Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6205/2018/1
Applicant	Abra Mining Pty Ltd
ACN	110 233 577
File Number	DER2018/001572
Premises	Abra Base Metals Project General Purpose Lease G52/292 MEEKATHARRA WA 6642
Date of Report	**28 June 2019**
Status of Report	Draft for Internal Review

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1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
ANZECC/ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality http://www.waterquality.gov.au/anz-guidelines
Applicant	Abra Mining Pty Ltd
Application	As defined in Table 2 of the Decision Report
ARI	Average Recurrence Interval
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
Decision Report	refers to this document
Delegated Officer	an officer under section 20 of the EP Act
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
ha	hectare
m^3	cubic metres

Term	Definition
mbgl	metres below ground level
mg/L	milligrams per litre
m/s	metres per second
mtpa	million tonnes per annum
Occupier	has the same meaning given to that term under the EP Act
Prescribed Premises	has the same meaning given to that term under the EP Act
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Primary Activities	as defined in Table 3 of the Decision Report
Risk Event	As described in *Guidance Statement: Risk Assessments*
RIWI Act	*Rights in Water and Irrigation Act 1914*
RL	reduced level
ROM	run of mine
SAG	semi autogenous grinding
TDS	Total Dissolved Solids
Tonnes per annum	tpa
TSF	Tailings Storage Facility
uPVC	unplasticised polyvinyl chloride
Works Approval Holder	Galena Mining limited
µS/cm	microsiemens per centimetre

2. Purpose and scope of assessment

Abra Mining Pty Ltd (Abra) submitted to DWER an application for a Works Approval under the EP Act. The application which was received on 31 October 2018, is for the construction of a category 5 Prescribed Premises at the Abra Base Metals Project (Premises) for the processing of mined ore.

The category 5 infrastructure comprises of the following components:

- Three stage crushing with fine ore bin storage;
- Single stage ball mill with a flash flotation cell treating cyclone underflow;
- Flotation and concentrate regrind to produce a lead/silver concentrate;
- Concentrate dewatering utilising a thickener and a filter to produce a transportable concentrate;
- Tailings thickener; and
- Tailings Storage Facility (TSF)

Other infrastructures associated with the Premises, airstrip, power station, chemicals storage facilities, administration buildings and accommodation camp are not included in this assessment. A category 85 waste water treatment plant and a category 89 putrescible landfill are also being constructed at the Premises, with approval granted through Work Approval W6178/2018/1 on 13 March 2019.

Galena intends to apply for a Licence to operate the category 5 Premises following the completion of the works and the submission of compliance documentation.

The Premises is located on General Purpose Lease G52/292 which is approximately 200 km north of Meekatharra and 190 km south of Newman in the Midwest region of Western Australia (Figure 1).

Metallurgical test-work indicated that the lead concentrate produced on site will have 60-70% Pb. The processing methods will recover 96% Pb and up to 90% Ag. The lead-silver sulphide concentrate will be shipped to port for export.

The Decision Report presents an assessment of potential environmental and public health risks from the emissions and discharges associated with the construction and operation of the Premises.

This assessment has resulted in DWER issuing Works Approval W6205/2018/1 (Issued Works Approval) which is contained in Attachment 1.

2.1 Application details

Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Galena Works Approval application – Category 5 – Final 29/10/2018	31 October 2018
Application – Works Approval – Galena Mining Limited – General Purpose Lease G52/292 – Shire of Meekatharra – Supporting information	31 October 2018
Abra base Metals Project – Response to request for further information	23 November 2018
Abra Base Metals Project – Updated information to include a 3 stage crushing circuit	5 March 2019

Abra Base Metals Project – Change in proponent name and ABN	18 April 2019
Abra Base Metals Project – Response to request for further information on groundwater composition	15 May 2019
Abra Base Metals Project – Response to request for further information on surface water management	20 May 2019
Abra Base Metals Project – Response to Draft Works Approval	11 June 2019
Abra Base Metals Project – Response to further information on TSF decant system	18 June 2019

3. Background

The application relates to the following Primary Activities at the Premises for the prescribed premises categories defined in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) as listed in Table 3.

Table 3: Prescribed Premises Categories

Classification of Premises	**Description**	***Approved Premises production or design capacity or throughput***
Category 5	Processing or beneficiation of metallic or non-metallic ore: premises on which — (a) metallic or non-metallic ore is crushed, ground, milled or otherwise processed; or (b) tailings from metallic or non-metallic ore are reprocessed; or (c) tailings or residue from metallic or non-metallic ore are discharged into a containment cell or dam.	1,200,000 tonnes per annum

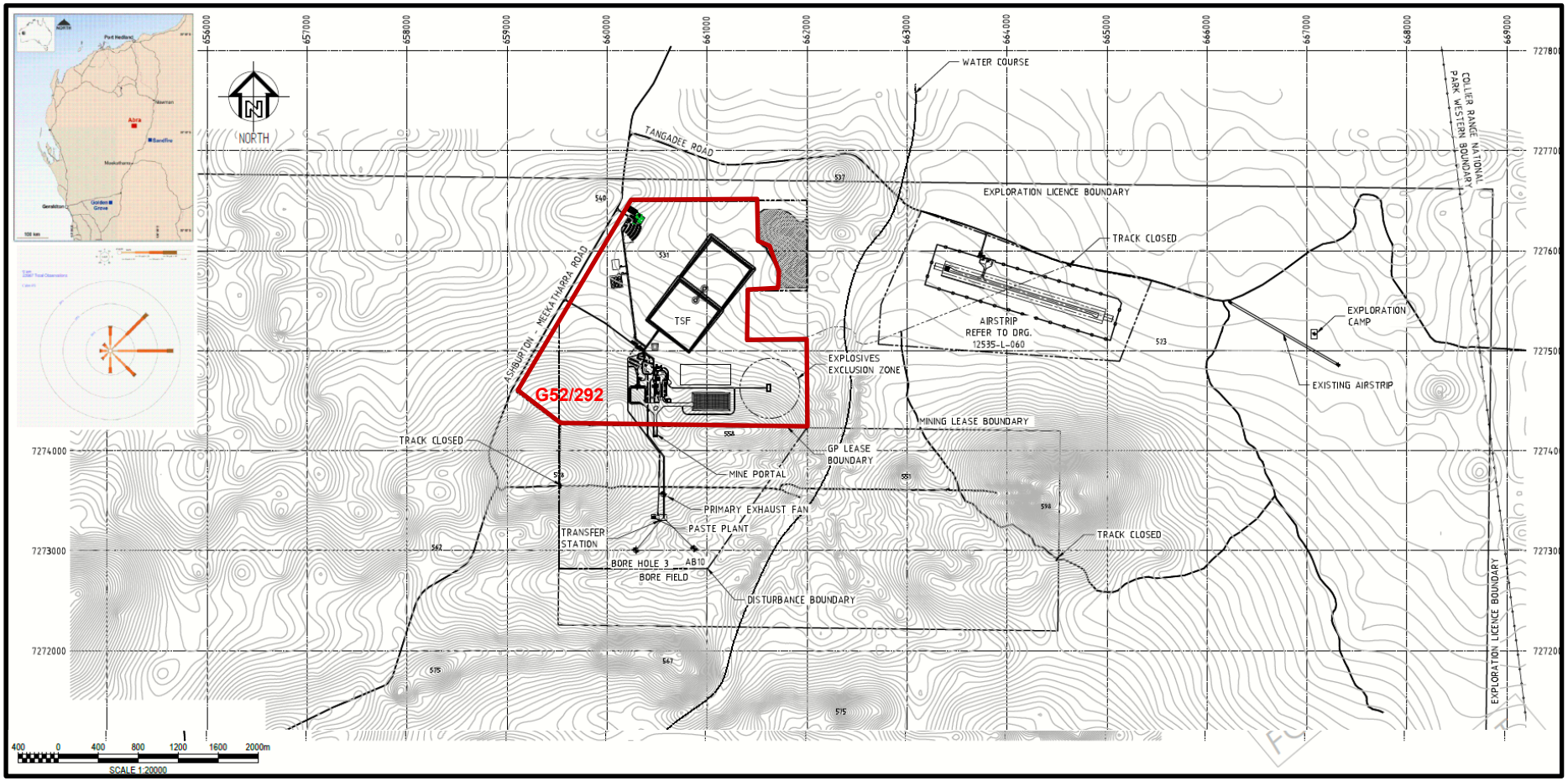

Figure 1: Premises boundary subject of Works Approval W6205/2018/1

4. Overview of Premises

4.1 Operational aspects

The operational aspects as defined within the Application are detailed below.

Category 5 – Processing or beneficiation of metallic or non-metallic ore

4.1.1 Process plant and associated infrastructure

The plant layout of the processing circuit is shown in Figure 2. The overall process diagram is shown in Figure 3.

The stages of processing will comprise:

Crushing and Ore Storage

The crushing plant has been designed to operate 24 hours a day seven days a week, with a design annual throughput rate of 1,200,000 tonnes at a crushing rate of 200 tonnes per hour.

The crushing circuit will comprise of the following main equipment:

- 90 tonne live capacity ROM bin;
- Primary jaw crusher;
- Secondary cone crusher;
- Tertiary cone crusher; and
- Product screen undersize

There are total of seven strategic dust collection points within the crusher area for total airflow of 20,800m³/hr. Five dust collections pointswill be installed within the screening area for a total airflow of 10,000m³/hr.

A central dry filtration (baghouse) dust collector is selected and located by the ‘drive in sump’ between the crushing and screening areas. An integrated duct system connects all dust collection points in crushing and screening to the baghouse.

Grinding

The grinding circuit is designed for an annual throughput of 1,200,000 tonnes at a throughput rate of 150 tonnes per hour to produce a final product with a P_{80} of 150µm. The grinding circuit consists of:

- ball mill;
- flash flotation cell;
- cyclone classification; and
- associated conveyors and ancillary equipment.

Water is added to achieve a mill discharge density of 75% solids w/w. Flotation reagents, pH modifier lime, pyrite depressant and sodium cyanide are added as part of the grinding circuit process.

The dual discharge flash flotation cell has been included in the design to recover fast floating lead minerals and minimise the potential overgrinding of the denser lead minerals. Floatation reagents xanthate-collector and frother will be added to effect the flotation process.

Sump pumps will be provided in the grinding area to collect spillage and clean up and will pump the slurry to the cyclone feed hopper or to tails as required.

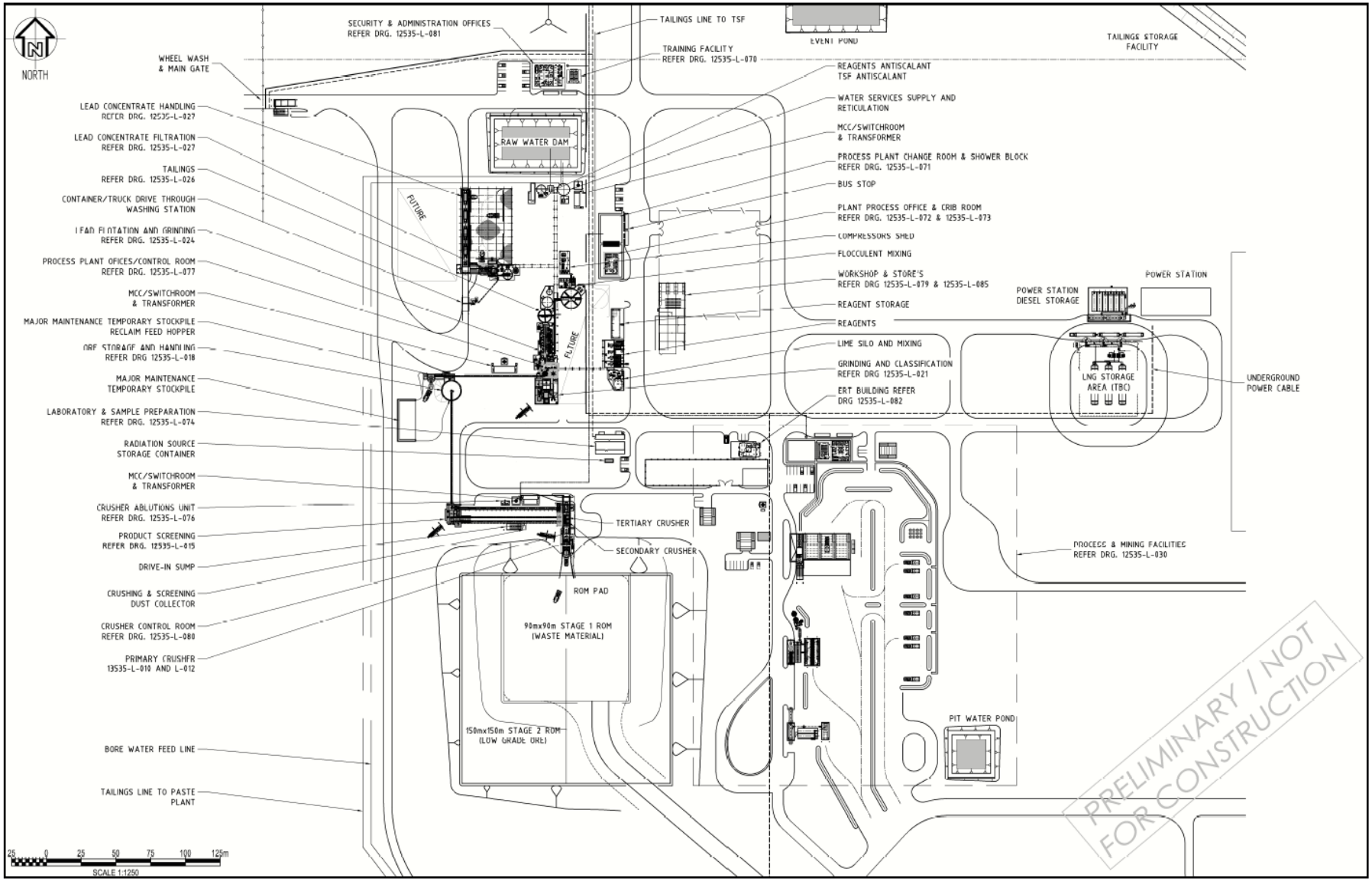

Figure 2: Plant Layout

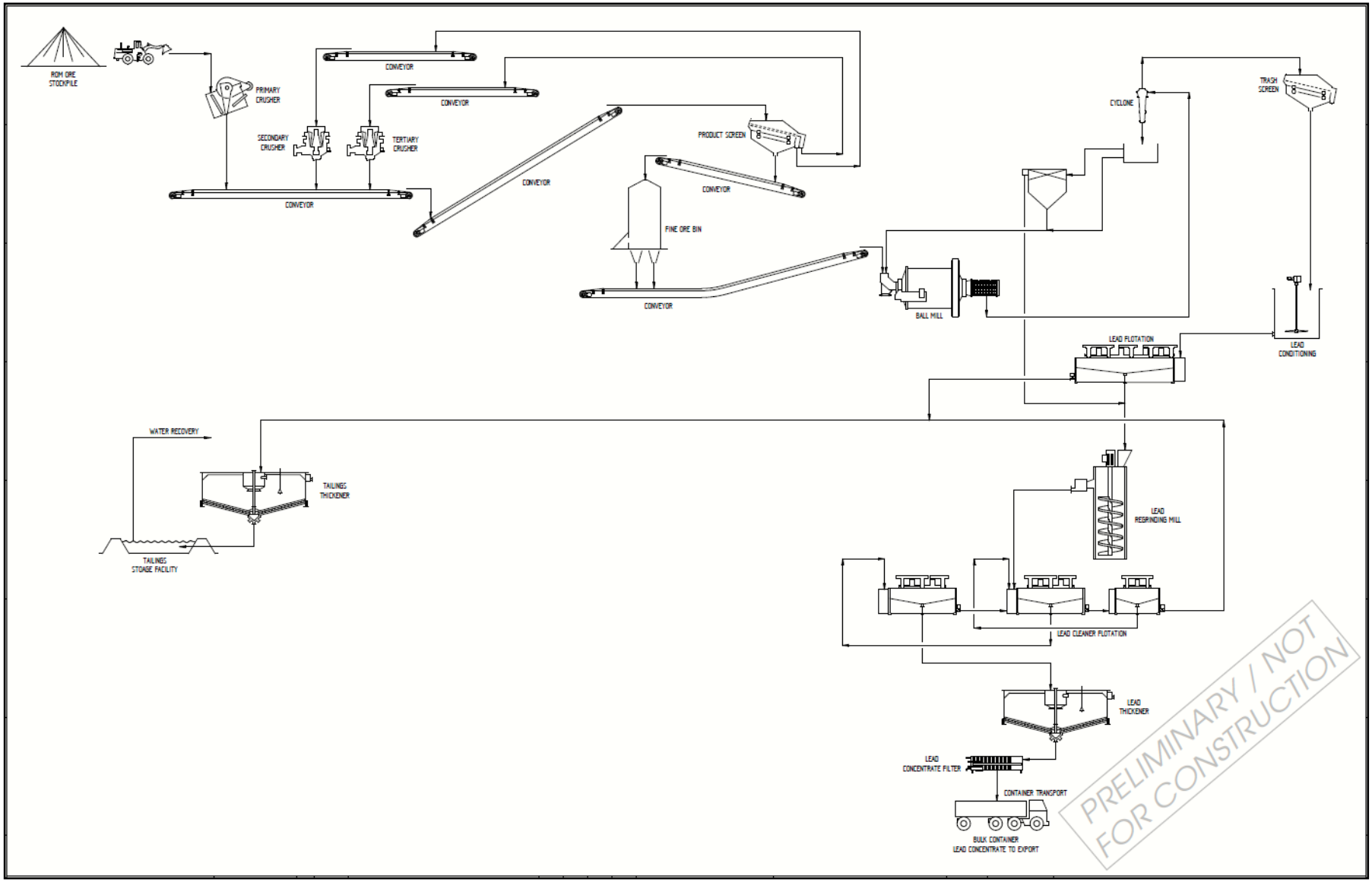

Figure 3: Overall Process Diagram Flow

Lead/Silver Flotation

The Lead/Silver Flotation consists of:

- rougher conditioning tank
- 2x rougher flotation cell
- 3x scavenger flotation cell
- rougher concentrator
- scavenger concentrator
- associated conveyors and ancillary equipment

The lead flotation condition tank was designed to a nominal volume of 30 m^3. Flotation reagents sodium cyanide, and lead/silver collector xanthate will be added to the lead flotation conditioning tank. Conditioned slurry will be pumped to a lead rougher/scavenger flotation cells by a feed pump.

