2.5 Hydrology (Surface Water)

The Project sits within the Central and Southern Yorke Peninsula catchment. There are no permanent watercourses on Yorke Peninsula although ephemeral watercourses do occur, as do numerous drainage pathways in small discrete catchments. Salt lakes and claypans also occur, particularly in the south.

The topography surrounding the Project is characterised by gently undulating hills, with elevations rising to just over 200m, separated by several broad gently sloping gullies. These ephemeral drainage channels cross the site in a south-easterly trending direction, with slopes less than 1.5% that gently increase to 3% towards the eastern end of the property, ultimately draining to Gulf St Vincent. Typically, the catchments within the project area vary in elevation from 60m to 20m from west to east. The defined catchment areas vary from between 48km² to 0.5km².

Soils in the project area are generally loams and sandy loams, with a typical clay content of less than 30%. The low rainfall (less than 350mm per annum) experienced in the region and permeable soils result in little overland flow. Run-off is only generated after very intense rainfall events which occur infrequently.

During these periods of high intensity rainfall, sheet flow can occur across the Project site. Any channel flow across the Yorke Highway and the St Vincent Highway is managed by Yorke Peninsula Council/ Transport SA via culverts. Runoff passing through the site during such rainfall events can reach Gulf St Vincent. Pre-development drainage pathways and catchments surrounding the Project are shown in Figure 2-14.

The estimated extents of the 100-year average recurrence interval (ARI) flood for the undeveloped site are shown in Figure 2-15.

2.6 Hydrogeology (Groundwater)

2.6.1 Site Investigations

Since the previous description of the hydrogeology in the MLP, an additional three groundwater investigation wells have been installed (see Figure 2-16), bringing the total to 41 investigation wells on the Hillside Project site. The information provided from the additional wells is detailed in Appendix 2.3-A.

2.6.2 Static Water Level

Rex continues to monitor monthly depth to water levels in all of the 23 vertical groundwater investigation wells. Eight investigation wells were chosen to represent the groundwater levels due to their dispersion over the Hillside Project site. Figure 2-18 displays the locations of the eight investigation wells. Figure 2-17 below displays the static groundwater levels of the eight investigation wells from August 2012 to January 2019 (note that there was an equipment malfunction in July 2018 hence the gap in results). Figure 2-17 identifies that there has been no material change to the depth to water during the six years of monitoring.

