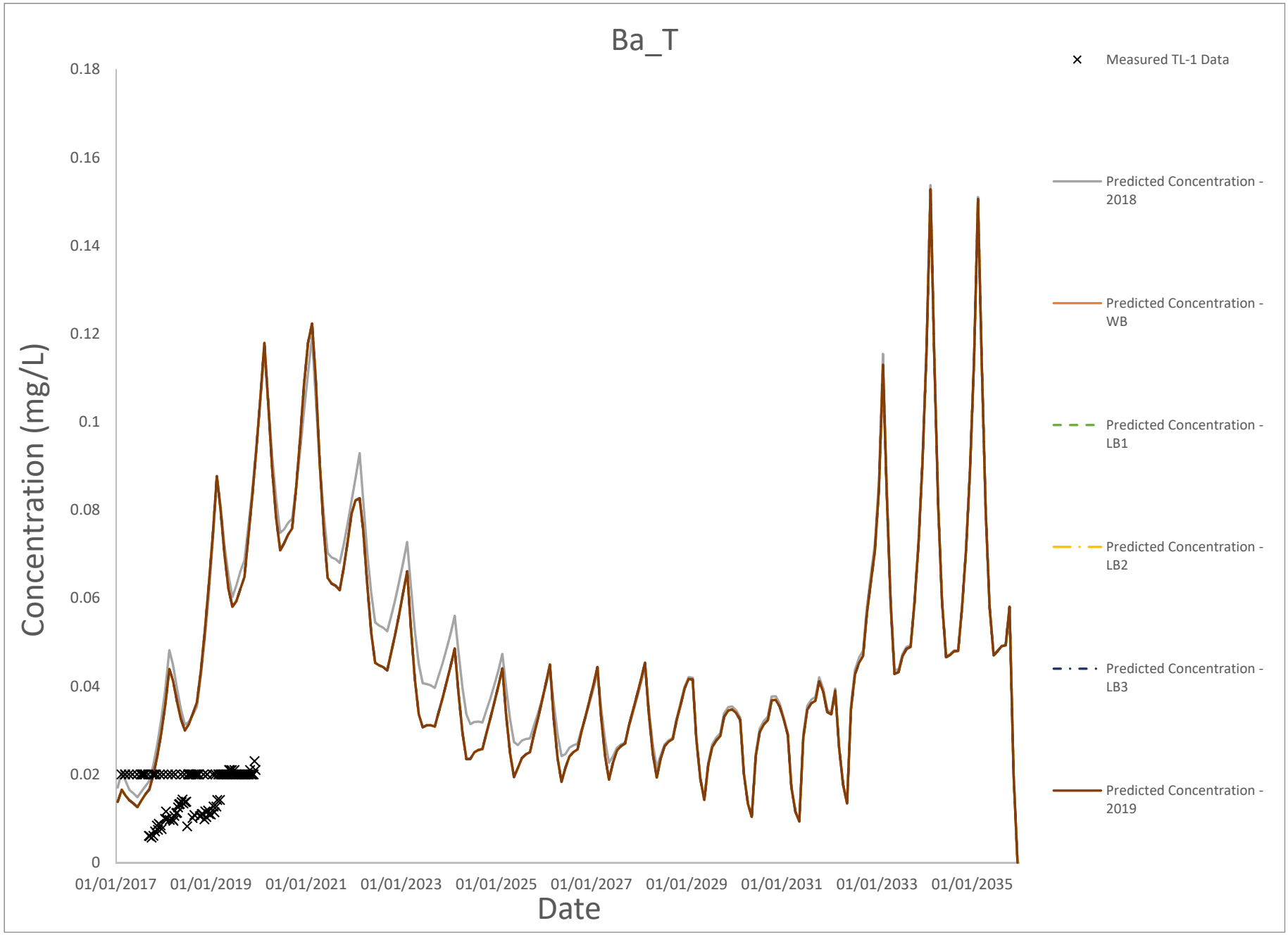

P_D
Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

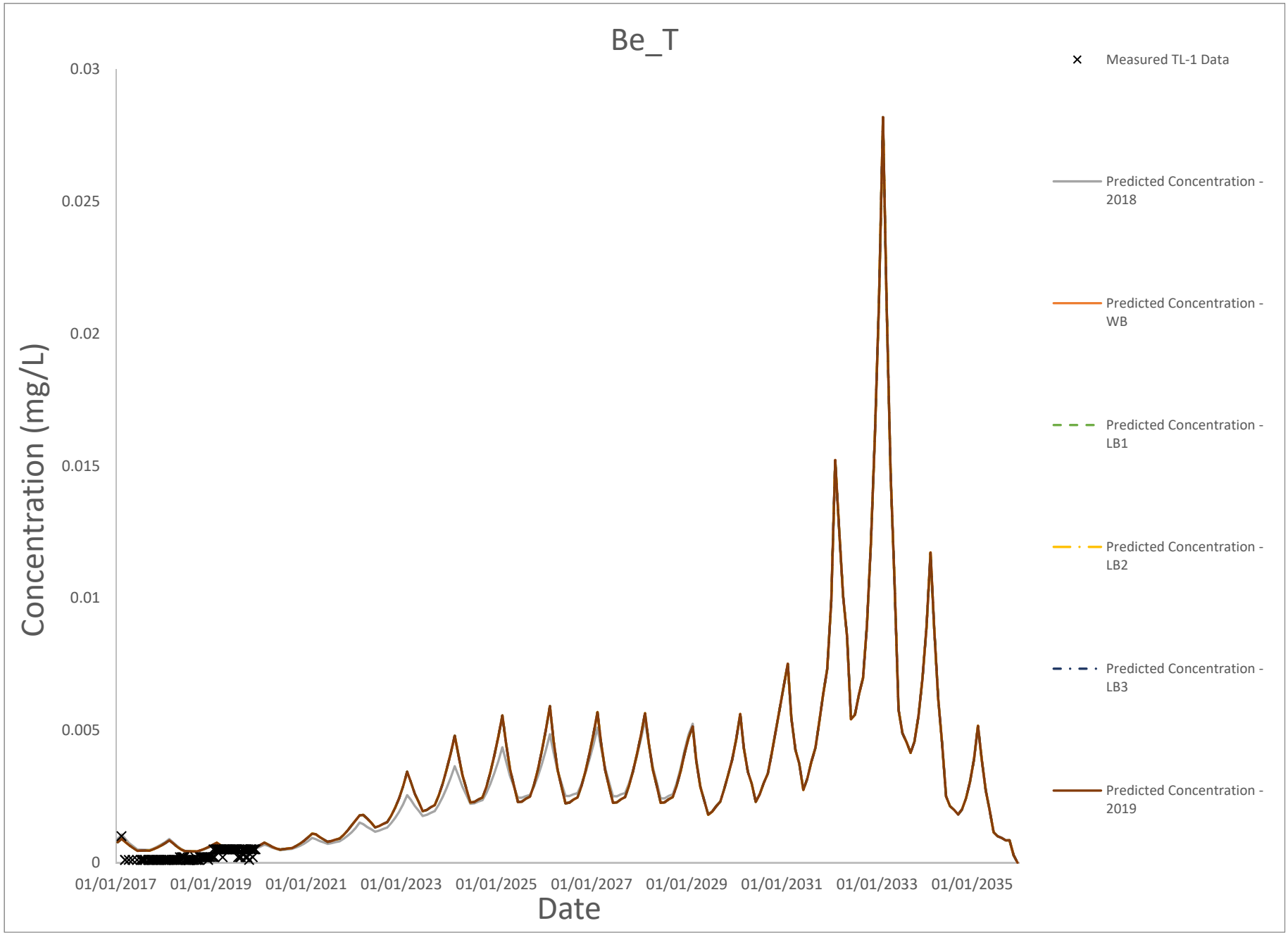

Al_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0
2
4
6
8
10
12
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

