Attachment 15.3

Milne Port Water Management Plan

(59 Pages)

Mary River Expansion Project

Port Surface Water Management Plan

2019-04-12	1	Approved for Use	A Grobbelaar	R Goosen	V.Lavric	T Atiba
2018-09-13	0	Approved for Use	A Grobbelaar	R Goosen	V.Lavric	T Atiba
Date	**Rev.**		**Prepared By**	**Checked By**	**Approved By**	**Approved By Client**

Table of Contents

List of Appendices

Appendix B Drawing H353004-40000-220-272-0008-0001 - Surface Water Management Plan - Milne Port

1. Introduction

This document describes the various earthworks and infrastructure features that are planned to be constructed as part of the Expansion Project and how storm water is managed as a result of the new features. This document covers the design of all surface water infrastructure required to satisfy the approved Civil Design Philosophy for the Milne Port.

Storm water management and drainage systems were applied in various locations across the site to ensure that surface water runoff will have limited interference with infrastructure at the port.

Care was taken to ensure that where possible, the existing watersheds and streams remained in their original state. This was done through the use of berms, ditches, swales and culverts.

For more detail refer to the Issued for Construction (IFC) drawings for the relevant areas. For a list of the related IFC drawings see Appendix A.

The overall layout for the Port storm water Drainage Plan can be seen in Appendix B.

2. References

2.1 General

2.1.1 All applicable federal, territorial (Nunavut) and local laws and regulations apply, in particular, the following are applicable:

- OHSA Occupational Health and Safety Act
- CSA Canadian Standards Association
- MHSA Mine Health and Safety Act (Nunavut – S.N.W.T. 1994)
- OHSR Occupational Health and Safety Regulations
- NBCC National Building Code of Canada (2010)
- ASTM American Society for Testing and Materials
- ASCE American Society of Civil Engineers
- NFPA National Fire Protection Association
- NRC Natural Resources Canada – Explosives Safety and Security Branch

2.2 Reference Documents

Reference is made to the contents of the following documents, articulated during the previous phases of the project and the current phase:

- H353004-00000-200-210-0001: Civil Design Philosophy
- H337697-0000-10-122-0001: Storm Water Management and Drainage System Design
- H337697-6170-10-122-0001: Milne Port Drainage System and Storm Water Management Ponds
- H337697-6170-10-122-0002: Mine Site Drainage System, Storm Water and Sediment Management
- Standard Specification H353004-00000-260-200-0001: Quarried Fill Materials
- Standard Specification H353004-00000-200-078-0008: Site Conditions
- NB 102-181/30-7: Baseline Hydrology Report, Knight Piesold, Jan 04, 2012
- Updated Design Peak Flow Assessment. Knight Piesold, 2016
- Final Environmental Impact Statement (FEIS), Mary River Project, February 2012
- H353004-00000-228-066-0001: Mary River – Snowmelt and Rainfall Frequency Analysis.
- H353004-40000-200-210-0001: 2018 Water Management Report.

3. Overview

This document is divided into different areas of interest. The areas are grouped as follows:

- Rail Dumper drainage area that consists of the rail yard, dumper and storm water diversions berms / canals / ditches in the area.
- Ore Processing drainage area which will include the feed stockpile pad as well as the crushing and screening pad. This area will also include for laydowns that are constructed next to the areas and storm water diversions required as a result.
- Stockpile No.1 drainage area that will include the extension of the existing Stockpile and the upgrade/modifications to the existing settling pond No.1 as well as No.2 and associated storm water infrastructure.
- Stockpile No.2 drainage area that will include the stockpiles, stacker reclaimer berm, maintenance area, eastern berm and the western berm.

- Roads drainage areas will be grouped together. These include various access roads, existing road modifications and larger bypasses.
- Balance of Work drainage areas. All other areas not covered in the above mentioned shall be referred to as the balance of work and will include a number of laydown areas, accommodation camp pad and some storm water diversions.

The layout of the various drainage areas above is depicted in Figure 3-1 below.

General principles applied to the drainage management plan are as follows:

- All hydraulics designs where done using software from Bentley “Flow Master” or “HEC-Ras” by the USA Army Engineering Core.
- Where velocities in channels or ditches are above 1.5m/s, erosion protection is provided through placement of rip rap (Stone pitching).
- Erosion protection is provided at all concentrated discharge points i.e., culvert / channel / ditches exits into the environment. The protection is in the form of rip rap.
- Culverts are Corrugated Steel Pipes (CSP) unless otherwise stated.

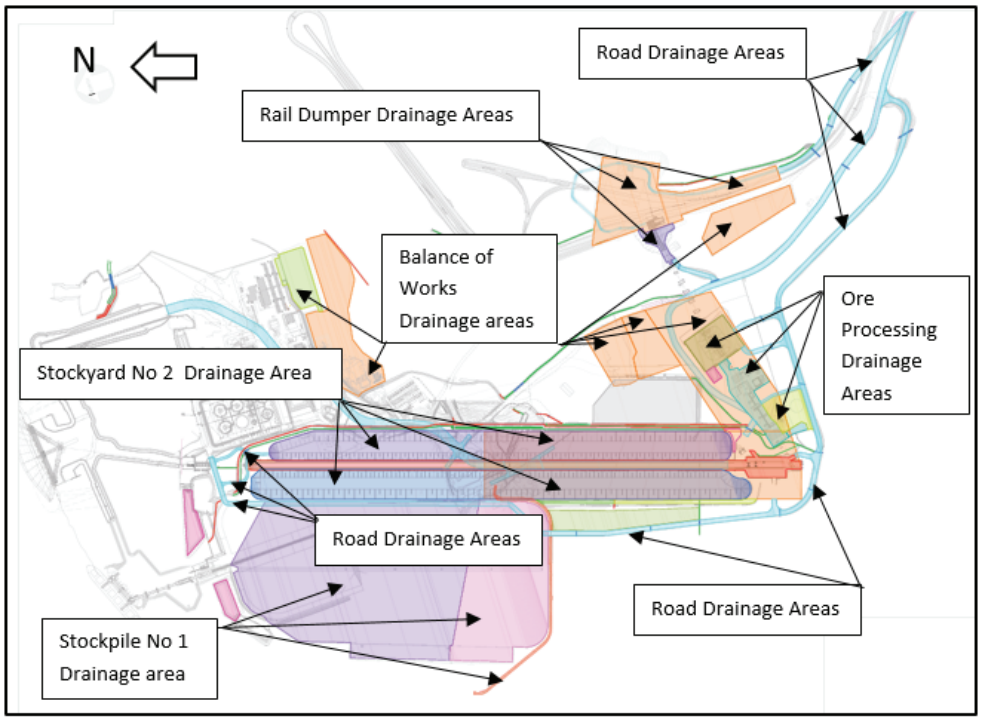


Figure 3-1: Port Drainage Areas

4. Rail Dumper Area Drainage

This section describes the drainage for the Rail Yard, Dumper and cut-off drains P-SWD-5 and P-SWD-6.

4.1 Rail Yard

The rail yard is to be constructed close to where the existing quarry (Q1) is located. Due to the grading requirements for the railway, the majority of the rail yard terrace is flat. Where possible, the terrace is graded away from the facilities to facilitate natural overland drainage. It is then collected in a cut-off ditch and diverted towards storm water diversion P-SWD-5.

Figure 4-1 shows the rail yard drainage.

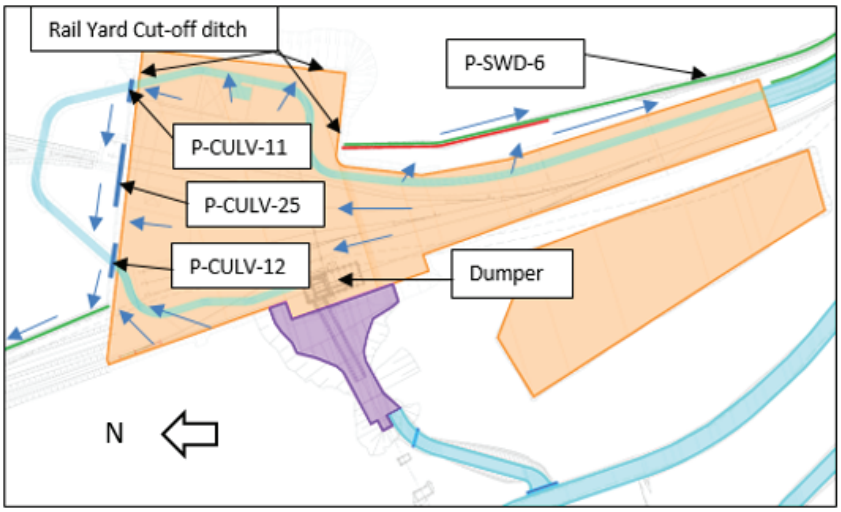


Figure 4-1: Rail Yard Drainage Plan

The rail yard terrace cut-off ditch was designed and analysed with the following results:

- Bottom Width - 1m
- Side Slopes - 1V:1.5H
- Flow - 1.621 m^3/s
- Velocity - 1.43 m/s (no rip rap required).

The rail yard cut-off ditch crosses the future railway formation and the Railyard Workshop bypass road with 1200mm diameter culverts (see P-CULV-25, P-CULV11 and P-CULV 12 in Figure 4.1). The culverts have widenings and rip rap upstream and downstream of each culvert. This will be constructed when the railway & bypass road are constructed.

Where storm water flow velocities are modelled above 1.5m/s, adequate rip rap protection against erosion is provided as per drawing titled “Site Wide – Standard Drawing – Earthworks & Drainage Details” No. H353004-00000-221-294-0006-0001.

Two nominal 600mm diameter culverts are designed beneath the southern end of the rail yard to drain water that accumulates between the rail terrace and P-SWD-6.

4.2 Rail Car Dumper

The drainage for the rail car dumper is shown by the flow direction arrows in Figure 4-2.

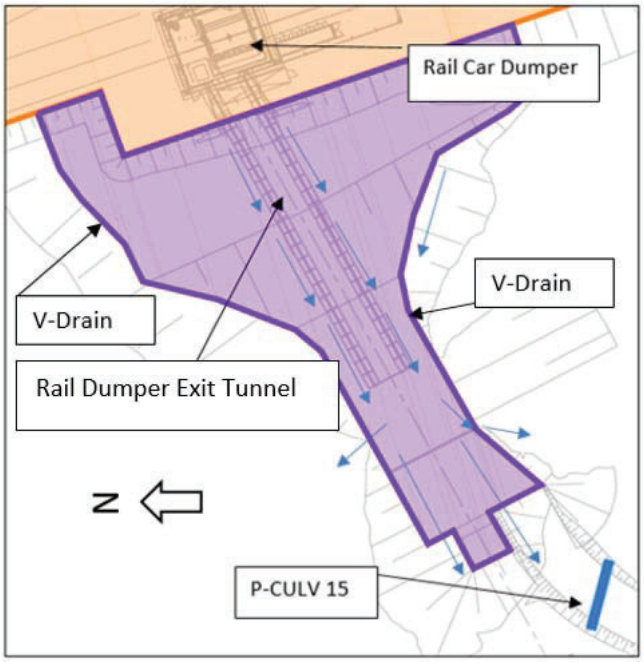


Figure 4-2: Rail Car Dumper Drainage Plan

The design ensures that water drains away from the dumper and the dumper exit tunnel. General drainage is based on overland flow with the various dumper areas graded to facilitate this. Vee-Drains are provided at the interface between the excavation/backfill slope interface.

Due to the steep slopes of the backfill, there are high flow velocities expected and rip rap is placed where water concentrates. This is to protect against scouring.

The results of the analysis are as follows:

- V-Drain with side slopes of 1V:3.52H and 1V:3.13H for the left and right sides of the dumper tunnel backfill.
- Flow - 0.008 m^3/s
- Velocity - 1.05 m/s

4.3 P-SWD-6

Storm water diversion No.6 will initially extend inside the rail yard area. When the rail yard is constructed the portion of the diversion overlapping the rail yard will be demolished. The diversion collects runoff from the rail yard but will primarily serve as a cut-off for water flowing from the catchment area to the east and diverting it towards the south. Figure 4-3 shows the diversion.

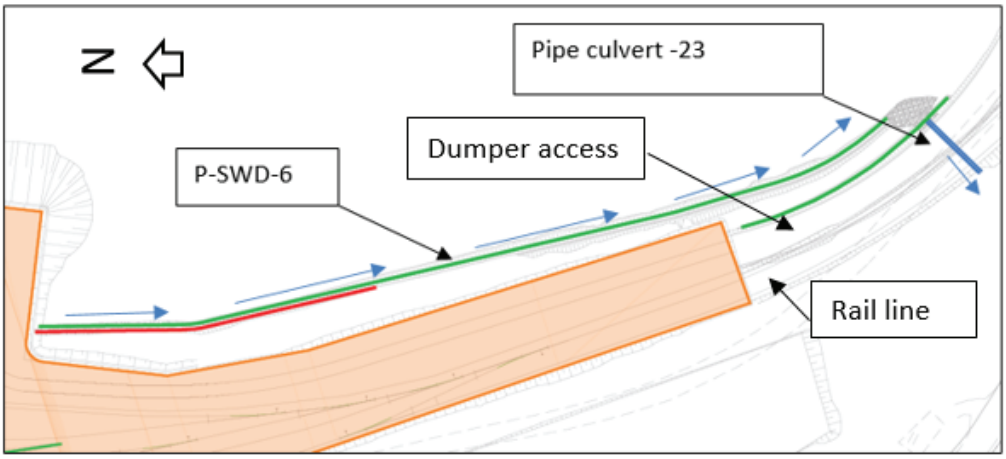


Figure 4-3: P-SWD-6

The ditch will daylight at the downstream end where it passes through P-CULV-23, underneath the Rail Yard Access Road. This road and its drainage is described in Section 8.1.

The diversion was modelled and analysed as a combination of berm and channel taking into account the surrounding existing ground. The results were as follows:

- Berm Height Required = 1 m
- Channel bottom width = 0.5 m
- Maximum Velocity = 1.28 m/s

Based on the results rip rap will only be provided at the discharge point.

4.4 P-SWD-5

Storm water diversion No.5 is planned for construction in 2018 and will extend inside the Rail Yard area. When the rail yard is constructed the portion of the diversion overlapping the rail yard will be demolished. The diversion will collect runoff from the rail yard but will

primarily serve as a cut-off for water flowing from the catchment area to the east and diverting it towards the north. Figure 4-4 shows the diversion.