The combined rougher and scavenger concentrate will report to concentrate hoppers with the rougher concentrate stream pumped either to the regrind feed or to the cleaner feed as required. The scavenger cell tail will discharge into the lead scavenger tailings hopper and pumped to the tailings thickener. The lead cleaner scavenger tail will also report to the lead scavenger tails hopper and will combine with the lead scavenger tails.

Rougher and scavenger concentrate will be dewatered in a two cyclones to provide an underflow density of 55% solids w/w. Cyclone overflow and regrind mill discharge will report to a lead cleaner feed conditioning tank.

The lead cleaner circuit will comprise of two stages of cleaning, with a cleaner scavenger circuit relieving the circuit. Concentrate from the lead cleaner cells will be pumped to the lead concentrate thickener. The calculated concentrate grade is 70-77% Pb and will vary according feed grade, flotation conditions and recovery parameters set by operations personnel.

Sump pumps will be provided for spillage and clean up.

Lead Concentrate Thickening and Filtration

Concentrate from the lead flotation circuit will be pumped to the lead concentrate thickener. The lead concentrate filtration section will consist of an agitated lead concentrate filter feed storage tank, filter feed pumps and vertical plate pressure filter. The lead concentrate tank (300 m^3) will have a maximum working capacity for 210 m^3 of slurry. Lead concentrate thickener overflow will gravitate to the process water tank. Flocculant will be added to the process

The thickened concentrate slurry will be pumped from the lead concentrate tank to the batch pressure filter for dewatering. The thickened concentrate will be filtered by a vertical plate pressure filter. The pressure filter will dewater the slurry to produce a filter cake containing nominally 9-10% w/w moisture and a filtrate containing minimal solids.

The dewatered filter cake will discharge onto a concrete pad below. Concentrate will be loaded by a front end loader into half height containers, which will be fitted with removable lids to seal them for transport. During loading, the front and rear doors of the concentrate shed will be closed, to stop a through breeze blowing dust out of the shed.

The lead concentrate filter area will have a sump pump to collect any spills. The concentrate filter area sump pump will discharge into the lead filtrate hopper.

Tailings Thickening and Disposal

Flotation tailings from the scavenger tails pump will be pumped to a tailings thickener feed box and then to the thickener. Flocculant will be add to the process to increase the settling rate and underflow density to approximately 65% solids w/w. Tailings thickener overflow will gravitate

directly to the process water tank. The thickened tails will then be pumped to the TSF or to the paste plant.

Tails water return from the TSF will be returned to the process water tank. The tailings thickener area sump pump will return spillage and clean up to the thickener feed box.

4.1.2 Tailings Storage Facility

The project is based on a design mining rate of 1.2 mtpa. This will produce approximately 100,000 tpa of ore concentrate and 1,1 mtpa of process residue that will be deposited in a tailings storage facility (TSF). It is proposed to reclaim approximately one third of the tailings during the life of mine for re-processing in a paste plant and returning underground to fill completed mine voids. The TSF has been designed to store approximately 8.5 million tonnes over the life of mine and a two cell configuration. Allowing for local topography, the maximum embankment height is to be approximately 15 metres. Figure 4 shows the Galena TSF design.

TSF Construction (CMW, October 2018 - PER2018-0128AE Rev 1)

The TSF will be a two cell, paddock type facility, located to the north of the plant site, between two intermittent creek lines. The TSF will be constructed in six stages. The Stage 1 Cell A starter embankment, with a maximum height of 9 m, will provide nominally 2 year's storage with a tailings impoundment area of approximately 26.5 ha. Cell B will be added to provide an addition storage life of 2 years for Stage 1. Cell B Stage 1 will have a maximum height of 8 m with a tailings impoundment area of approximately 37.5 ha. The Stage 1 embankments will be raised by 3m in Stages 2 and 3 to provide the life of mine storage of 15 years.

The TSF starter embankments will be a zone embankment comprising an upstream zone of compacted select mine waste and a downstream zone of traffic compacted mine waste. The starter embankments will be raised using upstream construction techniques and select mine waste.

The design incorporates a rock-ring decant with submersible decant pumps in each cell to recover water from the TSF. The decant pond is to be raised in conjunction with the raising of the perimeter embankments. Return water will be pumped directly to the process plant for reuse. The starter embankments and TSF cell basins will be lined with Geosynethic Clay Liner (GCL) to produce a low permeability liner with hydraulic conductivity of $1x10^{-12}$ m/s at the base of the TSF to reduce seepage.

A surface water diversion channels will be constructed as part of the development of the TSF site. This diversion channels and bunds will divert catchment runoff from the ridge areas, to the south of the TSF behind the plant site towards the north, away from the TSF.

Construction Stages

Stage 1 - Cell A Starter: construction of the starter embankments to crest RL539.5 m and drainage diversion.

Stage 1 - Cell B Starter: construction of the starter embankments to crest RL535.5 m in Year 2.

Stage 2: raising construction of embankment by 3 m:

- Cell A: Raising of embankments in Year 4.
- Cell B: Raising of embankments in Year 7.
- Construction of decant accessway and decant rock-ring.

Stage 3: raising construction of embankment by 3 m:

- Cell A: Raising of embankments in Year 11.
- Cell B: Raising of embankments in Year 13.

• Raising of the decant accessway and decant rock-ring

The estimated tailings storage areas, volumes and storage capacity for the TSF are summarised in Table 4 based on an approximately 32.6% being used for paste backfill to the underground mining operations. The estimated storage characteristics of the proposed TSF was based on the following tailings characteristics:

- 65% solids;
- Particle size distribution - 60% passing 75 µm, with approx. 3% passing 3 µm; and
- Tailings density 1.865 t/m3 (dry) – Undrained settling test.

Table 4: Estimated Tailings Storage Areas and Storage Volumes

Stage	Crest RL (m)	Area (ha)	Cumulative Volume (Mm^3)	Cumulative Storage Capacity (Mt)	Cumulative Storage Life (years)
1 – Cell A	539.5	26.5	800,000	1.49	2.6
1 – Cell B	535.5	37.5	800,000	2.98	5.3
2 – Cell A	542.5	24.5	764,713	4.41	7.8
2 – Cell B	538.5	35.1	1,088,858	6.44	11.4
3 – Cell A	545.5	22.5	822,896	7.54	13.3
3 – Cell B	541.5	32.8	1,187,402	9.43	16.7

Surface water diversion channels will be constructed as part of the development of the TSF site. The diversion channels and bunds will divert catchment runoff from the ridge areas, to the south of the TSF behind the plant site towards the north, away from the TSF.

Return pipeline Infrastructure

Detailed design of the pipeline infrastructure has not yet occurred. Abra Mining committed that detail design will incorporate both tailings delivery and water return pipelines within earthen bunds to contain material in the event of spillage. Pipelines will be equipped with pressure sensors (Abra Mining, 11/06/2019).

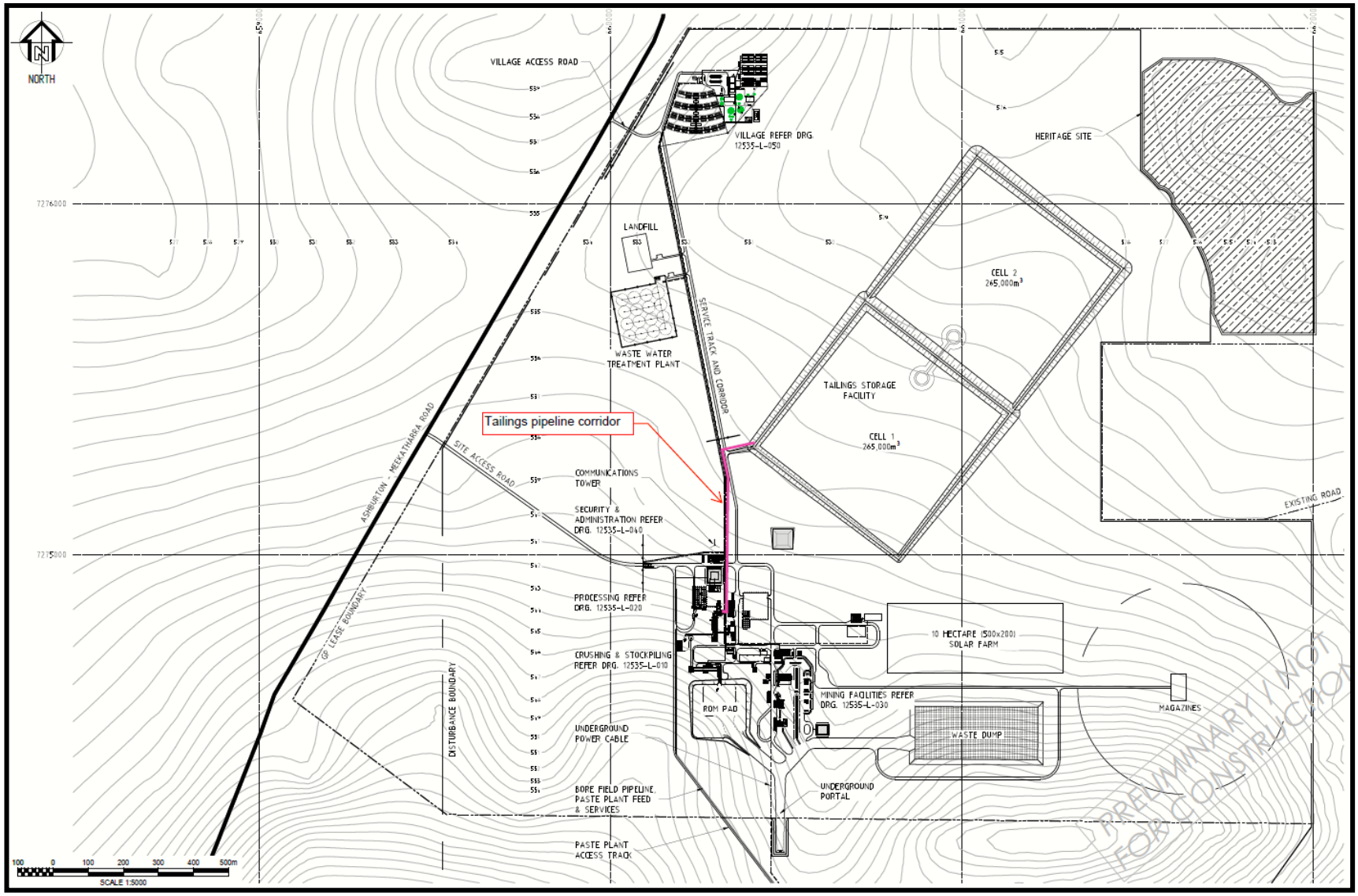

Figure 4: TSF design and pipeline corridor.

TSF Operation

The following operational considerations have been incorporated into the design:

- Tailings in the form of slurry will be discharged sub-aerially and cyclically into the facility in thin discrete layers, not exceeding 300mm thickness, to allow optimum density and strength. Deposition will take place via multiple spigots from around each cell of the facility.

  The tailings have rapid settling characteristics. If too many spigots are open, the tailings will tend to deposit near the embankment. If this occurs, single point discharge practices may be required from time to time to force the tailings away from the embankment.

- Spigotting of tailings is to be carried out such that a beach is developed to force the supernatant pond to be is maintained within and around the rock-ring decant. The pond is to be maintained away from the perimeter embankments at all times.

- Water will be removed from the facility and pumped back to the process plant via a decant pump located in a rock-ring decant structure. The recommended average water recovery should not be less than 50% of slurry water inflow or 36 t/hr.

- The minimum operational freeboard for the TSF under normal operating conditions is to be 0.5m, plus allowance for temporary storage of the 1% average exceedance probability (AEP) 72-hour storm event whilst maintaining required total freeboard (Section 8).

- On eventual decommissioning, the facility will remain as a permanent feature of the landscape and drain to an increasingly stable mass. The top surface and batters will be stabilised and rehabilitated.

Seepage Analysis

Seepage analyses were undertaken to estimate the position of the phreatic surface for the embankment design for the proposed starter embankment stage (embankment height 9 m) and final stage (15 m embankment height). The analyses were undertaken using a 2D finite element analysis. Material properties used in seepage modelling are provided in Table 5.

Table 5: Permeability Values Adopted

Permeability values adopted	
Material Zone	**Permeability, K (m/s)**
Deposited Tailings	10^{-6}
Compacted Mine Waste	10^{-4}
Select Mine Waste	10^{-9}
Foundation Soils	10^{-9}**

**GCL has a nominal permeability of 10^{-12}m/s, however 10^{-9}m/s has been adopted in the finite element analyses due to mathematical instability.

The seepage analyses indicated very low seepage flow can be expected from the TSF (Table 6). The use of a GCL in lining the facility will ensure negligible seepage from the TSF.

Table 6: Results of Seepage Analyses

Stage	Approximate Embankment Length (m)	Estimated Seepage per day for embankment section (m^3/day)
Starter Embankment	1,500	<0.0005
Final Embankment	1,500	<0.005

Water Balance

The results of a water balance analysis for the proposed TSF operation indicate a potential annual average water return of around 50% to 55% of the tailings slurry water deposited into the facility should be expected, under average climatic conditions.

The water recovery system, pumps and piping must be designed for a minimum recovery of not less than 1,317 m^3/day. This will allow an average water return of 860 m^3/day plus removal from the facility of stormwater from 1% AEP, 72-hour storm event over 180 days.

The results also indicate that water recovery will vary according to the management of the facility, specifically the size of the pond and running beaches.

4.1.3 Commissioning

A commissioning period of 6 months after construction is required to accommodate the period where variable ore feed will determine the quantity of tailings produced before a steady state is achieved.

Process plant: commissioning works will consist of monitoring plant inputs (ore feed, energy, water, reagents), performance of emission controls (water sprays, drainage systems etc.) and incidence of equipment breakdowns. A six months commissioning period is required to monitor facility performance up to the point steady state production rates are achieved.

TSF: commissioning works will consist of testing pumping equipment, monitoring spigot and tailings beach development and sampling during the period that variable tailings deposition rates are produced. A six months commissioning period is required to monitor facility performance up to the point steady state (design capacity) deposition rates are achieved.

4.2 Infrastructure

The Premises infrastructure, as it relates to Category 5, is detailed in Table 7 and with reference to the Site Plan (Figure 2).

Table 7: Premises infrastructure

	Infrastructure	Site Plan Reference
	Prescribed Activity Category 5	
Ore Process plant with design throughput of 1,200,000 tonnes per year		
1	Crushing and ore screening	Figure 11
2	Grinding mill and associated infrastructure (cyclones, feed pumps etc)	Figure 12
3	Conditioning tanks, flotation cells and associated infrastructure	Figure 13
4	Lead cleaning, thickener circuit and filter	Figures 14 and 15
5	Concentrate handling area (concrete hardstand and sumps)	Figures 14 and 15

	Infrastructure	Site Plan Reference
6	Tailings thickener and associated infrastructure	Figure 16
Tailings Storage Facility (TSF)		
7	Two cells above ground paddock style facility	Figure 8
8	Tailings delivery and decant return pipelines	Figure 4
Other activities		
9	Water storage and recirculation	Figure 17

4.3 Exclusions to the Premises

The following activities/infrastructure will be occurring/ located at the Premises which are not included in the scope of this assessment:

- Clearing of native vegetation
- Abstraction of groundwater (production borefield) is regulated under the *Rights in Water and Irrigation Act 1914* (RIWI Act)
- Mine dewatering
- Power station
- Fuel storage and dispensing compound
- Accommodation camp
- Explosive magazine
- Administration offices
- Infrastructure corridors (roads and power corridors)

5. Legislative context

Table 8 summarises approvals relevant to the assessment.

Table 8: Relevant approvals and tenure

Legislation	Number	Approval
Mining Act 1978	ID76733	Approval granted on 10/06/2019
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	*Purpose permit number - CPS 8234*	Permit to clear 128ha ofnative vegetation within mining tenement G52/292, L52/194, M52/776.
Dangerous Goods Safety Act 2004.	*DG licence will be applied for before start of site works*	Pending
Rights in Water and Irrigation Act 1914	GWL 027461 (under assessment)	Application submitted to DWER for approval to abstract for 0.8GL per year for the Abra project for camp use, dust suppression and processing ore.