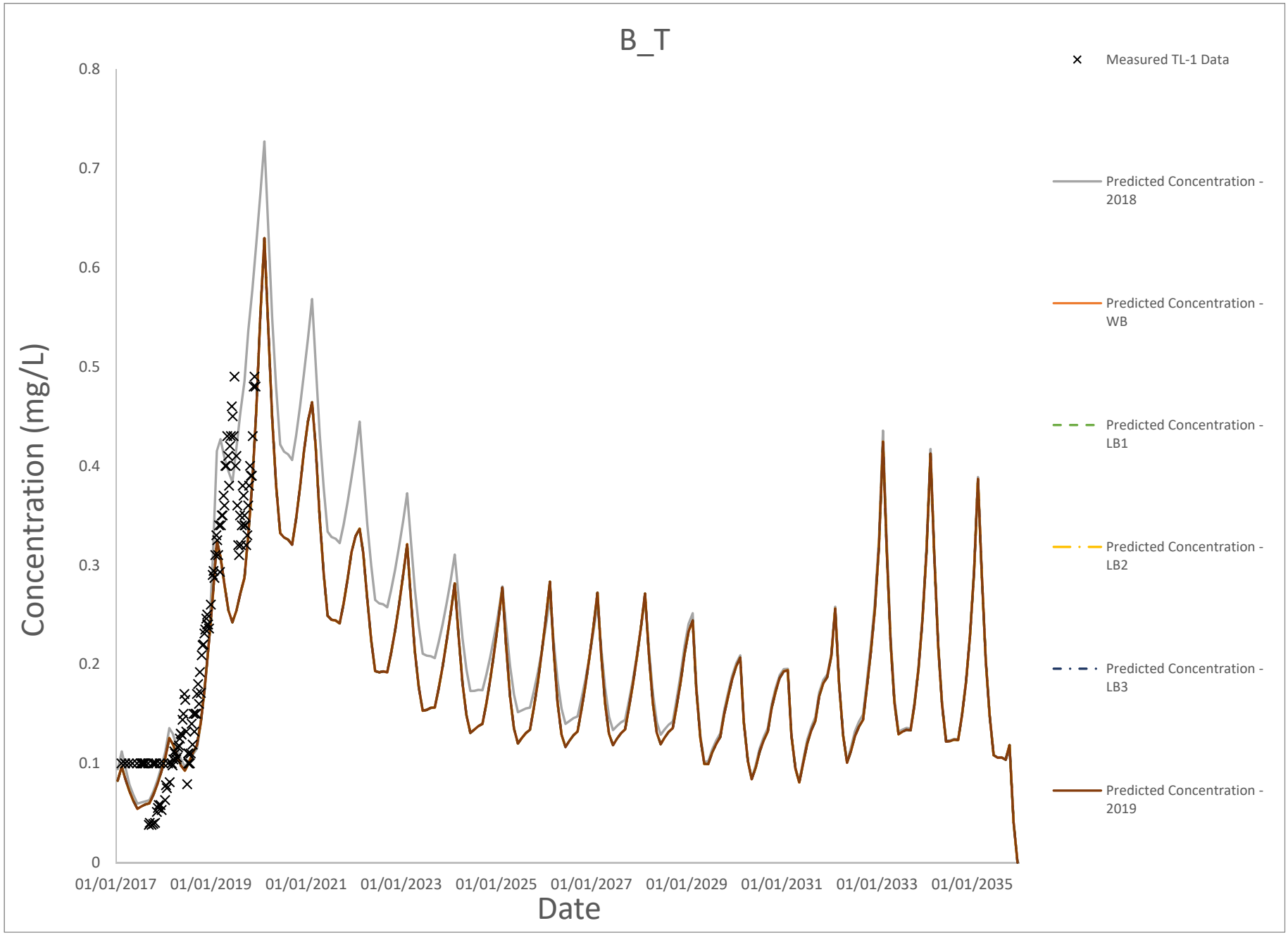

Mn_D
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

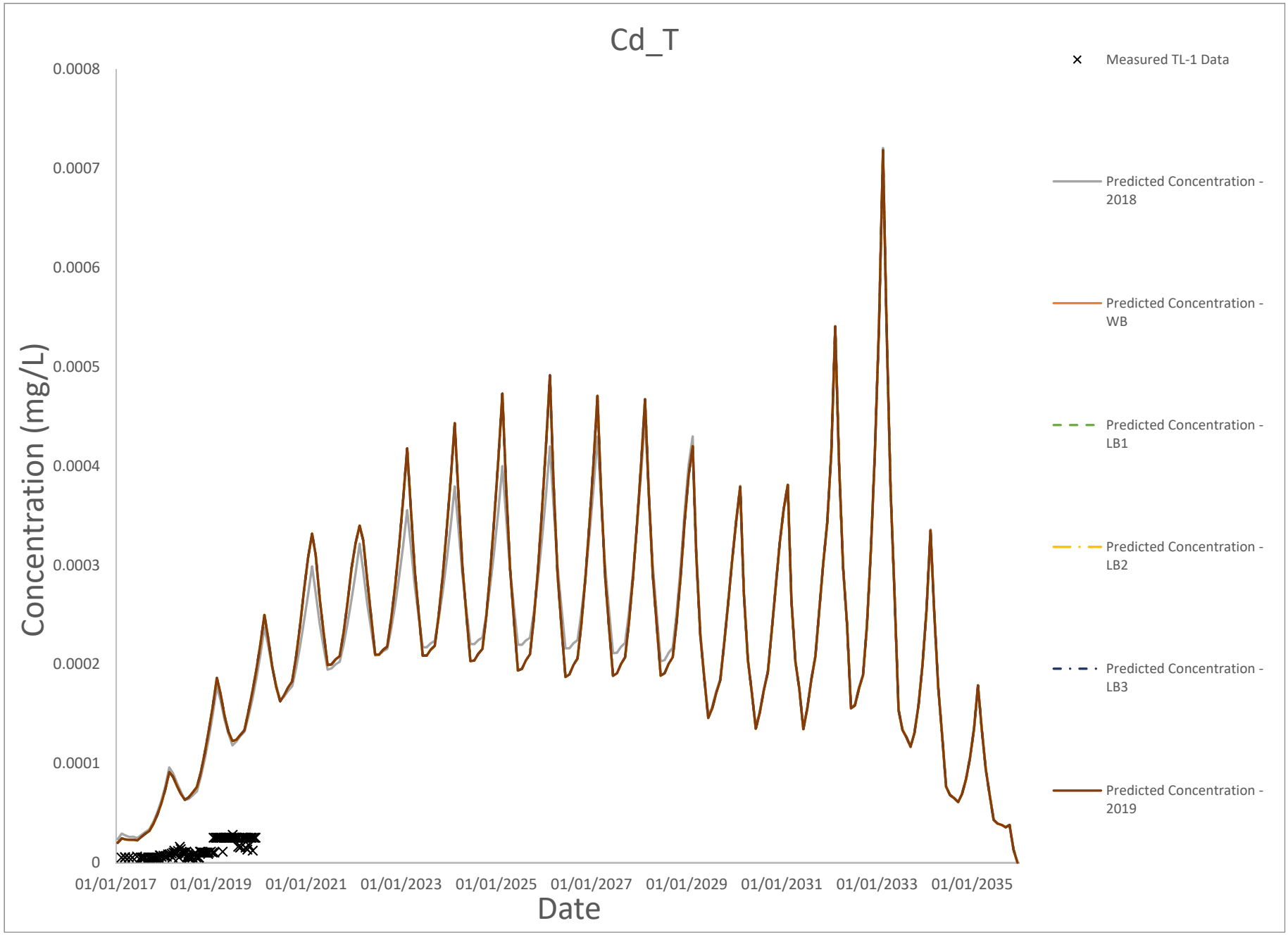

Sb_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

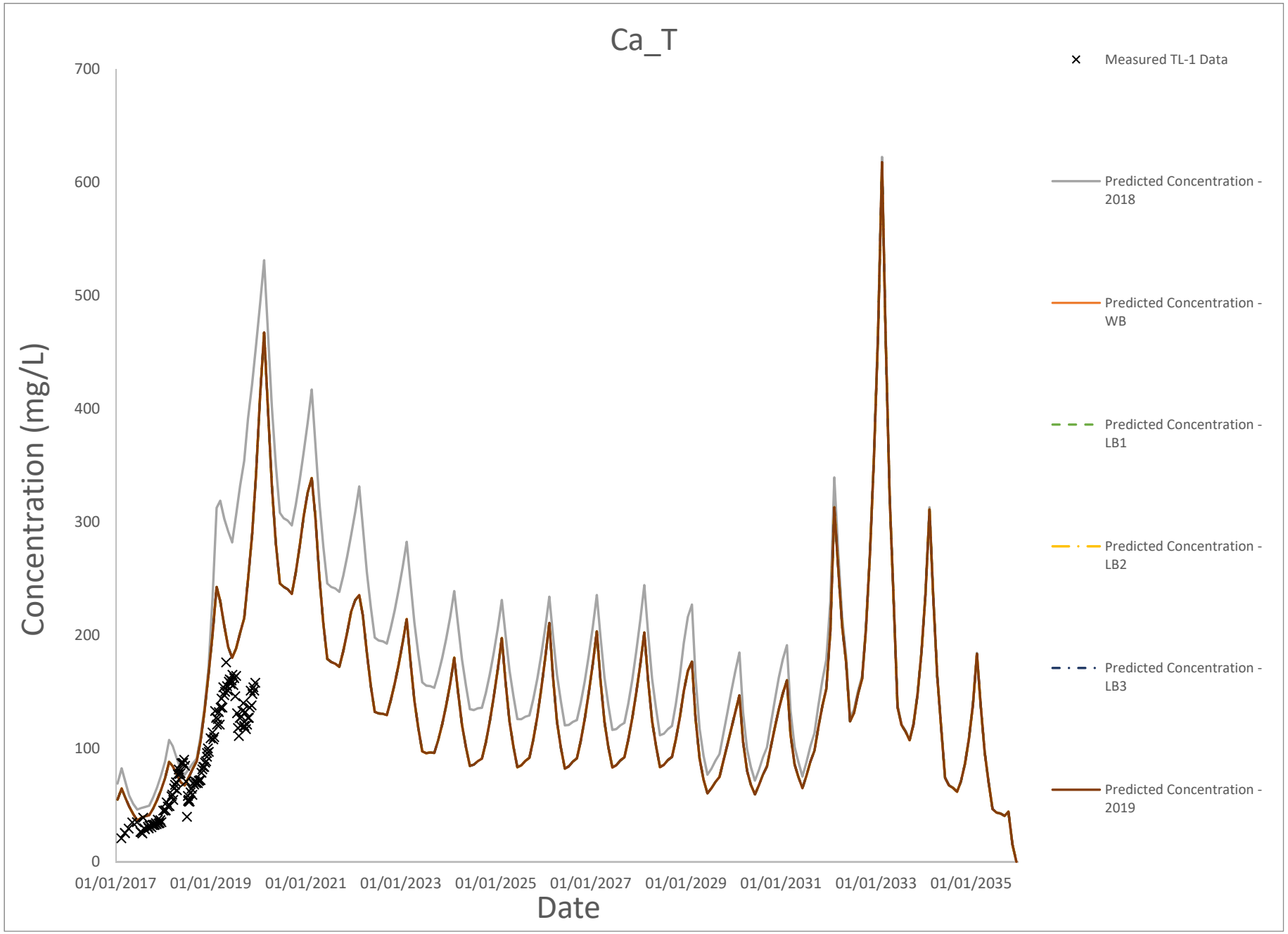

As_T
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

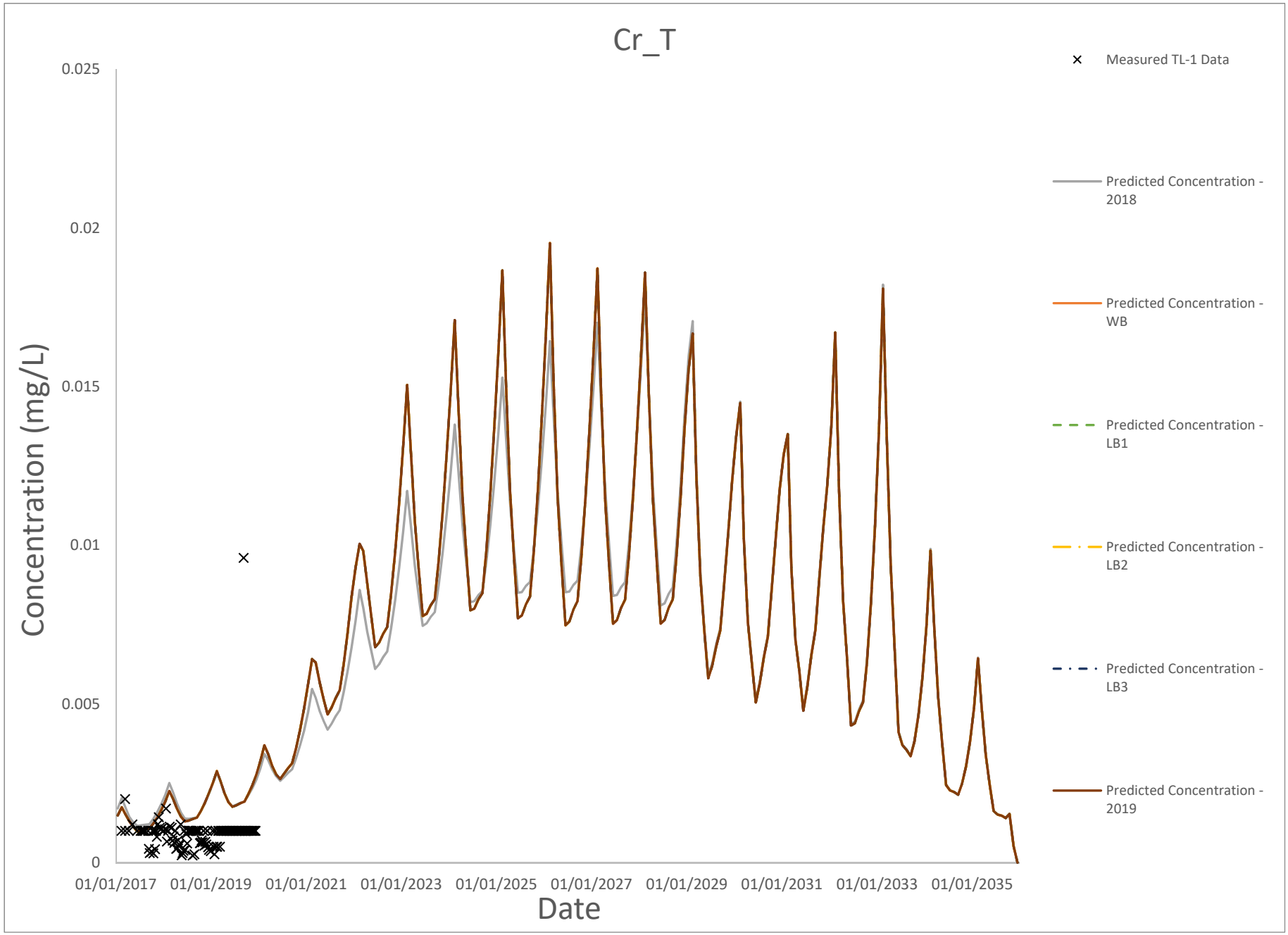

Ba_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