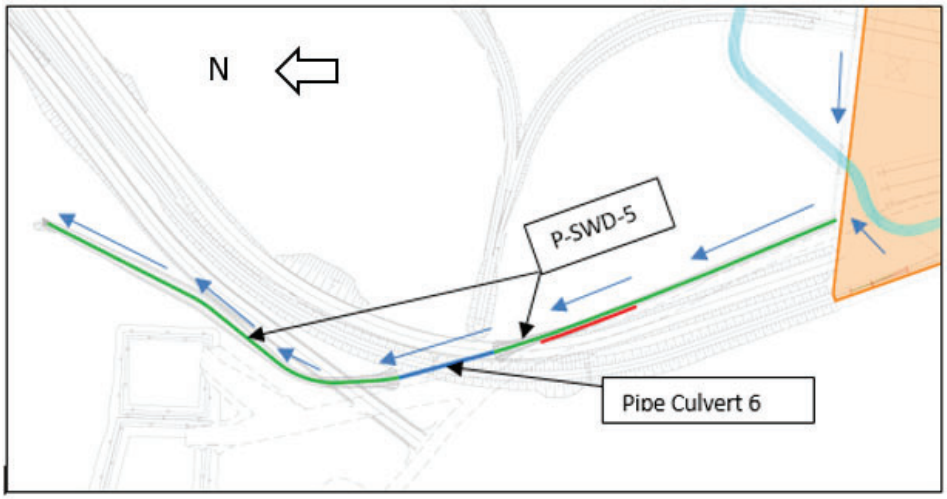


Figure 4-4: P-SWD-5

When the railway line is constructed it will require construction of a new culvert (P-CULV-6) to allow water to pass underneath the railway formation. The culvert is designed as a 1200mm diameter CSP with rip rap placed on the upstream and downstream side. The channel will also be widened at the culvert to allow space for the placing of pipes.

The diversion was modelled and analysed as a combination of berm and channel taking into account the surrounding existing ground. The results are as follows:

- Berm Height Required = 1 m
- Channel bottom width = 0.5 m
- Maximum Velocity = 1.40 m/s

Based on the results no rip rap, will be required in the channel except at the culvert as mentioned above and at the discharge point.

5. Ore Processing Area Drainage

5.1 Crushing Feed Stockpile

The crushing feed stockpile will be used to store ore before it is crushed and screened. In accordance with the civil design philosophy, runoff from this area needs to be contained in a

settling pond and discharged once the water quality criteria has been met. The pad and pond is indicated in Figure 5-1.

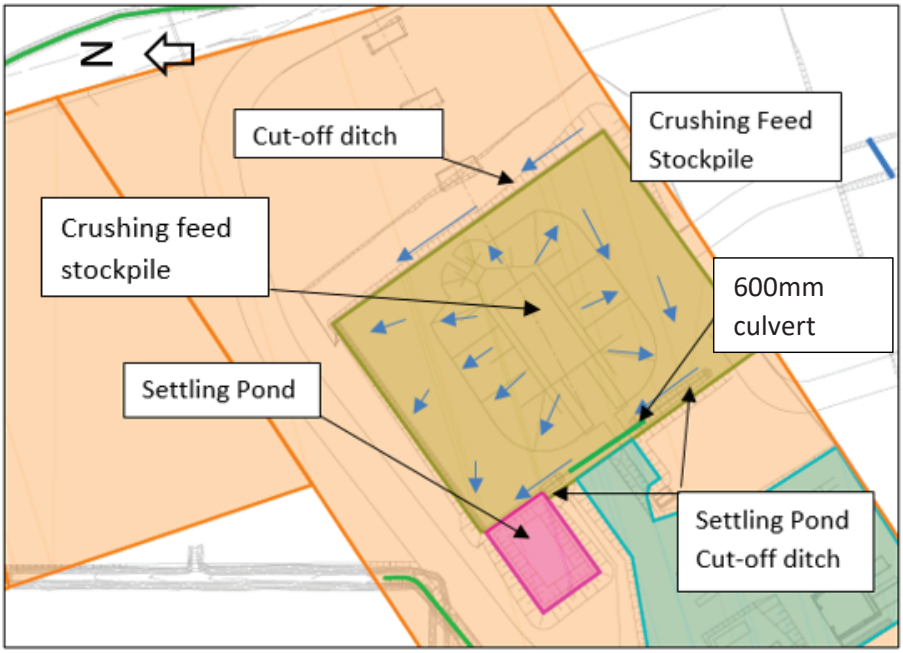


Figure 5-1: Crushing Feed Stockpile Pad Drainage Plan

5.1.1 Crushing Feed Stockpile Pad

The pad mainly drains through overland sheet flow and into a ditch on the western side and down a berm on the northern side. The ditch has one culvert crossing to allow access to the pad from the crushing and screening pad. The details of the ditch are as follows:

- Bottom Width - 0.5m
- Side Slopes - 1V:1.5H
- Flow (1:200) - 0.064 m^3/s
- Velocity - 0.95 m/s

The culvert is constructed as a 600mm diameter CSP.

On the eastern side of the pad a cut-off ditch is constructed to separate clean water from potential sediment impacted runoff on the pad. The ditch will flow in 2 directions (to the

north and to the west) around the pad and daylight onto laydown LP5 and LP6 respectively. The channel was designed and analysed with the following results:

- Bottom Width - 0.5m
- Side Slopes - 1V:1.5H
- Flow - 0.035 m^3/s
- Velocity - 0.52 m/s

5.1.2 Crushing Feed Stockpile Settling Pond

The main inflow to the pond is from the settling pond drainage ditch. The pond has an emergency overflow that flows onto laydown LP5 and is designed in accordance with the Civil design philosophy.

The following values were applied in sizing the pond:

- Catchment area - 14 389 m^2
- Runoff Coefficient - 0.9
- Rainfall (1:10 year 24 hour) - 40.8mm

With the above it was determined that the required pond capacity is 528 m^3.

The spillway is designed to safely discharge the 1:200 year return period rainfall event. The result of the design and analysis are as follows:

- Bottom Width - 0.5m
- Depth - 0.15m
- Flow - 0.064 m^3/s

5.2 Crushing and Screening Pad

1

Storm water runoff as a result of precipitation on the crushing and screening pad is dealt with as sheet flow. This flow is depicted in Figure 5-2.

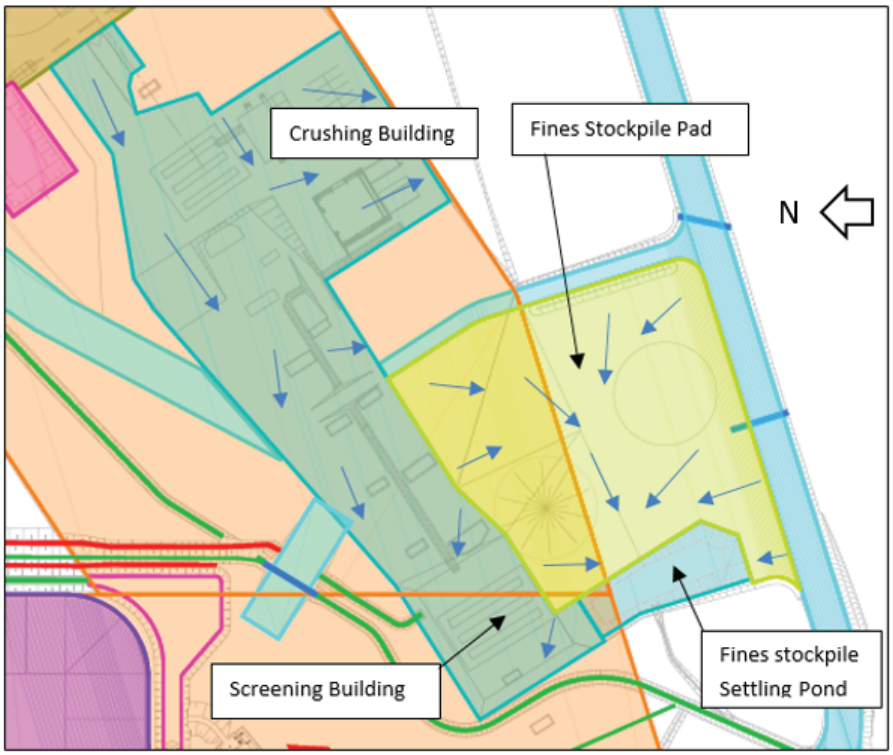


Figure 5-2: Crushing and Screening Pad Drainage Plan

Where utility berms are constructed, nominal 600mm diameter culverts are installed to ensure no ponding of water and promote free flow through the area.

The fines stockpile is situated next to the screening building. Runoff from the fines stockpile must be captured in a settling pond. The pond calculation results are as follows:

- Catchment area - 10 771 m^2
- Runoff Coefficient - 0.9
- Rainfall (1:10 year 24 hour) - 40.8mm

With the above it is determined that the required pond capacity must be 396m^3.

The spillway is designed to safely discharge the 1:200 year return period rainfall. The result of the design and analysis are as follows:

- Bottom Width - 2.0m

- Depth - 0.1m
- Flow - 0.09m^3/s

6. Stockpile No.1 Drainage

Stockpile No.1 is to be extended to allow for fines product stockpiling. (Stockpile No.2 will occupy a portion of the footprint area of the existing Stockpile No.1). Due to the need to maintain the area for the stockpile No.1 while Stockpile No.2 is developed, the Stockpile No.1 extension is required.

The expansion of Stockyard No.1 will be done in two stages. The stormwater runoff for the stockyard will be conveyed into four ponds which are:

- existing Pond No 1 & new No1A (situated north of the stockyard);
- existing Pond No 2 and new No 2A (situated north east of the stockyard);
- and a new Pond No 3 (situated on the western side of the stockyard).

Ponds No1 & new No1A and No 2 & new No 2A caters for the runoff from the existing Stockyard No 1 and future planned northern section of Stockyard No 2. Pond No 3 will cater for mainly the storm water run-off from the area resulting from the expansion with the water shed being the location of the existing reclaim conveyor. This area drains to the western side of the stockyard. The pond will be constructed in two stages in parallel with the staged construction of the expansion. Figure 6-1 shows the layout.

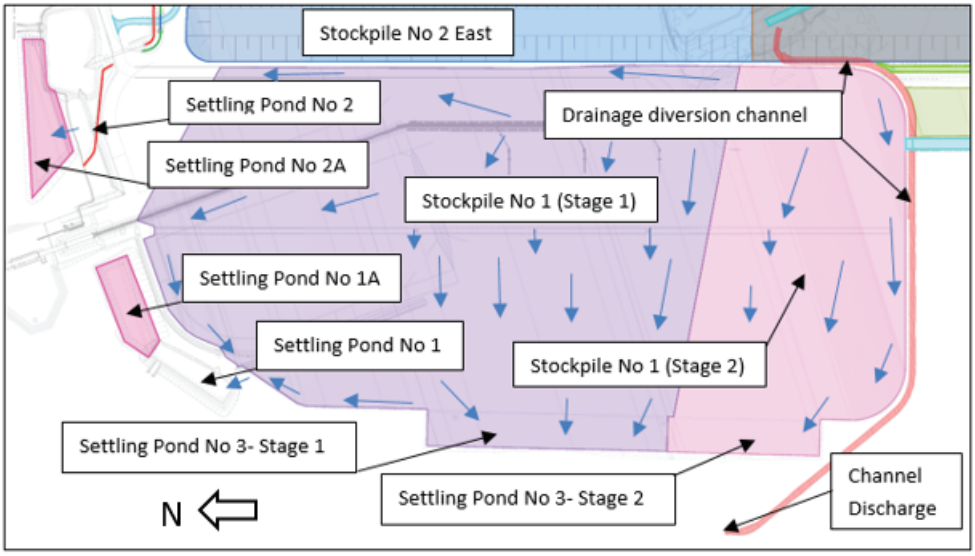


Figure 6-1: Stockpile No.1 Extension with Settling Pond No.1, No.1A, 2&2A and Pond 3 stage 1 & 2

The catchment area for Settling Pond No.1 & 1A will decrease due to the following reasons:

- In order to optimize fill quantities and the requirement to drain the furthest located point on the stockpile expansion towards the north (Pond 1 & 1A), it resulted in the reduction of the drainage area to Pond 1 & 1A and the creation of Pond No 3. It required a large fill to create a gradient sufficient enough to drain water to Pond 1 & 1A in the north of the Stockpile.

As a result, the catchment for the majority of the stockpile expansion in stage 1 (132,945m^2) drains to a newly created Pond 3. The stage 2 expansion (22,312m^2) drains to the expanded Pond 3 to the south end of the pond.

The stage 1 and stage 2 settling pond 3 volumes are 4882m^3 and 8,193m^3 for the combined development of stage 1 & 2

The reduced settling pond 1 &1A catchment is 60,866m^2 which reduces the storage volume required for the 1:10 year return period to 2,235m^3

Figure 6-2 shows both the existing Pond No.1 ,1A and Settling Pond 3 stage 1 & stage 2 compartments.