Legislation	Number	Approval
	CAW202141(1)	CAW202141(1) authorises construction of six non-artesian bores on mineral leases E52/1455 and M52/776.

5.1 Part IV of the EP Act

The proposal was not referred to DWER – Environmental Protection Division as it was not deemed to be a 'significant proposal' by the applicant.

5.2 Part V of the EP Act

5.2.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015);*
- *Guidance Statement: Setting Conditions (October 2015);*
- *Guidance Statement: Licence Duration (August 2016);*
- *Guidance Statement: Decision Making (February 2017);*
- *Guidance Statement: Risk Assessments (February 2017);* and
- *Guidance Statement: Environmental Siting (November 2016).*

5.2.2 Clearing

The clearing of native vegetation is not approved under the Works Approval.

6. Consultation

The Application was advertised on 21 January 2019 seeking public comment. Comments were due by the 11 February 2019. No comments were received.

7. Location and siting

7.1 Siting context

The Premises is located on General Purpose Lease G52/292. The Premises is located approximately 200 km north of Meekatharra, 190 km south of Newman and 100 km west of the Great Northern Highway.

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 9.

Table 9: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Residential Premises	Tangadee homestead – 40 km NE of the Premises Woodlands homestead – 40 km WSW of the Premises

	Mingah Springs homestead – 40 km SE of the Premises

7.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 10. Table 10 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 10: Environmental values

Specified ecosystems	**Distance from the Premises**
RAMSAR wetland Sites in Western Australia	None within 2 km of the Premises
Department of Biodiversity, Conservation and Attractions (DBCA) Managed Lands and Waters	Approximately 7.5 km to the east of the Premises
Threatened Ecological Communities and Priority Ecological Communities	None within 2 km of the Premises
Biological component	**Distance from the Premises**
Threatened/Priority Flora	Priority 3 species located approximately 2 km north of the Premises
Threatened/Priority Fauna	*Dasycercus blythi* located 8 km to the east of the Premises

7.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 11.

Table 11: Groundwater and water sources

Groundwater and water sources	**Distance from Premises**	**Environmental value**
Public drinking water source areas	No nearby public drinking water source areas.	Not applicable
Major watercourses/waterbodies	No nearby major watercourses or water bodies. There are two major drainage lines about 200 m south and 400 m east of the project. 5 Mile Creek is an ephemeral creek which remains dry for long periods of time and only flows during heavy rainfall events.	Provides surface drainage during heavy rainfall events. 5 Mile Creek discharge into the Ethel River which is located over 6 km away. Provides temporary aquatic environments for active and passive dispersers.
Groundwater	Rockwater assessed the groundwater at the Premises during 2018 and found groundwater levels ranged from 16-54	Groundwater is this area is good quality and is suitable for livestock drinking, potable or

Groundwater and water sources	Distance from Premises	Environmental value
	mbgl. Groundwater under the TSF is expected to be 22mbgl. Abstraction bores located within 4 km of the Premises belong to Abra Mining.	industrial use.

7.5 Groundwater chemistry

Field measurements from small bores pre-existing on the site indicate that the groundwater is fresh and pH ranges from 8.4 to 7.9.

Groundwater composition is shown in Table 12.

Table 12: Groundwater characterisation

Analyte	Unit	AB10	AB7	EP1	Ethel River Bore	HY1
pH	pH unit	8.29	7.93	8.36	8.21	8.4
EC @25^{0}C	µS/cm	864	772	678	1040	1160
TDS @180^{0}C	mg/L	462	408	391	578	669
TSS	mg/L	13	<5	819	105	41
Turbidity	NTU	8.6	0.2	562	64.6	27.7
Total alkalinity as $CaCO_3$	mg/L	310	263	168	263	254
Acidity as $CaCO_3$	mg/L	<1	11	<1	4	<1
Sulphate as SO_4	mg/L	44	48	39	61	121
Chloride	mg/L	69	65	58	147	142
Calcium	mg/L	42	46	38	56	60
Magnesium	mg/L	31	35	28	43	50
Sodium	mg/L	75	50	34	65	76
Potassium	mg/L	9	9	8	18	11
Aluminium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	mg/L	0.061	0.006	<0.001	<0.001	0.001
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.253	0.41	<0.001	<0.001	0.16
Nickel	mg/L	<0.001	0.004	<0.001	<0.001	<0.001
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Iron	mg/L	0.11	<0.05	<0.05	<0.05	<0.05
Chromium VI	mg/L	<0.001	<0.001	<0.001	0.001	<0.001

Nitrate – N	mg/L	4.46	2.69	13.4	4.7	14.7
Total nitrogen -N	mg/L	5.2	3	15.1	5.4	16.7
Total phosphorous - P	mg/L	0.06	<0.02	<0.05	0.04	<0.05

7.6 Tailings waste materials characterisation

The results of the particle size distribution and Atterberg Limits testing indicate that the tailings can be classified as a non-plastic sandy silt Unified Soil Classification (USC). The soil particle density of the tailings is 3.52 t/m^3 and hydraulic conductivity of 1x10^{-5} to 10^{-7}m/s. The Emerson Class Number Test indicates that the tailings materials are dispersive.

Geochemical characterisation of the process tailings were based on composite samples of ore collected from drilling programs. These composite samples were processed in a laboratory scale metallurgical testing program to produce samples of the base metals concentrate and process residue (tailings). Static tests and mineralogical assessment were carried out with the tailings samples.

DWER has recommended the Leaching Environmental Assessment Framework (LEAF) test and kinetic test for the tailings characterization. ABRA informed that the given the insufficient amount of tailings sample remaining, LEAF and kinetic tests were not performed.

Tailings slurry analysis show that barium, lead, arsenic, copper and manganese concentration are above the Assessment Levels for Soils – Ecological Investigation Levels (Contaminated Sites Management Series, DWER 2010). The sulfide-mineral suite was dominated by pyrite. Tailings water analysis indicates that lead, nickel and copper concentrations are above ANZECC 2018 freshwater 95% level of protection.

A list of the elements present in the tailings is shown in Table 13.

Table 13: Tailings characterisation

Sample Description	**Characterisation**	
Tailings slurry *Engineering Properties*	• 65% solids • Assumed design density 1.865 t/m^3 • Specific gravity: 3.52 • Angle of internal friction: 31º • Particle size distribution: 60% passing 75 µm, with approx. 3% passing 3 µm • Hydraulic conductivity: 1.0 x 10^{-5}m/s to 1.0 x 10^{-7}m/s	
Tailings slurry *Chemical Composition*	Fe – 191.6g/kg	B – <50mg/kg
	Ba – 154.6g/kg #	As – 39.9mg/kg #
	Si – 125g/kg	Ni – 25 mg/kg
	S – 44.1g/kg	Sb – 16.62mg/kg
	Ca – 15g/kg	Co – 14.5mg/kg
	Mg – 15g/kg	V – 7mg/kg
	Mn – 8.9g/kg #	Mo – 5.9mg/kg

	Al – 7.2g/kg	Th – 2.05mg/kg
	Pb – 4.8g/kg #	Ag – 2.02mg/kg
	K – 3 g/kg	Tl – 1.89mg/kg
	Na – 1.3g/kg	U – 0.68mg/kg
	Cu – 812mg/kg #	Sn – 0.4mg/kg
	Sr – 634.7mg/kg	Cd – 0.27mg/kg
	F – 250mg/kg	Bi – 0.24mg/kg
	Zn – 85mg/kg	Hg – 0.07mg/kg
	P – 80mg/kg	Se – <0.01mg/kg
	Cr – 62mg/kg	
Tailings water *Chemical Composition*	Fe – < 0.01mg/L	B – 0.02mg/L
	Ba – 0.06mg/L	As – 0.0007mg/L
	Si – 0.85mg/L	Ni – 0.1mg/L *
	SO_4 – 112mg/L	Sb – 0.005mg/L
	Ca – 24mg/L	Co – 0.16mg/L
	Mg – 12.36mg/L	V – < 0.01mg/L
	Mn – 0.14mg/L	Mo – 0.0057mg/L
	Al – 0.02mg/L	Th – < 0.000005mg/L
	Pb – 0.086mg/L *	Ag – 0.00025mg/L
	K – 16.8mg/L	Tl – 0.00021mg/L
	Na – 29.9mg/L	U – 0.000092mg/L
	Cu – 0.4mg/L *	Sn – 0.0003mg/L
	Sr – 0.16mg/L	Cd – < 0.0005mg/L
	F – 0.5mg/L	Bi – < 0.000005mg/L
	Zn – < 0.01mg/L	Hg – < 0.0001mg/L
	P – < 0.1mg/L	Se - < 0.0005mg/L
	Cr – < 0.01mg/L	

Note: #concentration above Assessment Levels for Soils – Ecological Investigation Levels

***concentration above ANZECC 2018 freshwater 95% level of protection**

7.7 Soil type

The surface soils are described as fine sandy/silt, interspersed with gravel and stone between 200 – 500mm in depth before encountering hard duricrust. Soil depth above hardpan duricrust is variable. Soil depth of approximately 300mm can range from duricrust at surface (no soil) up to soil depths of 1m.

Galena undertook an auger drill rig programme over the project site on a 200 metre grid pattern to characterize horizons in the top 20 metres. A number of test pits have been dug, principally in the proposed location of the tailings storage facility (TSF) and borrow pit. The results of the materials classification tests on the hardpan materials from the TSF area (depth 2-4m) indicated these materials were silty gravel with a fines content (passing 75 micron) between 14% and 23%.

7.8 Surface Water Hydrology

The Abra However, it is located well above these major creeks, and the hydraulic analyses presented in the Rockwater Surface Water report (September 2018) indicated that the peak flows resulting from these catchments would not impact on the project area and underground mine.

The Abra lead-silver deposit is located near major drainage lines, in an area subject to high flood flows. The project is elevated well above the surrounding major drainage lines. However, the project's planned infrastructure intersects or lies close to two minor creeks. There are two major catchments (A and B – Figure 5) with the potential for peak flows to impact the project area and underground mine, and three smaller catchments (C, D and E – Figure 6) that could impact the project's surface infrastructure.

The characteristics of the catchments which could impact the Abra project are listed in Table 1. The nearest Bureau of Meteorology (BoM) station is Tangadee (Stn. 007179), located 45 km east-north-east of Abra. Annual Rainfall (1960 to 2018) averages 269 mm.

Table 14: Catchment characteristics

Catchment	Area (km^2)	Length (km)
A	40.5	7.6
B	5.5	4.0
C	0.12	0.7
D	0.74	1.5
E	1.17	2.1

The hydraulic analyses presented in the Rockwater Surface Water report (September 2018) indicated that the peak flows resulting from these catchments would not impact on the project area and underground mine. However, the planned infrastructure, in particular the TSF, intersects or is close to two minor drainage lines which flow northwards. High rainfall events could result in flooding and potential damage to the TSF walls.

7.9 Meteorology

The area is characterised by a 'hot semi-arid' to 'hot desert' climate, influenced by infrequent summer rainfall events and mild winters. Average daily maximum temperatures range from 19.1

degrees in winter and 38.3 degrees during summer. The average annual rainfall in the area is 239.1 mm with most occurring from January to July. Weather data is obtained from the Bureau of Meteorology for the Town of Meekatharra located approximately 200 km south of the proposed Premises.

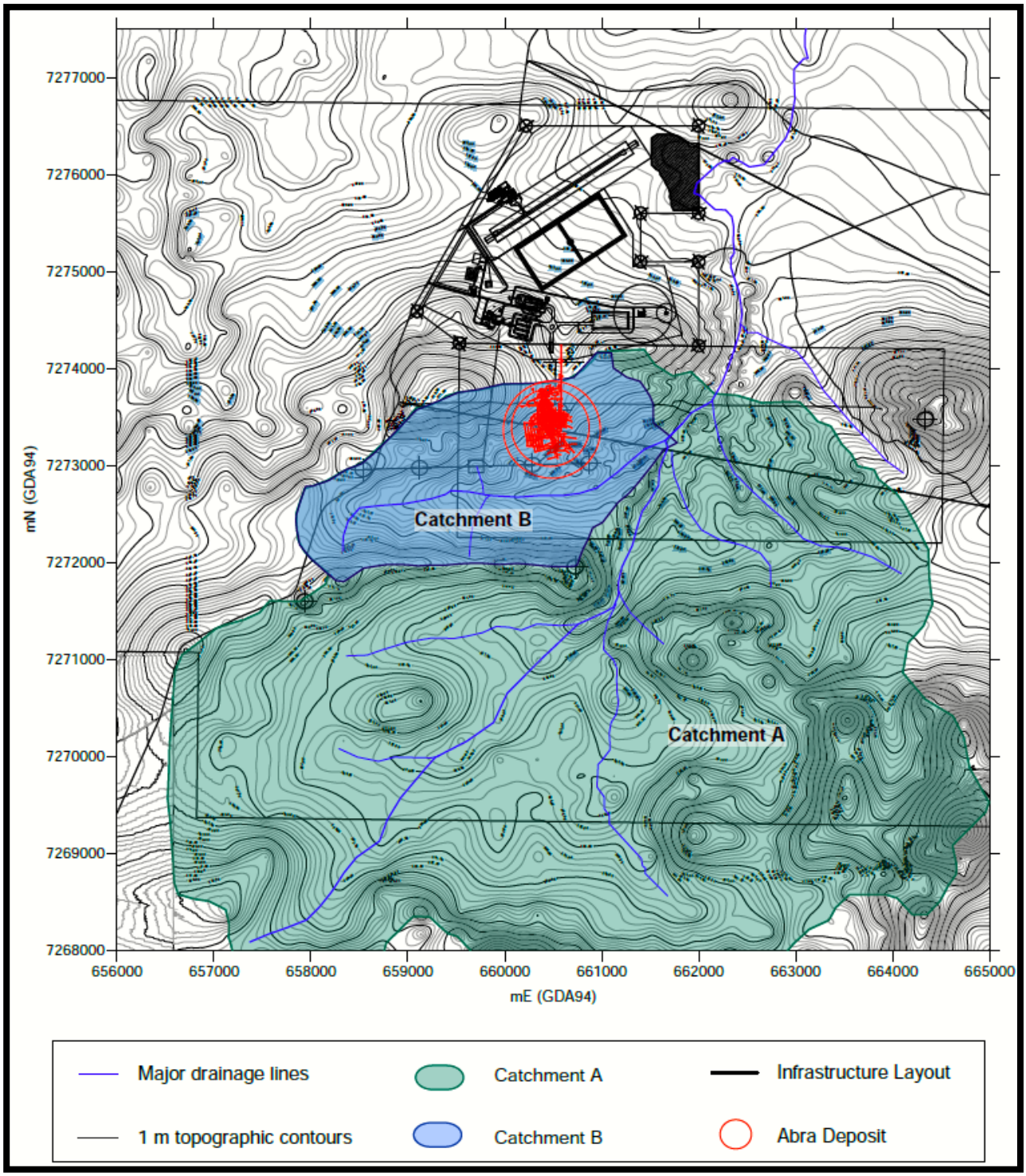

Figure 5: Major catchment areas.

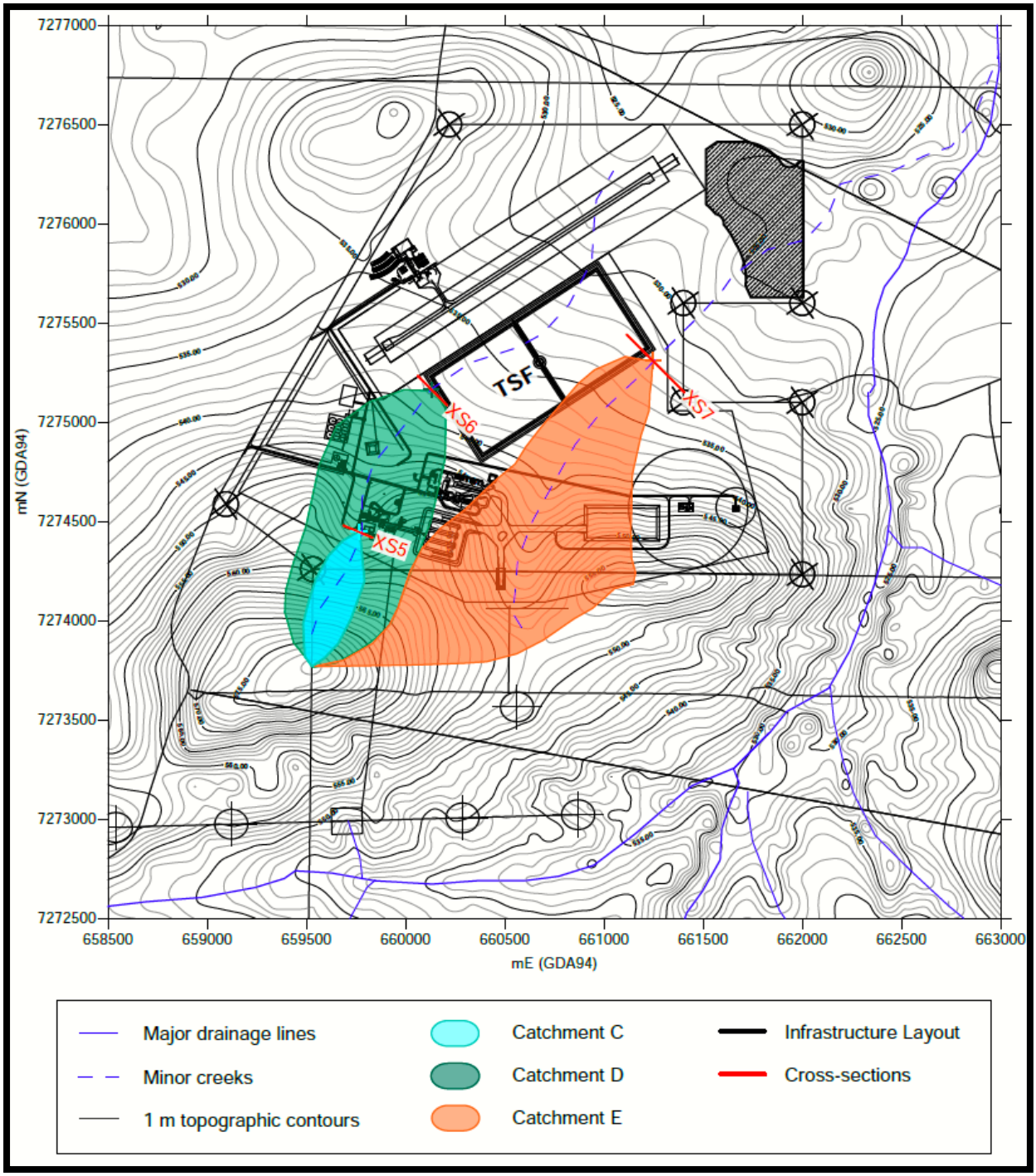

Figure 6: Minor catchments (C, D and E) around plant area (Rockwater, 2018). Final infrastructure layout has been realigned to avoid drainage line.