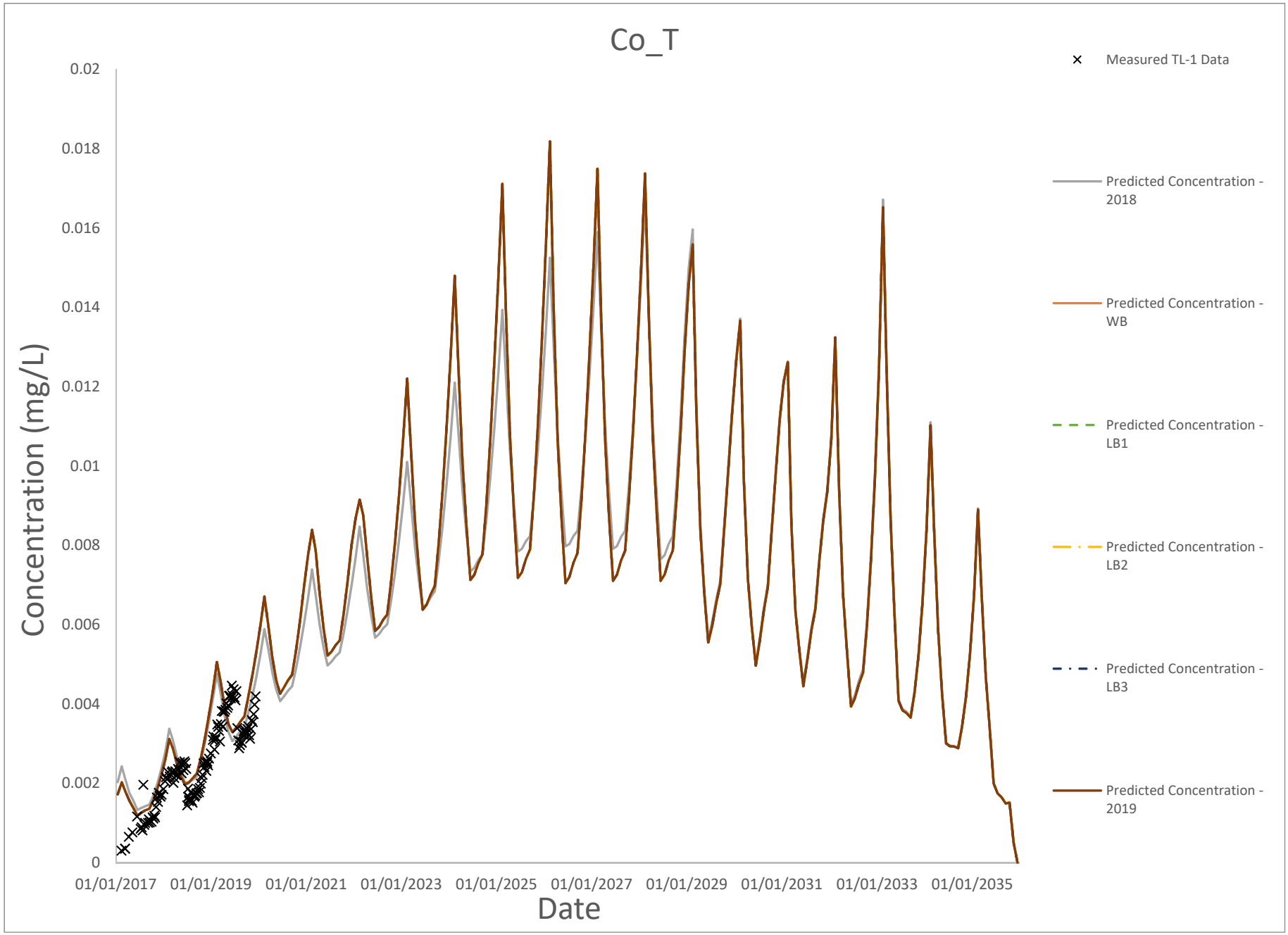

Be_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

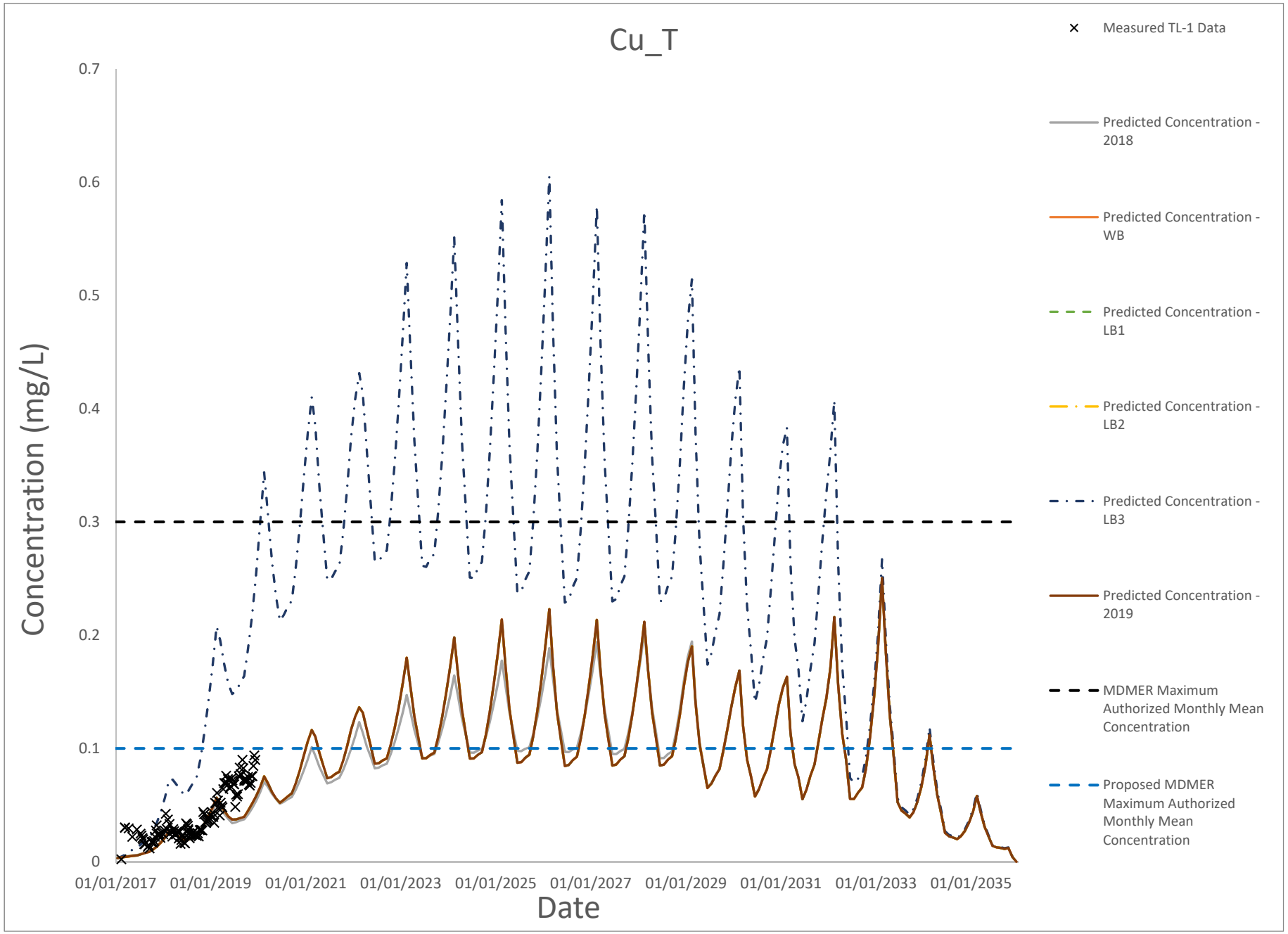

B_T
Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

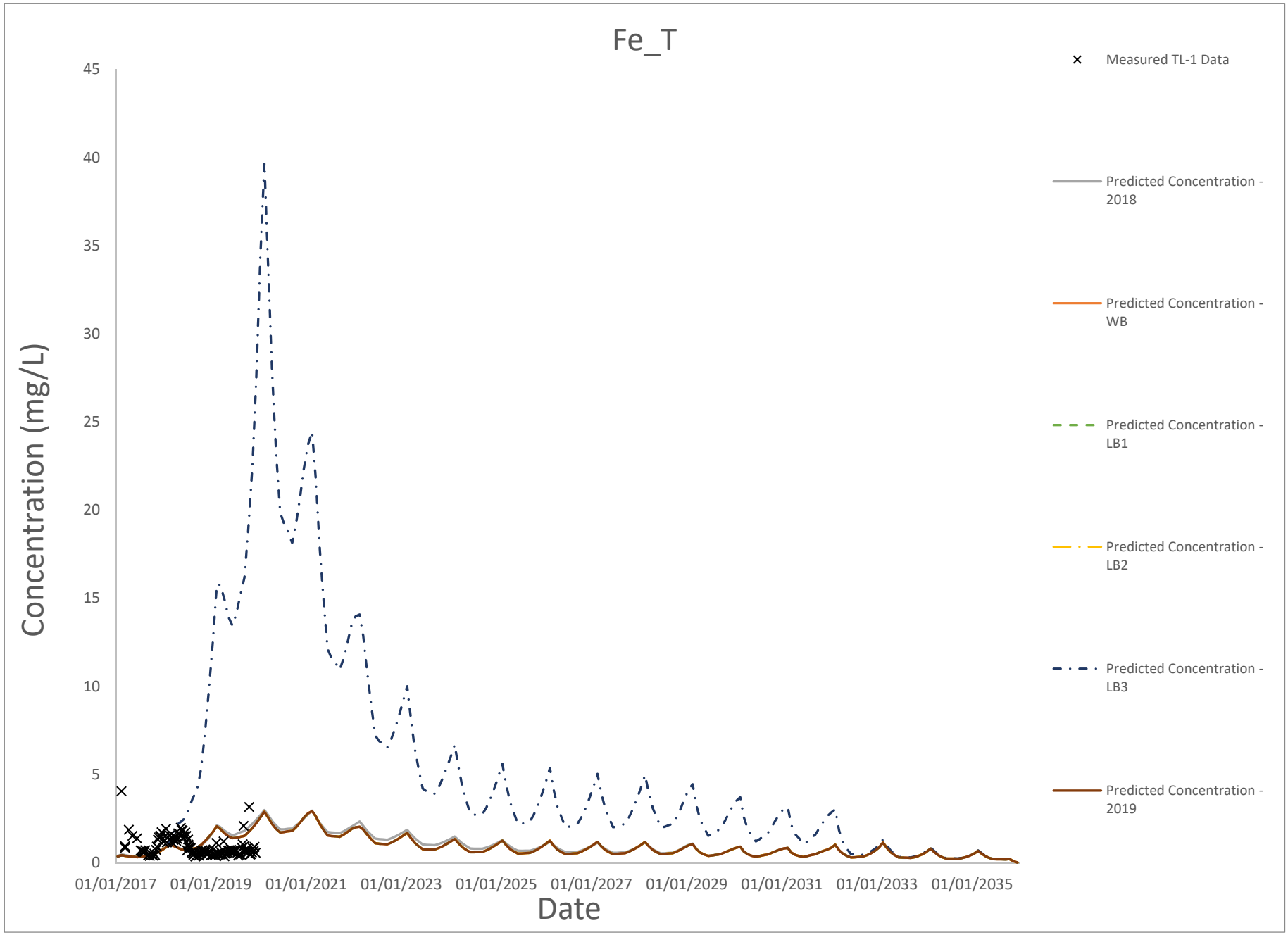

Cd_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
01/01/2017
01/01/2019
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