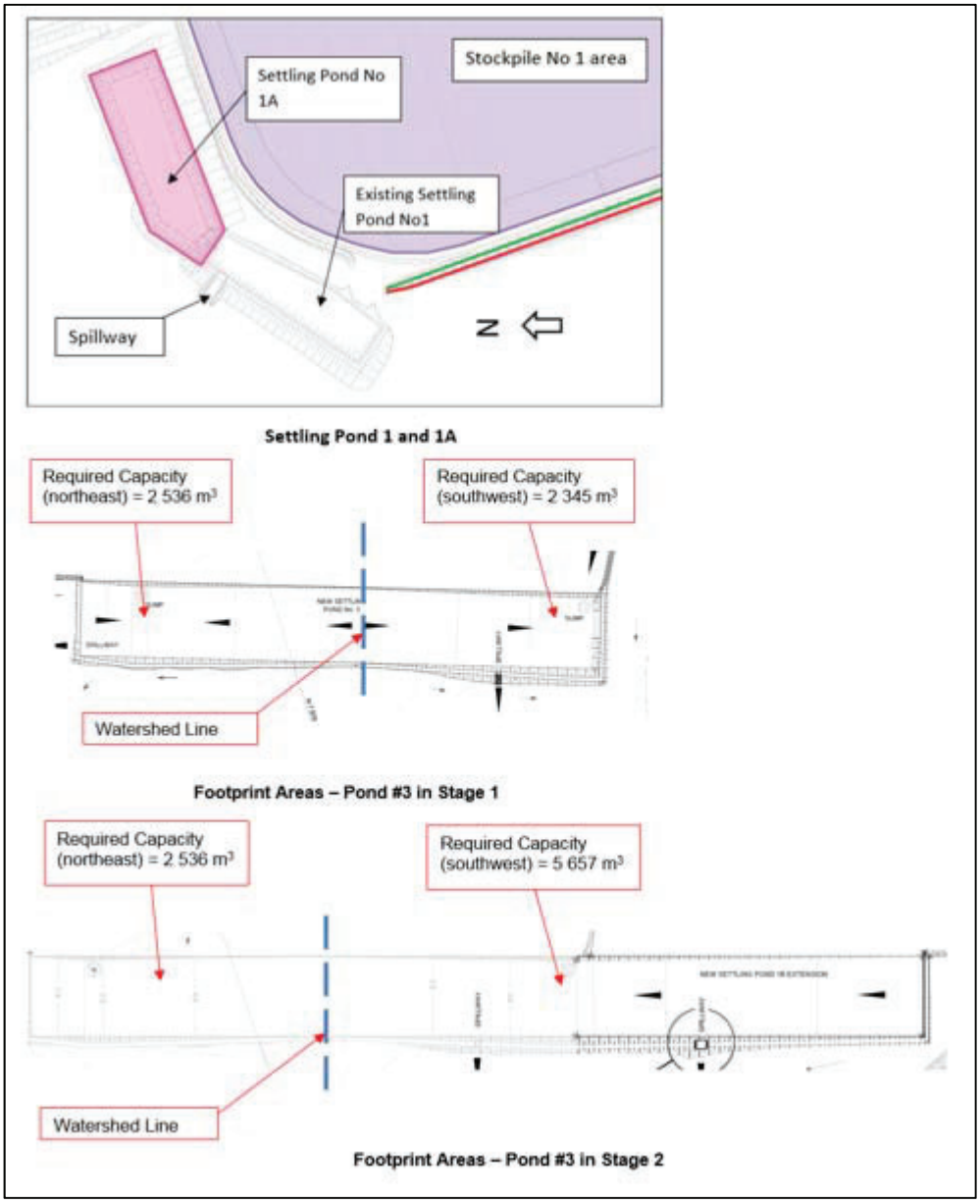


Figure 6-2: Settling Pond 1, 1A, 3 (Stage 1 & 2)

6.1 Settling Pond No.2 and No.2A

The catchment area for Settling Pond No.2 will increase due to the construction of the new Stockpile No.2. A portion of the Stockpile No.2 (East & West)will drain to the existing Pond No.2. Due to the increase in the catchment area for Pond No.2, the settling pond will not have sufficient capacity to contain the run-off.

A new compartment will be constructed to provide sufficient storage capacity. The existing pond crest and spillway need to be lifted to increase storage capacity.

The emergency spillway is re-designed at a higher elevation with the same cross-sectional profile which then provides sufficient capacity to discharge the 1:200 year return period flow. Figure 6-3 shows the proposed modifications.

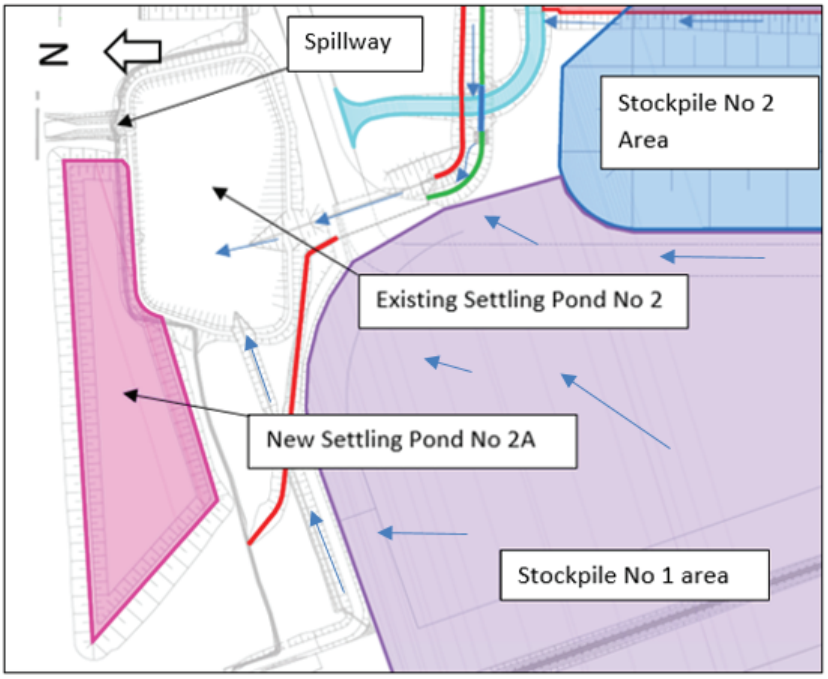


Figure 6-3: Settling Pond 2 and 2A

The results of the calculations associated with the pond extension can be seen below:

- Catchment area - 185,852 m^2
- Runoff Coefficient - 0.9
- Rainfall (1:10 year 24 hour) - 40.8mm

Using the calculations above the total required pond capacity must be 6,825 m^3. The combination of Settling Pond No.2 and No.2A will be constructed to ensure that this volume is achieved.

The combined Settling Pond No 2 & &2A will utilize the Pond 2 existing spillway which was calculated to be adequate to accommodate the 1:200 year flood event.

6.2 Northern Utility Berm

Due to the construction of Settling Pond No.2A, Ship Loader No.1 power cables will have to be relocated. A utility berm will be constructed between the existing road and Settling Pond 2. The berm crosses an existing drainage ditch that discharge water into Settling Pond 2. A culvert (P-CULV-28) will be constructed as a 600mm CSP. No rip rap is required since the velocity is calculated below 1.5m/s for the design return period of 1:25 years. See Figure 6-4 for the utility berm and culvert.

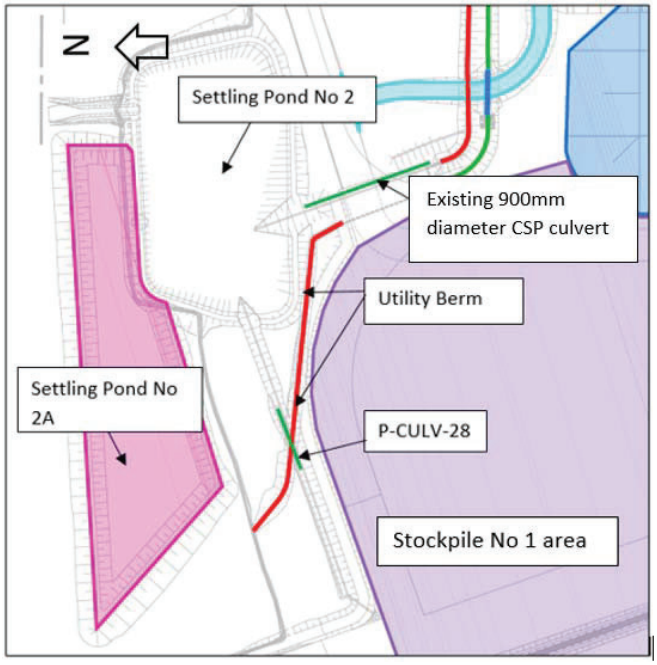


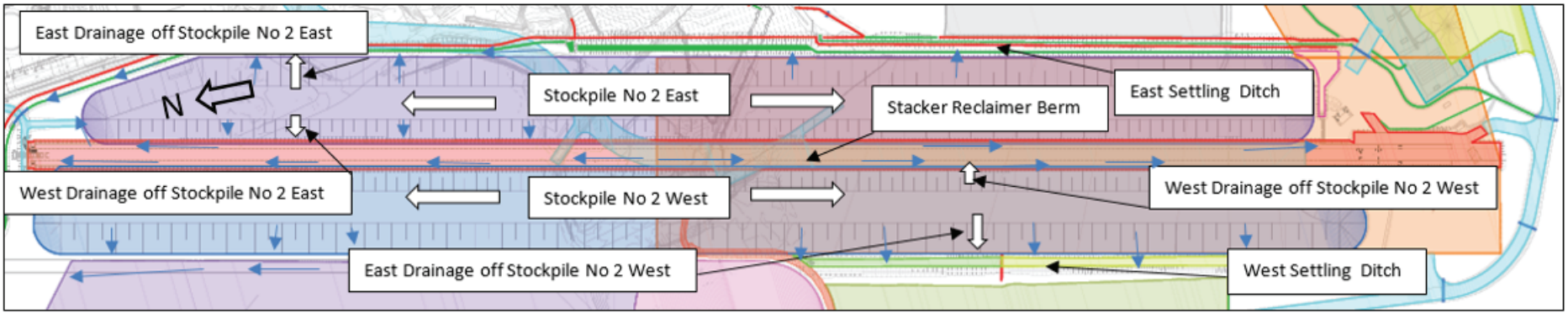
Figure 6-4: Northern Utility Berm Drainage

7. Stockpile No. 2 Drainage Area

Stockpile No.2 area consists of the following:

- Stockpile No.2 East
- Stockpile No.2 West
- Stacker reclaimer Berm
  - Northern Section
    - Access Roads
  - Middle Section
  - Southern Section
    - Maintenance Area / Storm Lock Position
    - Storm Lock Cradle
    - Berm Surroundings

The above will be discussed in the following sections. An overall layout of the area can be seen in Figure 7-1.



1

Figure 7-1: Stockpile No.2 Drainage Plan

7.1 Stockpile No.2 East

1

Runoff from the stockpile draining towards the outside of the stockpile is collected in the Eastern Berm. (The eastern berm drainage is discussed in more detail in Section 7.4.)

Stockpile runoff draining inwards to the stacker reclaimer berm is collected in a precast 900mm x 900mm concrete drain on top of the berm. The drain will be constructed with no gradient due to limitations of the stacker reclaimer rail. The accumulated run-off flows in both north and south directions through hydraulic head build up inside the 900mm x 900mm drain. At the end points it discharges off the berm where the following occurs:

- In the south direction, water is conveyed in a swale towards a settling ditch along the Eastern Berm where it is retained (Similar to the settling ponds described previously).
- In the north direction, discharge is onto the stockpile area itself which is graded to drain into Settling Pond No.2.

7.2 Stockpile No.2 West

Runoff from the stockpile draining to the outside of the stockpile will be contained by the Western Berm. Due to limitations on natural ground gradient there are 2 ways in which the runoff will be managed:

- On the southern end water will be contained inside the western berm enclosed area which forms a containment / settling pond (see Section 7.5.1)
- On the northern end, water is conveyed towards the north and eventually ends up in Settling Pond No.2/2A - pending gradients. (see Section 7.5.2).

Runoff draining inside the stockpile to the stacker reclaimer berm is managed similar to Section 7.1 in the 900mm x 900mm drainage channel. Storm water finding its way to the southern end will be retained through surrounding berms (forming the West Settling Ditch – See Figure 7-1) until after suspended solids testing. Channel flow to the north will drain to the settling ponds to the north and is facilitated through construction of berms and specific located culverts draining into the Settling Ponds No.2/2A.

7.3 Stacker Reclaimer Berm Southern Section

The southern end of the stacker reclaimer berm will include a maintenance area (incorporating the storm lockdown position). Figure 7-2 shows the southern section in more detail.

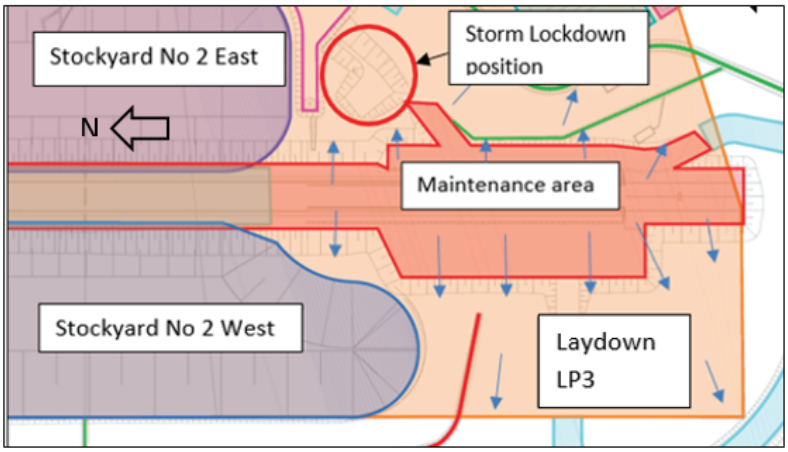


Figure 7-2: Stacker Reclaimer Berm Southern Section Drainage Plan

Storm water runoff from this area will be facilitated through natural run-off from the maintenance area onto the surrounding LP3 lower level ground. From here it is either directed to a swale or culvert and onto the natural environment.

The surrounding area will flow on Laydown LP3 as described in the 2018 Water Management Plan, H353004-40000-200-210-0001, and be diverted through the use of swales and ditches.

7.4 Stockpile No.2 Eastern Berm

The eastern berm has multiple functions as summarized below:

- Due to the natural low point along the eastern section of stockpile No 2, clean water runoff will have accumulated against the eastern berm. The berm serves to prevent clean water from entering the stockpile area by ponding against the berm
- Allow for overflow of the clean water towards the south when accumulating in access of the berm height during extreme events.
- Prevent potential sediment impacted runoff from Stockpile No.2 from enter the natural surroundings
- Settling out suspended solids from runoff generated inside the stockpile area
- Conveying water north toward the existing Settling Pond No.2
- Used for utilities such as electricity and fibre optic cable routing.

7.4.1 Eastern Clear Water Pond

The clear water pond will be used to temporarily store runoff which will be pumped out or discharged into the overflow channel. The berm will be lined with a geomembrane to

prevent water from the clear water pond entering the stockpile area. Figure 7-3 shows the extents of the pond.

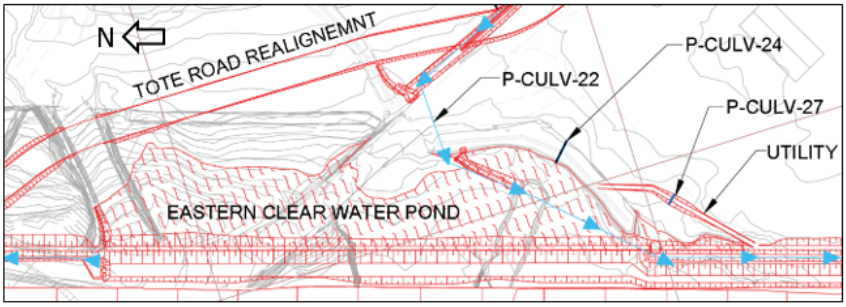


Figure 7-3: Eastern Clear Water Pond

The extent of the pond is dictated by the overflow level of the pond and care was taken to ensure that no infrastructure such as road or cables will be inundated.