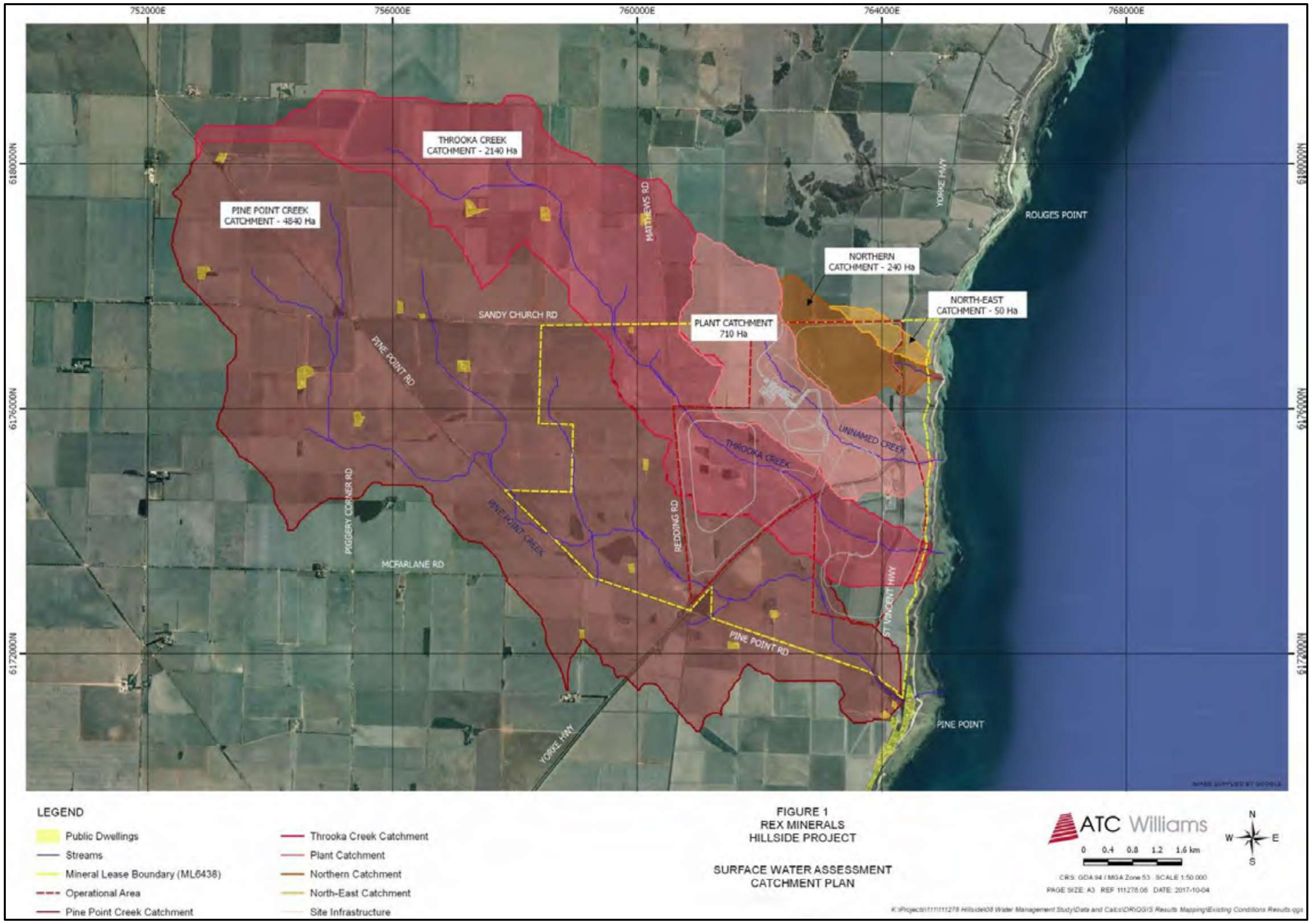


Figure 2-14: Pre-development drainage pathways and catchments

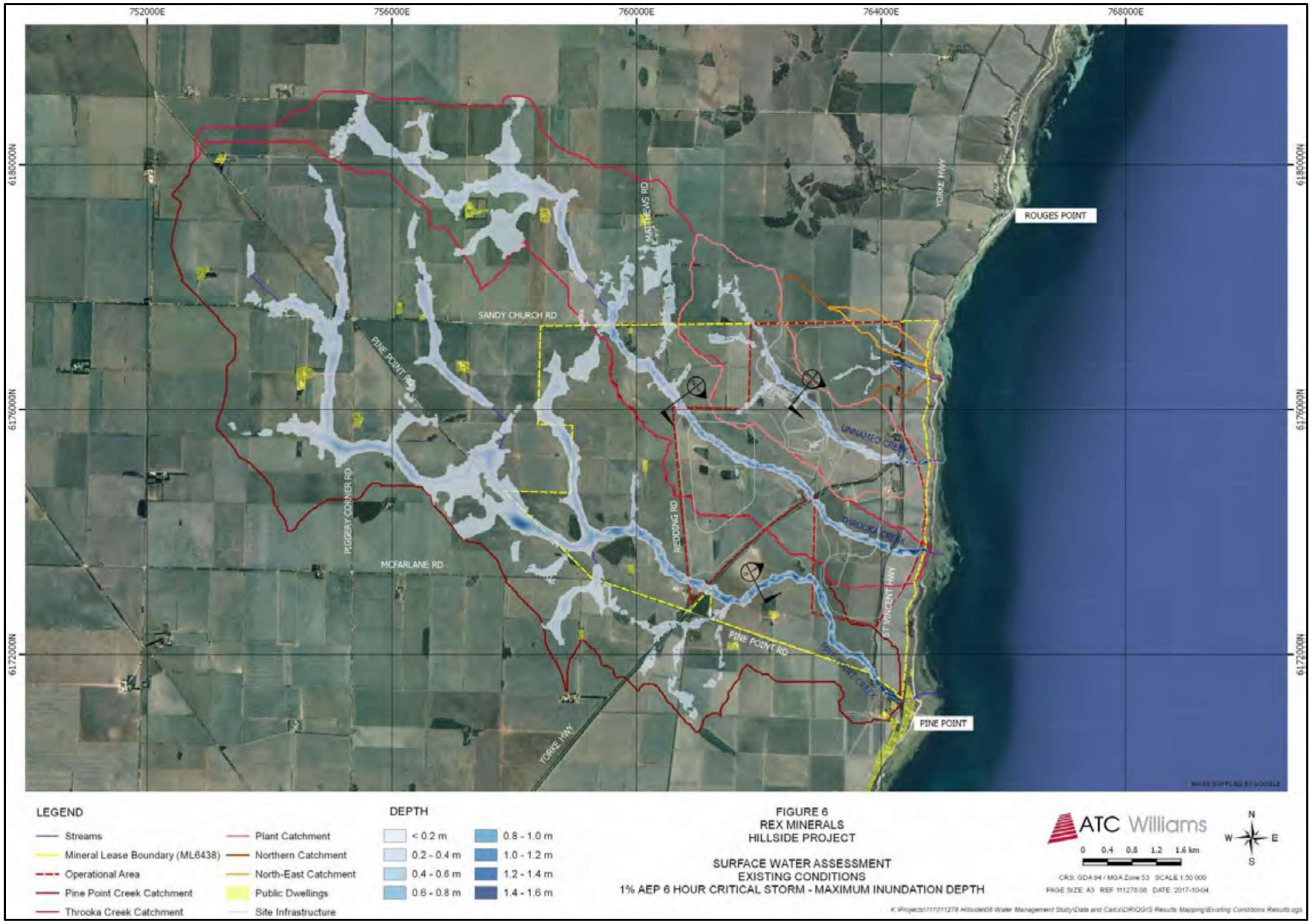


Figure 2-15: Estimated extents of the 100-year ARI flood pre-development

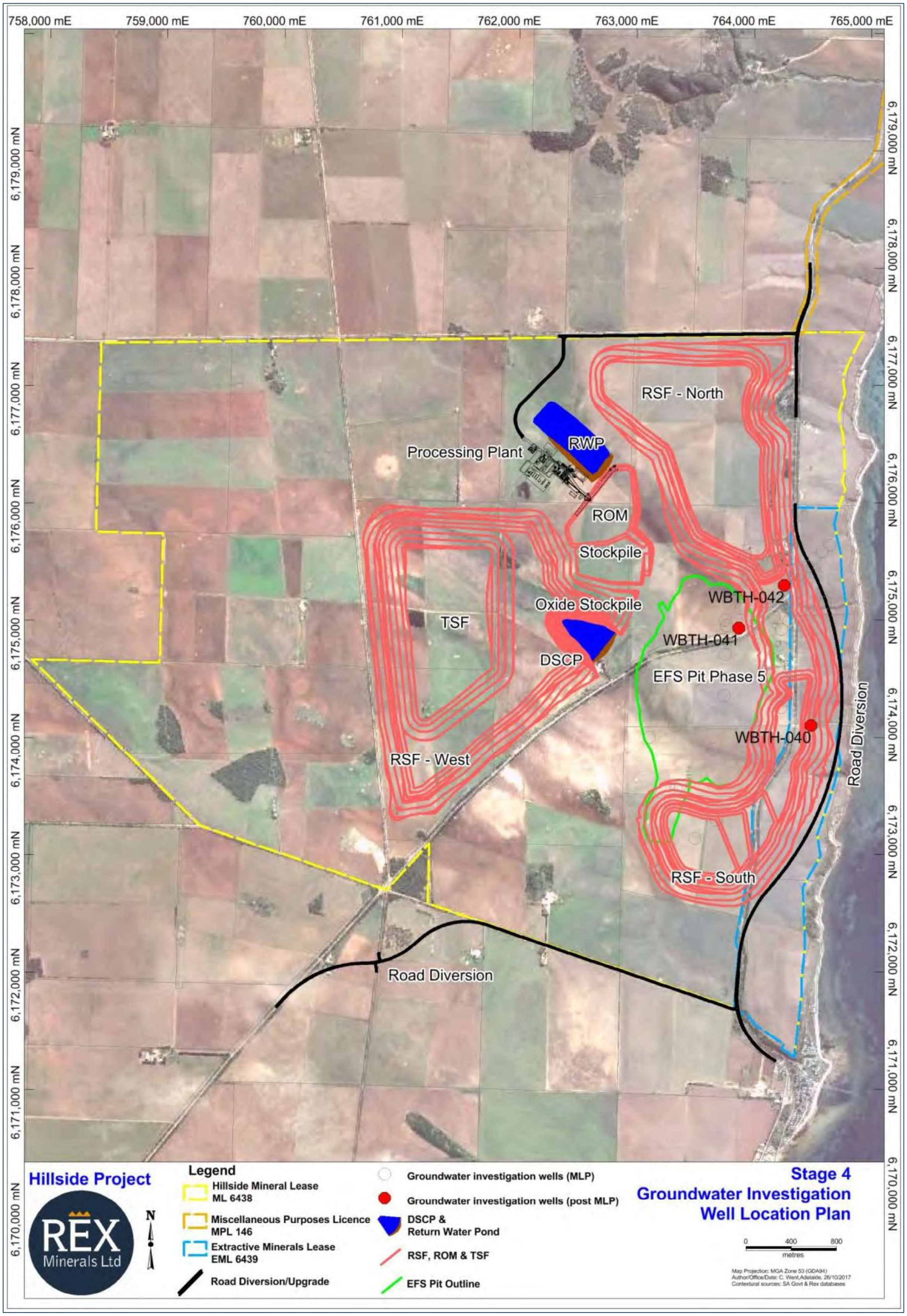


Figure 2-16: Stage 4 groundwater well locations

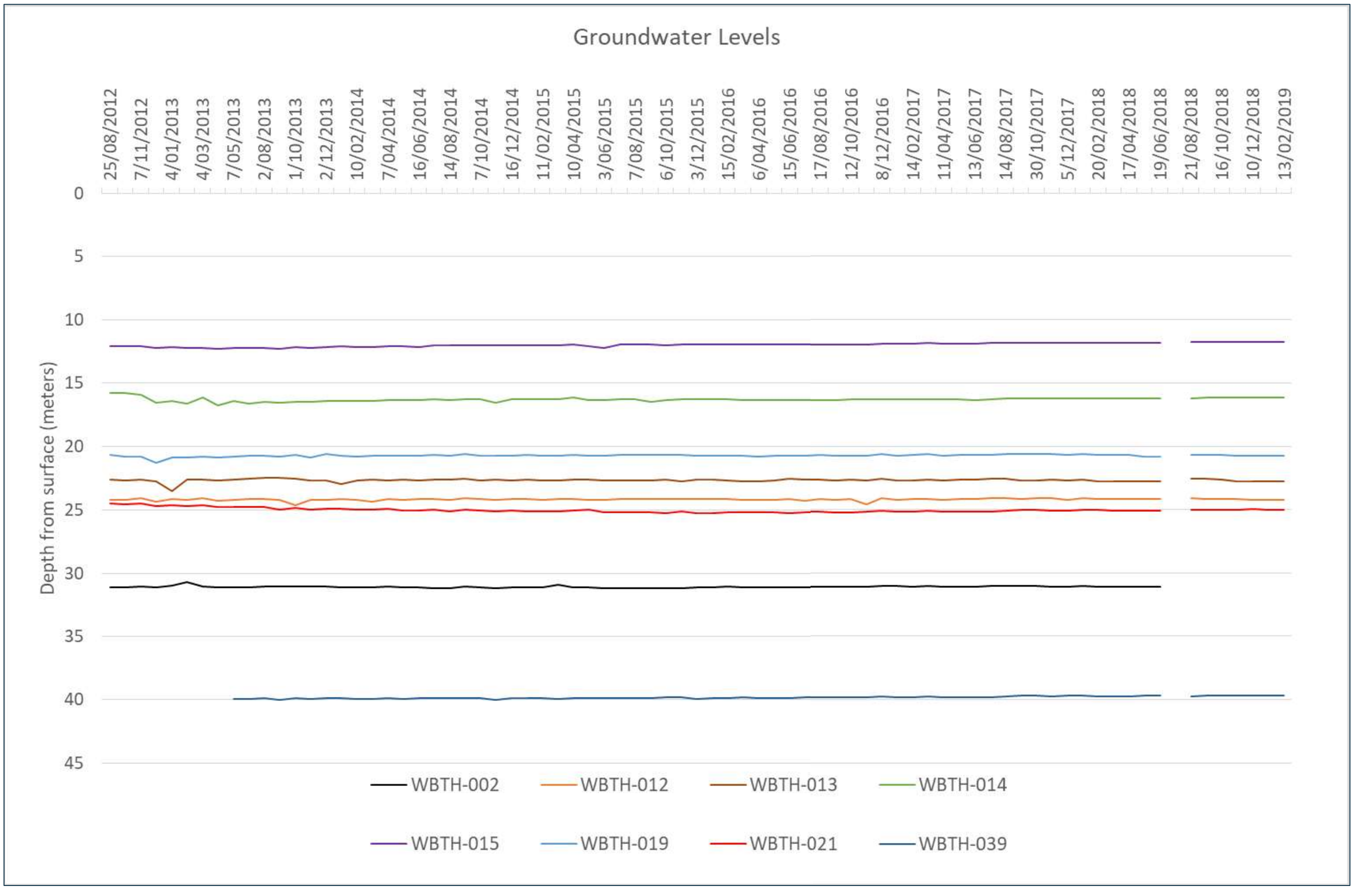


Figure 2-17: Depth to water levels in all of the eight vertical groundwater investigation wells (August 2012–January 2019)

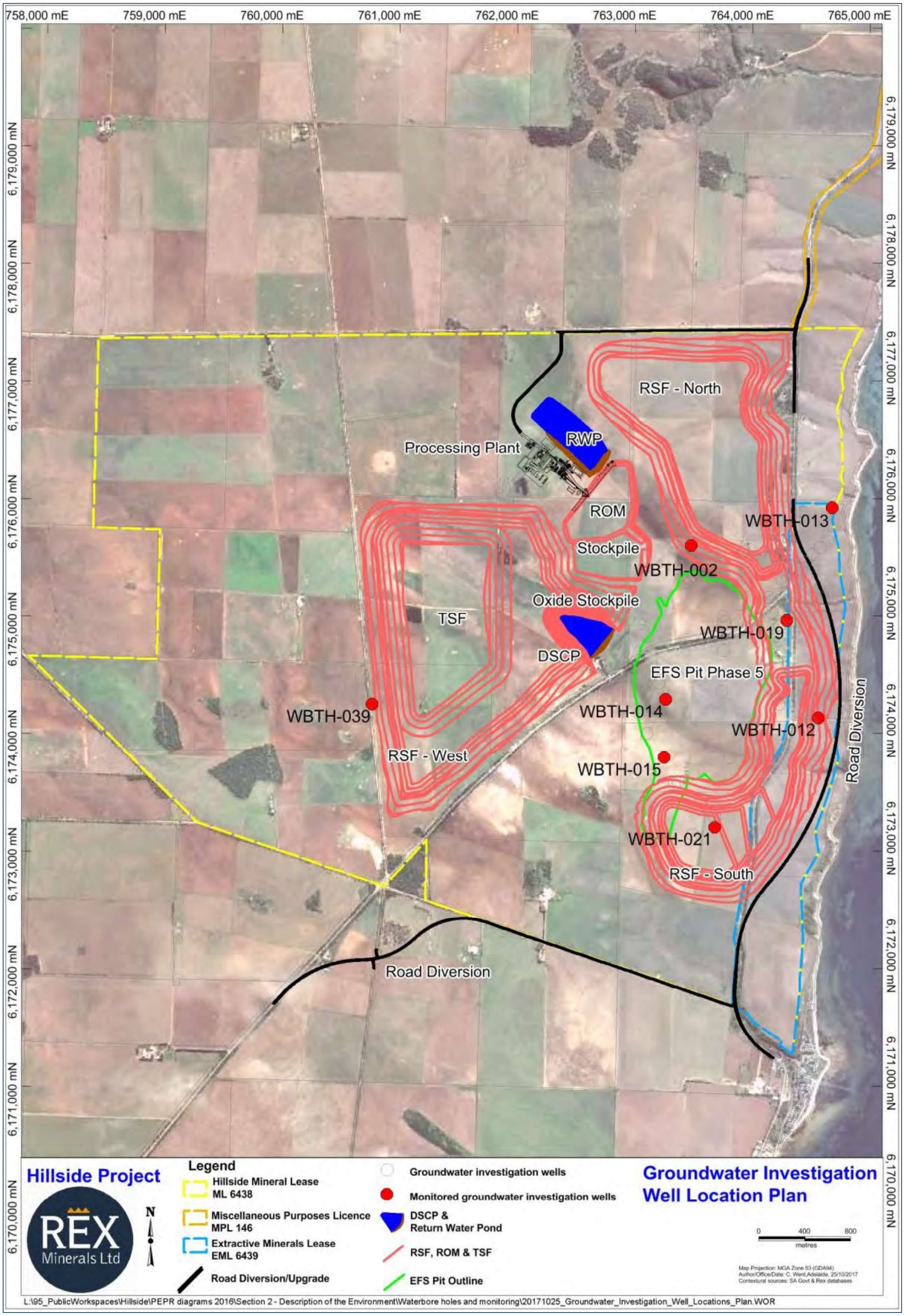


Figure 2-18: Eight representative groundwater investigation well locations

Function	Indicative Manufacturer	Indicative Model	Sound Power Level dB(A)	Exhaust Outputs Emission Certification	Fire Ignition Source	Indicative Number
Light Mining						
Pump	Pioneer	PP68C21	113		N/A	6
Bus					N/A	1
Lighting tower	All Light	LED			N/A	22
Communication trailer	Wenco				N/A	8
Light vehicles	Toyota	Hilux	100		N/A	34
Ambulance					N/A	1
Fire truck					N/A	1
Subtotal					**N/A**	**73**
Grand Total					**N/A**	**122**

The site will also have a mobile crushing and screening plant for road base and stemming for blasting. The plant will be in the 500kW prime mover range with US EPA Tier 3 Equivalent or EU Stage IIIA Equivalent exhaust outputs. The sound level is expected to be 118dB(A). This plant is expected to be operated during daytime operations only.

3.5.8 Mine Dewatering

Provide:

- *estimated inflows of groundwater and stormwater and water from any other mining activities into mine workings;*
- *details of mine dewatering infrastructure, and mine water management and disposal;*
- *contingency measures for greater than planned water inflows into mine workings; and*
- *a mine water balance of water inflows and water outflows during operations and at mine completion (if not included in the water balance in Section 3.5.4).*

Modelling of groundwater and stormwater inflows show that the mine workings will be relatively dry with an inflow starting at approximately 40L/s increasing steadily through mine life to a maximum inflow of approximately 100L/s in Year 12 (see Figure 3-33). The groundwater modelling for the revised pit configuration is provided in Appendix 3.4-B.