8. Risk assessment

8.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Tables 15 and 16.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Tables 15 and 16 below.

Table 15. Identification of emissions, pathway and receptors during construction

Risk Events						**Continue to detailed risk assessment**	**Reasoning**
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction, mobilisation and positioning of infrastructure	Vehicle movements on unsealed access roads	Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	No receptor present.
		Dust			None	No	No receptor present.
	Earthworks, construction of new buildings, plant and infrastructure	Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	No receptor present.
		Dust	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	No receptor present.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			Flora and vegetation		Potential to be deposited on vegetation and may prevent photosynthesis and plant respiration	No	The natural dust tolerance of vegetation species should prevent vegetation impacts. There are also no Declared Rare Flora, TECs or PECs within or in a 30 km radius of the Premises.
	Storage and use of hydrocarbons and chemicals	Spills and breach of containment	Soil and vegetation adjacent to the area of spill or breach	Direct discharges to land	Soil contamination inhibiting vegetation growth and survival	No	Managed under a Dangerous Goods licence. The general provisions of the EP Act and *Environmental Protection (Unauthorised Discharges) Regulations 2004* apply, as does the *Dangerous Goods Safety Act 2004* and associated Regulations.

Table 16: Identification of emissions, pathway and receptors during commissioning and operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Category 5 Processing or beneficiation of metallic or non-metallic ore	***Process Plant***	Dust	No residences in proximity	Air / wind dispersion	None	No	No receptor present.
			Adjacent vegetation		Potential suppression of photosynthetic and respiratory functions	Yes – refer to section 8.6	Potential to cause soil contamination if spills occur. Lead sulfide is highly toxic (Acute Toxicity 4 - Globally Harmonised System (GHS)); large spills may result in potential impact to vegetation and fauna
		Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	No receptor present.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
	Process Plant	Process liquors, chemical reagents and slurries	Adjacent vegetation Soils and groundwater systems	Pipeline failure or tank/bund overflow causing spill to ground; flow to vegetation and drainage lines	Death or adverse impact to adjacent vegetation Soil and/or groundwater contamination	Yes – refer to section 8.5	Potential to cause soil contamination if spills occur; large spills may result in potential impact on water quality and aquatic biota in tributaries and drainage lines.
		Contaminated stormwater	Drainage lines Riparian vegetation	Stormwater runoff Gravity flow overland	Contamination of drainage lines with sediment and metals in sediment Loss of riparian vegetation	Yes – refer to section 8.4	Potential impact on water quality and riparian vegetation.
		Spills from conveyor belts	Soil Vegetation and fauna	Air Runoff	Soil contamination Adverse impacts on vegetation and fauna habitat	Yes – refer to section 8.6	Potential to cause soil contamination if spills occur. Lead sulfide is highly toxic (Acute Toxicity 4 - Globally Harmonised System (GHS)); large spills may result in potential impact to vegetation and fauna
	Bulk fuel storage	Breach of containment causing hydrocarbon discharge to land	Soils and groundwater	Direct discharge	Soil and groundwater hydrocarbon contamination	No	Managed under the *Dangerous Goods Safety Act 2004*. Beacon will seek a Dangerous Goods Licence From DMIRS
	Workshop/Stores ***Wash down bays***	Hydrocarbons Lead contaminated water	Soil and groundwater	Release to ground	Soil and/or groundwater contamination	Yes – refer to section 8.7	Potential to cause soil and groundwater contamination if spills or leaks occur
	TSF	Discharge of tailings through TSF embankment failure	Drainage lines in pathway of tailings Soil and vegetation	Direct discharges to land and infiltration to soil	Death or adverse impact to adjacent vegetation Soil contamination	No	Managed by DMIRS under the *Mining Act 1978*.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Tailings seepage	Adjacent vegetation Soil Groundwater	Seepage to groundwater adjacent to TSF and seepage from the base of the TSF with infiltration into soils	Groundwater mounding Groundwater contamination Soil contamination inhibiting vegetation growth and survival	Yes – refer to section 8.8	Potential to cause groundwater mounding inundating root zones of vegetation, groundwater and soil contamination.
		Dust from surface of TSF containing tailings contaminants	No residences or other sensitive receptors in proximity	Air / wind dispersion	Potential to be deposited on vegetation and soil	No	The Delegated Officer considers the natural dust tolerance of vegetation species should prevent vegetation impacts. There are also no Declared Rare Flora, TECs or PECs within or in a 2km radius from the TSF.
		Spillage of tailings through leaks, pipeline ruptures or failure	Soil and groundwater	Rupture of pipeline causing tailings discharge to land	Death or adverse impact to adjacent vegetation and wildlife Soil contamination	Yes – refer to section 8.8	Potential for soil and groundwater contamination through release of tailings slurry/tailings decant water

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 17 below.

Table 17: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 18 below.

Table 18: Risk criteria table

Likelihood		**Consequence**		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		**The following criteria has been used to determine the consequences of a Risk Event occurring:**		
			Environment	**Public health* and amenity (such as air and water quality, noise, and odour)**
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale:** mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

8.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment table 19 below:

Table 19: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

8.4 Risk Assessment – Stormwater runoff

8.4.1 Description of stormwater runoff

Construction and Operation

Disturbed land and construction activities may result in turbid water and sediment being discharged on and off the Premises.

8.4.2 Identification and general characterisation of emission

Stormwater with sediments from disturbed soils, stockpiles and earthmoving activities.

8.4.3 Description of potential adverse impact from the emission

Turbid, sediment laden water released to drainage lines and associated catchment during storm or extreme rainfall events resulting in poor surface water quality, increased sedimentation and potential loss of riparian vegetation.

The nearest surface water feature is approximately 1.6km to the east of the process plant.

8.4.4 Applicant controls

Construction and Operation

No detailed design of the stormwater management system for the process plant has yet occurred.

Conceptual design of the process plant catchment area is provided in Figure 7.

Abra Mining will utilise roadways where possible to segregate uncontaminated and contaminated catchment areas and direct uncontaminated water flow away from the process area.

The event pond/drainage basin basis of design is as follows:

1. HDPE lined
2. Designed to hold 1:100 AEP event
3. 300mm freeboard
4. Transfer pumps to pump water to the TSF in the event of rainfalls exceeding 1:100 AEP

Abra Mining has committed to provide *For Construction* drawings to DWER when they become available (Abra Mining 11/06/2019).

Storm water and site run off will be collected and pumped to the tailings thickener for recovery and re-use.

8.4.5 Consequence

The impact from contaminated stormwater runoff at the Premises could result in short term impacts to the drainage lines and associated catchment area. Therefore, the consequence is ***Major***.

8.4.6 Likelihood of Risk Event

The reports provided with the application did not contain sufficient information to determine whether stormwater will be appropriately designed or managed. Therefore, the likelihood of the consequence is ***Possible***.

8.4.7 Overall rating of stormwater runoff

Comparison of the consequence and likelihood ratings described above with the risk rating matrix (Table 17) determines the overall rating of risk for stormwater runoff at the Premises to be ***High***.

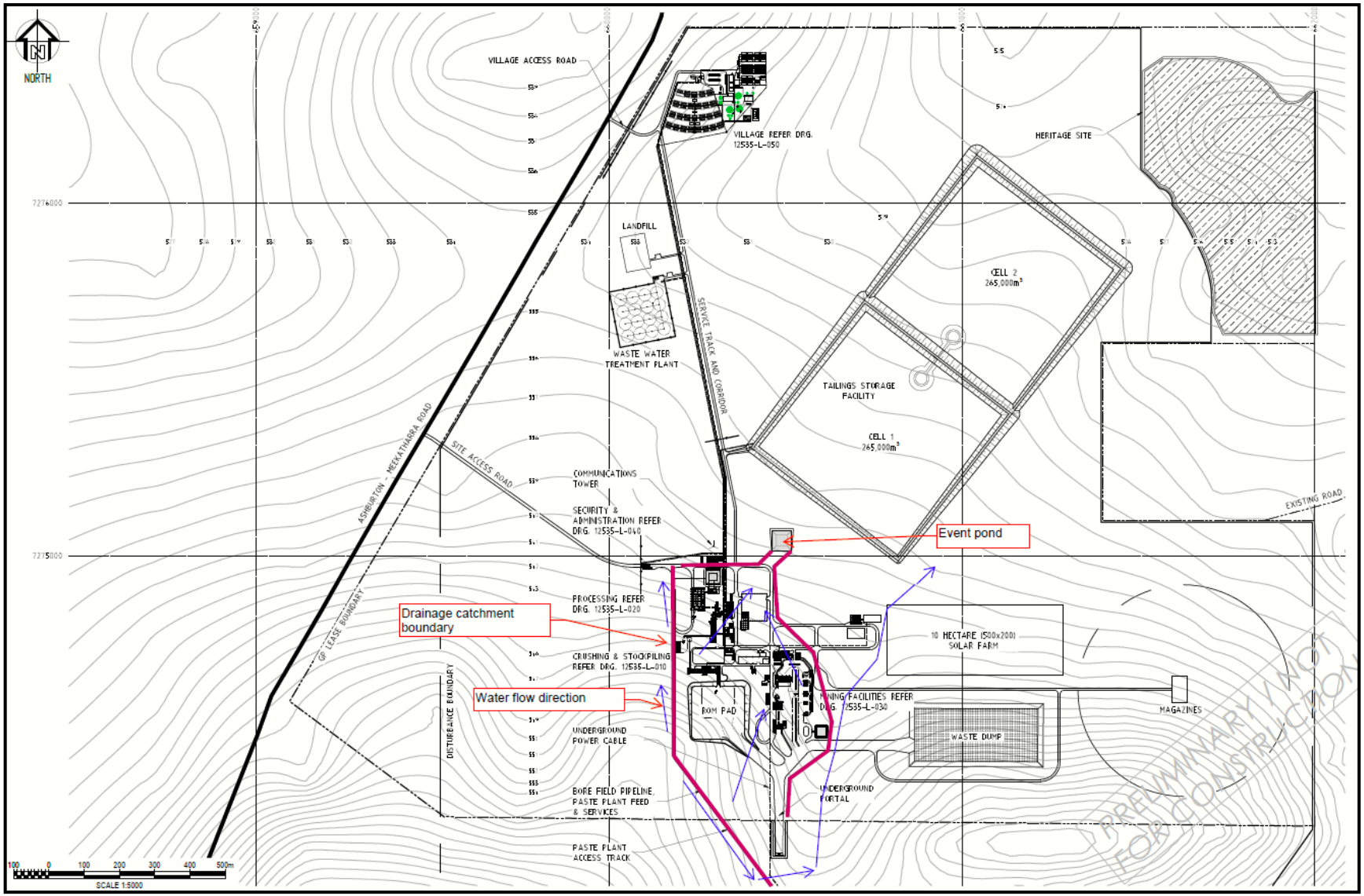

Figure 7: Prescribed premisses – conceptual drainage design.

8.5 Risk Assessment – Spills of processing reagents during commissioning

8.5.1 Description of spills of processing reagents during operations

During the ore processing, reagents released to ground may occur from overflowing tanks (poor or faulty process control), pipeline failures, failures of bunding or sump pumps, or catastrophic mechanical failures of tanks.

8.5.2 Identification and general characterisation of emission

Alkaline liquors with metals and cyanide in solution, and flammable liquids (frother).

8.5.3 Description of potential adverse impact from the emission

The release of processing slurries may inundate and destroy adjacent vegetation and result in localised soil and groundwater contamination. A large spill due to a pipeline or tank failure or overflow may result in release to drainage lines.

8.5.4 Applicant controls

The Applicant's controls to manage spills of processing reagents during commissioning are set out in Table 20 below.

Table 20: Applicant's controls for contaminated drainage from the process plant

Site infrastructure	Controls
Process Plant	*Flash flotation* - sump pump will be located in the flocculant mixing area and will pump spillage to the tailings thickener. *Lead-Silver flotation* - sump pumps will be provided for spillage and clean up. *Lead concentrate thickening and flotation* - the lead concentrate thickener area floor will have a sump pump to collect any spills; - the lead concentrate filter area will have a sump pump to collect any spills *Tailings thickening and disposal* - the tailings thickener area sump pump will return spillage and clean up to the thickener feed box. No detailed design of individual containment areas has yet been done. Abra Mining committed to install concrete bunding around the process plant to contain 110% of the storage capacity of the largest vessel (Abra Mining, 11/06/2019).
Processing reagents including: • Flocculant • Hydrated lime • Sodium Cyanide • Frother (Methyl Isobutyl Carbinol	A sump pump will be located in the flocculant mixing area and will pump spillage to the tailings thickener Hydrated lime will be off loaded, as powder, from a tanker with a dedicated blower into a 60t capacity silo. A dust extractor will be located on the top of the silo to prevent lime egress during unloading.

(MIBC))	Sodium cyanide will be delivered to site in 1,000kg bulk bags. MIBC will be delivered to site in 800kg IBCs. No detailed design of individual containment areas has yet been done. Abra Mining committed to install concrete bunding to AS 1940 standards in hydrocarbon and reagent storage areas (Abra Mining, 11/06/2019).
Detention basin	Abra Mining committed to design the event pond/drainage basin basis as follow: 1. HDPE lined 2. designed to hold 1:100 AEP event 3. have300mm freeboard 4. include transfer pumps to pump water to the TSF in the event of rainfalls exceeding 1:100 AEP (Abra Mining, 11/06/2019)

8.5.5 Consequence

Based on the information provided for this assessment and the absence of construction and containment details, DWER will adopt a precautionary approach. If a spill occurs and impacts on soil, groundwater and vegetation, this could result in high level on-site impacts. Therefore the consequence is ***Major***.

8.5.6 Likelihood of Risk Event

The likelihood of a spill resulting in impact to vegetation is ***Possible***.

8.5.7 Overall rating of spills of processing reagents during operations

Comparison of consequence and likelihood ratings described above with the risk rating matrix (Table 17) determines the overall rating of risk for processing reagent spills impacting on vegetation to be ***High***.

8.6 Risk Assessment – Spills from conveyor belts and storage shed during commissioning

8.6.1 Description of spills from conveyor belts and storage shed during operations

During the ore processing, processed ore can fall from the conveyor belt on the ground or blown off. Lead concentrate can be blown off from the storage shed.

8.6.2 Identification and general characterisation of emission

Processed ore containing high concentration of lead.

8.6.3 Description of potential adverse impact from the emission

The release of lead containing material may result in localised soil contamination and impact on

vegetation and wildlife. A large spill due to a conveyor belt failure may result in release to ground.

8.6.4 Applicant controls

The Applicant's controls to manage spills of processed ore during commissioning are set out in Table 21 below.

Table 21: Applicant's controls for contaminated drainage from the process plant

Site Infrastructure	Controls
Crushing area	Spillage and clean-up will be collected by sumps and subsequently pumped to the cyclone feed hopper. No detailed design has yet occurred. Abra Mining committed to provide detailed *For Construction* drawings to DWER when they are prepared (Abra Mining, 11/06/2019).
Concentrate loadout shed	Concentrate will be loaded into half height containers, which will be fitted with removable lids to seal them for transport. Abra Mining intends to use the Rotabox system to transport base metals concentrate.

8.6.5 Consequence

Based on the information provided for this assessment and the absence of construction and containment details, DWER will adopt the precautionary approach. If a spill occurs and impacts on soil and vegetation, this could result in high level on-site impacts. Therefore the consequence is ***Major***.