7.4.2 Eastern Berm – Clear Water Overflow Channel

Although the Eastern Clear Water pond must be operated as empty during the rainy season by means of pumping, it may not always be empty when a large storm event occurs. It is therefore necessary to have an emergency overflow. This overflow channel can be seen in Figure 7-4.

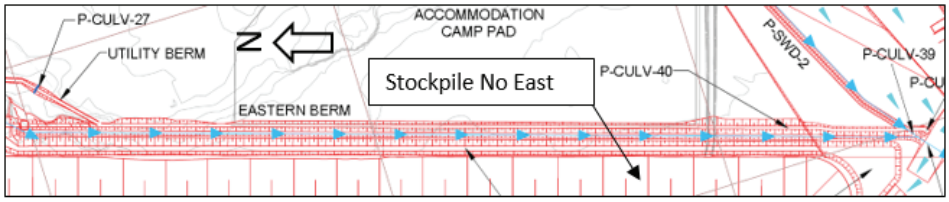


Figure 7-4: Eastern Berm – Clear Water Overflow Channel

The overflow channel has been designed as a trapezoidal channel to convey the 1:100 year flood event and is built on top of the eastern berm. The water will flow south and connect with P-SWD-2 (see Section 9.7). South of the Accommodation Camp Pad a 600mm diameter culvert (P-CULV-40) will be installed through the berm to allow water to enter the channel. The area will also be locally shaped to ensure that there is no ponding of water against this portion of the berm/channel. The calculation results for the overflow channel are as follows:

- Bottom Width - 0.5m
- Side Slopes - 1V:1.5H
- Flow - 1.144 m^3/s

- Normal Flow Depth - 0.727m
- Velocity - 0.99 m/s

7.4.3 *Eastern Berm – Settling Ditch*

As part of the containment of runoff from the stockpile area, a settling pond in the form of an elongated ditch is designed and is constructed on the south eastern end of the stockpile area as can be seen in Figure 7-5.

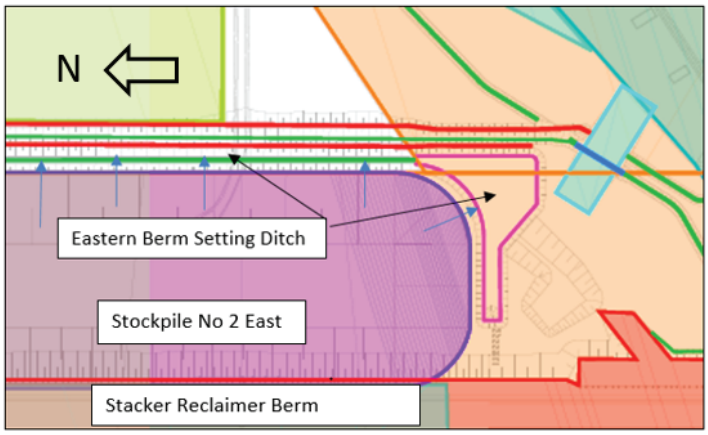


Figure 7-5: Eastern Berm – Settling Ditch

The settling ditch must be able to contain the runoff volume from the 1:10 year 24-hour storm event. The ditch will have a sump at the southern end that will be used to empty the ditch by means of pumping as soon as the necessary criteria is achieved for discharge as per the Environmental Design Criteria. An emergency overflow is designed to the north that will discharge into the northern section in an extreme event. This overflow was designed for the 1:200 peak flood. The calculations are as follows:

- Catchment area - 83 766 m^2
- Runoff Coefficient - 0.9
- Rainfall (1:10 year 24 hour) - 40.8mm

With the above it was determined that the required pond capacity is 3 075 m^3.

The spillway is designed for the 1:200 year return period. The spillway design result is as follows:

- Bottom Width - 1.5m
- Depth - 0.2m

- Flow - 0.346 m^3/s

7.4.4 *Eastern Berm – Northern Section*

The northern section of the eastern berm is a combination of ditch and berm conveying water towards the existing Settling Pond 2. Figure 7-6 shows this section.

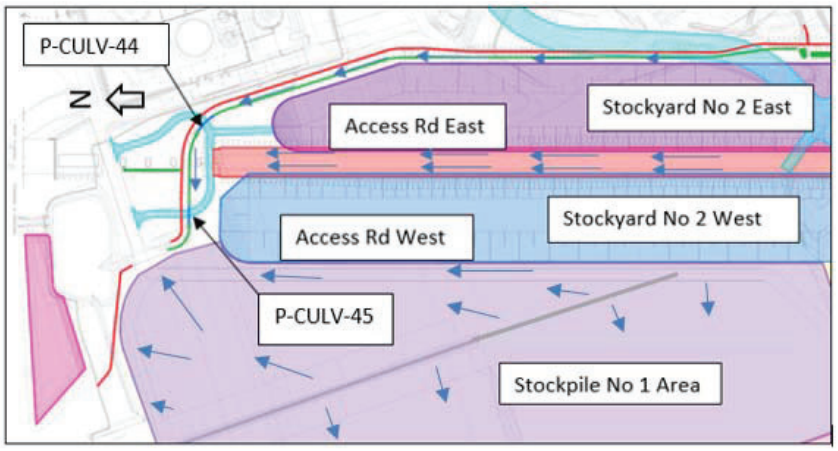


Figure 7-6: Eastern Berm – Northern Section

The ditch will cross two access roads where culverts will be used to allow for safe passage of the flow. The culverts and the ditch were designed to cope with the 1:100 year flood. The ditch will link up with the existing drainage system, from where it will pass underneath an existing culvert and into settling pond 2 (see Section 6.1).

The results from the design and analysis of the ditch is reflected below:

- Bottom Width - 1m
- Side Slopes - 1V:2H
- Flow - 0.772 m^3/s
- Max Normal Flow Depth (0.2% fall) - 0.486m
- Max Velocity (1.6% fall) - 1.22 m/s

Based on the above there is no need for rip rap except for the culverts (see Section 8.5).

7.5 Western Berm

The western berm will be constructed to perform the following functions:

- Prevent runoff from Stockpile No 2 from entering the natural surroundings

- Settling out suspended solids from runoff generated inside the Stockpile No.2 West area for the southern section of the berm

Figure 7-7 shows the overall layout of the Western Berm.

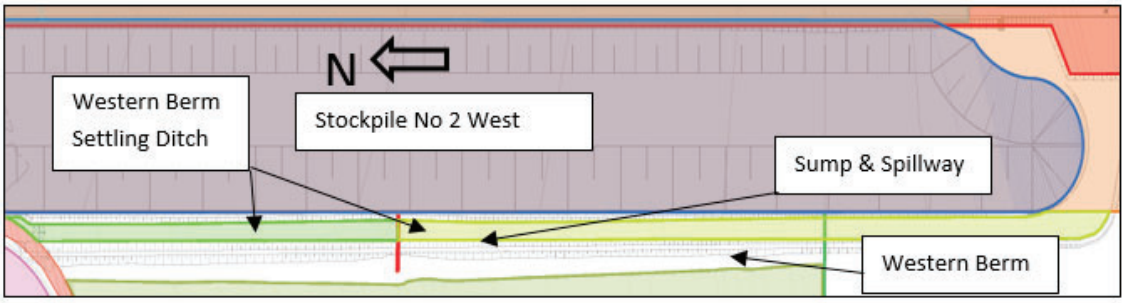


Figure 7-7: Western Berm Drainage Plan

7.5.1 *Western Berm Settling Ditch*

As part of the environmental requirement to contain runoff from the stockpile area and due to a lack of gradient to drain storm water naturally, a settling pond in the form of an elongated ditch is designed and will be constructed on the south western end of the stockpile.

The settling ditch is designed to contain the runoff volume from the 1:10 year 24-hour storm event. The ditch has a sump that is centrally placed and will be used to empty the ditch as soon as the necessary Environmental criteria for discharge has been achieved. An emergency overflow channel will be constructed in the same location as the sump that allows spillway water into the natural environment. This overflow is designed for the 1:200 peak flood. Calculation results are reflected below:

- Catchment area - 83,327m^2
- Runoff Coefficient - 0.9
- Rainfall (1:10 year 24 hour) - 40.8mm

With the above calculations the required pond capacity is 3,060 m^3.

The spillway is designed to safely discharge the 1:200 year return period. The result of the spillway design indicates the following geometry:

- Bottom Width - 3.0m
- Depth - 0.18m
- Flow - 0.344 m^3/s

7.5.2 Western Berm – Northern Section

The northern section of the western berm conveys water towards Settling Pond N02 &2A. The drainage system of Stockpile No.2 is discussed in Section 6.

7.6 Drive Station

The yard conveyor drive station is situated at the northern end of Stockpile No 2. This area is designed to allow for sheet flow runoff to drain off the pad and into the ocean. A 20m wide road connects the existing area with the proposed ship loader causeway. This road does not require any drainage culverts as there are no stream / drainage crossings. Figure 7-8 shows the area.

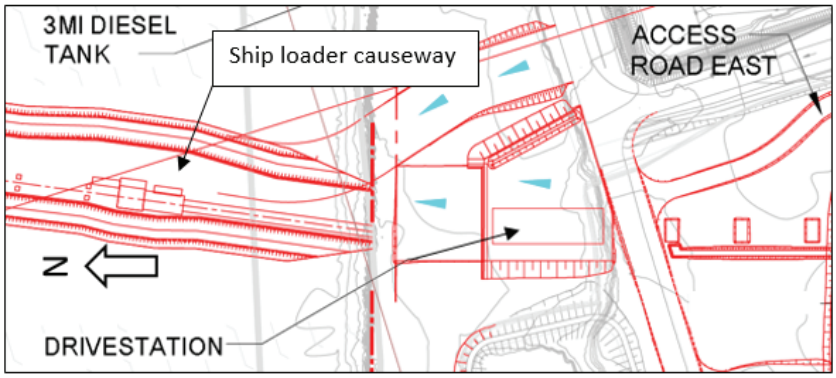


Figure 7-8: Drive Station

8. Road Drainage Areas

8.1 Rail Yard Access Road

The rail yard access road will be constructed to facilitate the delivery of the dumper module and will be utilised for future access to the rail yard. The road is designed with 3 drainage culverts:

- P-CULV-23 – 2 x 900mm Diameter CSP
  - This culvert crosses both the rail yard access road as well as the future rail formation. The culvert will initially be constructed underneath the road and will be extended when the railway is constructed.
- P-CULV-48 - 600mm Diameter CSP
- P-CULV-47 - 600mm Diameter CSP

The Rail Yard Access Road is shown in Figure 8-1.

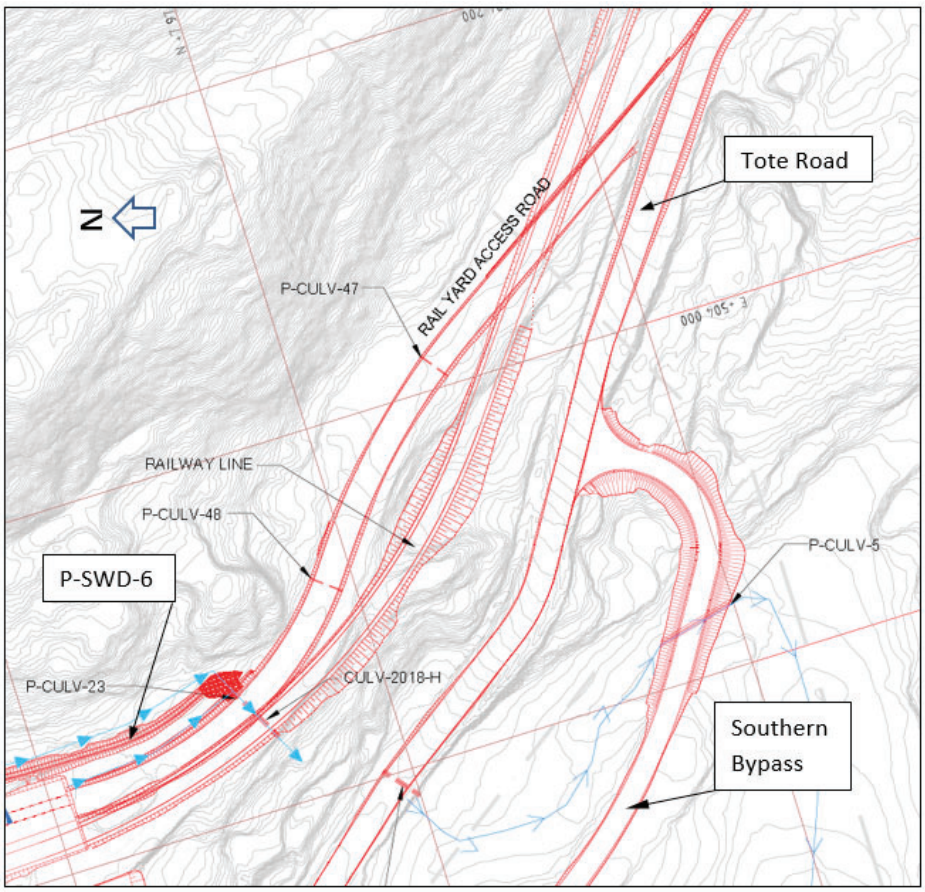


Figure 8-1: Rail Yard Access Road Drainage

8.2 Tote Road Drainage

This section discusses the drainage of the Tote Road and is covered in 3 Sections.

8.2.1 Tote Road Upgrade

At the southern end of the port the Tote Road requires upgrading to allow for the transportation of the dumper module and indexer building module. Figure 8-2 shows the area of consideration.