Uncertainties and sensitivity to change of groundwater model assumptions, i.e., the inflows cited throughout this section, is presented in Table 5-59 of Section 5.16.

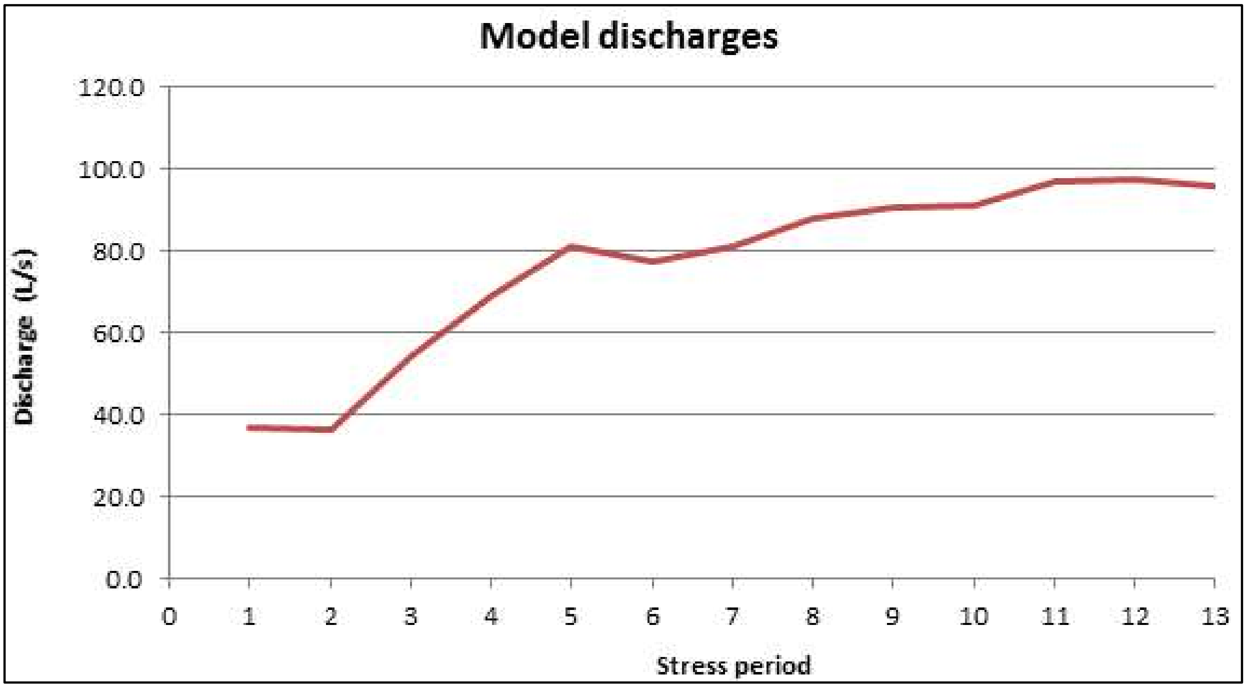


Figure 3-33: Modelled mine dewatering water

Average rainfall in the Project area is 350mm/a and the average evaporation rate is 1,300mm/a. Rainfall rarely exceeds 50mm/d. Assuming this falls within the Phase 5 pit void within one day it would contribute approximately 850L/s for a 24-hour period. Based on the existing mine dewatering system this would take approximately 20 days to dewater, including existing modelled water inflows.

The mine dewatering system will consist of transportable pump stations connected in series, to pump water from a number of pit drainage cells. These cells will be located at or near the bottom of each pit stage. The pumps will be added progressively as the mine advances. Water will be channelled from the road to the drainage cells via engineered drains. The water will be pumped to the decant seepage collection pond (DSCP), where it will be used for dust suppression, and/or pumped to the process water pond. The mine dewatering system has been designed to meet the expected water inflows over the life of mine.

There will be a maximum of four pump stations with two pumps on standby. Each station is modelled to deliver up to approximately 120L/s over 100m vertically. The water will be pumped to the DSCP.

The Hillside Project is in a semi-arid area, mining activities will generate dust during dry periods. The major dust generation will be from haul trucks and drilling operations (see Appendix 2.1-A). Assuming 12km of haul road is active at any one time and 4 active drills, it is estimated that Rex will require an average of 56L/s of water for good dust suppression (equivalent to 4.8ML/d or 1800ML/a). During the initial mining stages, the water produced by the mine (40L/s) will be in slight deficit for what is required in the mine. The deficit will be supplemented from the planned borefield (see Section 3.6.4). After production Year 2 (Year 3 on Figure 3-33), mine water will be in surplus for dust suppression. Excess mine water will be used in the plant. Dust suppression will be provided by three modified mine trucks fitted with 150kL tanks that are filled from the decant seepage collection pond. The trucks will also supply water to drills for their dust suppression. It is estimated that two water trucks delivering two loads per hour are required at the maximum production rate, with a backup water truck on standby. The mine water balance is explained in detail in Figure 3-59.

3.5.8.1 Contingency measures

In the case of unexpected water flows such as an extreme storm event of 1% AEP in 24 hours of 109mm/d, around 3,500L/s can be expected to fall within the maximum pit outline equating to approximately 300,000m^3. This amount of water cannot be diverted by the proposed pumping stations. In this case, personnel and equipment would be evacuated from the pit and emergency pumps would be brought in to pump the water from the pit floor to the TSF via the DSCP. Emergency pumps can be mobilised within 48 hours to enable water to be pumped to the TSF, ensuring that the TSF remains within the specified decant pond limits (Section 3.6.4, via the DSCP and operations to resume once the water has been removed from the pit.

3.5.9 Sequence of Mining and Rehabilitation Operations

Provide the following information on the sequence of operations in both text and map form:

- *description of the sequence of mining stages;*
- *sequencing of progressive and final rehabilitation, including demonstration that progressive rehabilitation has been integrated with the mining plan;*
- *an estimation of the quantities of sulphide minerals that have the potential to generate acid or mobilise metals, or other hazardous minerals to be mined at each mining stage; and*
- *any mineral resource that may be sterilised from future mining by the planned mining operations.*

3.5.9.1 Sequence of mining and rehabilitation

The following development stages are referred to throughout this PEPR document, particularly in Chapter 5:

- Construction (C): the period where the project is constructed. Pre-strip of the open pit will also commence during this period. This is anticipated to be 1 year (referred to as Year -1);
- Operations (O): the period of active mining and processing. This is planned as 14 years and ends with the processing of the last ore;
- Closure (Cl): this is the period of active closure implementation where demolition and rehabilitation of the site is conducted. At this stage, given the level of progressive rehabilitation to be implemented, active closure is planned to take one year; and
- Post-closure (PC): this is the period between active closure being completed and relinquishment of the mining lease. During this time monitoring and, where required, maintenance activities, will be conducted. The post-closure period is dependent on the achievement of all completion criteria, i.e., the achievement of all outcomes required prior to relinquishment. These outcomes and associated timeframes where applicable are detailed in Chapter 5 of this PEPR.

The Project will be mined in five phases with up to three phases operating concurrently. A high-level schedule of the Project construction to active closure completion is shown in Figure 3-34.

3.8.6 Site Security

Describe infrastructure and measures that will be adopted to prevent unauthorised access by the public, including fencing, signage etc.

It is proposed that the site will be securely fenced with a chain link fence a topped with three runs of barbed wire security fence coupled with no entry signage. The security fence will generally follow the operational area boundary (impact footprint) as illustrated in Figure 3-3. Access to site will be via the site access road as described in Section 3.8.1.6. The access will be controlled using a boom gate for vehicles and a turnstile type person gate with swipe card access for personnel entering the site.

It is proposed that site security will be contracted to a recognised security firm during construction and revert to owner operator during operations. Fit for work testing will be conducted at the guard house prior to personnel entering the site.

3.8.7 Stormwater, Silt Control and Drainage

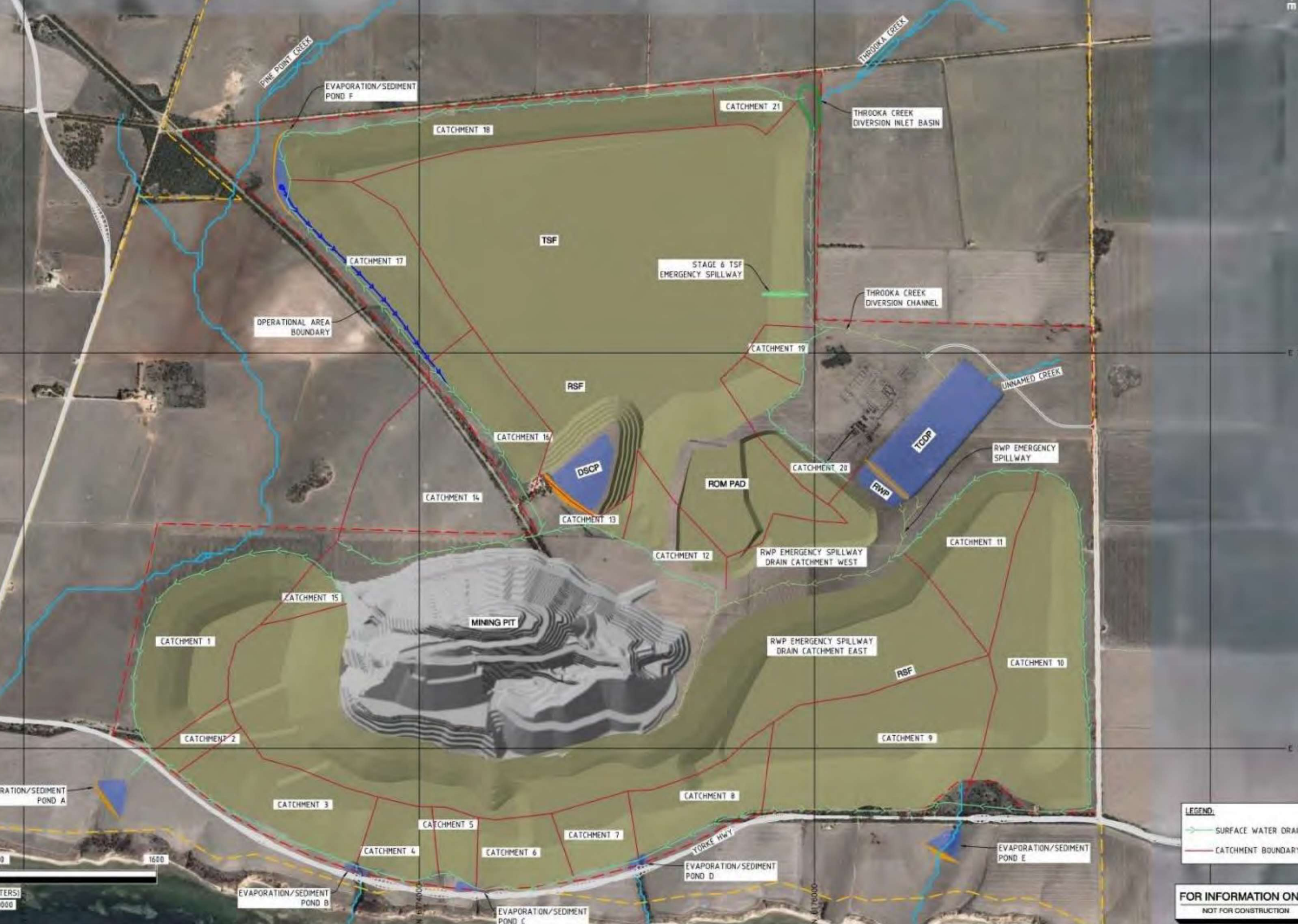
Describe:

- *location and design of silt management structures;*
- *run-off control on disturbed and rehabilitated areas;*
- *storage, diversion and disposal of clean water (discharge water must comply with the applicable Environment Protection Authority South Australia water policy); and*
- *a whole of site stormwater balance, if not included in the water balance in Section 3.5.4.*

3.8.7.1 Surface drainage

The existing flow regime will change as site infrastructure will intersect the two northern drainage lines (Unnamed Creek and Throoka Creek) shown in Figure 3-92. Surface water drains have been designed and will be constructed along the toes of the TSF and RSF (see Figure 3-92 for location and flow directions and Figure 3-93 and Figure 3-94 for surface water infrastructure typical design).