8.6.6 Likelihood of Risk Event

The likelihood of a spill resulting in impact to vegetation is ***Possible***.

8.6.7 Overall rating of spills of processing reagents during operations

Comparison of consequence and likelihood ratings described above with the risk rating matrix (Table 17) determines the overall rating of risk for processing reagent spills impacting on vegetation to be ***High***.

8.7 Risk Assessment - Hydrocarbon discharges during commissioning of the workshop/wash down facilities

8.7.1 Description of hydrocarbon discharges from the workshop/wash down facilities during commissioning

Oils, greases and diesel released to ground during commissioning from maintenance workshops and wash down facilities associated with failures of bunding or sumps or catastrophic mechanical failures of tanks.

8.7.2 Identification and general characterisation of emission

Oils and greases (hydrocarbons) may be released to ground (through spills, poor handling or inadequate bunding). Incorrectly sized or a poorly maintained oil/water separator may result in overflow/release of hydrocarbons to ground or to stormwater.

8.7.3 Description of potential adverse impact from the emission

Releases of hydrocarbons outside bunded areas may result in localised soil contamination. Long term undetected spills or leaks may also result in groundwater contamination. Spills may be transported with stormwater during rainfall events.

8.7.4 Applicant controls

The Applicant's controls for the workshop and wash down facility are set out in Table 22 below.

Table 22: Applicant's controls for the workshop/wash down facility

Site infrastructure	Controls
Diesel compound at workshop area	Comprise up to 2 x 110KL self bunded tanks fitted with overfill protection alarm
Wash down facility and workshop area	Vehicle washdown facilities will be located on site. At the mine workshop, the washdown bay will be constructed with a wedge pit to settle heavy sediment and then a triple interceptor before discharge to an infiltration /evaporation basin (Figure 18). Wastewater from the truck and tyre washdown points at the concentrate loadout facility will be returned to the process plant to recover any suspended lead
Bulk oil	Stored in 1,000 litre bulk pods. Waste oil will be stored in bulk tanks. Details on Figure 19.
All	Spill kits Oily rags, vehicle filters and other hydrocarbon waste Workshops, fuel dispensing and chemical storage locations will have 240 litre bin kits. The Emergency Response Team (ERT) will also have stocks of items required resulting from risk assessment and job hazard analysis. This detail has not yet been completed (Abra Mining, 11/06/2019).

8.7.5 Consequence

Based on the information provided for this assessment and the absence of construction and containment details, DWER will adopt the precautionary approach. If a release of hydrocarbons and lead containing wastewater to ground occurs, then the Delegated Officer has determined that the impact of the spill will be **Major**.

8.7.6 Likelihood of Risk Event

The likelihood of a spill resulting in impact to vegetation is ***Possible***.

8.7.7 Overall rating of discharges from the workshop/wash down facility during commissioning

The overall rating for discharges to land (large release of hydrocarbons) from the

workshop/wash down facility resulting in soil and groundwater contamination and poor surface water quality of drainage lines is ***High***.

8.8 Risk Assessment – TSF seepage during operations and pipeline failure spillage

8.8.1 Description of TSF seepage during operations

Seepage from tailings stored in TSF impacting on groundwater quality in the surficial aquifer underlying the premises. Field measurements of water samples from the TSF area indicate that the groundwater is fresh with salinities of 400 and 460 mg/L TDS and neutral pH. Metals are mostly below Limits of Reporting. Total nitrogen ranges from 3 to 16.7 mg/L; and phosphorus concentrations are low (Table 12).

8.8.2 Identification and general characterisation of emission

The tailings generated by the metallurgical test have been characterised by *GCA 2018* and detailed in section 7.6. The tailings sample was enriched with barium, arsenic, manganese lead and copper. Tailings slurry water had pH 7.6 and had elevated lead, nickel and copper.

Only static test was performed because of the limited amount of sample produced during the metallurgical test.

8.8.3 Description of potential adverse impact from the emission

Seepage from the TSF has the potential to cause mounding and contaminate groundwater. In the area of the planned TSF, silt and sand sheet-wash overlie colluvium, which consists of quartz and rock fragments in a weakly cemented silt and sand matrix. Groundwater level under the TSF is expected to be 22m below ground level.

There is a risk to drainage lines and the associated catchment area through groundwater contamination from seepage from the TSF.

The results of the materials classification tests on the hardpan materials from the TSF area (depth 2-4m) indicated these materials were non-plastic silty gravel with a fines content (passing 75 micron) between 14% and 23%. This testing confirms that a Geosynethic Clay Liner (GCL) will be required to line the TSF to manage seepage.

The seepage analyses indicate very low seepage flow can be expected from the TSF. The use of a GCL in lining the facility will ensure negligible seepage from the TSF (Table 23).

Table 23: Results from seepage analysis

Stage	Seepage flow (m^3/day/m of embankment)	Approximate embankment length (m)	Estimated seepage per day for embankment section (m^3/day)
Starter Embankment	0.00000036	1,500	<0.0005
Final Embankment	0.0000031	1,500	<0.005

The *TSF Design Report* states the following:

- The stability analyses indicate that the cases examined generally have adequate factors of safety for the drained and undrained conditions when compared with the recommended minimum factors of safety in ANCOLD (2012).
- The tailings storage should be operated in such a manner as to ensure that the `normal'

supernatant pond is kept well away from the embankment, within the rock-ring decant, at all times.

8.8.4 Criteria for assessment

The TSF has been designed in accordance with the *TSF Code of Practice* and the design conforms to *ANCOLD, 2012* and *Guide to the preparation of a design report for tailings storage facilities (TSFs).*

8.8.5 Applicant controls

The Applicant's controls for the TSF are set out in Table 24 below. The Applicant will also developed a TSF Operations Manual, which will undergo independent audits annually.

Table 24: Applicant's controls for the TSF

Site infrastructure	Construction	Operation details
TSF general	Designed to store 8.48 Mt of tailings over a 15 year life. Two cell, paddock type facility, located to the north of the plant site, between two intermittent creek lines. The two cell TSF will be constructed in six stages. Designed such that a 1% annual exceedance probability (AEP), 72-hour duration storm event can be temporarily stored on top of the TSF.	Minimum of 500 mm total freeboard comprising minimum operational freeboard (vertical height between the tailings beach and embankment crest) of 300 mm and a minimum beach freeboard of 200 mm plus allowance of the 1% AEP 72 hour event of 222 mm. The tailings discharge points, return water pump, beach, decant pond size and location, integrity of embankment and GCL, seepage downstream of the TSF will be visually inspected daily.
TSF starter embankment	The starter embankments and TSF cell basins will be lined with GCL. Stage 1, Cell A Starter: construction of the starter embankments to crest RL539.5 m and drainage diversion. Stage 1, Cell B Starter: construction of the starter embankments to crest RL535.5 m. The starter embankment and upstream raised embankments will have a minimum crest width of 6 m. Stage 2: raising construction of embankment by 3 m. Stage 3: raising construction of embankment by 3 m The embankment crest will have a 2% cross-fall towards the upstream side and 0.5m (minimum) high mine waste windrow at the downstream crest. Design slopes of 1(V):2(H) upstream and 1(V):3(H) downstream (Figure 9).	

Site infrastructure	Construction	Operation details
Tailings deposition	Multiple spigots located on the upstream perimeter embankment crest.	Discharged sub-aerially and cyclically into the TSF in thin discrete layers, not exceeding 300 mm thickness to allow optimum density and strength gain by subjecting each layer to a drying cycle. Deposition will take place via multiple spigots. Spigotting will be carried out such that the supernatant pond is maintained within and around the rock ring decant. Daily inspections.
Decant system and pond	Rock-ring type central decant structure. Decant structure and decant causeway will be raised along with the perimeter embankments. Decant pump located within the rock ring decant. Decant causeway - design slopes of 1:1.5 (V: H) and a 6m minimum crest width, with 0.5 m (minimum) windrows on both sides of the access way.	Decant pond is maintained away from the perimeter embankment at all times. Decant water will be removed from the TSF by a decant pump located in the rock ring structure and pumped back to the process plant
Pipelines (tailings delivery and decant return water)	No detailed design has yet occurred for the pipelines within the corridor. The basis of design is as follows: 1. graded earthen windrows on both sides to contain spills or leaks. 2. pressure sensors on the pipeline (Abra Mining, 11/06/2019)	The tailings delivery and water return pipes and containment corridor will be visually inspected daily for any visible leakage or damage.
Seepage recovery system	Seepage recovery bores (***if required*** – number and location to be determined)	
Monitoring system	Perimeter monitoring piezometers (installation of 12 piezometers) Eight groundwater monitoring bores to be installed (Figure 10). Monitoring bores will have a depth of approximately 80m, until transition zone rocks have been intersect. Bore logs will be submitted to DWER when they are constructed. Each bore will be cased with pvc pipe with a 50 mm diameter to allow for sample abstraction. If airlift yields are greater than 1 L/s, it is recommended that the bores be constructed with 100 mm	Monitor any phreatic surface within the embankments and foundations Standing water level (SWL) on a monthly basis. Quarterly ambient groundwater quality monitoring.

Site infrastructure	Construction	Operation details
	casing so that they could be used to recover contaminated groundwater or to lower groundwater levels, if necessary. (Rockwater, November 2018)	

8.8.6 Key findings

The Delegated Officer has reviewed the information regarding the operation of the TSF and has found:

1. No seepage recovery system is envisaged by the Applicant. The starter embankments and TSF cell basins will be lined with GCL with hydraulic conductivity of $1x10^{-12}$m/s to reduce seepage.
2. The Delegated Officer considers that the proposed location and number of groundwater monitoring bores can provide adequate baseline data.
3. A G licence is limited to 15m bgl. The applicant will need to seek approval from DMIRS to install monitoring bores 80mbgl as proposed in the Rockwater report.
4. It is recommended that the applicant collect groundwater samples after installing the monitoring bores.

8.8.7 Consequence

No details on the tailings return pipeline have been provided for this assessment. Therefore, DWER will adopt the precautionary approach. The vegetation impact of TSF pipeline ruptures during commissioning could result in high-level on-site impacts. Therefore, the consequence is ***Major***.

If seepage alters local groundwater quality, the *ANZECC, 2000 95% Freshwater* trigger values could be exceeded. Furthermore, the TSF is located within two ephemeral creeks. The impact of seepage during commissioning could result in short term impacts to the drainage lines and the associated catchment. Therefore, the consequence is ***Moderate***.

8.8.8 Likelihood of Risk Event

Based on the information provided, the likelihood of tailings being released to land from leaks and spills from pipelines during commissioning is considered ***Possible***.

Based on the Applicant's ambient groundwater monitoring requirements and that the installation of a GCL, an environmental impact from seepage commissioning will probably not occur in most circumstances. Therefore, the likelihood of the consequence is ***Unlikely***.

8.8.9 Overall rating of TSF seepage during commissioning

Comparison of the consequence and likelihood ratings described above with the risk rating matrix (Table 17) determines the overall rating of riskfor TSF pipeline ruptures to be ***High*** and seepage to be ***Medium***.