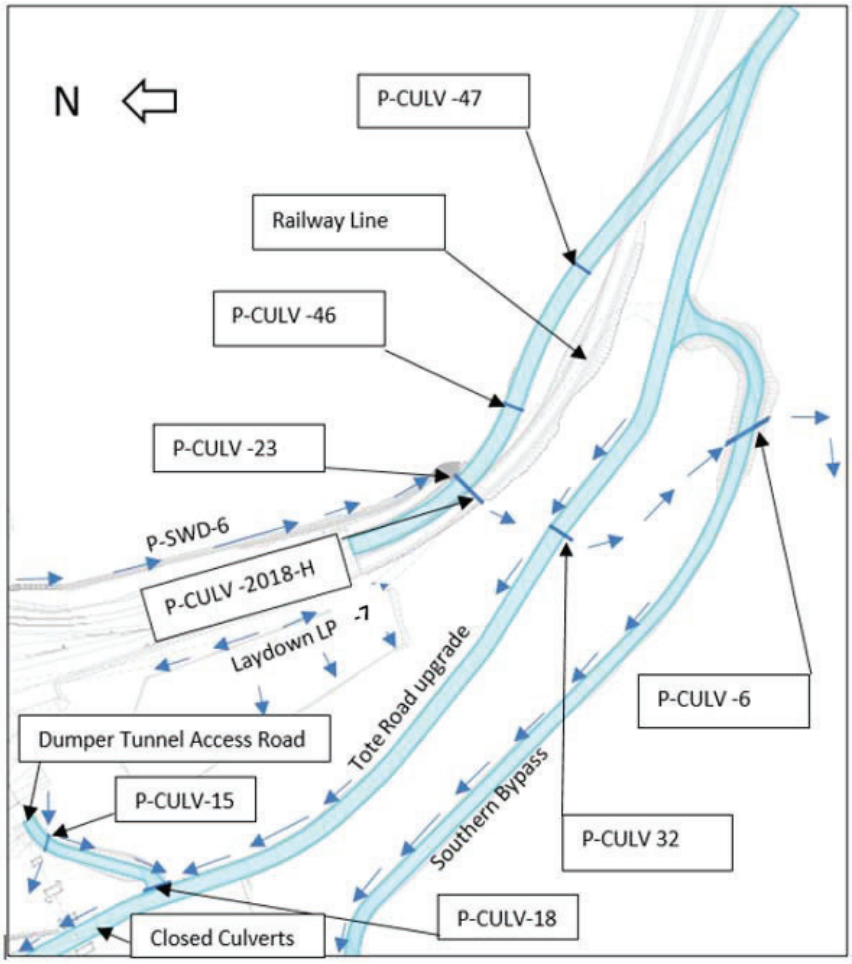


Figure 8-2: Tote Road Upgrade Drainage Plan

For this section, two existing culverts indicated in Figure 8-2 will be closed off to direct runoff away from construction activities. Water must flow to the north where it is collected in the Tote Road ditch.

This drainage section requires an additional culvert. Culvert P-CULV-32 allows safe passage of surface runoff water that primarily comes from P-SWD-6. Flow is discharged through this culvert. The culvert will be constructed out of 2x900mm diameter CSP with rip rap on both ends.

8.2.2 Tote Road Drainage Ditch

The existing Tote Road has a drainage ditch on the eastern side of the road. This ditch directs water to the north. The drainage ditch requires upgrading due to the additional

catchment area enforced by the culvert closures. Figure 8-3 shows the ditch location and culverts.

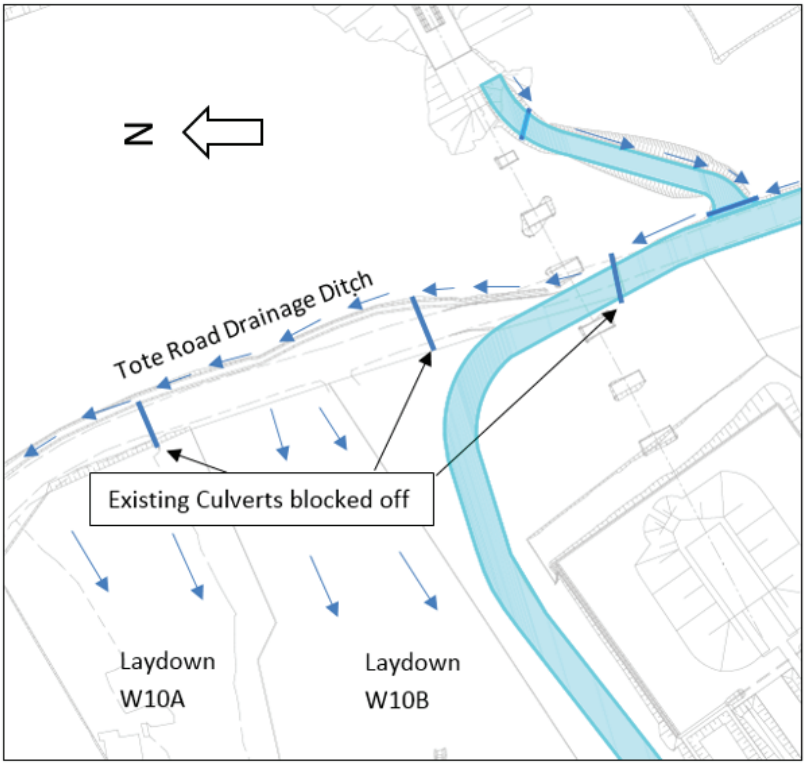


Figure 8-3: Tote Road Drainage Ditch

The ditch was sized and analysed. The results from the analyses are reflected below:

- Bottom Width = 2 m
- Side Slopes = 1V:2H
- Discharge (1:100) = 0.87 m^3/s
- Velocity = 1.82 m/s

Rip rap is provided to protect against erosion since the velocity exceeds 1.5 m/s.

In the first construction phase planned for 2018, the water is unobstructed up to the point where it needs to cross the Tote Road to the west at Culvert P-CULV-22. This culvert is designed to allow water to pass underneath the existing Tote Road into a ditch that will link up with an existing drainage ditch. The culvert will be constructed as 2x600mm diameter CSP pipes. 4 shows more detail for this area.

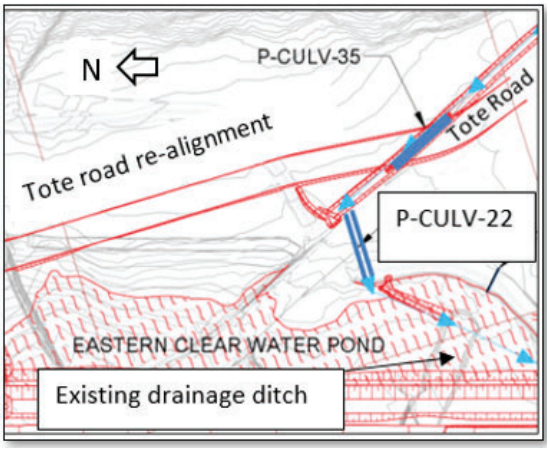


Figure 8-4: P-CUVL-22

In future, a Tote Road realignment is required which requires a crossing of the Tote Road drainage ditch – this is further discussed in Section 8.2.3 below.

8.2.3 Tote Road Realignment

The Tote Road realignment will be constructed to allow vehicles to travel around the proposed Stockpile No.2. The drainage of this road requires two culverts:

- P-CULV-35 - 2x600mm diameter CSP
  - Culvert to be placed inside the Tote Road drainage ditch (see section 8.2.2)
- P-CULV-9 - 600mm diameter CSP

Figure 8-5 shows this section.

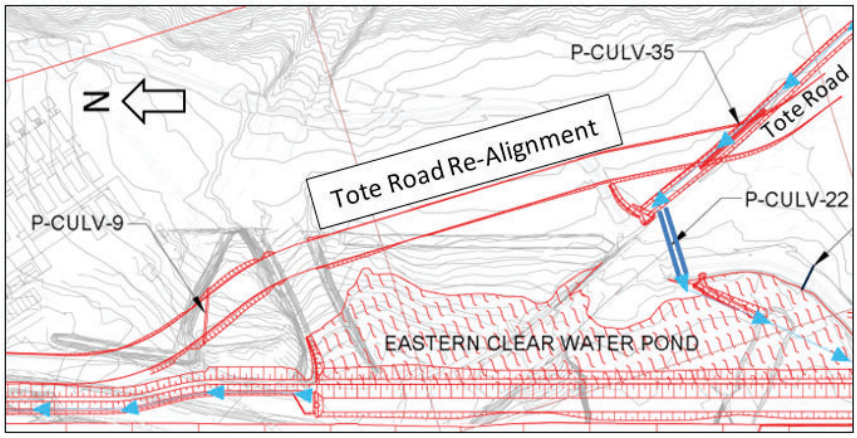


Figure 8-5: Tote Road Realignment Drainage Plan

8.3 Dumper Tunnel Access Road

This road connects the Tote Road to the dumper exit tunnel. Figure 8-6 shows the road.

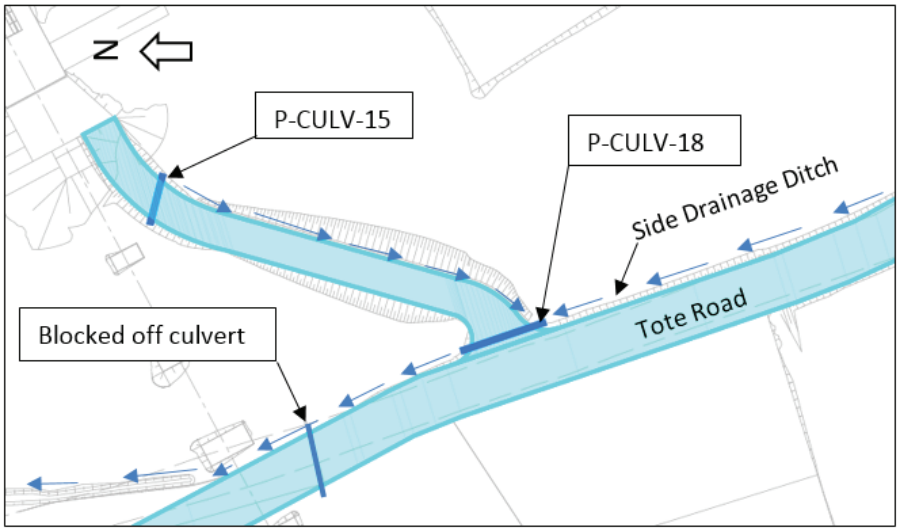


Figure 8-6: Dumper Tunnel Access Road Drainage Plan

The road will be constructed with the following storm water infrastructure:

- Side ditch to prevent water flowing over the road from the upstream catchment. The results from the design and analyses for this ditch are as follows:
  - Bottom Width - 0.5m
  - Side Slopes - 1V:1.5H
  - Depth - 0.4m
  - Flow - 0.05 m^3/s
  - Velocity - 1.45 m/s
- P-CULV-18 - 600mm diameter CSP
  - Culvert that will be constructed to allow flow from the Tote Road side ditch to drain underneath the dumper tunnel access road
- P-CULV-15 - 600mm diameter CSP
  - Culvert at low point to allow water to pass underneath the road.

8.4 Western Bypass Road

The Western Bypass will allow for vehicle access around the western and the northern side of Stockpile No.2.

Figure 8-7 shows the Western Bypass Road.

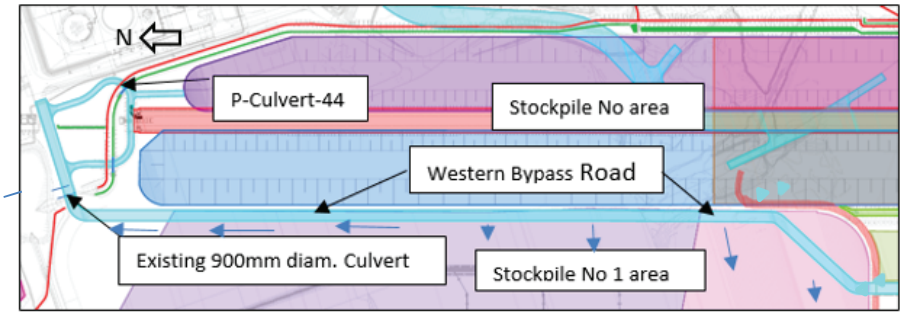


Figure 8-7: Western Bypass Drainage Plan

The road will only be demarcated route where it is routed through the existing stockpile area as no road layer works required on the stockpile area. Drainage will be as per the stockpile drainage plan.

In the north, the road will be lowered to allow vehicles to pass underneath the stockpile conveyor gantry. The road section is sloped in one direction to allow water run off when it exits a cut.

The demarcated road area on top of the Stockpile No.1 terrace also crosses an existing culvert that discharges into the existing Settling Pond No.2. From survey information it was determined that the culvert is a 950mm diameter CSP. The survey information was used to confirm that there is sufficient capacity in this culvert.

Two access roads are connected to the Western Bypass road that will allow vehicle access to the stacker reclaimer berm from the north.

The drainage for these roads will be discussed in Section 8.5.

8.5 Northern Access Roads

Two roads, access road east & access road west, will be constructed to allow for vehicle access to the northern section of the stacker reclaimer berm. These roads can be seen in in Figure 8-8.

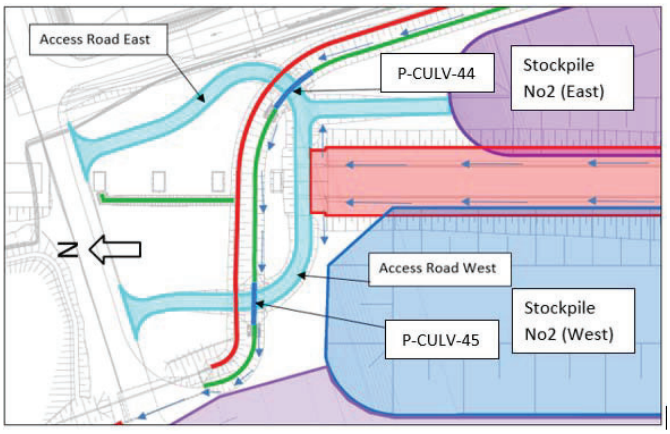


Figure 8-8: Northern Access Roads

The roads will be constructed across the Eastern berm as described in section 7.4.4.

The culvert details are as follows:

- P-CULV-44 - 900mm diameter CSP
- P-CULV-45 - 900mm diameter CSP

8.6 Southern Bypass Road

The main function of the Southern Bypass is to connect the Tote Road with Stockpile No.1. The road will also have roads branching off to provide access to the following areas:

- Stockpile No.2
  - Access Rd - 6
  - Access Rd - 7
- Fines Stockpile at the fines crusher
  - Access provided direct from the Southern bypass road
- Crushing and screening pad
  - Access Rd - 3
- Crushing Feed Stockpile
  - Access Rd - 4
  - Access Rd - 5

The road can be seen in

Figure **8-9**.