Surface water flow from the Pine Point Creek catchment will not intersect any site infrastructure during a 1-in-100 critical storm event. Upstream surface water (from Unnamed Creek and Throoka Creek) will be redirected around mine infrastructure via surface drains (Throoka Creek diversion drain) and into the Throoka Creek Diversion Pond (TCDP) which has been designed for a 1:100 ARI (1% AEP six-hour) storm event (Figure 3-95).



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REX MINERALS
HILLSIDE PROJECT

SURFACE WATER INFRASTRUCTURE

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FIGURE 19

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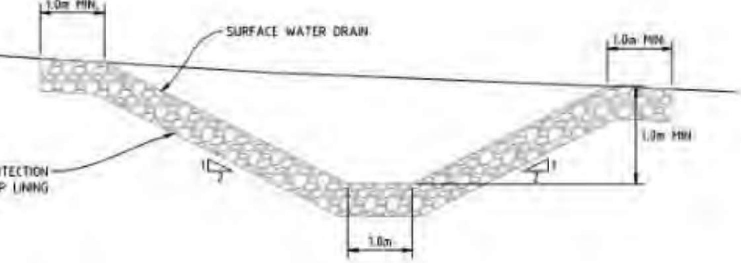

SECTION AA SURFACE WATER DRAIN TYPICAL SECTION
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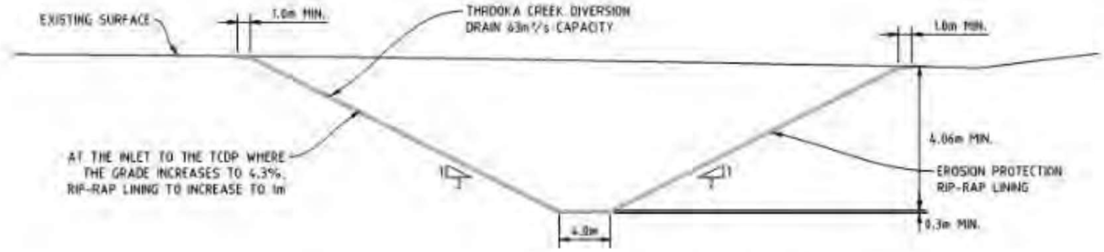

SECTION BB THROOKA CREEK DIVERSION DRAIN TYPICAL SECTION
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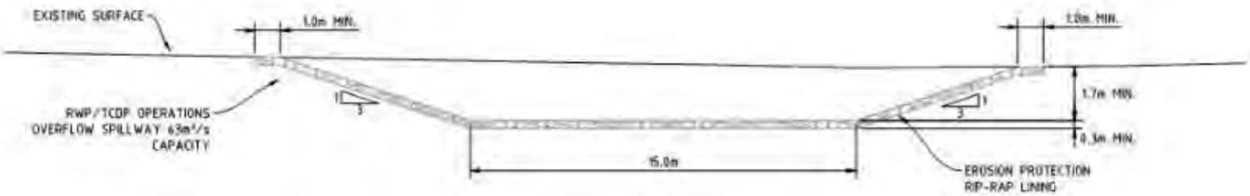

SECTION CC RWP/TCDP OVERFLOW SPILLWAY TYPICAL SECTION (OPERATIONS)
SCALE 1:250 033

SECTION DD THROOKA CREEK DIVERSION INLET BASIN TYPICAL SECTION
SCALE 1:500 029

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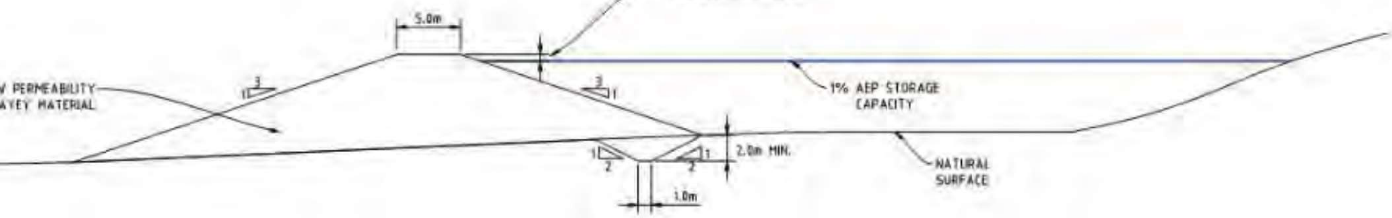
REX MINERALS
HILLSIDE PROJECT

SURFACE WATER INFRASTRUCTURE DESIGN

DWG. No.
FIGURE 3

SHEET SIZE A3



SECTION EE EVAPORATION/SEDIMENT POND A & E TYPICAL SECTION
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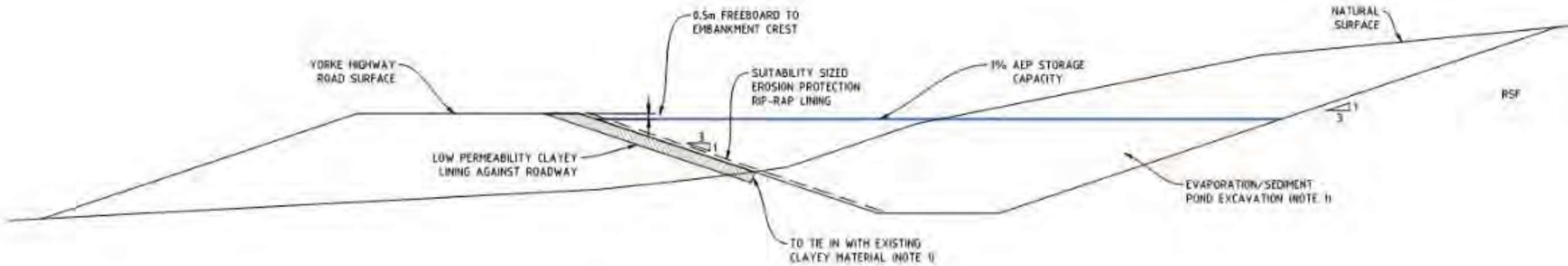

SECTION FF EVAPORATION/SEDIMENT POND B, C & D TYPICAL SECTION
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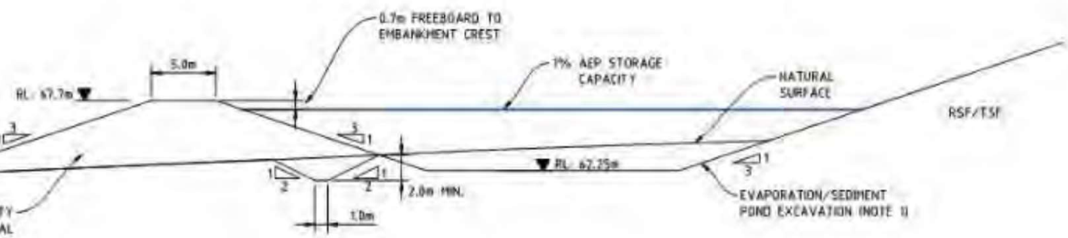

SECTION GG EVAPORATION/SEDIMENT POND F TYPICAL SECTION
SCALE 1:500 026 030

NOTE:

1. EVAPORATION/SEDIMENT POND EXCAVATION ASSUMED TO BE INTO LOW PERMEABILITY CLAY MATERIAL. TO BE CONFIRMED BY INVESTIGATION AT DETAILED DESIGN.

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REX MINERALS
HILLSIDE PROJECT

SURFACE WATER INFRASTRUCTURE DESIGN
MINE OPERATIONS - EVAPORATION/SEDIMENT POND

DWG. No.
FIGURE 35
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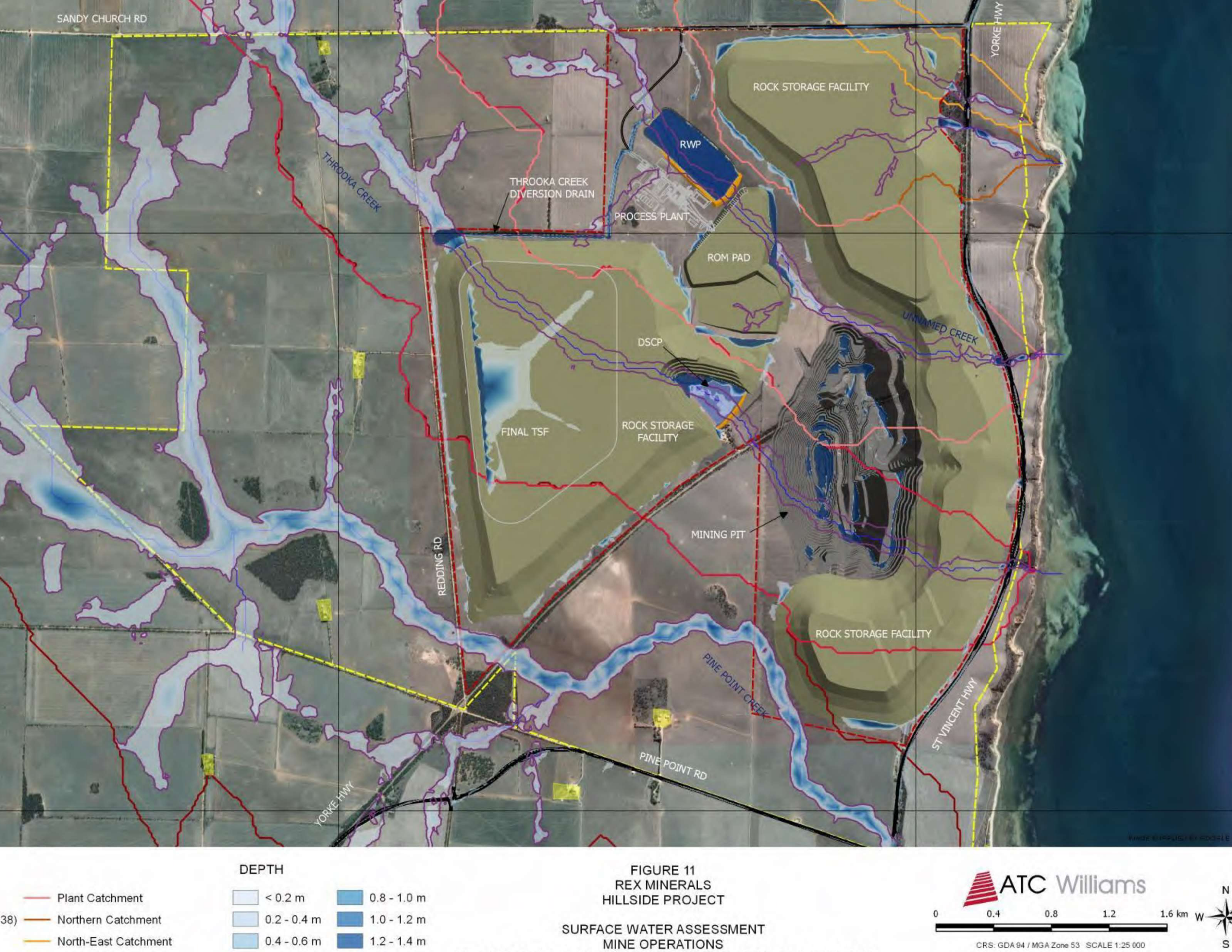

FIGURE 11
REX MINERALS
HILLSIDE PROJECT

SURFACE WATER ASSESSMENT
MINE OPERATIONS

All water that comes in contact with the operational footprint will be retained on site and directed to evaporation/sediment ponds to reduce sediment loads and then either used within the process water system or allowed to evaporate. Overflow from the internal drainage system (including the DSCP) will be directed to the open pit, which will provide temporary storage during major storm events.