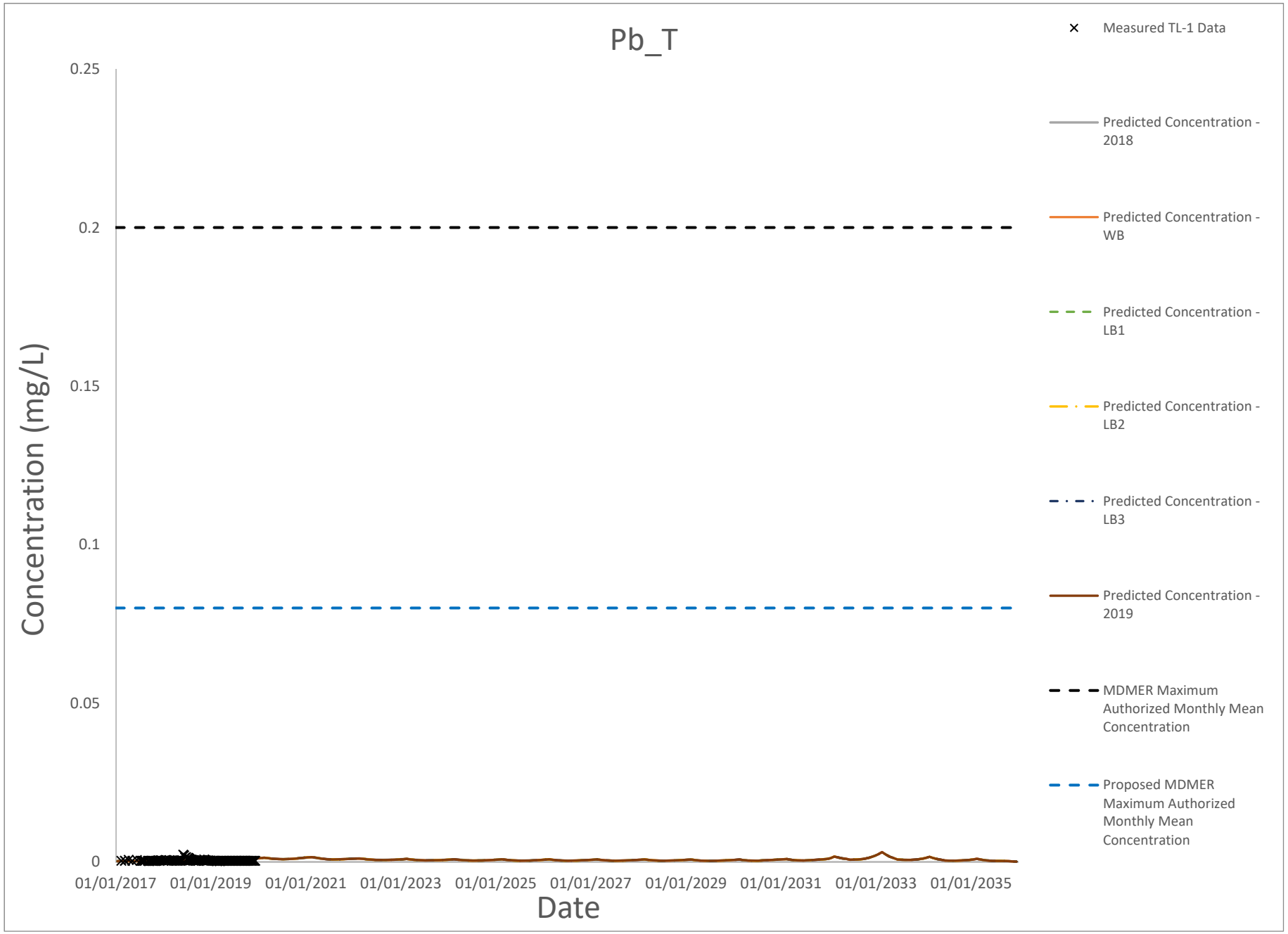

Ca_T
Concentration (mg/L)
Date
0
100
200
300
400
500
600
700
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