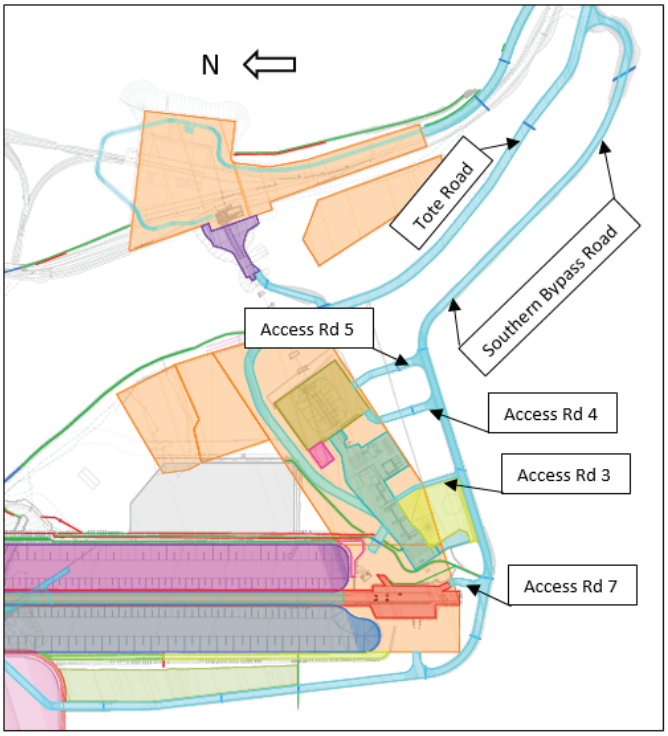


Figure 8-9: Southern Bypass Drainage Plan (i)

The following drainage culverts will be constructed at locations indicated in Figure 8-10, Figure 8-11 and Figure 8-12.

- P-CULV-34 - 600mm Diameter CSP
- P-CULV-1 - 600mm Diameter CSP
- P-CULV-2 - 600mm Diameter CSP
- P-CULV-43 - 600mm Diameter CSP
  - Culvert will be constructed inside Laydown LP3 daylight ditch as per the 2018 Surface Water Management Plan
- P-CULV-19 - 600mm Diameter CSP
- P-CULV-3 - 600mm Diameter CSP

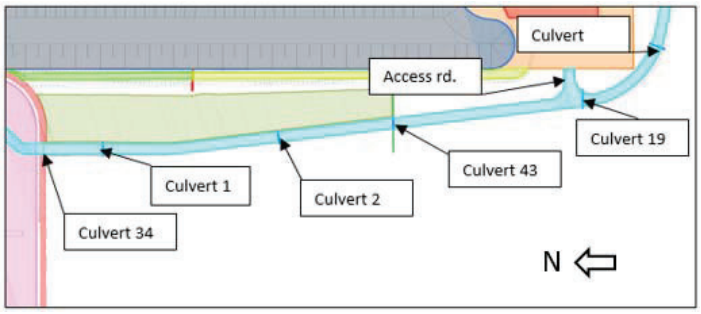


Figure 8-10: Southern Bypass Drainage Plan (ii)

- P-CULV-38 - 1200mm Diameter CSP
  - Culvert will discharge flow from P-SWD-2 (See Section 9.7)
- P-CULV-20 - 900mm Diameter CSP
- P-CULV-7 - 900mm Diameter CSP
- P-CULV-33 - 900mm Diameter CSP
- P-CULV-4 - 600mm Diameter CSP

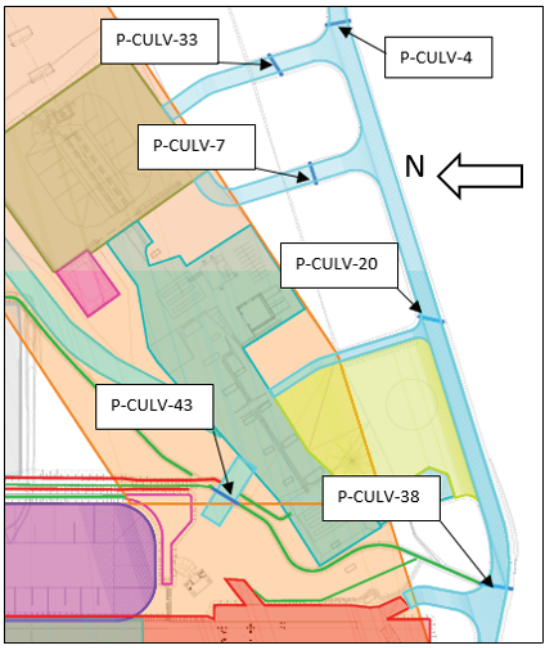


Figure 8-11: Southern Bypass Drainage Plan (iii)

- P-CULV-5 - 2 x 1200mm Diameter
  - Culvert will discharge flow from the east that was diverted through P-SWD-6 and underneath the Tote Road through P-CULV-32.

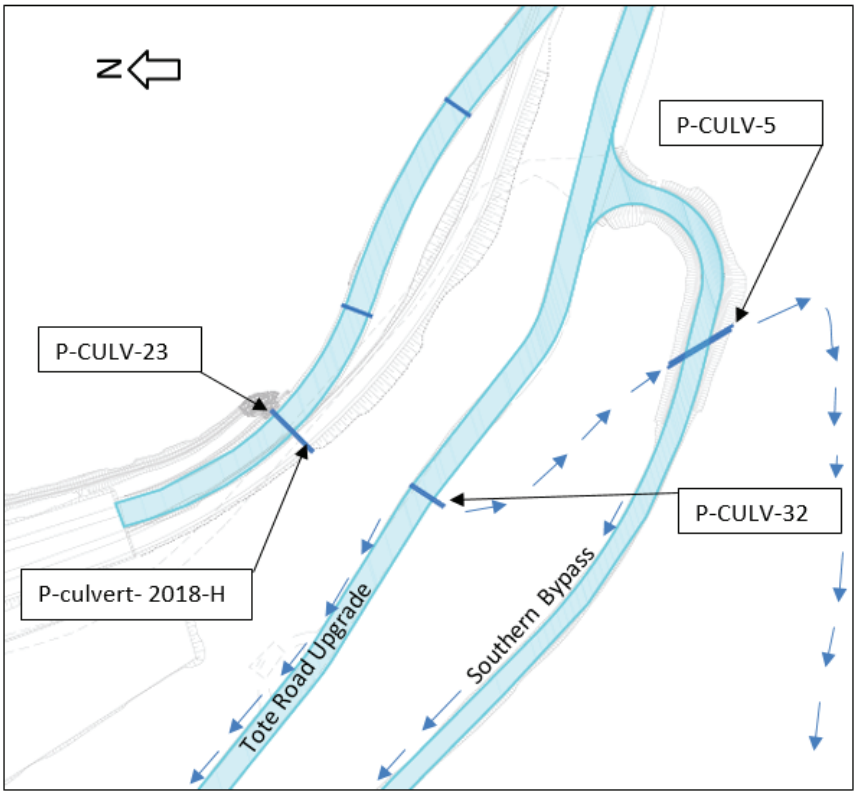
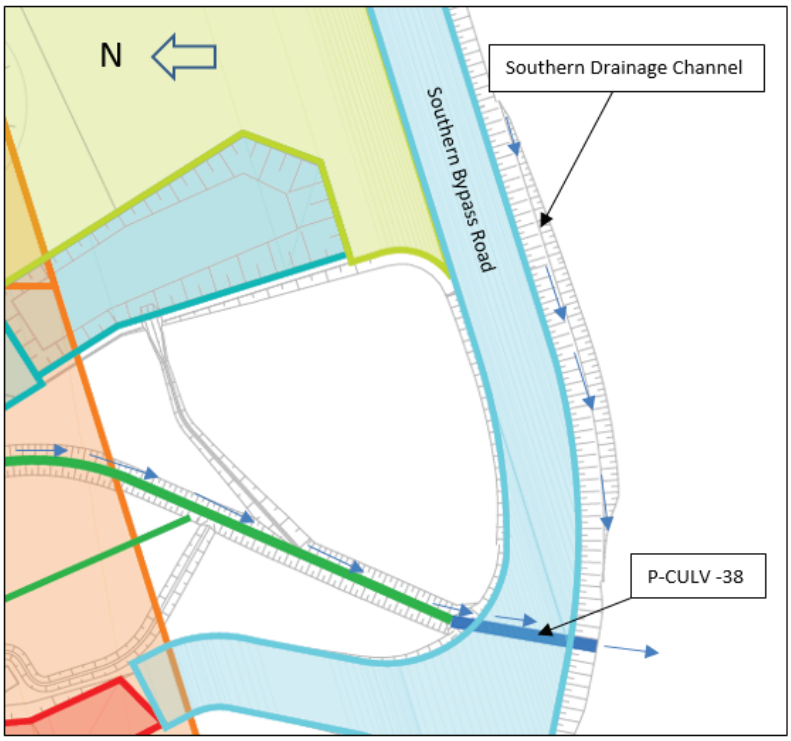


Figure 8-12: Southern Bypass Drainage Plan (iv)

For more detail on the culverts refer to the relevant road Issued for Construction (IFC) drawings.

The Southern Bypass also has one roadside ditch to allow drainage of a low-lying area from east to west toward P-CULV-38. The ditch can be seen in Figure 8-13.



1

Figure 8-13: Southern Bypass Road Side Drainage Channel

9. Balance of Work Drainage

9.1 Storm Water Diversion - P-SWD-3

Storm water diversion number 3 will be constructed to divert water away from Laydown LP2 situated to the south of the extended Port Site Camp. Both the diversion and the laydown area are planned to be constructed in 2018. Figure 9-1 indicates the diversion.

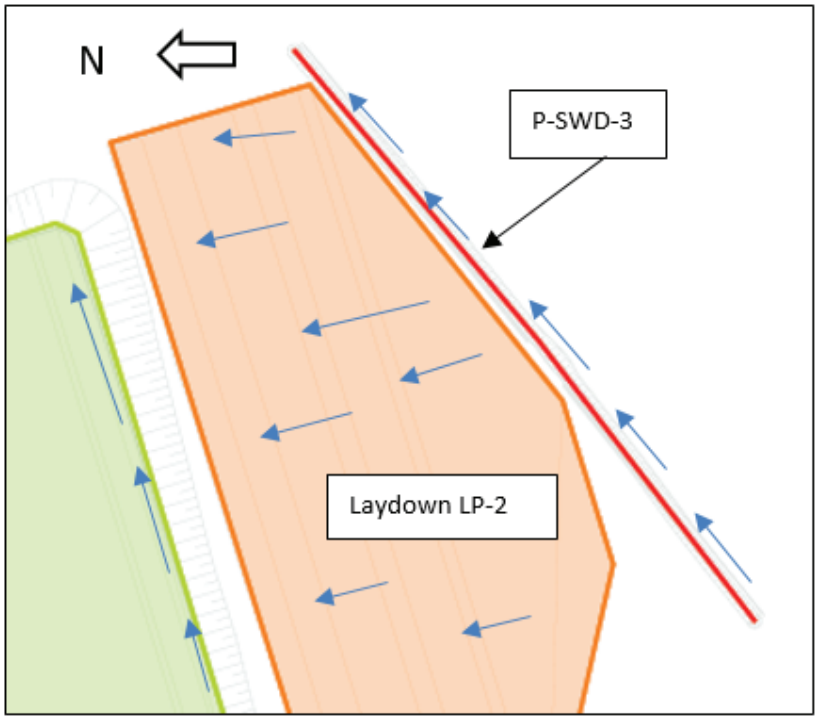


Figure 9-1: P-SWD-3

The diversion will be constructed as a berm collecting water from the catchment area to the south and primarily from P-SWD-5. When exiting the berm, the water will flow naturally towards the north joining the natural stream east of the Port Site Camp expansion (PSC).

The diversion was modelled and analysed as a berm taking into account the surrounding natural ground. The results were as follows:

- Berm Height Required = 0.6 m
- Maximum Velocity = 1.49 m/s

9.2 Laydown LP2 and New PSC extension area Drainage

Laydown LP2 and Port Site Camp (PSC) extension platform will be constructed south of the existing Port Site Camp. This area will be used for laydown of equipment and construction plant as well as to serve as the location of the relocated accommodation

modules as indicated in Figure 9-2

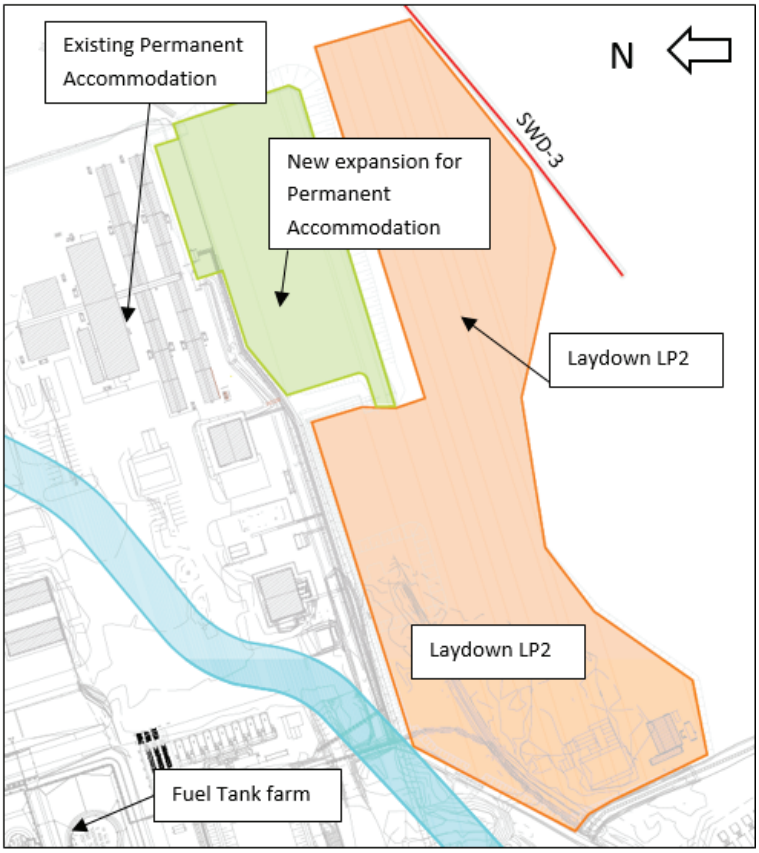


Figure 9-2: Laydown LP2 and PSC Extension Platform Location

Figure 9-3 shows the proposed LP2 laydown and PSC extension platform area in more detail.