Separate catchment areas have been defined for the operational footprint as well as proposed bunds and ponds (detention and retention) estimated for the Project infrastructure layout. The catchment areas and volumes have been estimated for a 1-in-100 ARI event. Using the appropriate run-off coefficient values and safety factors for each catchment area, sufficient pond volume storages for each catchment area has been determined (see Table 3-61). Figure 3-92 shows the location of the evaporation/sediment ponds and their related catchment areas.

Hydrological modelling presented in Figure 3-95 indicates that run-off impacts are potentially most significant at the north-western wall of the TSF. A drainage channel (Throoka Creek diversion drain) will be constructed along the northern toe of the TSF so that there is no increased build-up of water against the TSF during storm events due to the placement of the mine infrastructure. The south-western toe of the eastern RSF has been designed so that it does not interact with the modelled 1-in-100 ARI floodline. This will ensure that the natural run-off characteristics of the pre-mining drainage channel are maintained (Figure 3-95). This will be progressively monitored and controlled as the Project progresses from construction through to the operations phase.

Table 3-61: Quantities from 1% AEP event to evaporation/sediment ponds

Sediment Pond	Catchment Area (ha)	Excess Rainfall 1% AEP 6-hour event (m)	Volume (m^3)
A	56	0.0385	21,623
B	40	0.0385	15,254
C	25	0.0385	9,652
D	46	0.0385	17,741
E	128	0.0385	49,350
F	68	0.0385	26,205

Plant Stormwater Management

All runoff generated in the process plant area will be directed to the return water pond (RWP) for use as process water. The RWP has been sized based on the water balance to contain TSF decant water as well as stormwater from a 1:100 AEP, 72-hour storm event. The TCDP has been designed to retain water from the processing plant area for a 1:100 ARI (1% AEP six-hour) storm event (see Figure 3-96).

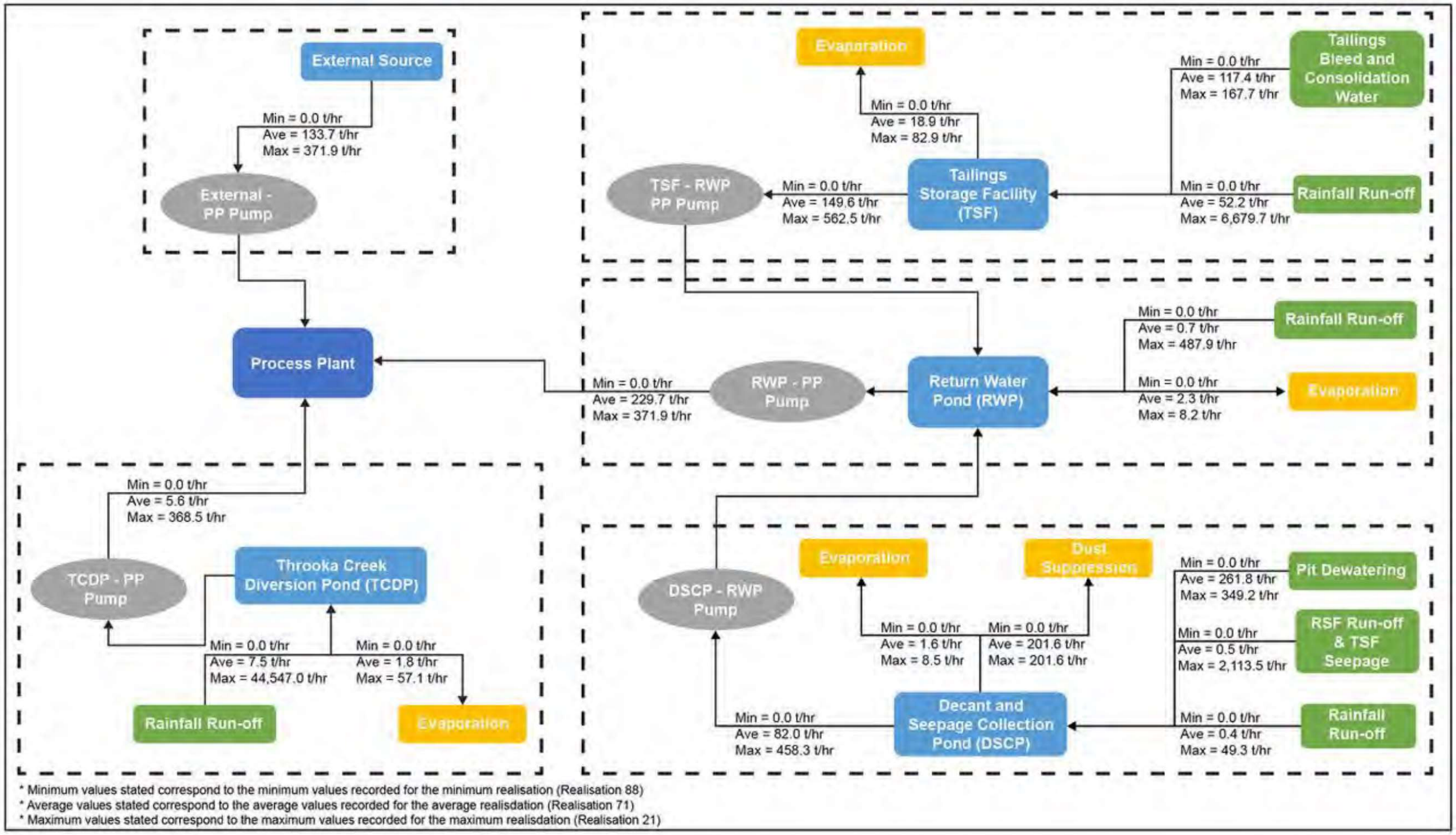

Figure 3-96: Hillside Project water balance flow diagram (ATC Williams February 2018)

The 2-D modelling of the operational case resulted in the following observations:

- Upper Throoka Creek is completely obstructed by the TSF and requires a diversion;
- the RSFs have been designed not to impede flow within Pine Point Creek; and
- the TSF, RSFs and ROM pad all shed contact water from batter slopes.

Throoka Creek Diversion

The Throoka Creek diversion was designed as an open channel excavated along the northern toe of the TSF and then north east to the TCDP. The open channel was sized to convey the peak flow from the upper portion of the Throoka Creek catchment prior to development from a 1% AEP storm event corrected for potential climate change in 2050 of 34.7m^3/s. The general arrangements of the open channels are presented in Table 3-62.

The excavation for the Throoka Creek diversion drain will be up to 15m deep. The area is to be barricaded as an exclusion zone for safety reasons. The downstream slope of the RSF surrounding the northern side of the TSF will be shaped to tie in with the diversion drain.

An inlet basin to the diversion has been allowed for (depth of 2.5m) to prevent backwater from inundating third party properties and Redding Road upstream of the project area. It will also assist in dissipation of both energy and velocity of surface water flows. The basin has been designed as an evaporation/sediment pond and is to be excavated with maximum slopes of 4:1 (H:V).

Table 3-62: Throoka Creek diversion culvert parameters

Parameter	North TSF Toe	TSF Toe to RWP
Base width	4m	15m
Side slopes (H:V)	2:1	3:
Grade	0.33%	0.50%
Design flow depth	2.m	0.95m

Erosion protection material will be required within the Throoka Creek diversion and the TSF embankment toe and a portion of the embankment slope in the immediate area.

The TCDP has subsequently required re-design to accommodate additional runoff from the Throoka Creek catchment. Sizing has been undertaken allowing for storage of a 1% AEP critical event on top of the previously designed capacity. This corresponds to an approximate volume of approximately 1,000ML.

The material to be contained within the topsoil and subsoil stockpiles is as found naturally and assumed to be benign, therefore any movement of water through these stockpiles will not contain any contamination pollutants other than silt.

The operational control measures consist of the following:

- surface water collection drains;
- surface water evaporation/sedimentation ponds;
- Throoka Creek diversion;
- increased RWP;
- RSF management;
- water level and quality monitoring; and
- design and location of TSF, RSF and stockpiles are surveyed regularly during operation to be consistent with mine plan.

See Figure 3-97 Surface water management during operations.

Surface Water Management Methodology

The overall strategy is to prevent discharge of any water that comes into contact with the mine footprint, and to keep surface water, from the upstream catchment area, away from the mining activities. This will be achieved by the following design concepts and management strategies:

- Construct perimeter bunds to separate upstream surface water from water coming into contact with exposed areas on the mine footprint;
- Install detention ponds which are terminating structures to stop and hold all inflow to allow for evaporation and infiltration as well as controlling and removing silts and/or pollutants;
- Install retention ponds which are non-terminating structures and are designed to temporarily store inflow, to control sedimentation and mitigate flood; and
- Contain on-site water recycling which aims to capture and use all available water that occurs within the mining footprint, via internal drainage circuits and detention ponds, for processing purposes and reducing the potential for contaminated run-off from exiting the site.

At mine closure the following design concepts and management strategies will be implemented.

- All disturbed surfaces will be shaped to direct run-off into the disused open pit. Agricultural topsoil and subsoil used for building the water diversion bunds at the toe of the RSF will be respread over the final landforms to provide a cover for mine rehabilitation;
- The surface water drains as detailed for operations, are to be left in place. The water quality of the runoff collected by each drain is considered to be clean as water will be collected from stabilised rehabilitated surfaces;
- The evaporation/sediment pond walls are to be removed and the area rehabilitated during the progressive rehabilitation of the RSF when the catchment to them is considered to have water representative of background. In some areas these structures may stay to naturally reintegrate with the surrounding environment; and

- The Throoka Creek diversion drain shall remain in place to naturally reintegrate with the surrounding environment after closure to permanently divert stormwater around the rehabilitated TSF. Stormwater will be diverted through the diversion drain and into the TCDP. Under extreme rainfall conditions, allowance for a closure TCDP spillway channel has been included to safely transfer any overflows from the TCDP into the open pit, should the pond not be breached to allow Throoka Creek to return to natural drainage.

The design of the surface water control system has been considered effective given the infrequent nature of high peak flow events and the capacity to store and retain excess water on site.

3.8.7.2 Silt control

Erosion and Silt Control

Surface water will be diverted around site infrastructure where practical, minimising the need for erosion and sediment control structures.

Disturbed areas, stockpiles and RSF on the site may generate an increase in the volume of sediment reporting to the downstream receiving environment, with a potential consequent decrease in ambient water quality compared with the pre-development site. Treatment will include retention ponds to allow suspended sediment loads to be reduced prior to discharge, and/or water reclaim infrastructure for re-use in the process.

Design volumes for sediment control structures have been finalised (see Figure 3-97 below) and erosion will be minimised by stabilising landforms using the following techniques:

- placement of artificial stabilising material, such as geofabric, as new landforms are constructed and established, particularly on exposed faces;
- progressive rehabilitation of exposed surfaces will be completed as soon as possible. Revegetation is the most cost-effective method of minimising sediment transport during the life of mine and post-closure; and
- where culverts, embankments or other drainage control devices are installed, consideration will be given to the use of energy dissipation structures such as rock spalls. These structures reduce flow velocity and the potential for erosion.