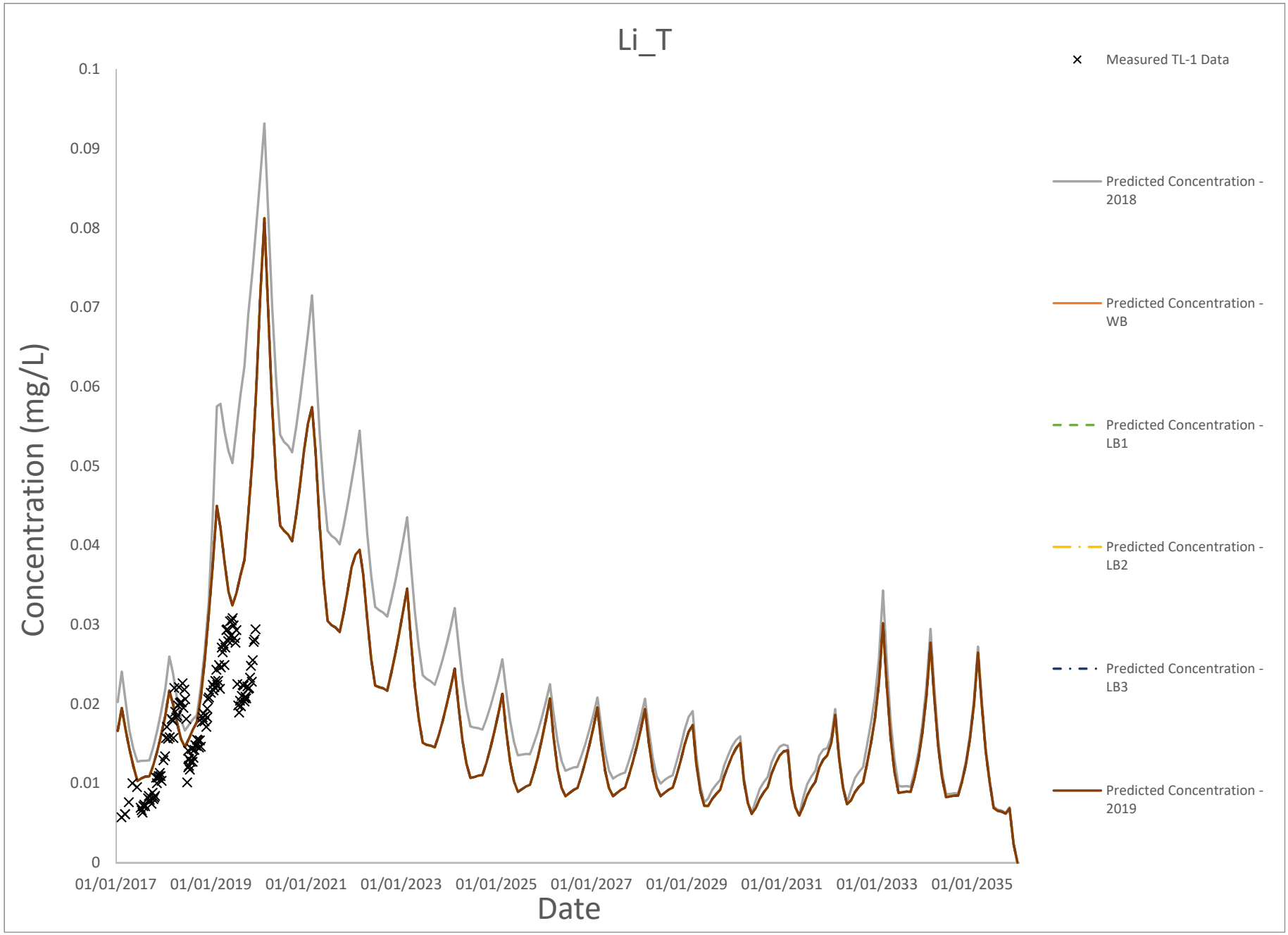

Cr_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date

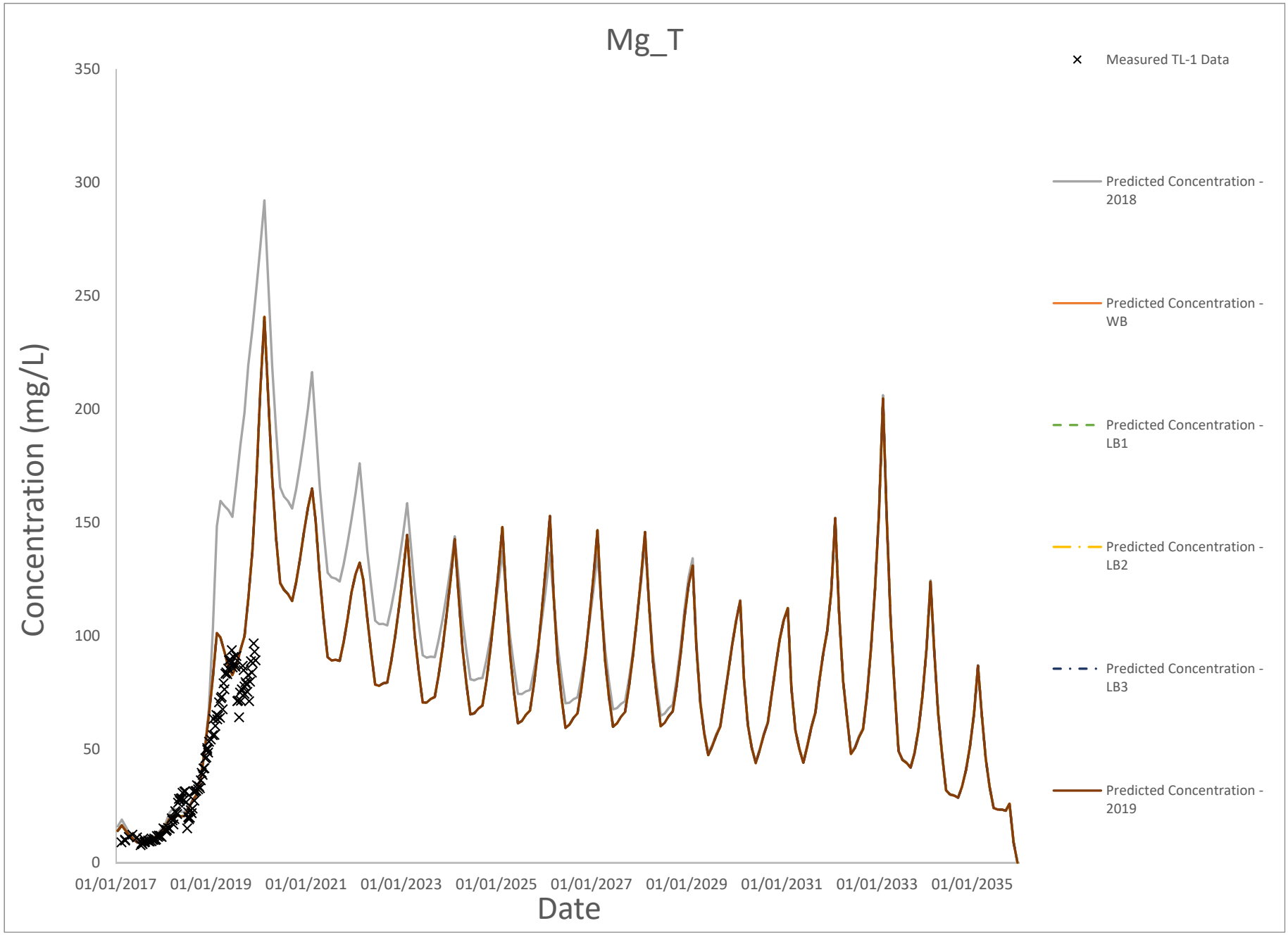

Co_T
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

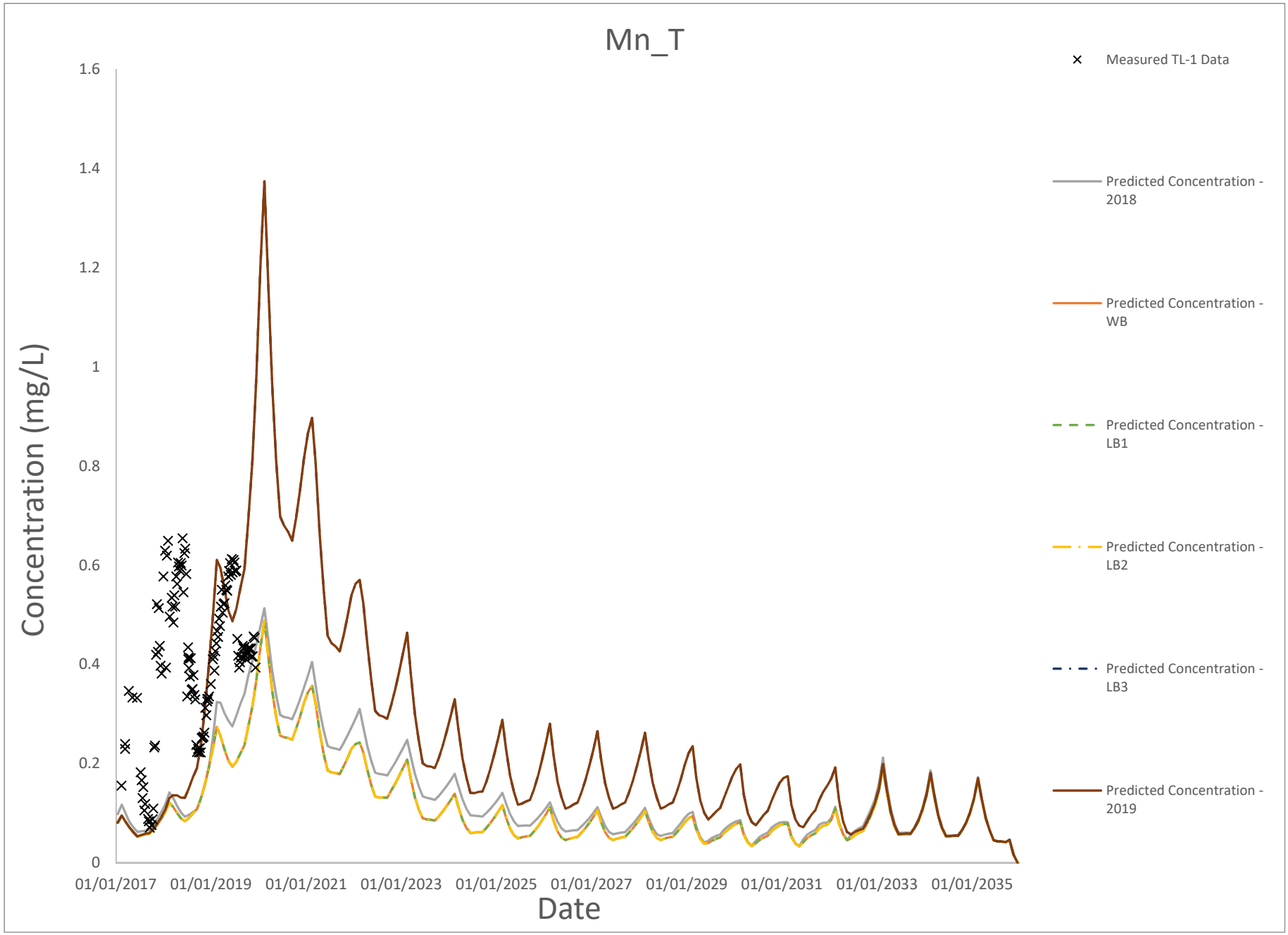

Cu_T
Concentration (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

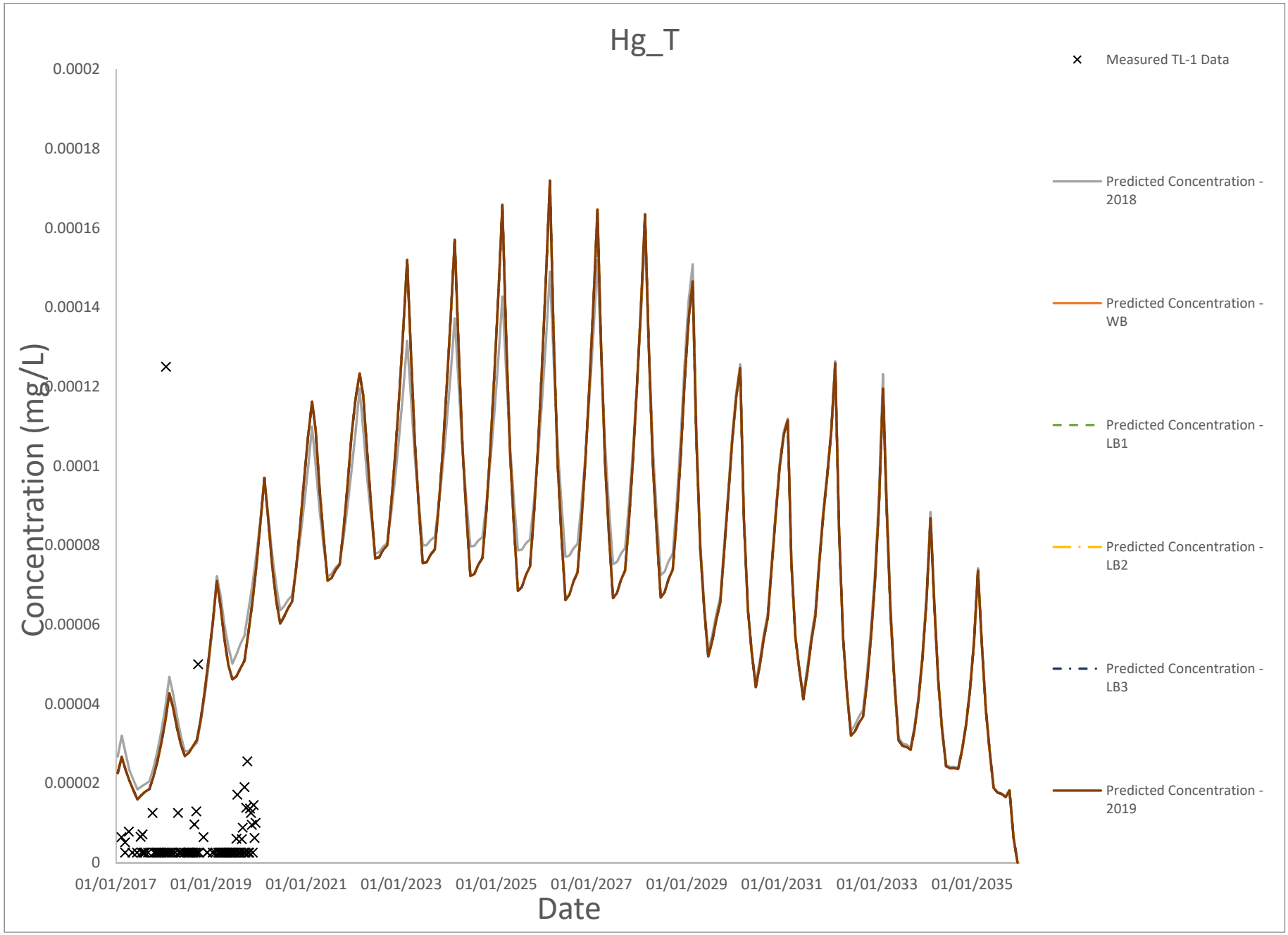

Fe_T
Concentration (mg/L)
45
40
35
30
25
20
15
10
5
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

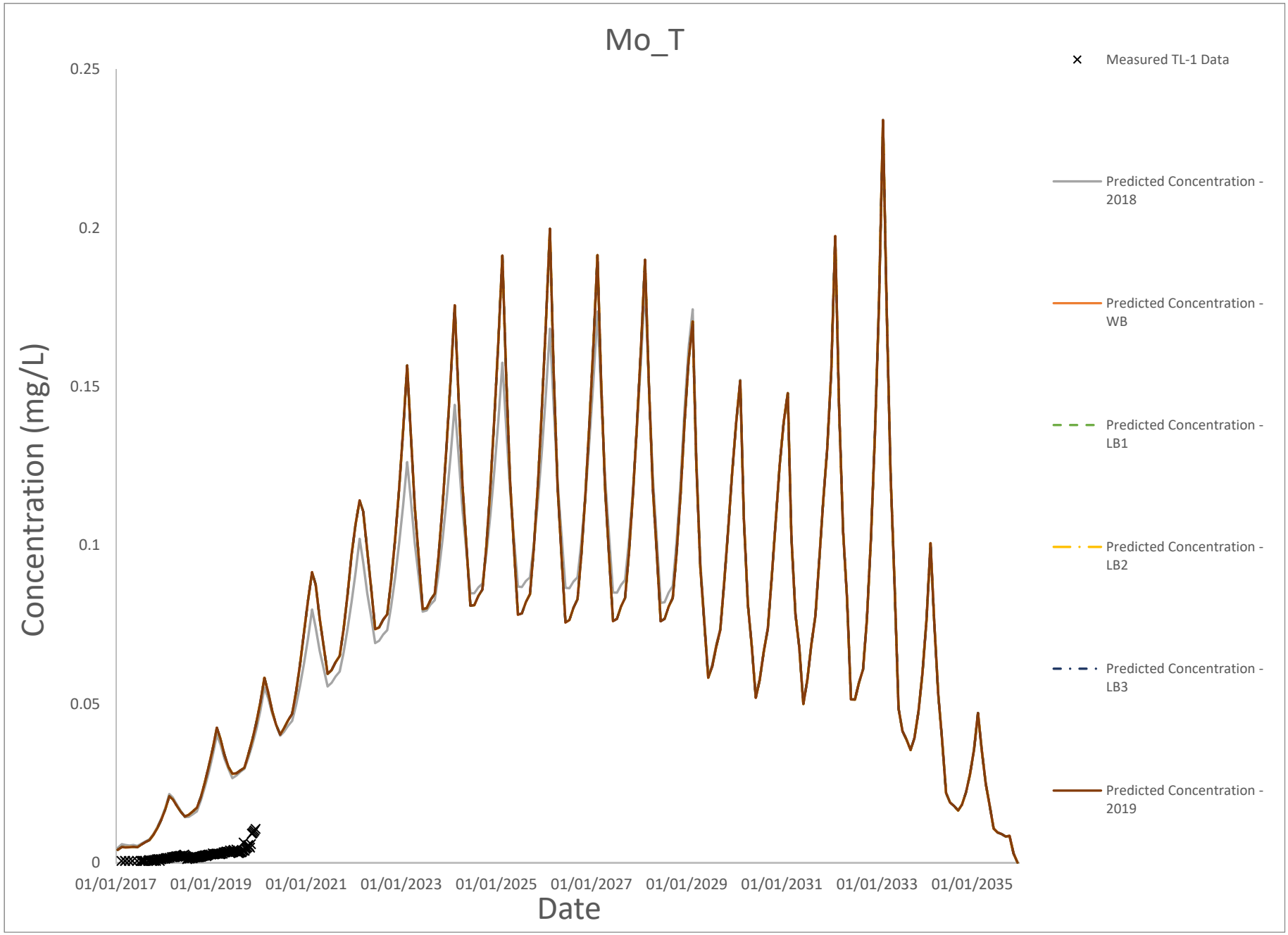

Pb_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration
Concentration (mg/L)
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