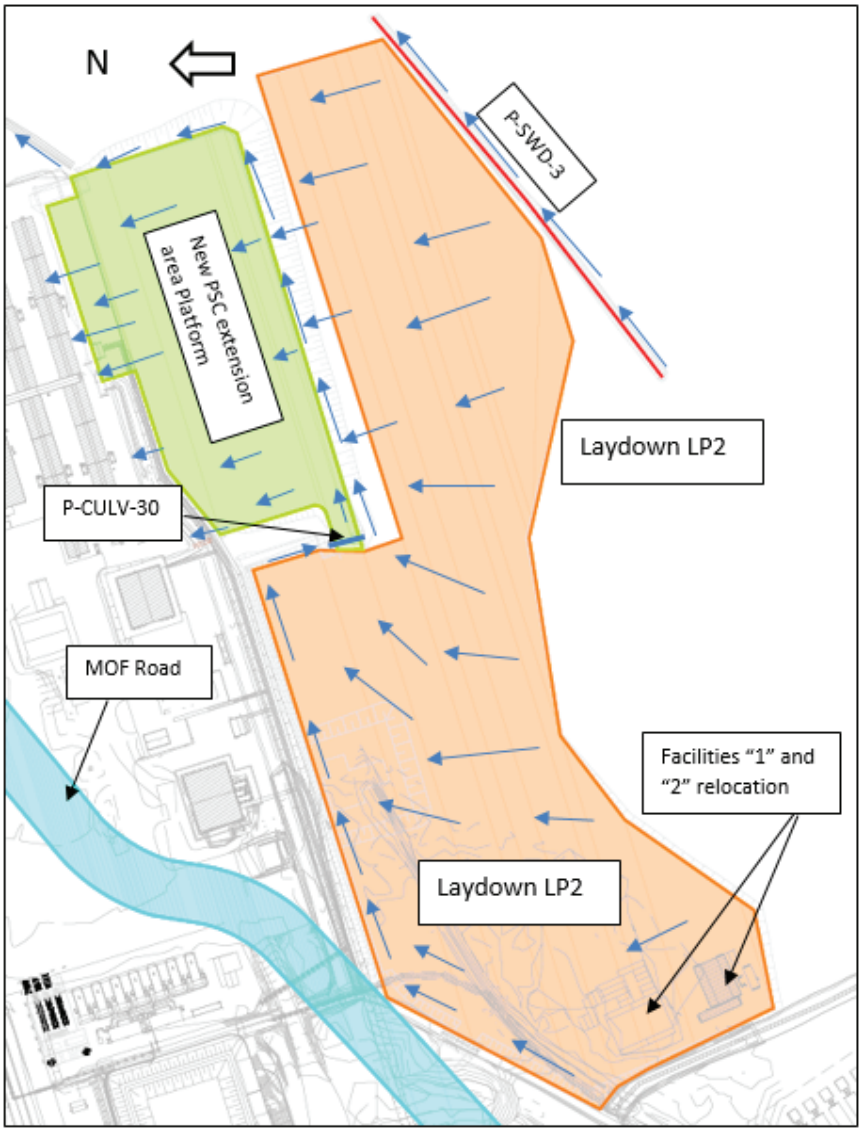


Figure 9-3: Laydown LP2 and PSC Extension Platform Drainage

The laydown LP2 has two zones of drainage. The south western area is graded to the north where it drains into a new channel running along the perimeter of LP2. This channel conveys the storm water to the east up until the new platform for the PSC extension. At this point the channel turns to the south and through a culvert (CULV-30) from where it turns again to the east and continues at the toe end of the PSC platform excavation until the end of the platform. At this point the channel turns through 90

degrees to the north where it eventually discharges into the existing natural drainage ditch.

The Laydown LP-2 area directly adjacent to the south of the new PSC extension platform is graded to drain storm water to the north and down the excavation of the PSC platform into the channel described above running along the southern perimeter of the PSC platform.

The PSC extended platform is graded to drain storm water overland across the platform to the north where it will discharge onto the existing PSC platform, and form part of the existing drainage system.

9.3 Drainage in the Barge Offloading Dock Area - P-SWD-7

At the existing barge offloading dock, there is an existing culvert (referred to as Culv-Exg-B) that conveys runoff from the south and discharges it to the west. The storm water is directed towards the sea via a berm (P-SWD-7) after exiting the culvert. Refer to Figure 9-4.

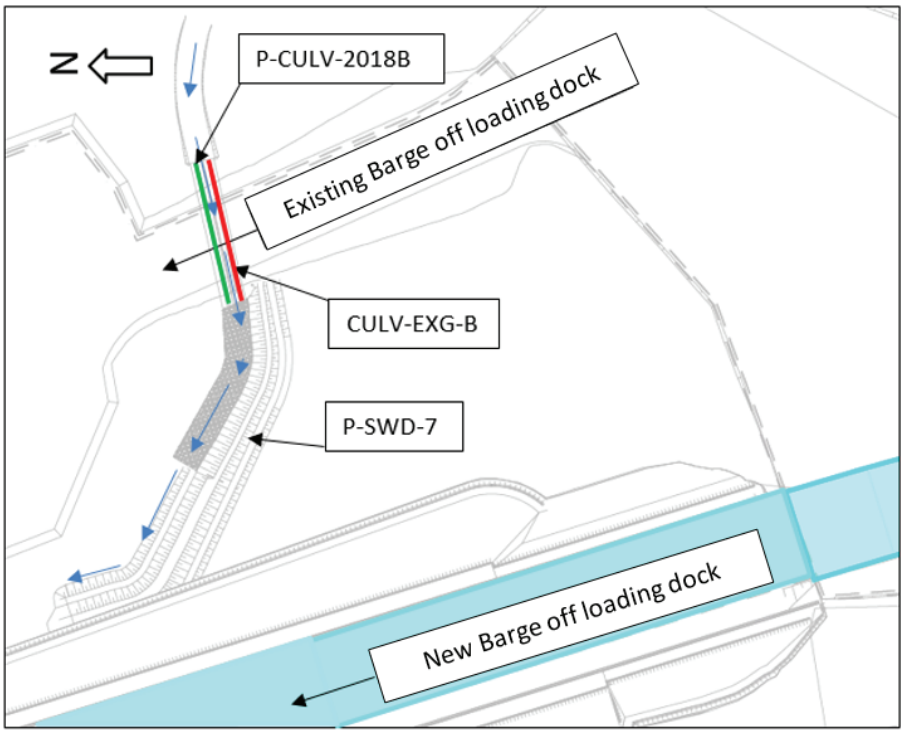


Figure 9-4: P-SWD-7

The existing culvert must be modified to ensure that no water for the 1:100 year flood event (See Civil Design Philosophy) will discharge towards the north which is not the natural discharge location for this stream. The berm P-SWD-7 is designed so that runoff will not interfere with the construction of the new barge offloading dock.

The existing culvert has two barrels of 1200mm diameter each. These are to be modified by lowering the inlet invert elevations and adding two additional 1200mm diameter barrels to the culvert at the same elevation.

- Based on the 1:100 year return period flood, the computed headwater elevation at the culvert's inlet is equal to 3.23 m. This is less than the maximum allowable elevation of 3.24m before a spill will occur to the north and into the sea.
- The calculated maximum velocity is equal to 1.83 m/s and as a result, rip rap will be placed at the inlet and outlet of the culverts to protect against erosion.

The diversion berm (P-SWD-7) is modelled and analysed taking into account the surrounding existing ground. The results are as follows:

- Berm Height Required = 1.2 m
- Maximum Velocity = 1.53 m/s

Based on the results, adequate rip rap shall be placed to protect against erosion.

9.4 Laydown W10A and W10B

Storm water runoff from laydown W10A and W10B will be directed to the west by constructing laydown levels that ensures adequate slope and flow. No swales will be constructed for the laydown area and all runoff will be considered as sheet flow. W10A and W10B are indicated on Figure 9-5.

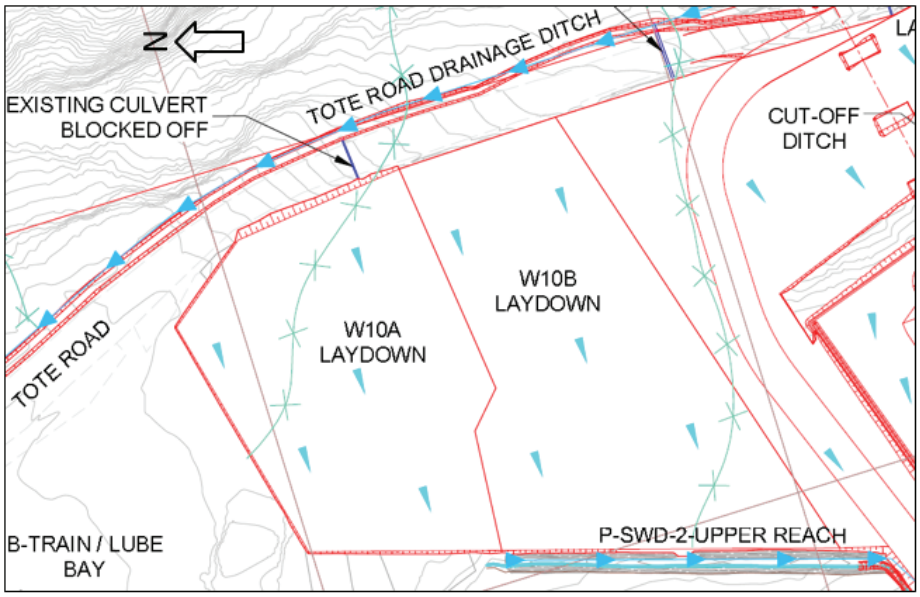
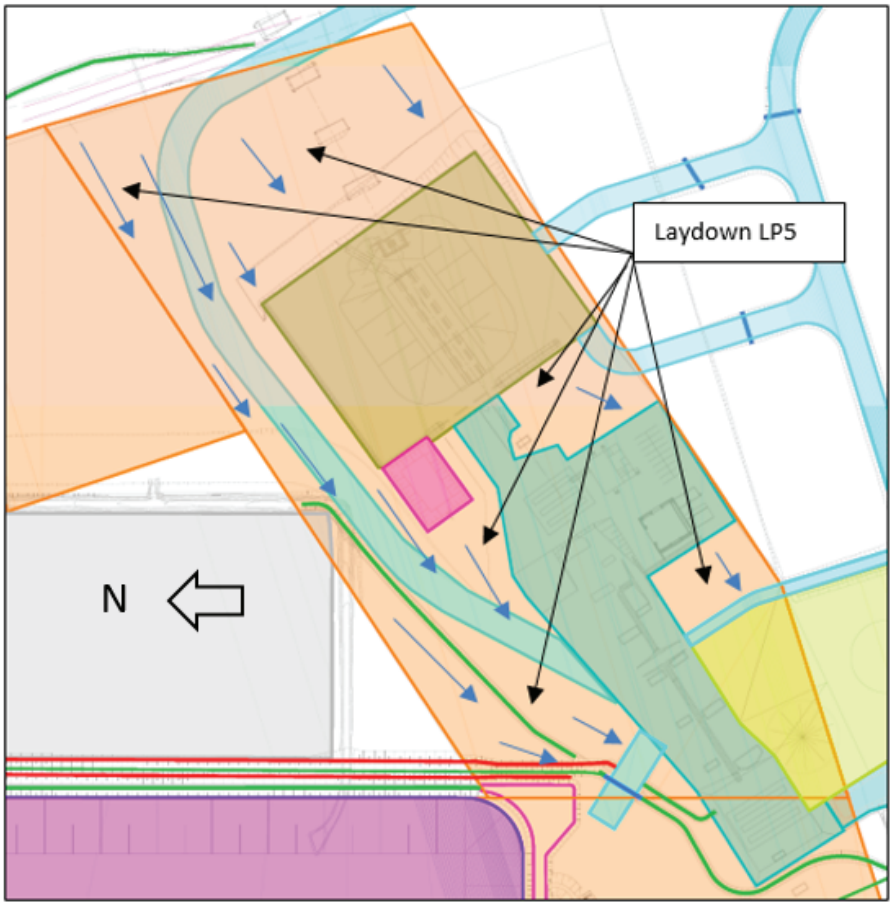


Figure 9-5: Laydown W10A and W10B Drainage Plan

Runoff from W10A will continue as sheet flow across the Accommodation Camp pad and runoff from W10B will flow into P-SWD-2-Upper Reach.

9.5 Laydown LP5

Laydown LP5 will drain towards the southwest through a combination of swales and sheet flow as per Figure 9-6.



1

Figure 9-6: Laydown LP5 Drainage

9.6 Laydown LP6

This laydown area will drain towards the west as sheet flow. This is achieved through grading the laydown to ensure adequate slope. The LP6 laydown area will discharge into the natural environment as shown on Figure 9-7.

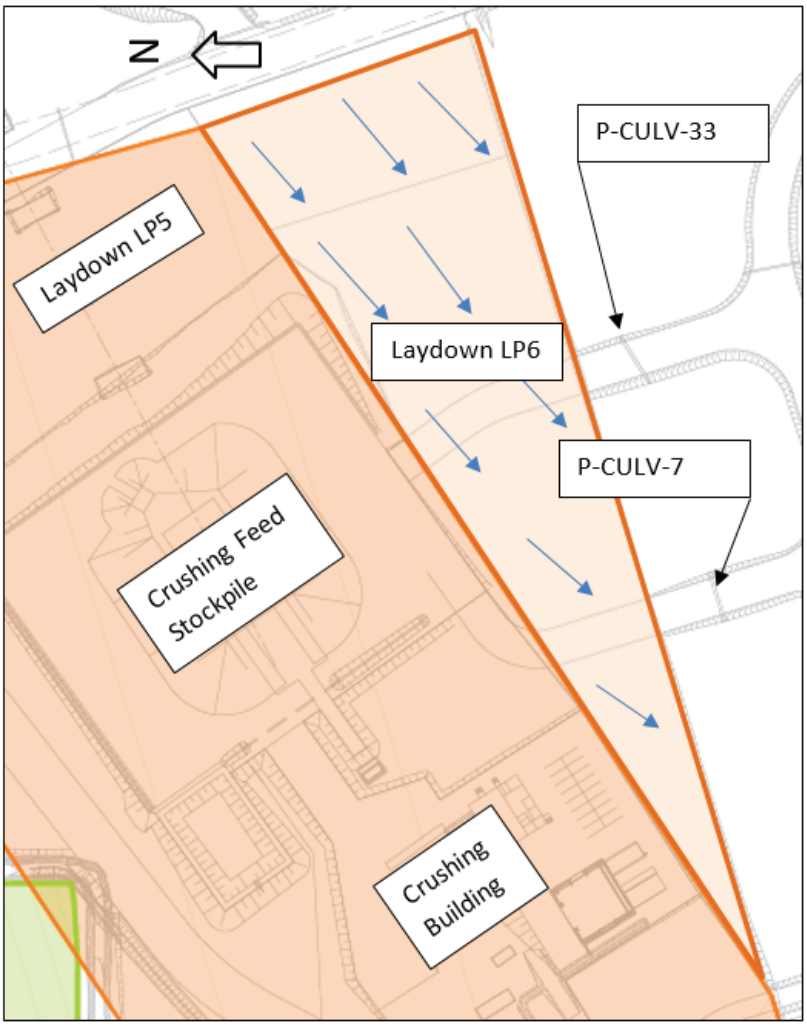


Figure 9-7: Laydown LP6 Drainage Plan

9.7 P-SWD-2

Storm water diversion No.2 consists of two sections:

- Upper Reach that was previously designed and constructed to facilitate drainage around the Accommodation Camp Pad.
- Lower reach that was designed to convey water to the south where it will discharge into the natural environment.