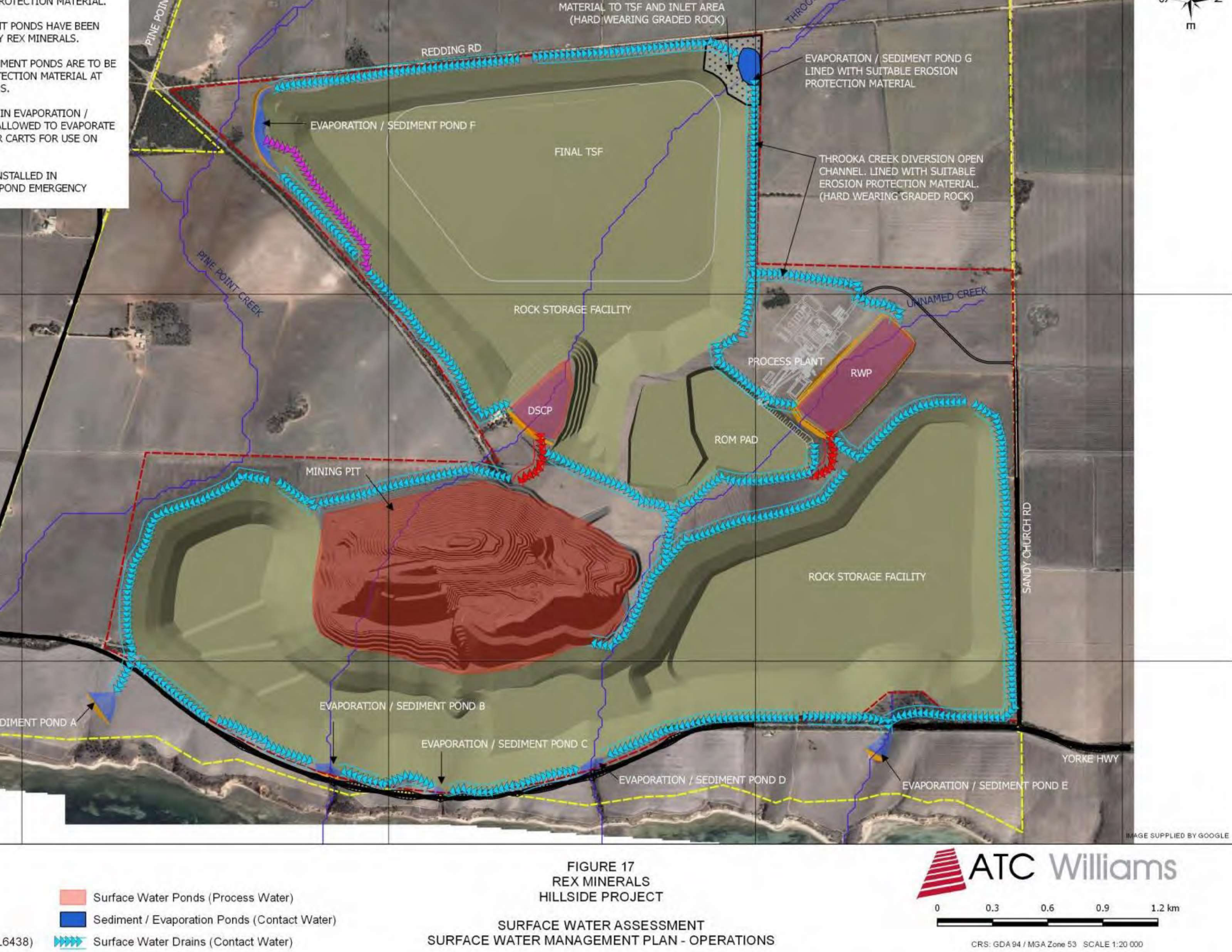

FIGURE 17
REX MINERALS
HILLSIDE PROJECT

SURFACE WATER ASSESSMENT
SURFACE WATER MANAGEMENT PLAN - OPERATIONS

5.14 Surface Water

5.14.1 Lease and Licence Conditions, Clause Outcomes, Strategies and Criteria

The tenement conditions to be complied with and the outcomes to be achieved over the life of the project are detailed in the relevant tenements, i.e., ML6438, EML6439 and MPL146. This section of the PEPR provides details relating to how those conditions and outcomes will be met throughout the life of mine and the monitoring to be implemented to provide evidence of achievement and compliance.

While the ML6438 conditions do not specifically identify surface water outcomes, the Schedule 2 conditions can be interpreted as required outcomes and have been applied as such in this section.

5.14.2 Applicable Legislation and Standards

The following legislation applicable for potential environmental impacts regarding Surface Water includes:

- *Environment Protection Act 1993* (SA);
- Environment Protection (Water Quality) Policy 2015 (SA);
- Environment Protection (Waste to Resources) Policy 2010 (SA);
- ANZECC/ARMCANZ (2000) Australian Water Quality Guidelines for Fresh and Marine Waters, Australian and New Zealand Environment and Conservation Council;
- National Health and Medical Research Council (2011) Council Australian Drinking Water Guidelines 6: National Water Quality Management Strategy;
- Environment Protection Authority, Bunding and Spill Management, August 2012;
- Australian Standard 1940-2004: The storage and handling of flammable and combustible liquids;
- Australian Standard 1692-2006: Steel tanks for flammable and combustible liquids; and
- Australian Standard AS/NZS 5667.1:1998: Water quality—Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.

5.14.3 Surface Water Context

Given its topography, Yorke Peninsula has little drainage definition and most of the surface water catchments terminate in the land-locked, saline lakes that are a common feature of the landscape (NYNRMB 2009). Surface water catchments have been altered significantly by land clearance and agricultural development.

The land within and surrounding the Project area is relatively flat. Slopes in the western section of the proposed ML are generally less than 1.5% and increase to approximately 3% toward the east around existing channelised drainage paths. There are no permanent creeks flowing within the Project area, however, there are several ephemeral drainage lines that cross the site in a general south-easterly direction. Sheet flow is the dominant drainage regime, particularly in the upper reaches of the catchments affecting the Project area. These pre-mining drainage points discharge to Gulf St Vincent.

The relatively flat terrain and high infiltration capacity of the soil within the Project area combined with low average annual precipitation, means that significant run-off is unlikely to be generated, unless under extreme storm conditions. There is no known periodic or sustained inundation, waterlogging or significant inputs of water at the site. Therefore, there are no users of surface water or water dependent ecosystems in the area. Dams are not a significant feature of the region, as piped water is the primary water source for irrigation and livestock.

Surface water runoff around the realigned Yorke Highway will be managed in accordance with the Development Assessment Commission approval.

An Independent Technical Report, the 'Tailings Storage Facility Feasibility Report', was conducted by ATC Williams in August 2016, updated February 2018, to design the 'Surface Water Management System', refer to Appendix 3.4-A. This assessment included:

- Modelling of the Surface Water Management System to manage surface water run-off around the proposed mining operation by the installation of Surface Water Collection Drains, Evaporation/Sedimentation Ponds and the Throoka Creek Diversion to minimise potential impacts from increased sediment, salinity and inundation from surface flows.

In addition, an Independent Technical Report, the 'Hillside Surface Water Assessment Report', was conducted by ATC Williams in August 2017 to observe and characterise the hydrological condition of the catchments and to identify any key infrastructure requirements that would influence the surface water management planning, refer to Appendix 5.14-A. This assessment included the following key points:

- the topography within the catchments consists of gently undulating hills with broad gently sloping gullies with grades less than 1.5%. Steeper slopes and gullies of approximately 3% are prevalent in the area adjacent to the coast, extending inland up to 1km;
- the catchment areas do not contain any permanent creeks or rivers due to the area's low rainfall and the relatively undulating nature of the topography. Historic drainage paths are not visible in the upper reaches of the catchments with the exception of the steeper catchment areas adjacent to the coast;
- light scour was observed in the area within 1 km of the coast indicating historic flows likely exceeding velocities of 1m/s;
- the soil within the catchment areas was reported to be permeable contributing to significant losses; and
- based on discussions with several residents, it is evident that surface water runoff from rain events is rare, again identifying low rainfall and relatively permeable near surface soils.

5.14.4 Surface Water Impacts and Outcomes

Table 5-49 provides the list of potential surface water impacts identified and the relevant outcomes to be achieved during the mine life to ensure mitigation of the impacts.

Table 5-49: Surface water – Potential impacts and relevant outcome

Potential Impact Event ID	Potential Impact Event Description
Applicable Outcome: Ensure no surface water contaminated as a result of mining operations leaves the Land; and ensure that (apart from water contained in the pit void); • no surface water contaminated prior to mine completion remains within the Land after mine completion; and • no contamination of surface water occurs after mine completion as a result of mining operations within the Land. (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)	
ML-SW1	Increased sediment loads in downstream surface water flows causing contamination to the surrounding environment.
ML-SW2	Contamination of surface water run-off with mine hydrocarbons and process chemicals causing contamination to the surrounding environment.
ML-SW3	Increased salinity of surface water run-off resulting in salt scald or salt deposition resulting in the contamination of the environment downstream of the mine site.
ML-SW4	Acid mine drainage transported by surface water run-off resulting in contamination to surrounding environment. *(The impact relates to Acid Rock Drainage and is therefore addressed in Section 5.15.)*
ML-SW5	Dissolved copper ions transported by surface water run-off causing contamination to surrounding environment.
ML-W1	Soil or water contamination due to incorrect waste disposal. *(The impact relates to Commercial and Industrial Waste and is therefore addressed in Section 5.20.)*
ML(C)-SW1	Increased sediment loads in downstream water flows causing contamination to surrounding environment.
ML(C)-SW2	Leachates (AMD and dissolved copper ions) chemically unstable at closure causing contamination to the surrounding environment. *(The impact relates to Acid Rock Drainage and is therefore addressed in Section 5.15.)*
MPL(C)-SW1	Increased sediment loads in downstream water flows from not properly stabilised land surfaces and/or flooding of adjacent areas from poorly maintained or insufficient drainage.
DSD EML-SW1	Increased sediment loads in downstream water flows as a result of runoff from extractive mineral stockpiles.
Applicable Outcome: The Tenement Holder must ensure that: • Mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing); and • inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion is not caused by mining operations; unless the Tenement Holder obtains a registered Waiver of Exemption under the Act to undertake mining activities (inclusive of inundation). (ML6438 Schedule 2 – Condition 24, EML6439 Schedule 2 – Condition 1.)	
ML-SW6	Inundation of public roads affecting road users due to changes in the natural surface water flow.
ML-SW7	Inundation of agricultural land affecting surrounding land users due to changes in the natural surface water flow resulting in loss of crop.

Potential Impact Event ID	Potential Impact Event Description
ML-SW8	Inundation of areas of remnant vegetation due to changes in the natural water flow resulting in a reduction in abundance of native flora.
ML-SW9	Disruption of downstream water flows resulting in loss of abundance of native flora.
DSD ML(C)-SW1	Inundation of public roads or agricultural land post-completion due to changes in the natural surface water flow.

5.14.5 Environmental Outcomes and Controls

The mitigation measures that will be implemented throughout the life of mine to mitigate potential surface water impacts are detailed in Table 5-50.

Table 5-51 then provides comment on the uncertainties and sensitives associated with the impacts and provides the future works committed to by Rex to address these uncertainties and sensitivities over the life of mine.