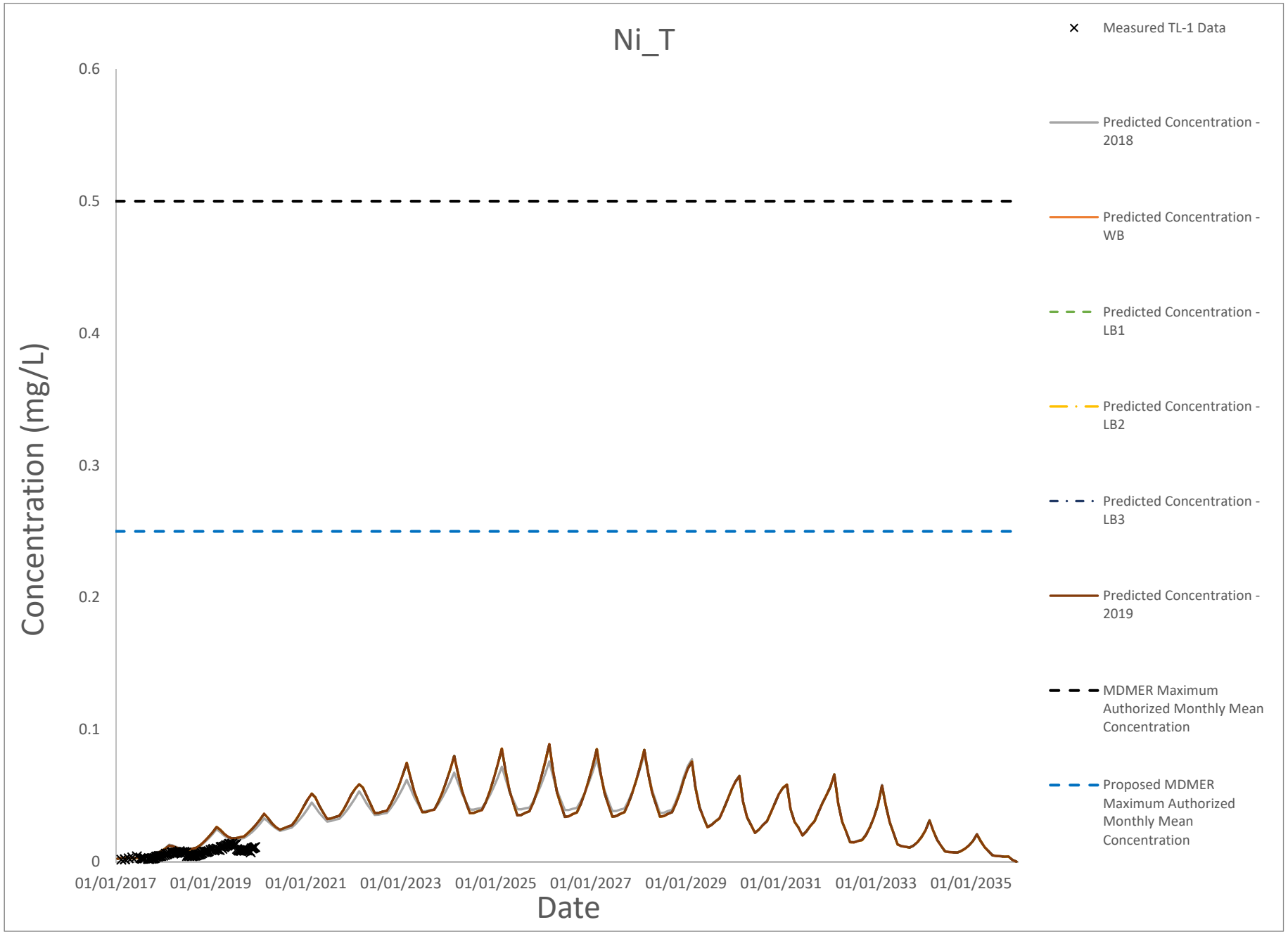

Li_T
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

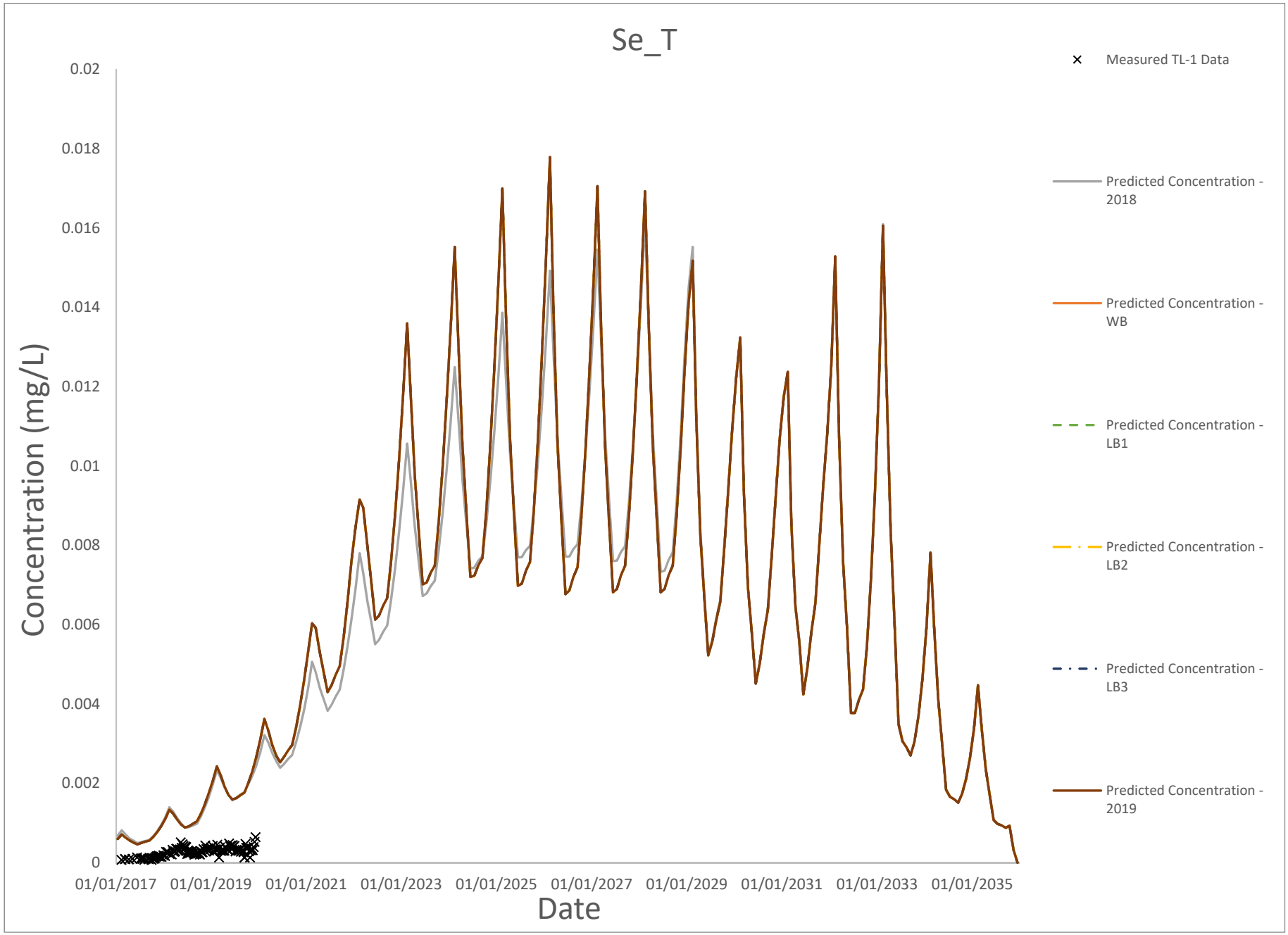

Mg_T
Concentration (mg/L)
350
300
250
200
150
100
50
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