9.7.1 *P-SWD-2 – Upper Reach*

This section of the diversion was designed and constructed to convey flow from a large catchment area upstream of the existing Tote Road and discharge it on the western side of the construction accommodation camp pad. For the future phase, this section will link up with P-SWD-2 – Lower Reach which is described in Section 9.7.2.

9.7.2 *P-SWD-2 - Lower Reach*

This reach will be constructed to convey water from the P-SWD-2 – Upper Reach, upstream catchment area and the Eastern Berm – Clear Water Overflow Channel around the crushing and screening pad. The ditch will have several culvert crossings as follows:

- P-CULV-39 - 1200mm Diameter CSP
  - Crossing to allow for utilities crossing over the ditch, on top of a berm
- P-CULV-37 - 1200mm Diameter CSP
  - Crossing to allow access into the stockpile area for front end loader and maintenance vehicles
- P-CULV-38 - 1200mm Diameter CSP
  - Crossing at the Southern Bypass

Figure 9-8 shows the diversion.

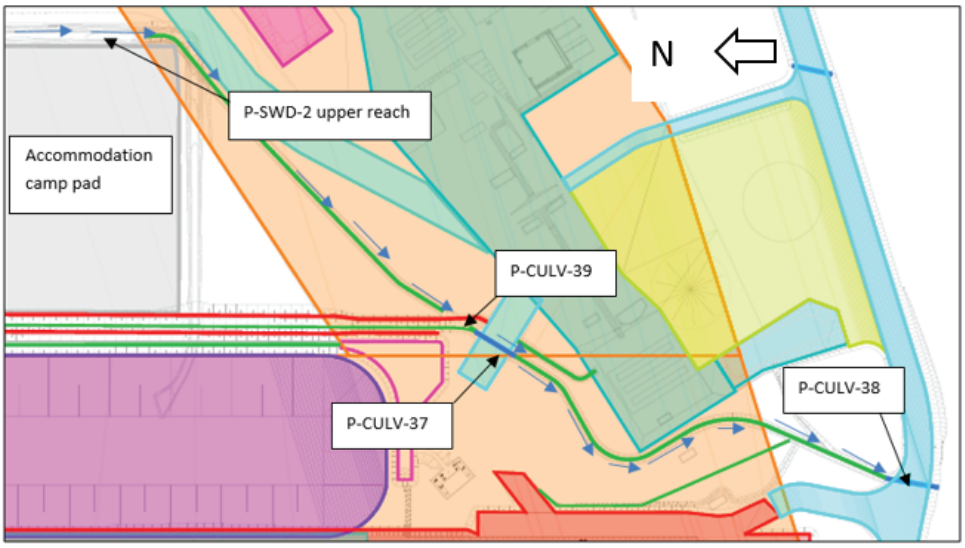


Figure 9-8: P-SWD-2

As part of the stacker reclaimer berm, a small trapezoidal ditch is designed to connect to this diversion.

The results of the design calculations for P-SWD-2 are as follows:

- Bottom Width - 0.5m
- Side Slopes - 1V:1.5H
- Flow - 2.348 m^3/s
- Max Normal Flow Depth - 0.995m
- Max Velocity - 1.18 m/s

Since this ditch drains a number of drainage areas; the above results are for the total drainage area when the highest flow is expected.

9.8 Laydown LP7

Figure 9-9 indicates the location of laydown LP7.

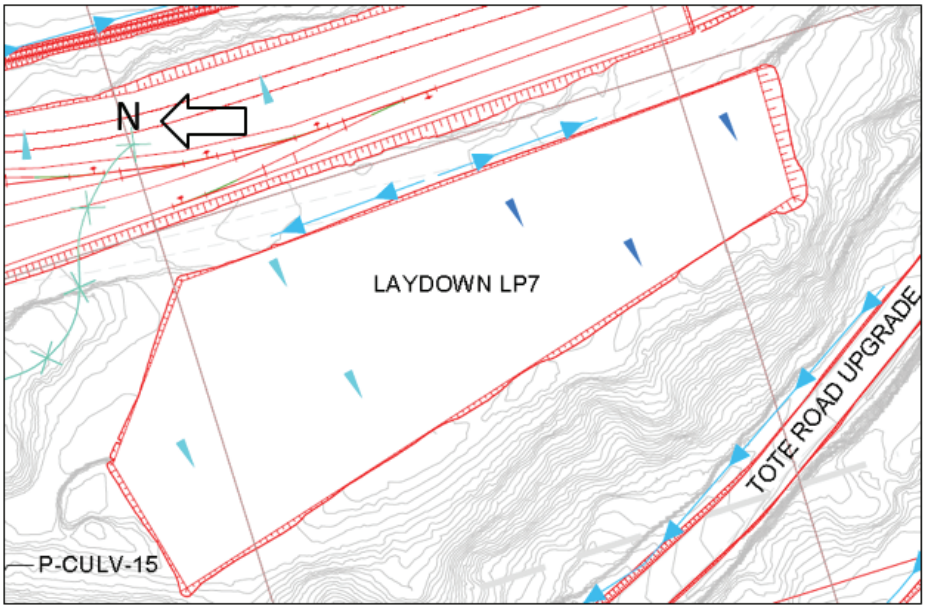


Figure 9-9: Laydown LP7 Drainage Plan

This laydown area will be drained as sheet flow to the west where it joins the Tote Road drainage and then diverts to the north.

9.9 Utility Berm – From Generation Station to South

Two drainage culverts will be provided beneath a utility berm. The details for the culverts are as follows:

- P-CULV-24 - 600mm Diameter
  - This culvert will be constructed beneath the existing utility berm located to the east of the eastern berm. No rip rap will be required.
- P-CULV-27 - 600mm Diameter
  - This culvert will be constructed beneath the new section of the utility berm. No rip rap will be required.

The area can be seen in Figure 9-10.

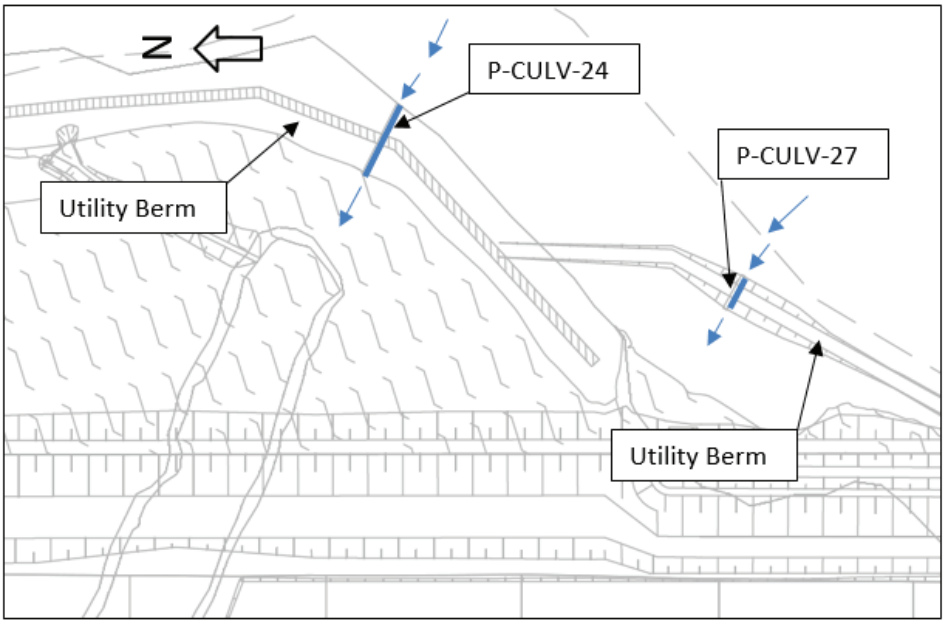


Figure 9-10: Utility Berm

9.10 Conveyor Bent Pads

Pads will be constructed along the conveyor alignment to support the conveyor bents located as per Figure 9-11. These platforms are in fill with a 1:200 fall across to facilitate drainage. Where they are in cut, daylight ditches will be constructed at 1:200 fall to ensure adequate drainage is achieved.

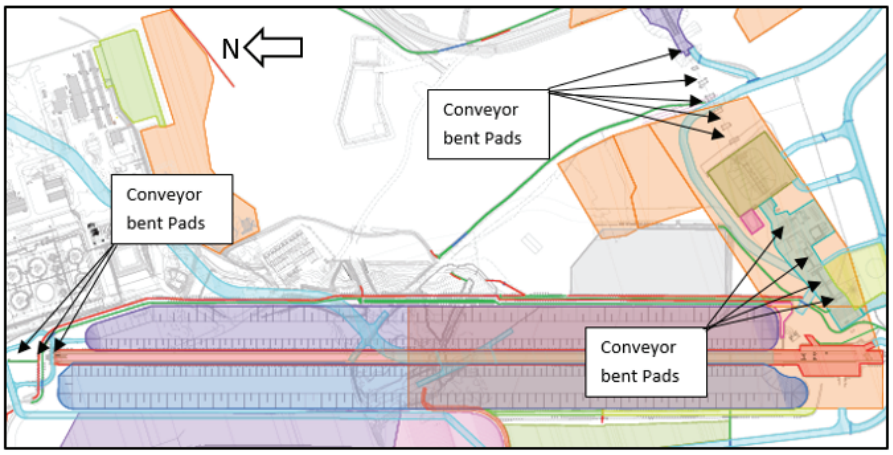


Figure 9-11: Conveyor Bent Pads

9.11 Accommodation Camp Pad

The Accommodation Camp Pad has been designed to allow for sheet flow across the pad. The catchment area only includes storm water runoff from the pad and flow from Laydown W10A. The pad drains toward the eastern berm and enters the clear water channel through P-CULV-40 as described in Section 7. Figure 9-12 shows the pad.

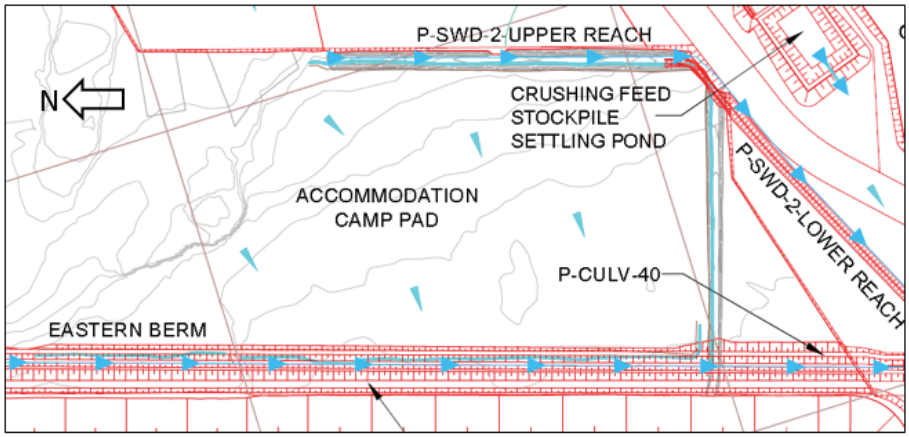


Figure 9-12: Accommodation Camp Pad Drainage

Appendix A
IFC Drainage Drawings List

Doc Number	Rev.	Doc Title	Sub Title	Status
H353004-40000-223-271-0009-0001	1	TOTE ROAD DRAINAGE UPGRADE	PORT SITE	Approved for Construction
H353004-00000-221-294-0002-0001	1	STANDARD DRAWING	PLAN AND PROFILE SHEET 1 OF 3	Approved for Construction
H353004-00000-221-294-0003-0001	1	STANDARD DRAWING	EARTHWORKS & DRAINAGE DETAILS	Approved for Construction
H353004-00000-221-294-0004-0001	1	STANDARD DRAWING	EARTHWORKS & DRAINAGE DETAILS	Approved for Construction
H353004-00000-221-294-0005-0001	2	STANDARD DRAWING	EARTHWORKS & DRAINAGE DETAILS	Approved for Construction
H353004-00000-221-294-0006-0001	1	STANDARD DRAWING	EARTHWORKS & DRAINAGE DETAILS	Approved for Construction
H353004-00000-221-294-0009-0001	1	STANDARD DRAWING	EARTHWORKS & DRAINAGE DETAILS	Approved for Construction

Doc Number	Rev.	Doc Title	Sub Title	Status
H353004-40000-228-272-0006-0001	1	CRUSHING AND SCREENING PAD	TYPICAL INTERNAL ROAD SECTIONS	Approved for Construction
H353004-40000-228-272-0005-0001	1	CRUSHING FEED STOCKPILE PAD	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0011-0001	3	LAYDOWN AREA LP2	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0012-0001	1	LAYDOWN AREA LP3	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0017-0001	1	LAYDOWN AREA LP5	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0016-0001	1	LAYDOWN AREA LP6	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0013-0001	1	LAYDOWN AREA LP7	DRAINAGE PLAN	Approved for Construction

Doc Number	Rev.	Doc Title	Sub Title	Status
H353004-40000-228-272-0014-0001	1	LAYDOWN AREA W10A	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0015-0001	1	LAYDOWN AREA W10B	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-272-0009-0001	2	LOCOMOTIVE WORKSHOP PAD	DRAINAGE PLAN	Approved for Construction
H353004-40000-228-271-0005-0001	1	MODULE ROAD AND TOTE ROAD	DRAINAGE DETAILS	Approved for Construction
H353004-40000-228-272-0018-0001	0	PORT SITE COMPLEX PAD EXPANSION	DRAINAGE PLAN	Approved for Construction
H353004-40000-221-272-0010-0001	0	RAIL CAR DUMPER	DRAINAGE PLAN	Approved for Construction
H353004-40000-221-272-0020-0001	0	STAGE 1 - NEW STOCKYARD No. 1	DRAINAGE LAYOUT	Approved for Construction

Doc Number	Rev.	Doc Title	Sub Title	Status
H353004-40000-221-272-0022-0001	1	STAGE 2 - NEW STOCKYARD No. 1	DRAINAGE LAYOUT	Approved for Construction
H353004-40000-228-271-0007-0001	1	STOCKYARD No.1 - BERM (P-SWD-4)	DRAINAGE PLAN	Approved for Construction

Appendix B
Drawing H353004-40000-220-272-0008-0001 - Surface Water Management Plan - Milne Port

1