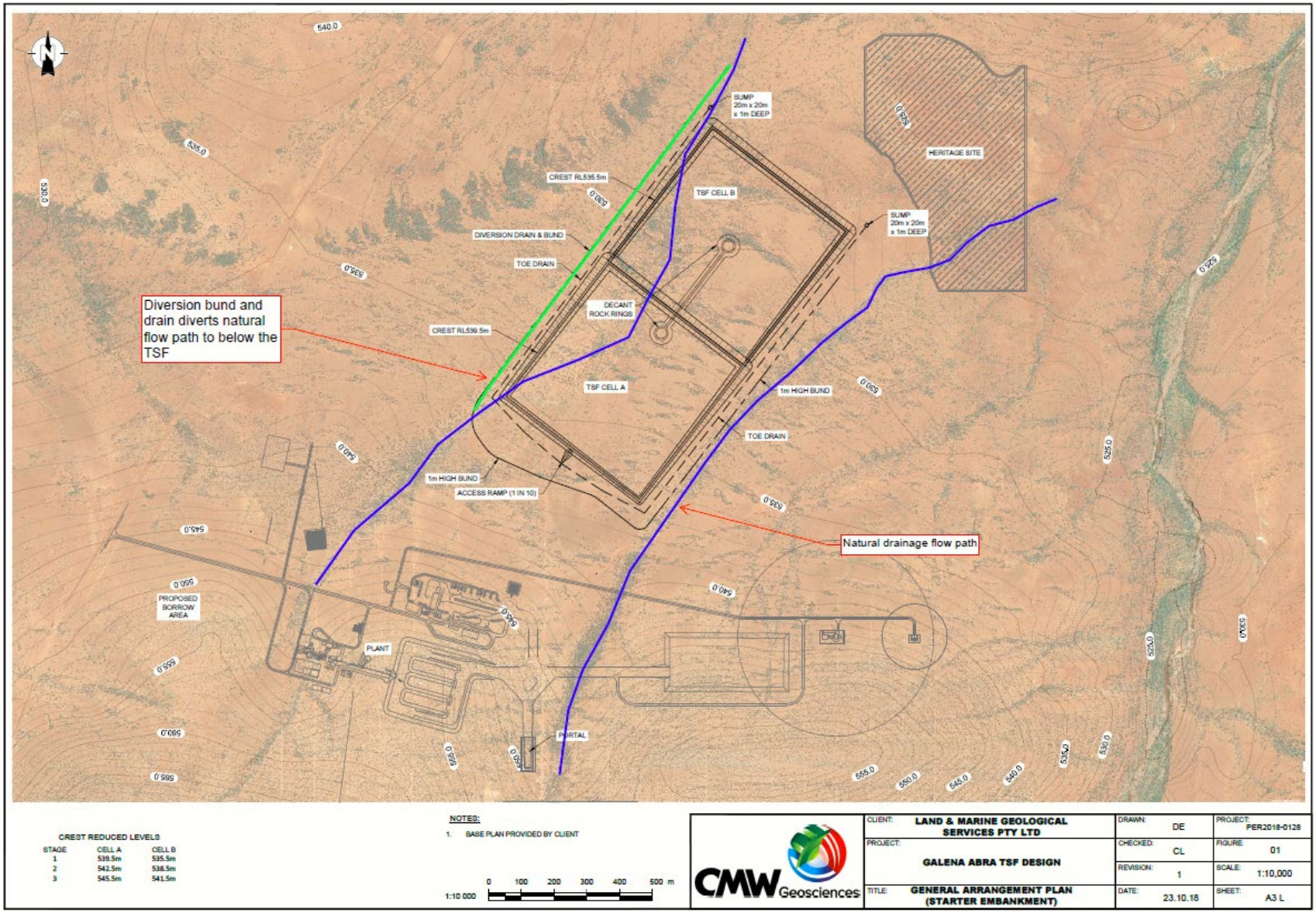

Figure 8: TSF design – General arrangement plan

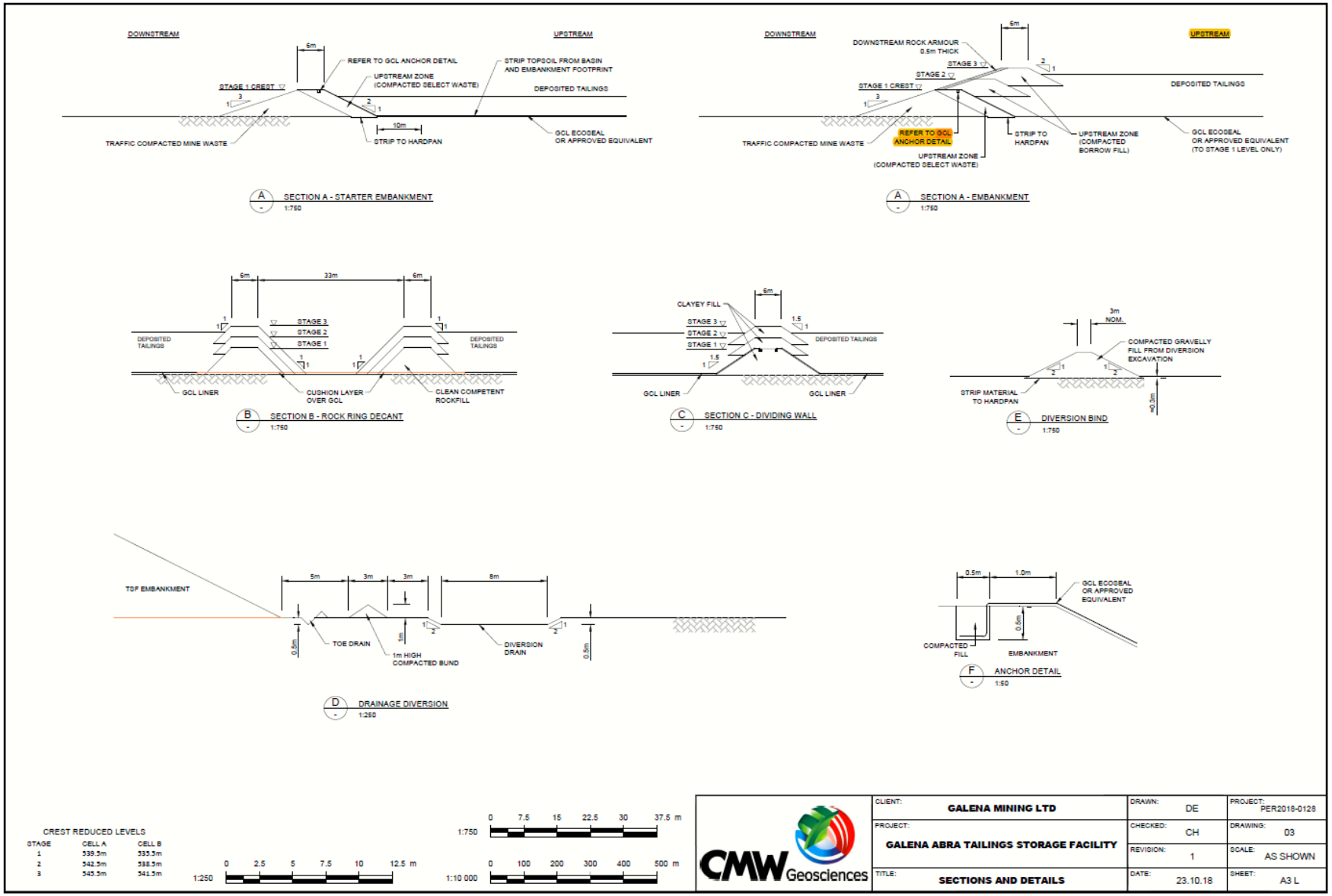

Figure 9: TSF design for sections and details

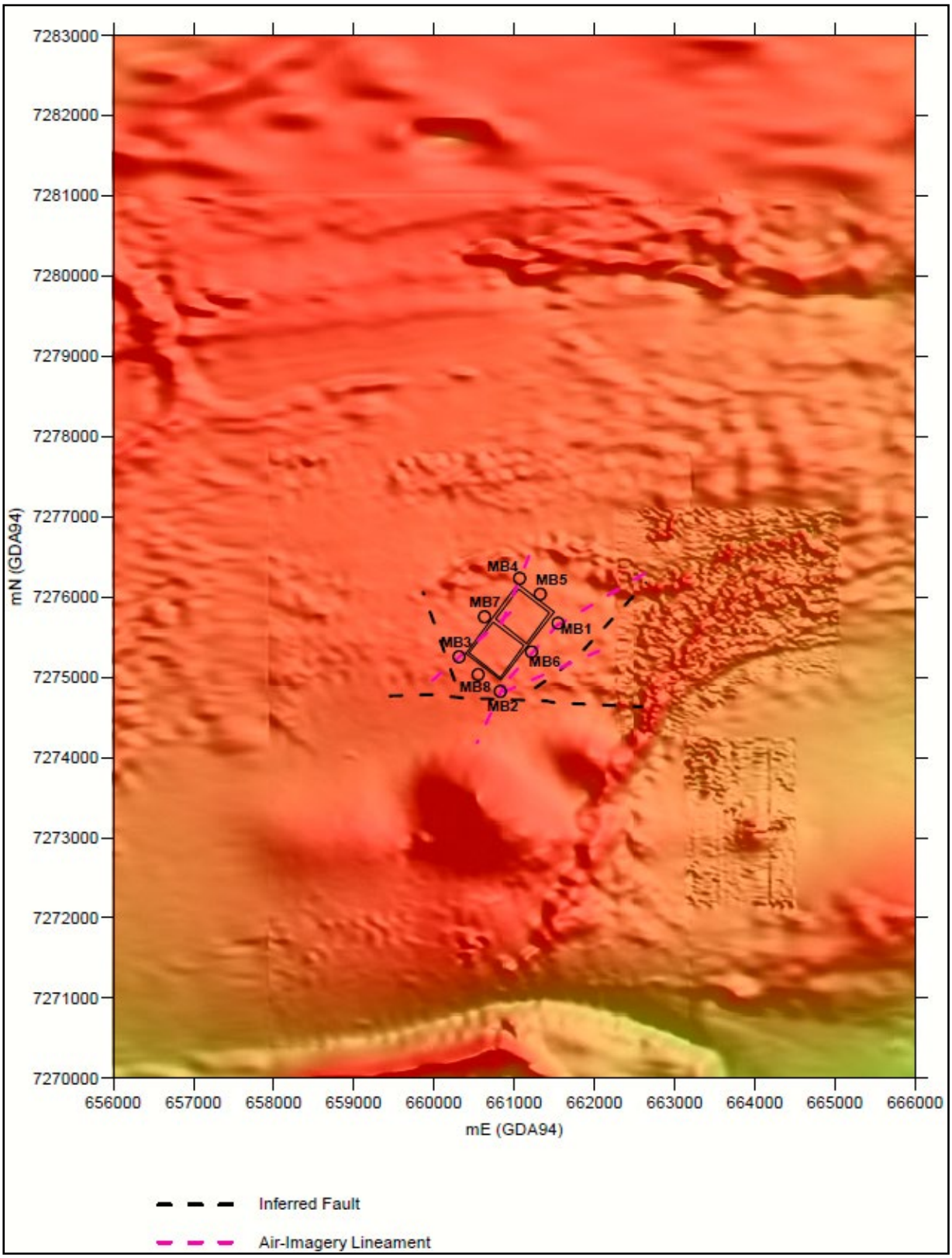

Figure 10: TSF monitoring bores sites

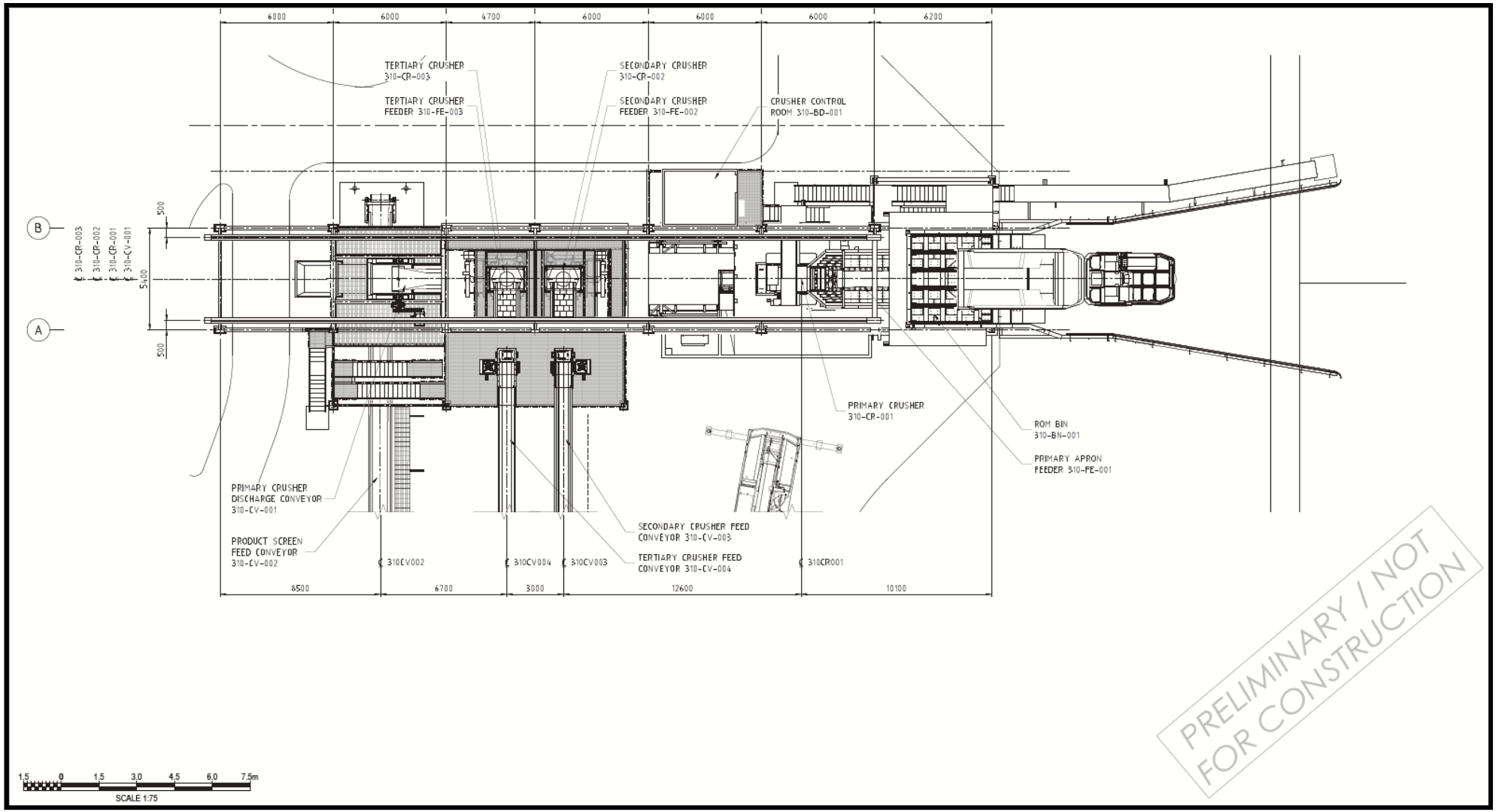

Figure 11: Crushing arrangement plan.

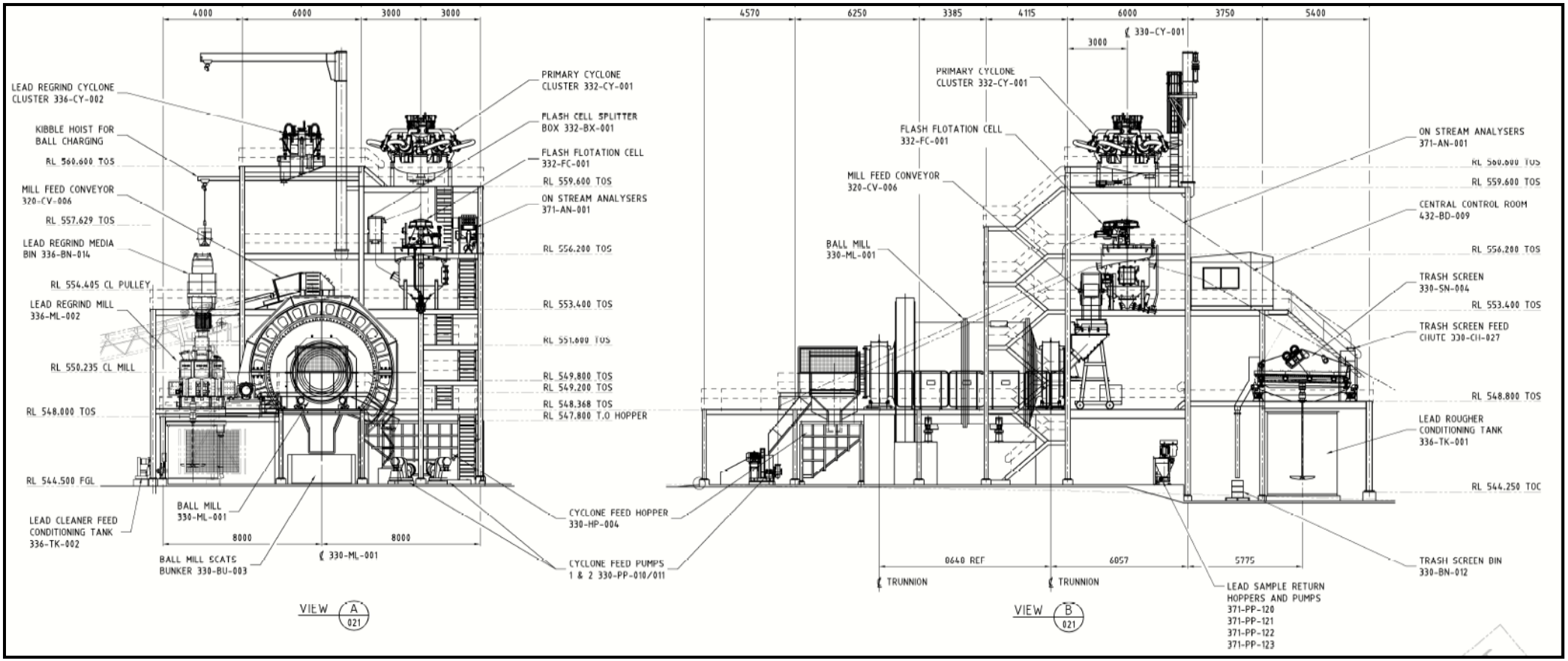

Figure 12: Grinding and classification arrangement plan.

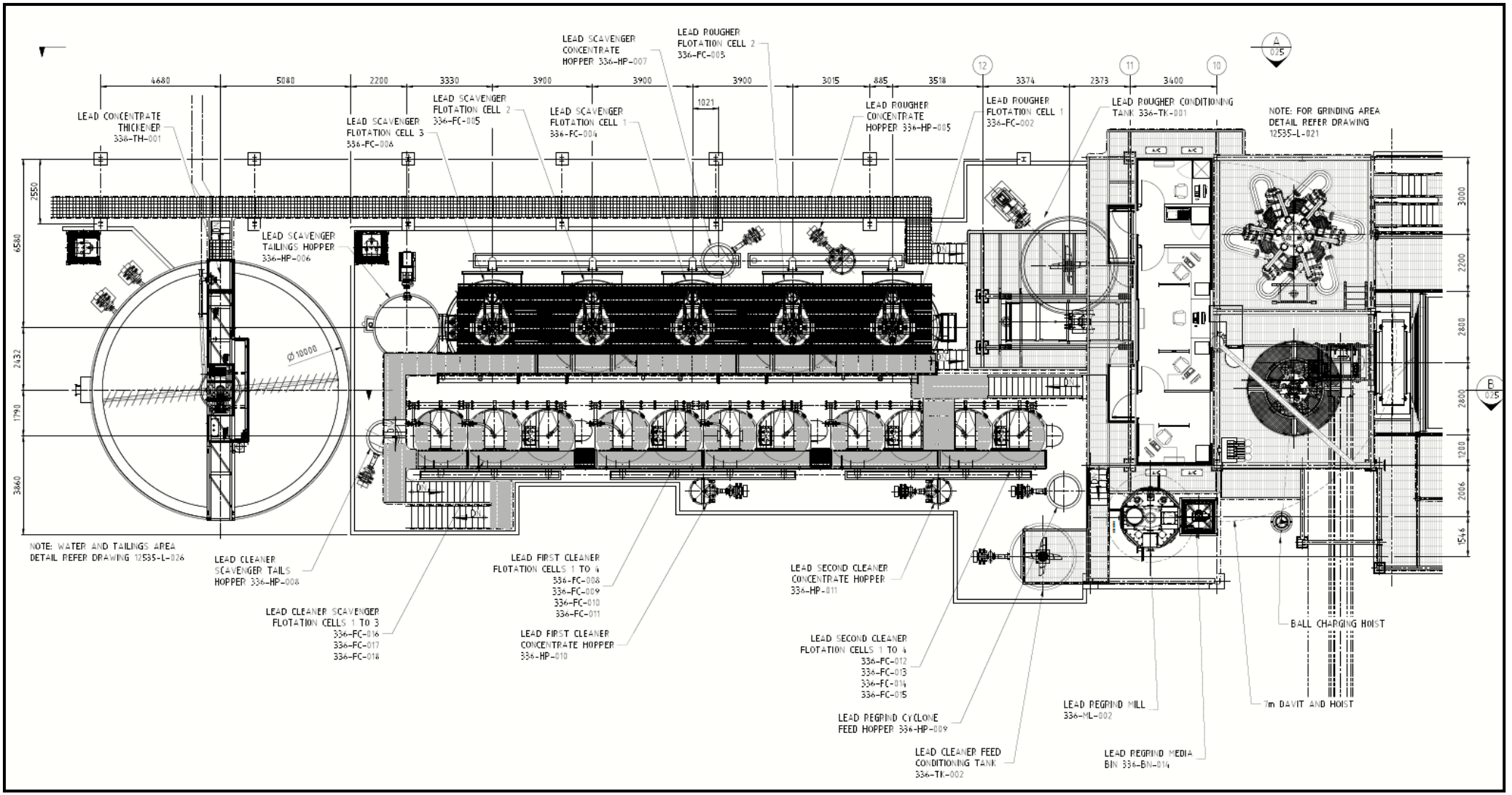

Figure 13: Lead flotation and regrind arrangement plan.