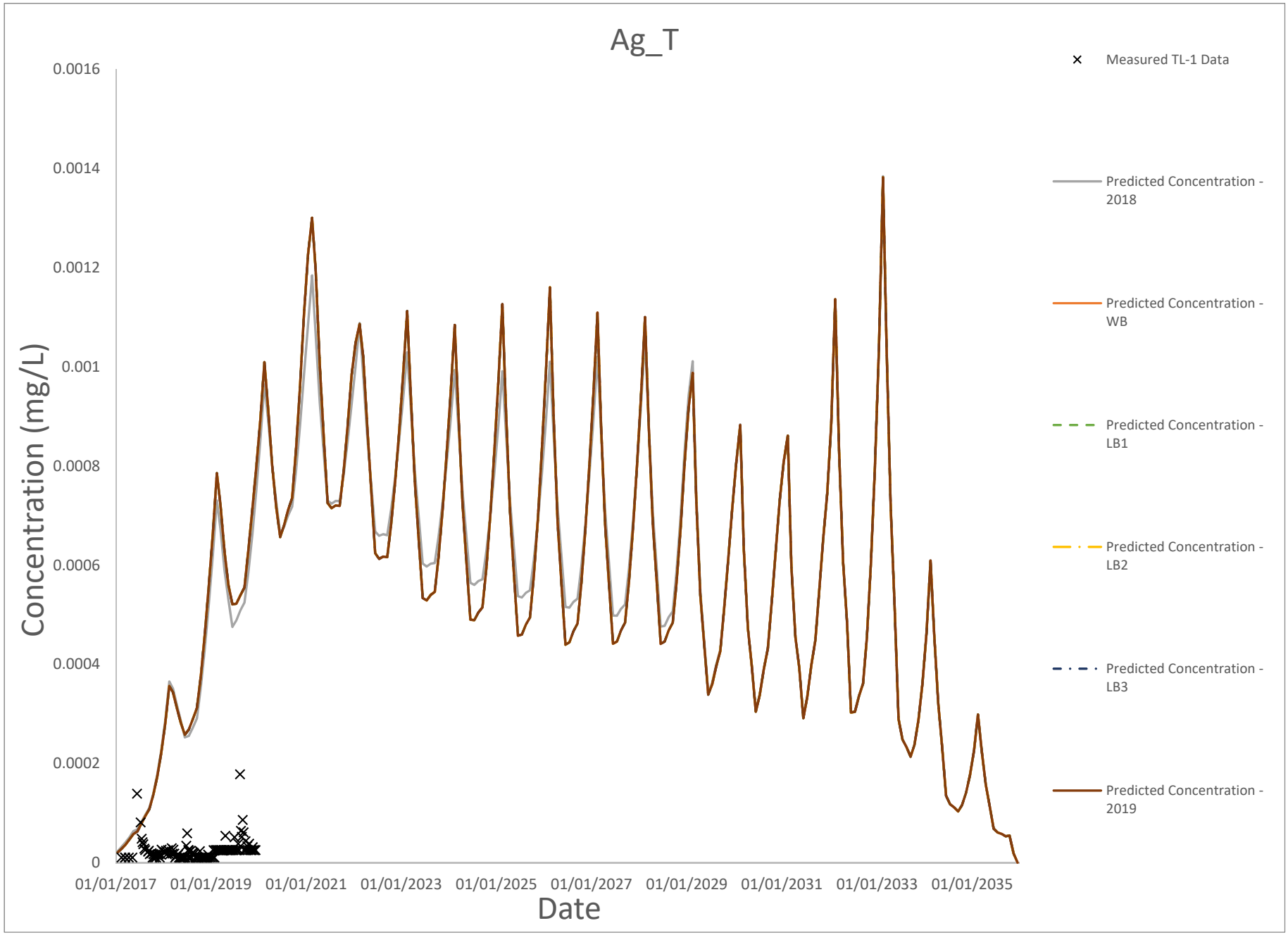

Mn_T
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

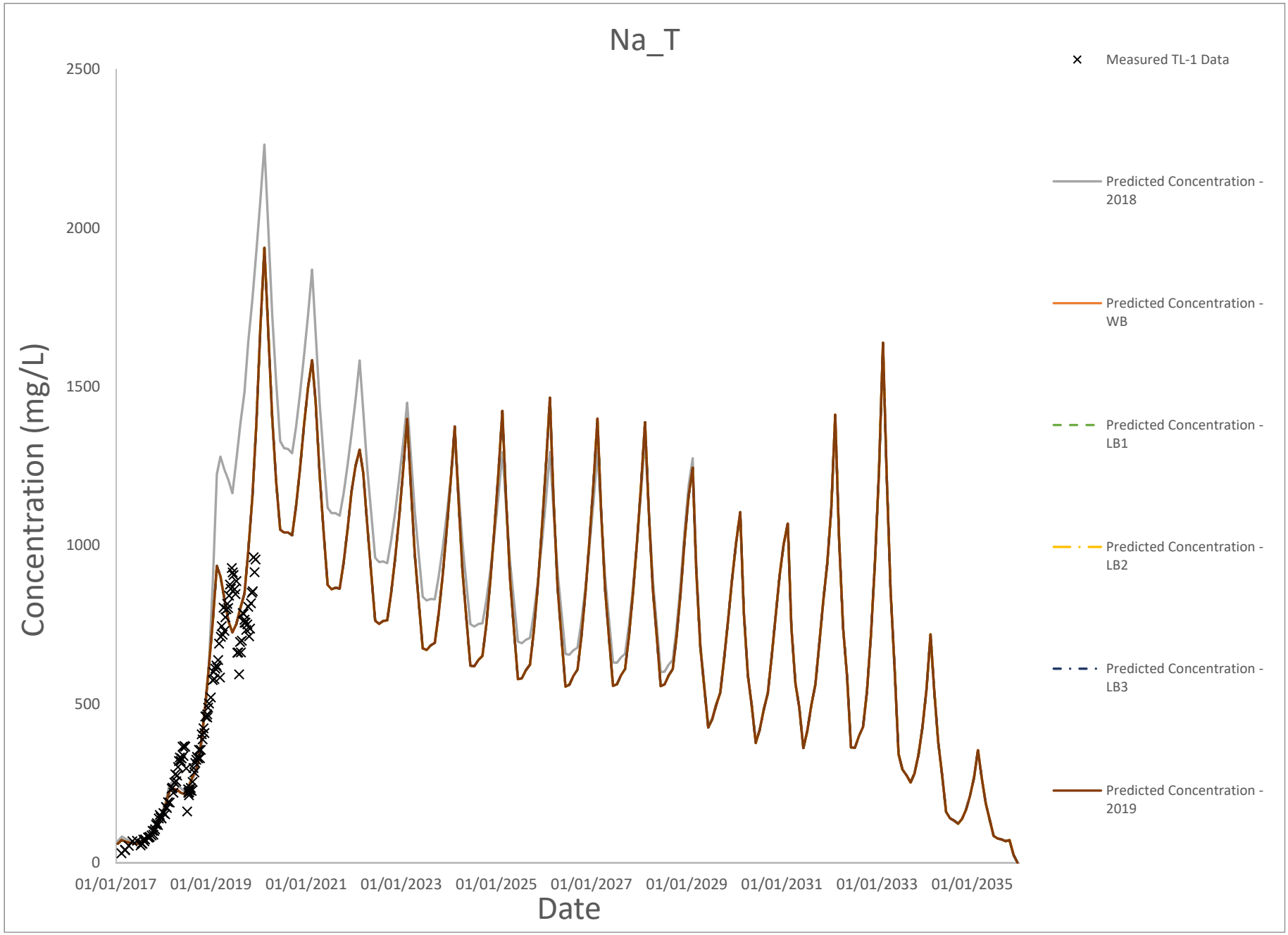

Hg_T
Concentration (mg/L)
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

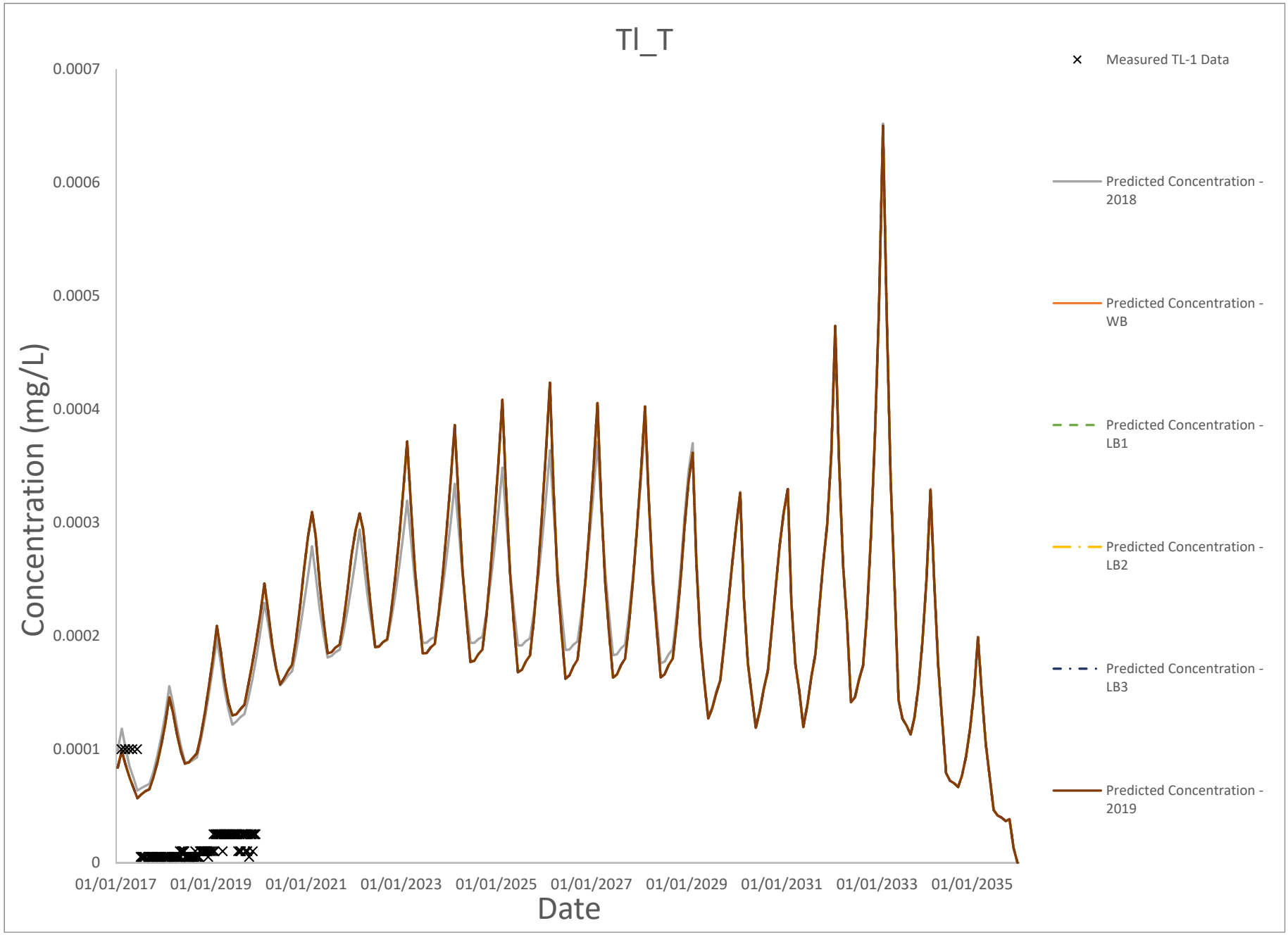

Mo_T
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019

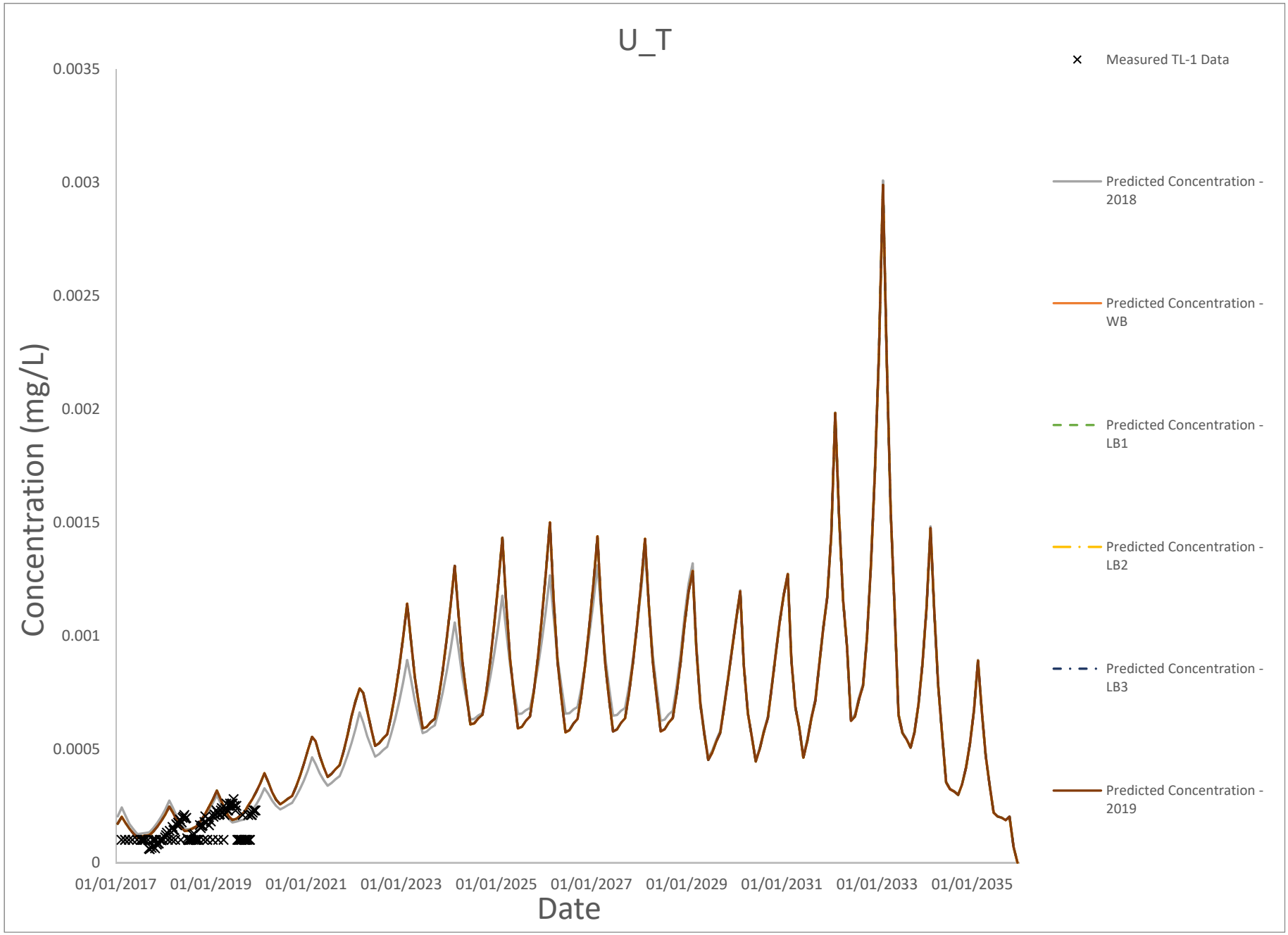

Ni_T
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
MDMER Maximum Authorized Monthly Mean Concentration
Proposed MDMER Maximum Authorized Monthly Mean Concentration