Table 5-50: Surface water control and management strategies

Source	Surface Water Control and Management Strategies	Responsibility	Timing
Applicable Outcome: Ensure no surface water contaminated as a result of mining operations leaves the Land; and ensure that (apart from water contained in the pit void); • no surface water contaminated prior to mine completion remains within the Land after mine completion; and no contamination of surface water occurs after mine completion as a result of mining operations within the Land. (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)			
Design/Engineering Controls			
Site surface water control (C, O, CI)	Surface water will be directed away from cleared areas to decrease erosion and sedimentation potential.	Sustainability Manager	Ongoing.
Contamination control (C, O)	Workshop and plant areas will be concrete lined and sumps and oily water separators will be installed.	Construction Manager	Construction.
Contamination control (C, O, CI)	Dust control utilising saline water will be contained to the internally draining Evaporation / Sedimentation Ponds.	Mining Manager	Ongoing.
Sediment control (C, O, CI)	Progressive landform stabilisation methods and utilisation of energy dissipation where necessary will minimise sediment loads in run-off from disturbed areas and landforms. (ML6438 Schedule 6 – Clause 30.3)	Sustainability Manager	Ongoing.
Site surface water control (C, O, CI)	Surface water collection drains designed to capture run-off from general areas disturbed by mining activities and directed toward one or more evaporation / sedimentation ponds, specifically for on-site water recycling to re-use all available water for processing purposes thus reducing potential for contaminated run-off exiting the Project. The collection drains will encourage opportunistic use of stormwater.	Sustainability Manager	Construction.

Source	Surface Water Control and Management Strategies	Responsibility	Timing
Site surface water control (C, O, CI. PC)	Surface water evaporation/sedimentation ponds will be constructed, designed to act as terminating structures for detaining all surface water runoff inflow, the purpose being to stop and hold all inflow to allow for evaporation and infiltration as well as controlling and removing silts and/or pollutants. The ponds are designed to have an emergency spillway, a v-notch weir and suitable erosion protection material.	Sustainability Manager	Construction.
Site surface water control (C, O, CI)	The Return Water Pond (RWP) is designed to retain water from the Process Plant area and the Throoka Creek catchment for a 1:100 AEP storm event in addition to storage of the TSF supernatant water (further discussed in Tailings Storage Facility Section 5.17). All surface water runoff (stormwater) generated in the process plant area will be directed to the RWP for use as process water.	Construction Manager	Construction.
Site surface water control (C, O, CI)	RSF perimeter drains designed to encapsulate and control surface water around the RSFs (refer to Section 5.14).	Mining Manager	Ongoing as RSFs are constructed.
Site surface water control (C, O, CI)	TSF and acid rock drainage design, engineering and management controls as detailed in Section 5.17 and Section 5.15 respectively.		
Management Controls			
Contamination control (C, O, CI)	Hydrocarbon and chemical procedures will include the appropriate use of bunding and storage, of spill kits, the use of hardstand areas where hydrocarbons are transferred and appropriate disposal in accordance with EPA requirements.	Plant Operations Manager (reagents) Mining Manager (hydrocarbons and explosives)	Ongoing.
Waste management (C, O, CI, PC)	Waste oils and hydrocarbons will be stored in approved containers on-site and removed by an EPA licenced hydrocarbon re-cycling and disposal group.	Sustainability Manager	Ongoing.
Waste management (CI)	On closure, sewage will be processed through the treatment plant at the processing site and it will remain in place until all other rehabilitation works have been completed. After completion of rehabilitation activities on the Project site, the sewerage treatment plants will be removed.	Closure Manager	Ongoing.
Relinquishment (PC)	The provision of a caveat on the land title post-closure will state that no contamination of surface water will occur after mine completion as a result of mining operations within the Land and any future landowner is required to maintain land on this basis. This will include undertaking any long-term control measures, monitoring and maintenance activities for surface water management (i.e., surface drains, remaining ponds, Throoka Creek diversion drain, RWP spillway) (response to ML6438 Schedule 6 – Clause 30.2).	Legal team	At relinquishment.

Source	Surface Water Control and Management Strategies	Responsibility	Timing
Leading Indicator Criteria (LIC) Trigger Response Measures			
LIC trigger (C, O, CI)	SW-LIC1 – Indicative response actions include: • Compare water quality results to control site to ensure it is not a result of inflow water quality; • Identification of the potential mining-related activity influencing the surface water quality; • Review adequacy of relevant control actions implemented to mitigate the identified cause; • Review weather forecast for potential for additional rainfall events to dictate timing for additional mitigation measures; and • Amend relevant mitigation measures as applicable.	Sustainability Manager	Ongoing throughout construction, operations and closure.
LIC trigger (C, O, CI)	The trigger response actions will be reviewed based on their effectiveness and amended with the regular update of the Surface Water Management Plan (SWMP) throughout the life of mine.	Sustainability Manager	Ongoing throughout construction, operations and closure.
Exceedance (C, O, CI)	In situations where an exceedance of surface water qualities downstream of the project area is detected, an investigation will be undertaken to identify the cause and what actions need to be taken to prevent this from recurring.	Sustainability Manager	Ongoing throughout construction, operations and closure.
Applicable Outcome: The Tenement Holder must ensure that: • Mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing); and • inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion is not caused by mining operations; unless the Tenement Holder obtains a registered Waiver of Exemption under the Act to undertake mining activities (inclusive of inundation). (ML6438 Schedule 2 – Condition 24, EML6439 Schedule 2 – Condition 1.)			
Design/ Engineering Controls			
Site surface water control (C, O, CI. PC)	'Surface Water Evaporation/Sedimentation Ponds' (sediment traps/evaporation ponds) will be constructed, designed to act as terminating structures for detaining all surface water runoff inflow, the purpose being to stop and hold all inflow to allow for evaporation and infiltration as well as controlling and removing silts and/or pollutants. The ponds are designed to have an emergency spillway, a v-notch weir and suitable erosion protection material.	Sustainability Manager	Construction.
Site surface water control (C, O, CI)	The RWP is designed to retain water from the Processing Plant area and the Throoka Creek catchment for a 1:100 AEP storm event in addition to storage of the TSF supernatant water (further discussed in Tailings Storage Facility Section 5.17). All surface water run-off (stormwater) generated in the process plant area will be directed to the RWP for use as process water.	Construction Manager	Construction.
Site surface water control (C, O, CI)	RSF Perimeter Drains are designed to encapsulate and control surface water around the RSFs (refer to Section 5.14).	Mining Manager	Ongoing as RSFs are constructed.

Source	Surface Water Control and Management Strategies	Responsibility	Timing
Closure surface water management (C, PC)	At mine completion, restoration as far as practicable of pre-mining natural flow regimes will be implemented, and water management infrastructure (stormwater, silt control and drainage infrastructure) used during operations will be decommissioned and removed if it is not required to sustain the post-closure hydrological regime.	Closure Manager	Closure.
Management Controls			
Records management (C, O, CI)	A surface water database will record annual rainfall, infiltration losses to the soil, flow velocities following a storm event and should land use change in the future, roughness values and catchment dimensions will be re-evaluated to assess floodplain levels.	Sustainability Manager	Ongoing.
General			
Implementation of SWMP (C, O, CI)	Implementation of the Surface Water Management Plan (SWMP), Surface Water Monitoring Program and Surface Water Response Procedures, the contents of which are detailed throughout this PEPR.	Sustainability Manager	Ongoing.
Training and awareness (C, O, CI, PC)	Site inductions for relevant personnel (employees, contractors and subcontractors); to ensure they understand of the Rex obligations in relation to surface water.	Safety/Training advisor	Ongoing prior to individuals commence work.
Training and awareness (C, O, CI, PC)	Surface water monitoring training for personnel conducting surface water monitoring.	Training advisor	Ongoing prior to individuals commencing monitoring.

Note: (C) = construction (O) = operations (CI) = active closure (PC) = post-closure to relinquishment.

5.14.6 Environmental Measurement Criteria

Surface water outcome measurement criteria and leading indicator criteria are outlined in Table 5-51, along with the monitoring plan and operational compliance plan required throughout the life of mine to ensure these criteria are met.

The monitoring plan is to be in place for construction, operations and the active closure period unless otherwise stated. The monitoring locations and frequency for the post-closure monitoring and maintenance period will be reviewed in consultation with the Regulator during the active closure period.

Table 5-51: Surface water – Environmental outcomes, uncertainties and future works

Control and Management Strategies	Current and Future Works			
	Uncertainties and Assumptions and Sensitivity to Change of Assumptions	**Current and Future Works List**	**Responsibility**	**Timing of Works**
Applicable Outcome: Ensure no surface water contaminated as a result of mining operations leaves the Land; and ensure that (apart from water contained in the pit void); • no surface water contaminated prior to mine completion remains within the Land after mine completion; and no contamination of surface water occurs after mine completion as a result of mining operations within the Land. (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)				
Refer to Table 5-50.	Surface water management system not constructed in accordance with design.	A review by suitably qualified independent expert (hydrology expert) of the Surface Water Management System will be conducted post-construction against the design specifications.	Construction Manager	Post-construction of the surface water management system.
Applicable Outcome: The Tenement Holder must ensure that: • Mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing); and • inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion is not caused by mining operations; unless the Tenement Holder obtains a registered Waiver of Exemption under the Act to undertake mining activities (inclusive of inundation). (ML6438 Schedule 2 – Condition 24, EML6439 Schedule 2 – Condition 1.)				
Refer to Table 5-50.	Typical roughness values have been used based on previous surface water assessments completed and observations of the catchments. Should land use change in the future, the resulting floodplain levels may also change.	Should land use change in the future, roughness values and catchment dimensions will be re-evaluated to assess floodplain levels.	Sustainability Manager	As and when land use changes on surrounding land over the life of the mine.

Control and Management Strategies	Current and Future Works			
	Uncertainties and Assumptions and Sensitivity to Change of Assumptions	Current and Future Works List	Responsibility	Timing of Works
Refer to Table 5-50.	Continuing losses are only applicable to the period for which precipitation is falling. This represents the critical scenario where the soil within the catchments remains saturated for the duration of the model simulation. Therefore, ongoing infiltration losses to the soil have not been modelled.	Rex's environmental monitoring program, which will include the recording of annual rainfall, will be used to modify and improve precipitation estimates after a statistically valid dataset is recorded, 3+ years.	Sustainability Manager	After 3 years of rainfall data on site.
	A 2D modelling approach was used therefore velocity of flows are depth-averaged at a single point.	Flow velocities will be recorded after each storm event by Rex's environmental team.	Sustainability Manager	After every storm event where there is flowing surface water sufficient to sample during construction, operations and closure.
	Calibration of the model is correct without any historical flows. Additionally, rain on grid modelling approach has been adopted for this study which may require review based on temporal patterns.	If there is a rainfall event that results in flow then the model will be re-calibrated with measured inputs such as rainfall, flow rates and velocities in water structures.	Sustainability Manager	Following the collation of surface water monitoring data from at least 2 storm events.
		Appropriate mechanisms to ensure effective transfer of liability and associated responsibility for any maintenance and monitoring of the site and control of any future development post-mine completion will be developed and implemented. (ML6438 Schedule 6 – Clause 30.2.)	Closure Manager	Plan developed during closure period and enacted prior to relinquishment, evidenced by inclusion in the Final Closure Plan.