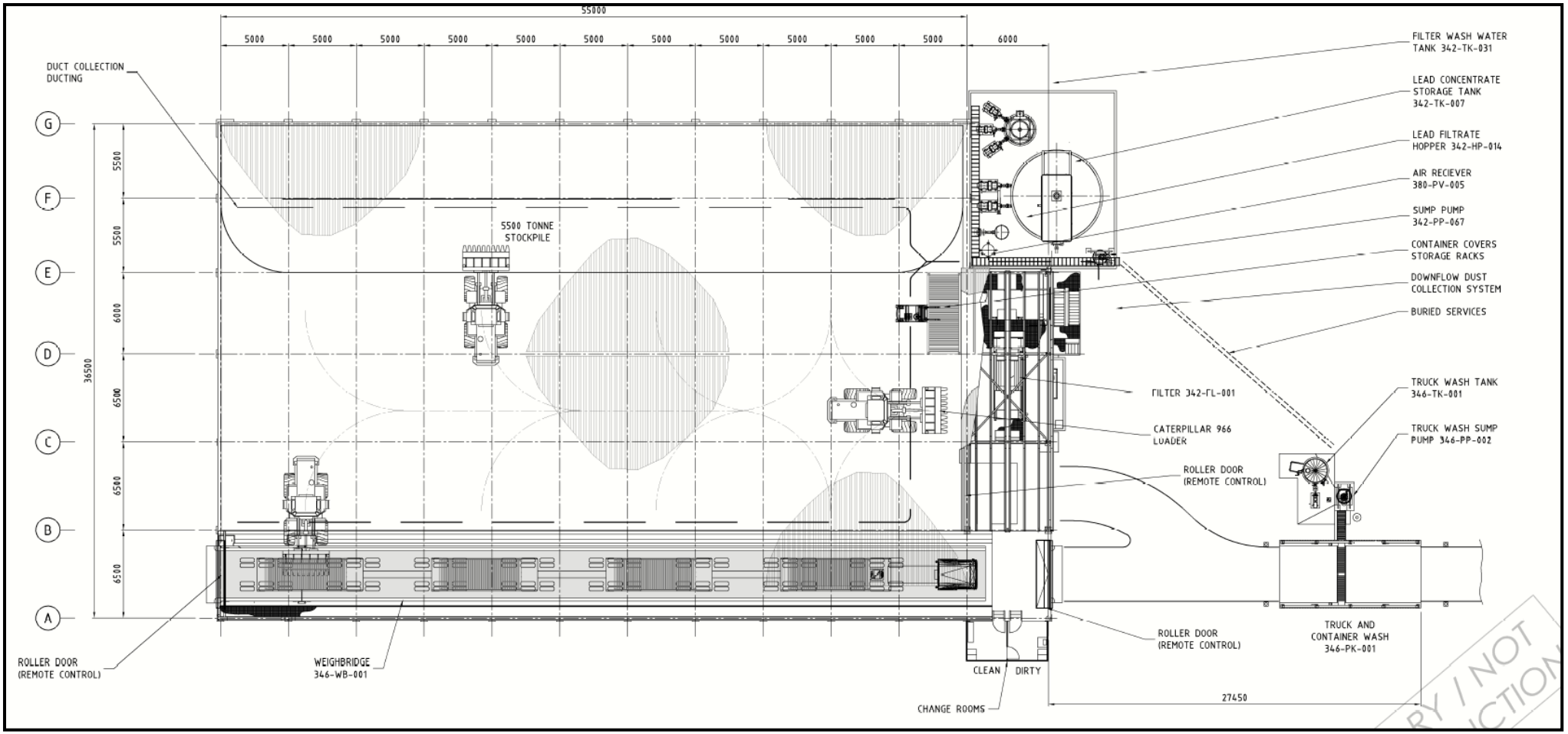

Figure 14: Concentrate filtration and handling areas.

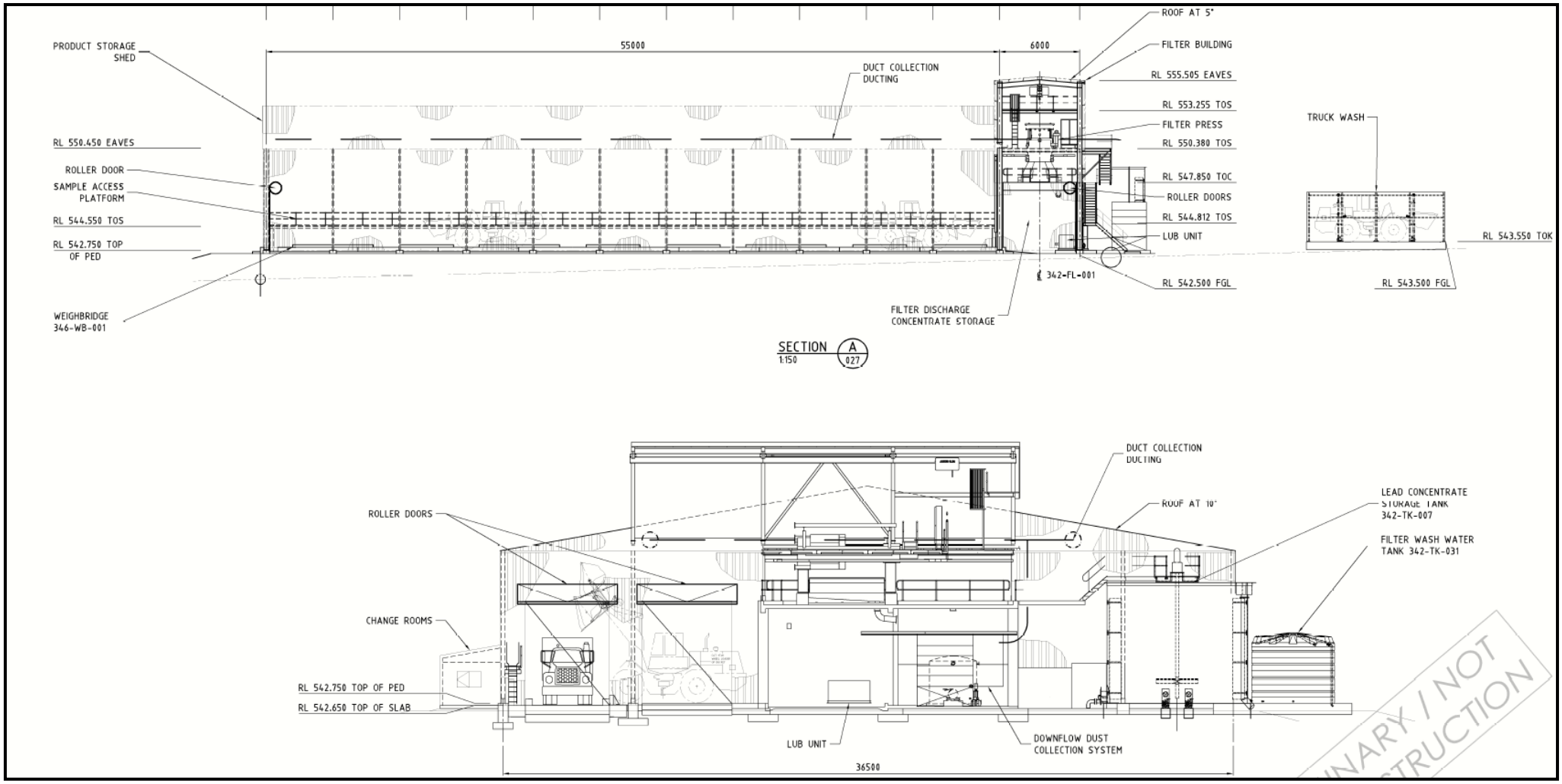

Figure 15: Product storage shed, concentrate filtration and handling areas.

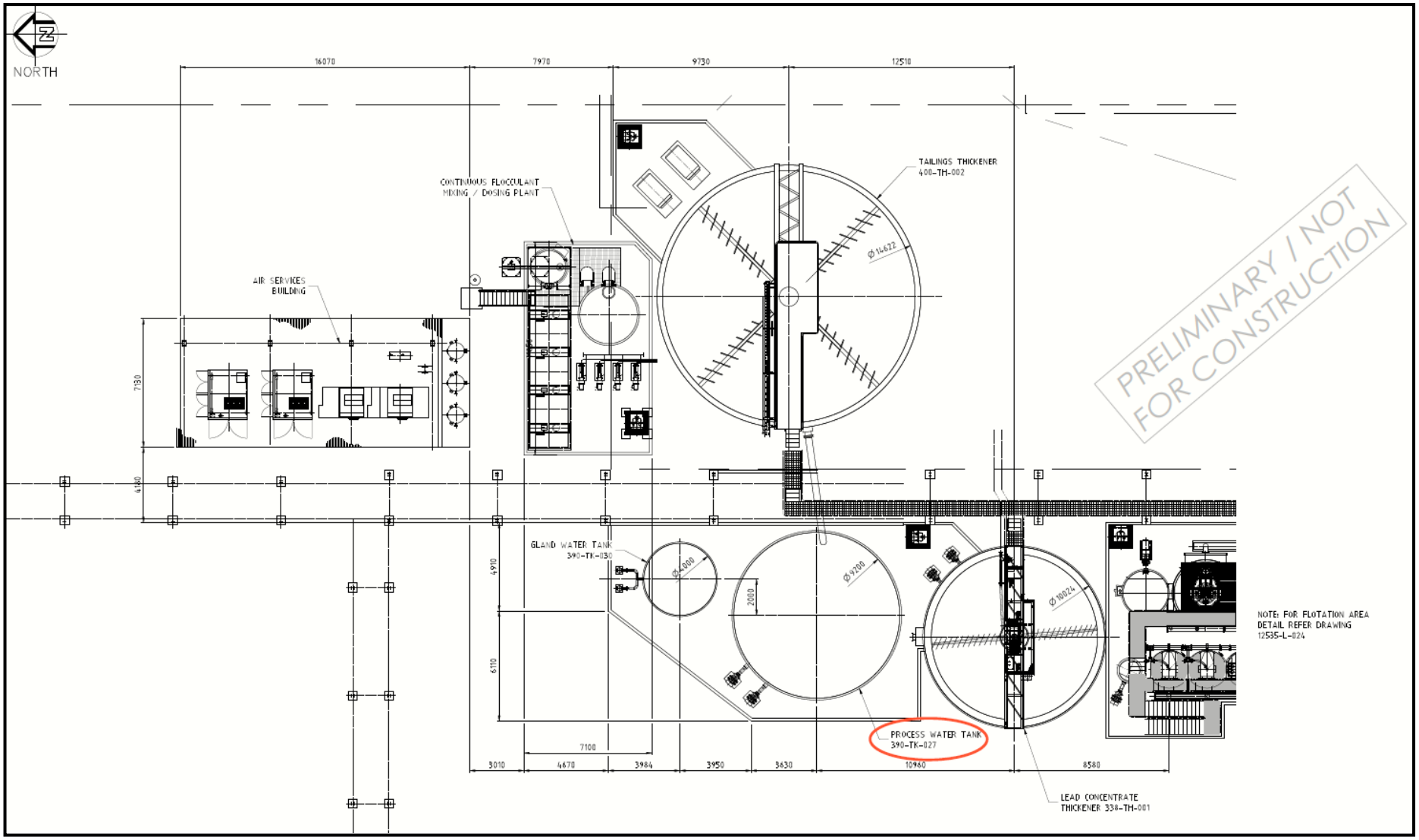

Figure 16: Tailings thickener arrangement plan.

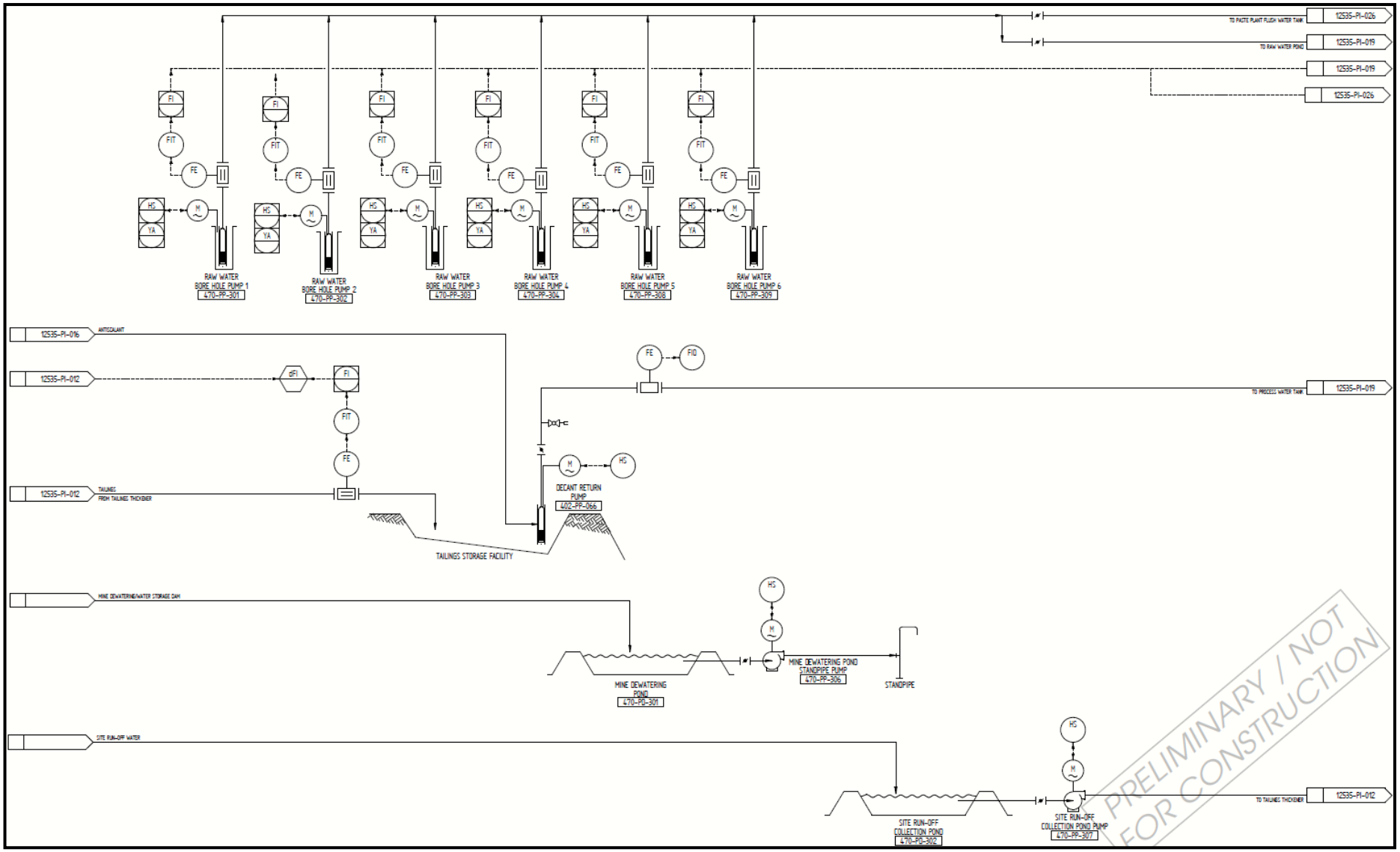

Figure 17: Tailings, water supply and collection ponds diagram – Galena Mining.