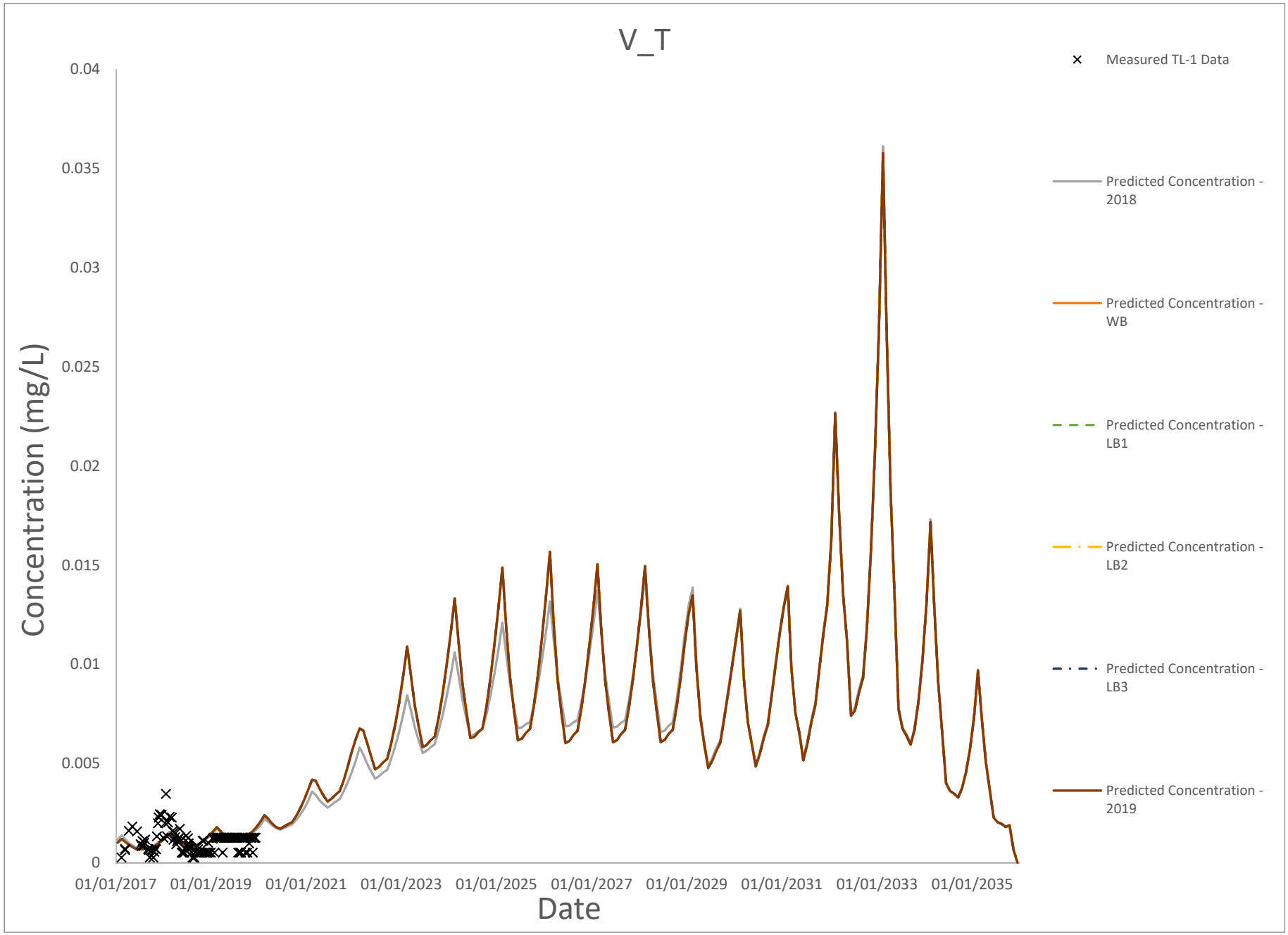

Se_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
01/01/2017
01/01/2019
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

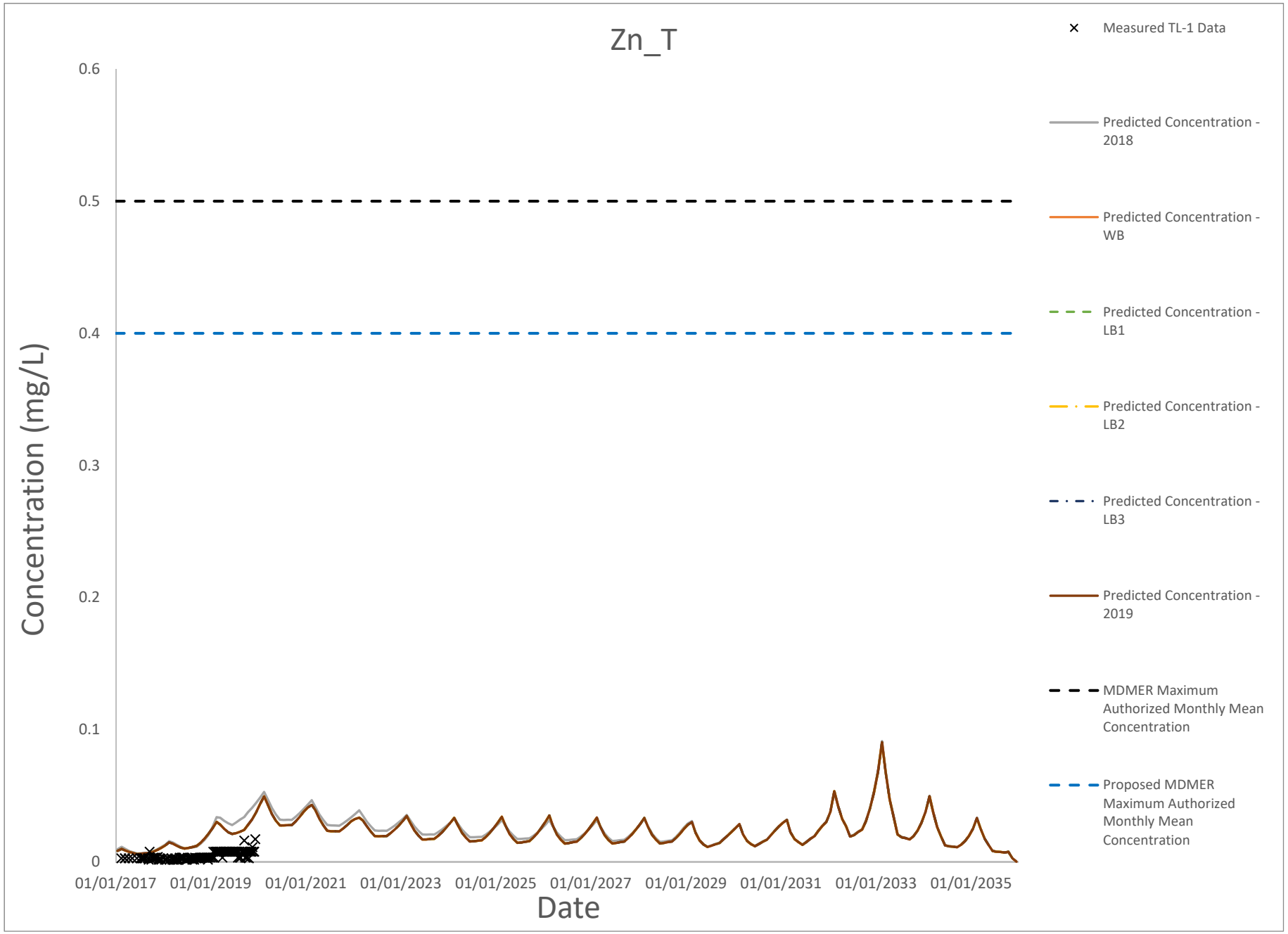

Ag_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
01/01/2017
01/01/2019
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

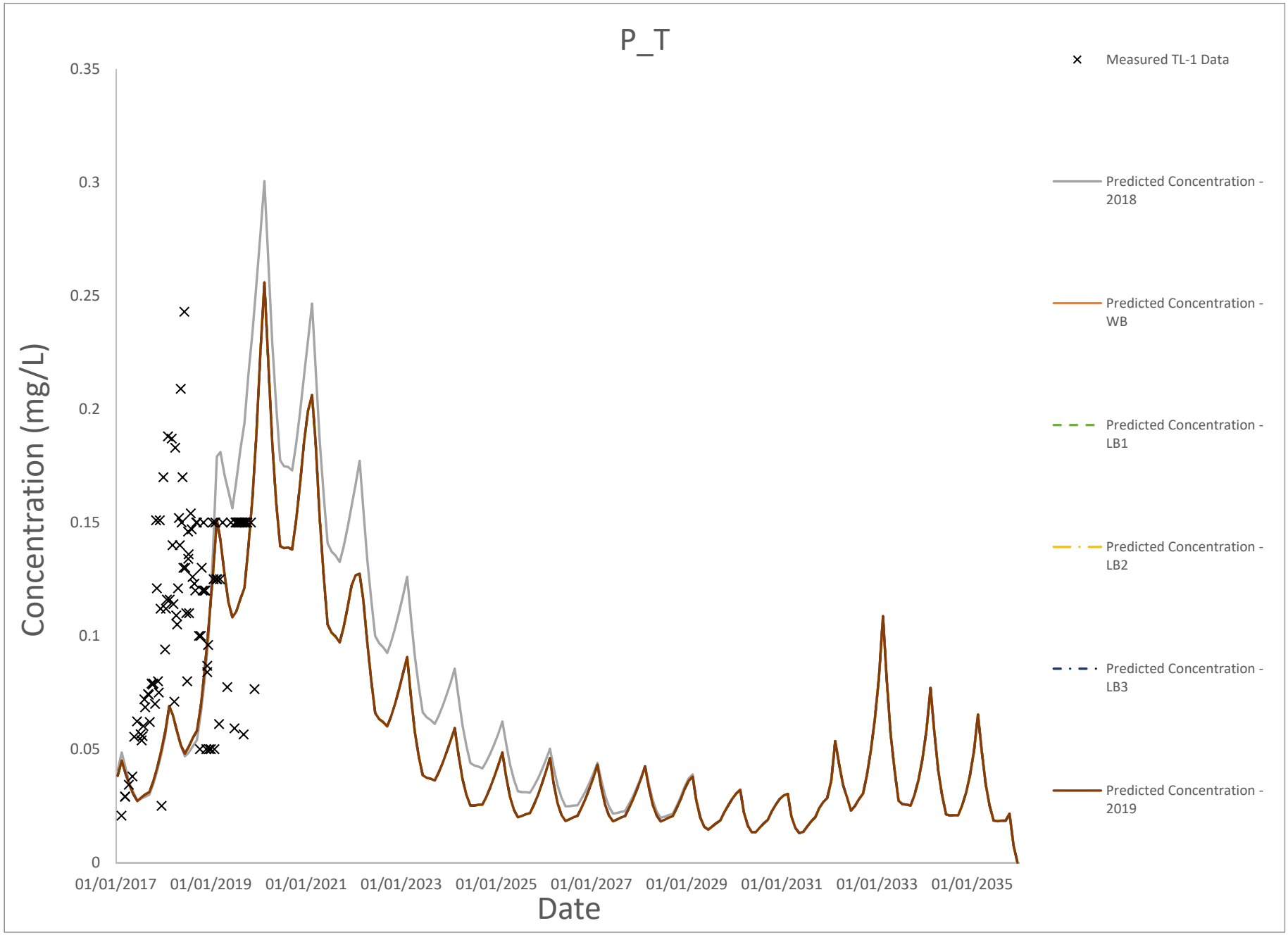

Na_T
Measured TL-1 Data
Predicted Concentration - 2018
Predicted Concentration - WB
Predicted Concentration - LB1
Predicted Concentration - LB2
Predicted Concentration - LB3
Predicted Concentration - 2019
Concentration (mg/L)
2500
2000
1500
1000
500
0
01/01/2017
01/01/2019
01/01/2021
01/01/2023
01/01/2025
01/01/2027
01/01/2029
01/01/2031
01/01/2033
01/01/2035
Date


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
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


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