Table 5-52: Surface water – Measurement criteria and leading indicator criteria

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
Applicable Outcome: Ensure no surface water contaminated as a result of mining operations leaves the Land). (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)							
Surface water quality as pH, Total Dissolved Solids (TDS), turbidity and dissolved copper ions sampled in accordance with AS/NZS 5667.1:1998 and samples will be analysed at a NATA accredited laboratory.	Active evaporation /sediment ponds in the Hillside impact footprint and any locations immediately downstream of these locations that are safely accessible where there is flowing or ponding – refer to Figure 5-9.	Monitoring records indicate that no surface water leaving the land is contaminated when compared to upstream surface water quality at the control site (i.e., parameters are within the range of the control site monitoring data) as a result of mining operations (C, O, Cl).	Following a precipitation event that results in surface water ponding or flow throughout construction, operations and closure and post-closure. Every 12 hours in the event of an uncontrolled discharge from any mine-related water storage throughout construction, operations, closure and post-closure.	Upstream control = stilling pond on Throoka Creek. Environment Protection (Water Quality) Policy 2015	**Leading indicator criteria (SW-LIC1)** Dissolved copper ions transported by surface water from samples collected from the evaporation/sedimentation ponds are within 10% of the limits of the range of the control site monitoring data.	Sustainability Manager	Reviewed after every precipitation event that results in surface water monitoring and reported in the Annual Compliance Report.
Visual inspections of storage / distribution areas for waste and hazardous substances for compliance with standards listed in Section 5.14.2.	All storage/distribution areas for waste and hazardous substances within the Hillside impact footprint.	Inspection records indicate that waste and hazardous substances are being managed in accordance with standards listed in Section 5.14.2. (C, O, Cl)	Monthly inspections. Annual review. During construction, operations and closure.	Waste, Hydrocarbon and Reagent Management Procedures.		Sustainability Manager	Reviewed after each inspection and review. Non-compliances to be reported in Annual Compliance Report.

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
TSF monitoring presented in Tailings Storage Facility Section 5.17.							
ARD monitoring presented in Acid Rock Drainage Section 5.15.							
Applicable Outcome: Ensure: • no contamination of surface water occurs after mine completion as a result of mining operations within the Land. (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)							
Surface water quality as pH, Total Dissolved Solids (TDS), turbidity and dissolved copper ions sampled in accordance with AS/NZS 5667.1:1998 and samples will be analysed at a NATA accredited laboratory.	Active evaporation /sediment ponds in the Hillside impact footprint and any locations immediately downstream of these locations that are safely accessible where there is flowing or ponding. Refer to Figure 5-9.	Monitoring records indicate that water quality from Hillside impact footprint landforms is no worse than the receiving environment as defined by monitoring results within the range of the upstream control site (CI, PC). In the event that precipitation events do not occur during the closure and post-closure period, proxy assessment of the potential for surface water contamination will be made through assessment of erosion of landforms as detailed in ARD Section 5.15 and TSF Section 5.17 and soil quality as detailed in Soil and Land Disturbance Section 5.8.	Following a precipitation event that results in surface water ponding or flow throughout construction, operations and closure. Every 12 hours in the event of an uncontrolled discharge as the result of a greater than 1% AEP event throughout construction, operations and closure. During closure and post-closure until such time as results show the required outcome.	Upstream control = stilling pond on Throoka Creek.		Closure Manager	Reviewed after every precipitation event that results in surface water monitoring and reported in the Final Completion Report.

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
TSF monitoring presented in Tailings Storage Facility Section 5.17.							
ARD monitoring presented in Acid Rock Drainage Section 5.15.							
Erosion and soil quality monitoring presented in Soil and Land Disturbance Section 5.8.							
Applicable Outcome: Ensure: • no surface water contaminated prior to mine completion remains within the Land after mine completion. (ML6438 Schedule 2 – Condition 25, MPL146 Schedule 2 – Condition 4, EML6439 Schedule 2 – Condition 2.)							
Visual inspection of the land and review of records of closure works of mine-related water storages by appropriate personnel – monitoring of removal of these storages or the contained contaminated surface water.	All surface water storages on the Hillside Impact footprint that could potentially contain contaminated surface water including the TSF, decant seepage collection pond (DSCP), erosion/ sedimentation ponds and RWP have been emptied of contaminated surface water.	Inspection and closure activity records indicate that no surface water contaminated prior to mine completion remains within the land (PC).	Once, prior to relinquishment.			Closure Manager	Prior to relinquishment and reported in the Final Completion Report.

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
Applicable Outcome: The Tenement Holder must ensure that: • Mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing); unless the Tenement Holder obtains a registered Waiver of Exemption under the Act to undertake mining activities (inclusive of inundation). (ML6438 Schedule 2 – Condition 24, EML6439 Schedule 2 – Condition 1.)							
Visual inspections for erosion caused by surface water flows or inundation as a result of the Project.	Third-party property and infrastructure adjacent to the lease boundaries as applicable to potential inundation locations. To be inspected from site boundary or closer where access is granted.	Inspection records provide evidence that mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) as based on the inundation modelling. (See Figure 5-10.) (C, O, CI)	Following a precipitation event that causes ponding in the evaporation/ sedimentation ponds throughout construction, operations and closure.	Inundation model – Figure 5-10.		Sustainability Manager	Reviewed after every precipitation event that results in surface water monitoring and reported in the Annual Compliance Report.
Visual inspections for erosion or other stormwater related damage, loss of containment and achievement of design specifications which verify operation in accordance with design.	Evaporation / sedimentation ponds and other surface water collection drains and control areas, including the Throoka Creek diversion, on the Hillside impact footprint.	Inspection records show no loss of containment or ponding that may influence surface inundation of surrounding third-party properties, infrastructure, public roads, agricultural land and remnant vegetation. (C, O, CI)	Following a precipitation event that causes ponding in the evaporation / sedimentation ponds throughout construction, operations and closure.			Sustainability Manager	Reviewed after every precipitation event that results in surface water monitoring and reported in the Annual Compliance Report.
Traffic accident monitoring for accidents that may be caused by inundation – refer to Traffic Section 5.19.							

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
Applicable Outcome: The Tenement Holder must ensure that: • inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion is not caused by mining operations; unless the Tenement Holder obtains a registered Waiver of Exemption under the Act to undertake mining activities (inclusive of inundation). (ML6438 Schedule 2 – Condition 24, EML6439 Schedule 2 – Condition 1)							
Visual inspections for erosion caused by surface water flows or inundation as a result of the Project.	Third-party property and infrastructure adjacent to the ML and EML lease boundaries as applicable to potential inundation locations. To be inspected from site boundary or closer where access is granted.	Inspection records provide evidence that mining operations do not cause inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion (PC).	Following a precipitation event (should one occur) that causes ponding in the evaporation/ sedimentation ponds throughout the post-closure period.	Inundation model – Figure 5-10.		Closure Manager	Reviewed after every precipitation event that results in surface water monitoring and reported in the Annual Compliance Report.

What Will Be Measured and Form (Method)	Locations	Outcome Achievement	Frequency	Control/ Baseline Data	Leading Indicator Criteria	Accountability	Reporting
Suitably qualified independent expert (hydrology expert) will conduct visual inspections and/ or review of design and construction records for the Closure Surface Water Management System detailed in Section 3.8.7 and Figure 3-102. Review will include: 1. in the event of rainfall, that the closure surface water management system is working as per design and no third-party inundation has occurred; or 2. in the event of no rainfall events resulting in surface water flow, that the closure surface water management system has been constructed to design and design is adequate for no third-party inundation. (Method will depend on occurrence of rainfall event resulting in surface water flow during the post-closure period.)	Closure surface water management system infrastructure locations.	Independent expert verifies that there has been or will be no inundation of third-party property and infrastructure by water (to a greater extent than would be expected to occur prior to mining operations commencing) after mine completion as a result of the mining operations.	Once, on closure, following completion of the surface water management system and following a rainfall event that caused surface water flow. Should a rainfall event sufficient to cause surface water flows not occur within the post-closure period, this review will be based on design and construction records for the Closure Surface Water Management System.	Inundation model – Figure 5-10. Operational surface water monitoring and visual inspection results. Closure Surface Water Management System design parameters and construction records.		Closure Manager	On closure, following completion of the surface water management system.

Figure 5-9: Surface water monitoring locations

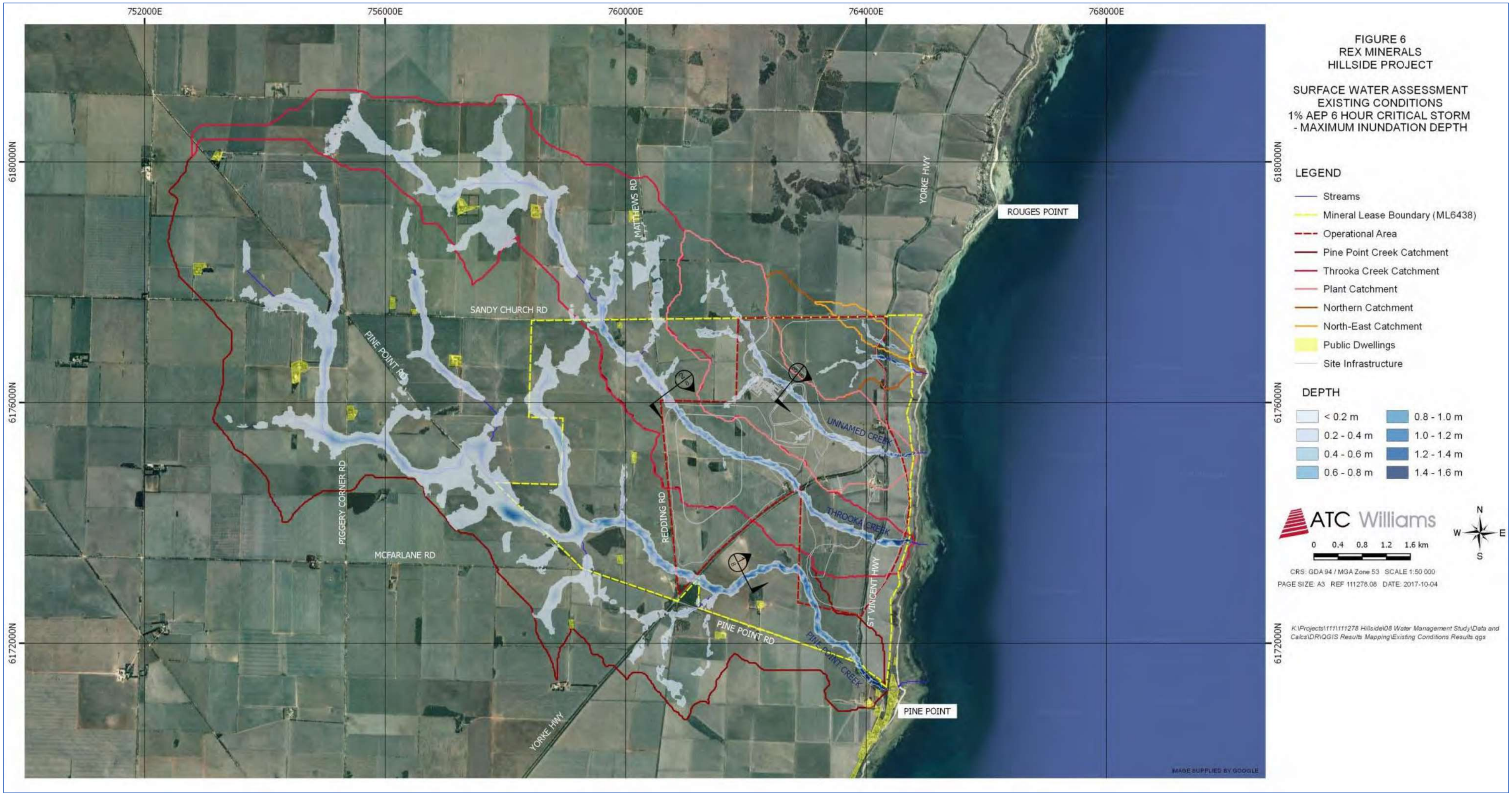

Figure 5-10: Surface water assessment – Existing conditions: 1% AEP six-hour critical storm (inundation)