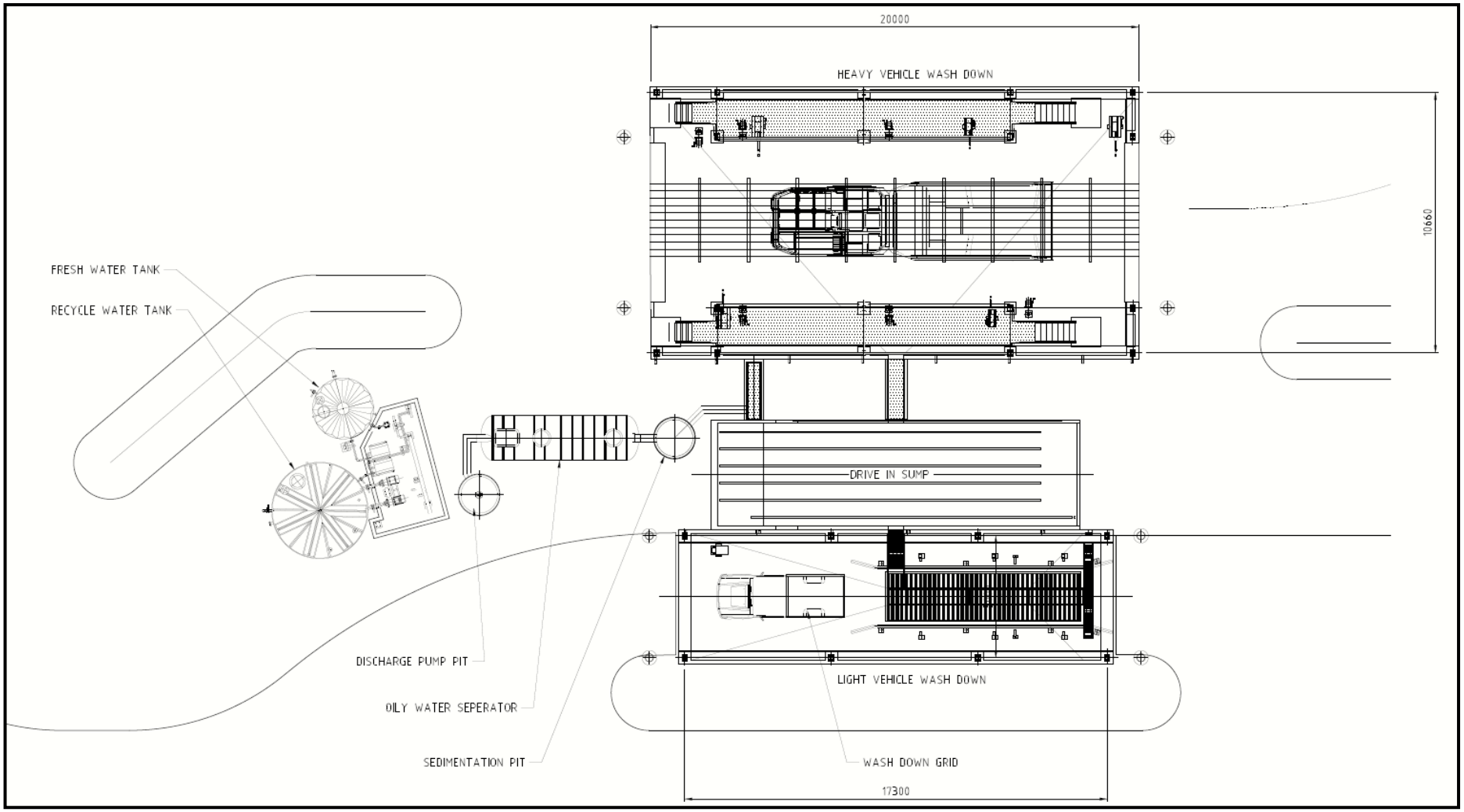

Figure 18: Heavy and light vehicle wash down area – Galena

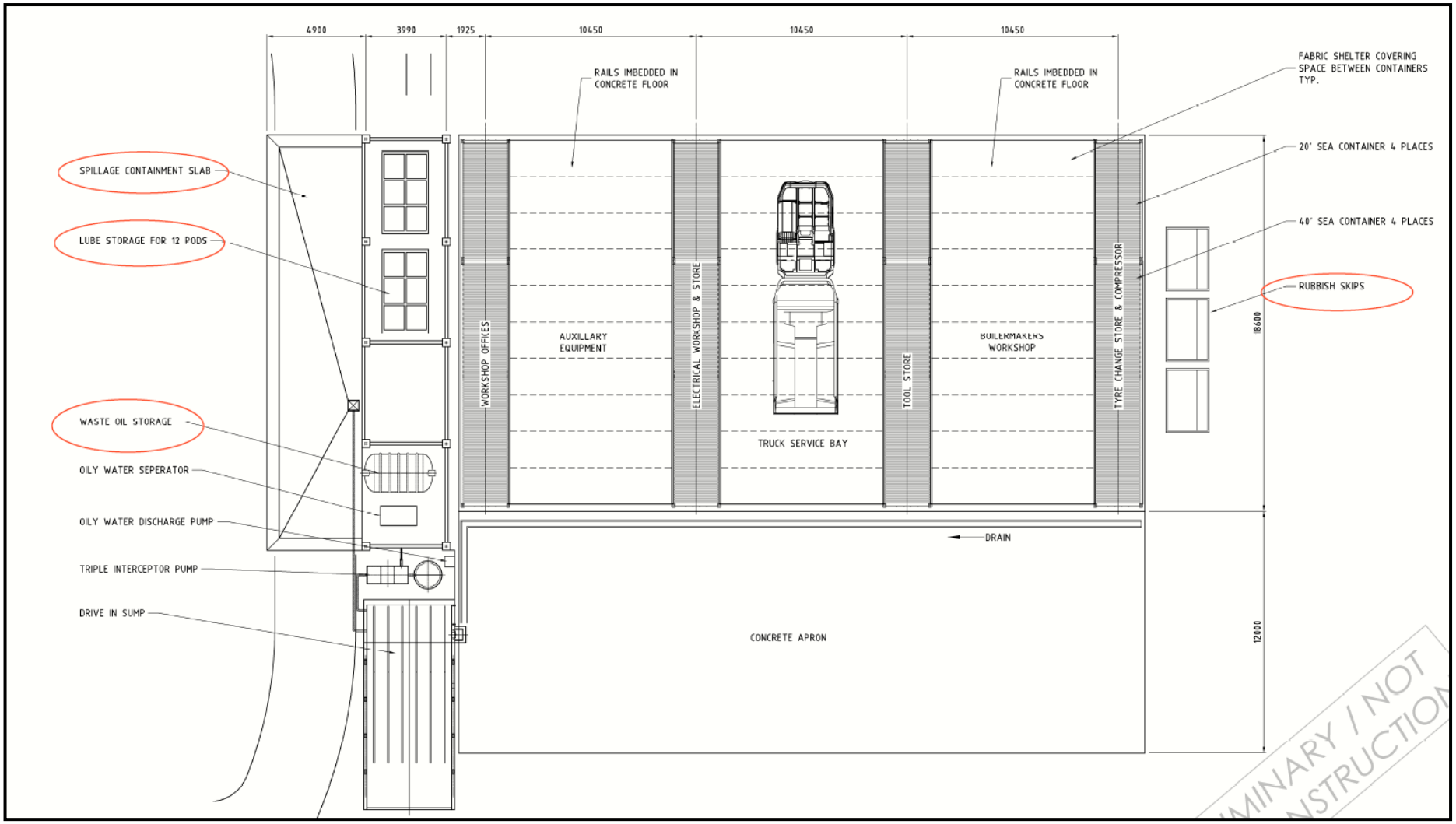

Figure 19: Workshop area and oil storage location.

8.9 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the Risk Events set out above, with the appropriate treatment and control, are set out in Table 25 below. Controls are described further in section 9.

Table 25: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1	Stormwater runoff	Ore processing and handling area Stormwater runoff Infrastructure drainage	Stormwater runoff from cleared and operational area potentially causing soil and groundwater contamination	Stormwater management as detailed in section 8.4	Major consequence Possible likelihood **High Risk**	Acceptable subject to Regulatory controls.
2	Spills of processing reagents during commissioning	Process plant	Discharges to land causing death or poor vegetation health; localised soil and groundwater contamination	As specified in section 8.5.4	Major consequence Possible likelihood **High Risk**	Major consequence Possible likelihood **High Risk**
3	Spills from conveyor belts	Process plant	Spills onto land causing poor vegetation health and localised soil contamination	As specified in section 8.6.4	Major consequence Possible likelihood **High Risk**	Major consequence Possible likelihood **High Risk**

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
4	Hydrocarbon discharges during operation of the workshop Lead contaminated water discharge from wash down facilities during commissioning	Workshops and wash down bays	Direct to ground/ soil and/or groundwater contamination	As specified in section 8.7.4	Major consequence Possible likelihood **High Risk**	Major consequence Possible likelihood **High Risk**
5	TSF pipeline ruptures during commissioning	Rupture of pipelines (tailings and return water)	Direct discharge to land potentially causing soil contamination inhibiting vegetation growth and survival Inundation of vegetation rooting zone Release to drainage lines and associated catchment and poor surface water quality	None specified	Major consequence Possible likelihood **High Risk**	Major consequence Possible likelihood **High Risk**
6	TSF seepage during commissioning	Seepage from TSF	Groundwater contamination	Refer to Applicant controls as detailed in section 8.7.5	Moderate consequence Unlikely likelihood **Medium Risk**	Acceptable subject to Applicant construction controls conditioned. Submission of compliance document to ensure that infrastructure has been constructed as per *Application 2018* and *TSF Design Report.* Operational controls for the operation of infrastructure and monitoring requirements.

9. Works Approval Controls

9.1 Infrastructure and Equipment

9.1.1 Process plant

The Applicant's controls and DWER's conditions have been included in the works approval. The following infrastructure and equipment in Table 26 must be constructed to minimise emission of contaminants from the process plant area.

Table 26: Risk assessment summary

Infrastructure	Requirements (Design and Construction)

Process plant area
(BOLD: means DWER specified construction)
	• Design capacity of 1.2 Mtpa.
	• Installation of :
	  ○ Primary crushing
	  ○ Single stage SAG milling with a flash flotation cell and pebble crusher
	  ○ Flash flotation and rougher flotation concentrate regrind
	  ○ Cleaner & re-cleaner flotation stages to produce a lead-silver concentrate
	  ○ Concentrate dewatering thickener and a filter to produce transportable concentrates
	  ○ Tailings thickening
	• **Plant shall be constructed on a concrete pad and concrete bunded with a containment capacity equivalent to 110% of the capacity of largest tank and drainage to the drainage basin/stormwater pond for recycling back to the process circuit;**
	• **Electric sump pumps installed in the concrete flooring to collect and pump any spilled material back into the process stream;**
	• **Flow transmitter and flow meter installed;**
	• **Conveyor belts, mixing tanks, flotation tanks and storage tanks are located on a concrete bunded area with plinths within the Process plant area; and**
	• **Stormwater diverted around and away from the process plant, landfill/s and workshop infrastructure areas by diversion drains.**

Process water tank	• Process water tank to be constructed with a minimum storage capacity of 400m^3. • **The process water tank must be adequately sized so that there will be no overflow.**
Drainage Basin / Stormwater pond	• Must be constructed with a 2.5 mm HDPE lining system with a permeability of 1 x 10^{-9} m/s or less. • **Retention sump sized to have a minimum capacity to contain runoff from the process plant, stockpiles, washdown and workshops areas so that there is zero discharge of contaminated stormwater from the site for a 1 in 100 annual exceedance probability (AEP) storm event over 72 hours;** • Drainage Basin adequately sized to maintain an operational freeboard of 300 mm.
Workshop / washdown areas	• Located on concrete pads constructed so that they drain to a clean water recovery system; and

	• Oil-water separator system - treated hydrocarbon concentration <20 mg/L. • Truck and tyre washdown points at a concentrate loadout facility with wash water to be returned to the process plant
Fuels storage	• As per *Dangerous Goods Act 2004* requirements.

DWER has also imposed conditions within the Issued Works Approval for ABRA to:

- Prepare a surface water management plan. The plan shall include details relating to:

  (a)Assessment of capacity of the stormwater infrastructure to contain runoff from the process plant, stockpiles, washdown and workshops areas so that there is zero discharge of contaminated stormwater from the site for a 1 in 100 annual exceedance probability (AEP) storm event over 72 hours;

  (b)Surface water drainage map of the site showing contours, flow paths.

- Construction of monitoring bores within the vicinity of the process water pond. Monitoring of these bores will also be required prior to commissioning with a comparison against the *ANZECC, 2000 95% Freshwater* values.

9.1.2 Processing reagents infrastructure and equipment

The following infrastructure (Table 27) should be constructed to manage the risk of spills from the processing reagents:

Table 27: Infrastructure requirements for processing reagents

Infrastructure	Requirements (Design and Construction)
Ore processing activities	All slurry containing facilities will be constructed within bunded concrete areas.
Reagent Storage • Hydrated lime • Sodium Cyanide • Zinc Sulphide • Frother (MIBC) • Sodium Ethyl Xanthate (frother) • Flocculant (Magnafloc 1011)	Contained within a concrete bund that will incorporate a collection sump to recover spillage and subsequently pumped back to the process. Stored in accordance with *AS 1940* and *AS 1692.* Level indicators to detect leaks, based on drops in level.

9.1.3 TSF infrastructure and equipment

The following infrastructure and equipment (Table 28) should be constructed to manage the TSF:

Table 28: Infrastructure requirements for the management of the TSF

Infrastructure	Requirements (Design and Construction)
TSF general	• Designed to store 8.48 Mt of tailings over a 15 year life. • Two cell, paddock type facility • Stage levels o Stage 1 Cell A – Crest level of 539.5mRL. o Stage 1 Cell B – Crest level of 535.5 mRL. o Stage 2 Cell A – Crest level of 542.5 mRL. o Stage 2 Cell B – Crest level of 538.5 mRL. o Stage 3 Cell A – Crest level of 545.5 mRL. o Stage 3 Cell B – Crest level of 541.5 mRL. • Designed to accommodate 1% AEP, 72-hour duration storm event
TSF starter embankment	Zoned embankment comprising an upstream zone of compacted select mine waste and a downstream zone of traffic compacted mine waste. Maximum embankment height of 9 m. The starter embankments and TSF cell basins lined with GCL with hydraulic conductivity of $1x10^{-12}$m/s. Design slopes of 1(V):2(H) upstream and 1(V):3(H) downstream. Crest width of 6 m.
Tailings deposition	Multiple spigots located on the upstream perimeter embankment crest.
Decant system and pond	Rock-ring type central decant structure located centrally within the TSF. Decant pump located within the rock ring decant. Decant causeway – design slopes of 1:1.5 (V:H) and a nominal 6 m crest width, with 0.5 m (minimum) windrows on both sides of the access way.
Pipelines (tailings delivery and decant return water)	HDPE pipelines installed within an unlined V trench with sufficient capacity to ensure all solids and liquors are captured within the trench. Flow sensors fitted to tailings delivery and decant return water pipelines to allow detection of loss of content.
Ambient groundwater monitoring system	Eight groundwater monitoring bores will be installed (refer to Figure 10). Monitoring bores will have a depth until transition zone rocks have been intersected at about 80 m

Infrastructure	Requirements (Design and Construction)
	depth. **Vibrating wire piezometers to monitor phreatic surface** **Both shallow and deep bores will be installed based on lithology types and groundwater depth characteristics.** Each bore will be cased with uPVC pipe with a 100 mm diameter to allow for sample abstraction, slotted from 12 m to 60 m and gravel packed. Monitoring of all bores prior to commissioning to provide baseline data for the project, with a comparison against *ANZECC 95% Freshwater* values.

9.1.4 Works Approval reporting

The Applicant has stated that construction is scheduled to commence September 2019. Stages of construction are detailed in Table 29. Works will be completed progressively, with compliance reporting required for the process plant, stormwater pond and TSF. A suitably qualified person will be required to confirm that each item of infrastructure specified in the works approval has been constructed to the specified requirements.

Commissioning of the process plant and TSF is authorised under the Issued Works Approval for a period no longer than six months following submission of the compliance report.

The Applicant will require an Issued Licence, prior to the operation of process plant and TSF.

Table 29: Proposed construction schedule

Stage	Component	Estimated Construction Completion Date
Stage 1	Construction Work Commencement	Q3 2019
Stage 2	Engineering Completion	Q2 2020
Stage 3	TSF Completion	Q3 2020
Stage 4	Process Plant Completion	Q4 2020
Stage 5	Commissioning Completion	Q2 2021

10. Determination of Works Approval conditions

The conditions in the Issued Works Approval in Attachment 1 have been determined in accordance with the *Guidance Statement: Setting Conditions*.

Table 30 provides a summary of the conditions to be applied to this Issued Works Approval.

Table 30: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and equipment Conditions 1, 2, 3, 4, 5	These conditions are valid, risk-based and contain appropriate controls.
Emissions Condition 6	This condition is valid, risk-based and consistent with the EP Act.
Record-keeping Conditions 7 and 8	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.
Specified Actions Ambient Groundwater: Conditions 9,10,11 and 12	These conditions are valid, risk-based and contain appropriate controls.

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the works approvals under the EP Act.

11. Applicant's comments

The Applicant was provided with the draft Decision Report and draft Works Approval on 7 June 2019. The Applicant provided outstanding information and comments on 11 June 2019 which are summarised, along with DWER's response, in Appendix 2.

12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Issued Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Alana Kidd
Manager, Resource Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Works Approval Application – Galena Mining – W6205/2018/1		DWER records (A1734215)
2.	Works Approval Application, supporting information – Galena Mining – W6205/2018/1		DWER records (A1734218)
3.	Works Approval W6205/2018/1 – Response to further information request		DWER records (A1742187)
4.	Works Approval W6205/2018/1 – Additional information		DWER records (DWERDT140006)
5.	Works Approval W6205/2018/1 – response to information request 1		DWER records (A1788931)
6.	Works Approval W6205/2018/1 – response to information request 2		DWER records (A1788932)
7.	Works Approval W6205/2018/1 – response to information request 3		DWER records (A1789371)
8.	Works Approval W6205/2018/1 – response to TSF decant system information request		DWER records (A1798072)
9.	Works Approval W6178/2018/1		accessed at www.dwer.wa.gov.au
10.	Abra Lead-Silver Project - Sites for TSF monitoring bores, Rockwater, November 2018	Rockwater, November 2018	DWER records (A1742187)
11.	Abra Lead-Silver Project – Hydrology and Surface Water Assessment, Rockwater, September 2018	Rockwater Surface Water report	DWER records (A1792267)
12.	Works Approval W6205/2018/1 – Abra Mining response to Draft Works Approval and Decision Report	Abra Mining, 11/06/2019	DWER records (A1795974)
13.	Australian Standard AS 1940-2004 The storage and handling of flammable and combustible liquids	AS 1940	accessed at www.saiglobal.com
14.	*Guidance Statement: Regulatory principles,* Department of Environment Regulation, July 2015	Guidance Statement: Regulatory principles	accessed at www.dwer.wa.gov.au

	Document title	In text ref	Availability
15.	*Guidance Statement: Setting Conditions,* Department of Environment Regulation, October 2015	Guidance Statement: Setting conditions	
16.	*Guidance Statement: Licence duration,* Department of Environment Regulation, August 2016	Guidance Statement: Licence duration	
17.	*Guidance Statement: Risk Assessments*, Department of Environment Regulation, February 2017	Guidance Statement: Risk Assessments	
18.	*Guidance Statement: Decision Making*, Department of Environment Regulation, February 2017	Guidance Statement: Decision Making	
19.	*Guidance Statement: Environmental Siting*, Department of Environment Regulation, November 2016	Guidance Statement: Environmental Siting	

Appendix 2: Summary of Applicant's comments on risk assessment and draft conditions

Condition	Summary of Applicant's comments	DWER response
Works Approval		
Condition 4 – Table 2	Table 2 specifies the single crusher and SAG mill but Site Plan 1 clearly shows the three crushers	Table amended

Attachment 1: Issued Works Approval W6143/2018/1