No drawdown in the alluvium is predicted as it is located well beyond the maximum extent of drawdown on the groundwater table.

Post mining (i.e., following the cessation of mine dewatering) groundwater levels around the BVS Pit final void will recover in line with the establishment of a final void lake. The establishment of the final void lake is described in the *Surface Water Report* (Appendix D). The water level within the BVS Pit final void is predicted to recover to a quasi-equilibrium elevation of approximately 234 mAHD. Hence, the predicted final void lake elevation is approximately 116 m lower than the pre-mining groundwater level within the BVS Pit footprint. This difference in groundwater elevation will generate a post mining hydraulic gradient that induces groundwater flow towards the BVS Pit final void. On this basis, the BVS Pit final void will remain a permanent groundwater sink. There will be a zone of drawdown around the BVS Pit final void in perpetuity and groundwater flow within this zone will be toward the final void.

Groundwater monitoring will be undertaken during mining operations and post mining to confirm the groundwater drawdown predictions and identify any unexpected changes in groundwater levels. Section 5.7 describes the proposed groundwater monitoring program and management measures.

5.6 IMPACT ASSESSMENT

5.6.1 Impacts on Groundwater Resources

The project site is located within the *Water Plan (Gulf) 2007* (the Gulf Water Plan) and *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017* (the GABORA Water Plan) areas. The Gulf Water Plan and the GABORA Water Plan identify the following regulated groundwater resources within the project site and its surrounds:

- Groundwater within the Jurassic strata of the Hooray and Hutton groundwater units, as defined in the GABORA Water Plan; and
- Groundwater within all other formations as described in the Gulf Water Plan.

The residual areas of Jurassic strata within the project site and its surrounds are located approximately 60 km west of the thicker Jurassic strata which form productive aquifers of the Great Artesian Basin (GAB). The residual areas of Jurassic strata within the project site and its surrounds are therefore hydraulically disconnected from the productive Jurassic aquifers of the GAB. These distant GAB aquifers will therefore not be impacted by the project.

The project's total predicted groundwater take from the GABORA Water Plan regulated groundwater resources is 0.04 ML (i.e. 40,000 L) over the life of the project. This represents a negligible proportion (0.00019%) of the 21,000 ML currently held in reserve within these groundwater resources.

Post mining there will be negligible groundwater take from the GABORA Water Plan regulated groundwater resources.

The remainder of the project's groundwater take will occur from the Proterozoic basement and the overlying weathered formation. These formations are not regulated under the GABORA Water Plan. However, groundwater in these strata is regulated as part of the Gulf Water Plan's groundwater management area.

The project groundwater take will be deemed 'associated water'. The proponent has the right to take associated water under the MR Act. Hence, a water entitlement under the Water Act (e.g. a water allocation or water licence) is not required for associated water take.

The take of associated water will be conducted in accordance with the applicable Queensland regulatory requirements (as described in Section 5.2). Specifically, the proponent will be required to quantify and report its actual groundwater take annually during the mine life in accordance with mandatory requirements of the MR Act.

In addition, any departure from the predicted groundwater take will be identified as part of the mandatory annual UWIR review process under the Water Act. The proponent will be obligated to investigate any departure from predicted groundwater take and assess the potential for any adverse environmental impacts arising from mining.

5.6.2 Impacts on Groundwater Supply Bores

A bore census was carried out to identify water supply bores that could potentially be impacted by the project. The bore census drew upon information gathered through consultation with relevant landholders, field inspections, advice from the proponent, and a search of the Queensland government's groundwater database.

The bore census was targeted towards water supply bores that could potentially be impacted by the project due to their proximity to proposed mining activities. The local hydrogeology was also taken into account in planning the bore census. The bore census included a conservative search radius of 5 km beyond the boundary of the project site.

The bore census confirmed that there is a general lack of water supply bores in the project site and surrounding area. This is to be expected, given the lack of agricultural, residential or industrial development.

There are no water supply bores within the project site. The bore census identified two water supply bores within 5 km of the project site boundary, including:

- RN 163296 is constructed within the Jurassic strata 4.5 km west of the BVS Pit; and
- Mt Norman 'Rockspear Bore' is constructed within the weathered profile approximately 4 km west of the BVS Pit.

Figure 5-5 shows that RN 163296 is located beyond the predicted extent of drawdown in the Jurassic strata from the project. Figure 5-6 shows that the Mt Norman 'Rockspear Bore' is located beyond the predicted extent of drawdown in the weathered profile from the project. Drawdown from the project is therefore not predicted to affect these bores, and the operation of the bores is not expected to be impaired as a result of the project.

5.6.3 Impacts on Watercourses and Drainage Features

Overview of Watercourses and Drainage Features

Figure 5-1 shows the surface drainage within and surrounding the project site.

The Woolgar River traverses the western boundary of the project site in a south-westerly direction. In the vicinity of the project site, the Woolgar River has a well-defined channel that is set within a narrow, discontinuous floodplain. The river channel contains a braided low flow channel with sand sheet deposits, bars and islands that have been formed by the extensive suspended sediment deposition during flow events.

The Woolgar River exhibits highly ephemeral, short duration, surface water flows that are typically restricted to the wet season (i.e., December to March). The Woolgar River flows for approximately four months per year, on average. The volume and timing of surface water flow in the river varies significantly between years depending on rainfall. On average, the majority of surface water flow occurs during the wet season between January and March.

The Woolgar River is a watercourse, as defined under the Water Act.

Several unnamed tributaries traverse the project site. These tributaries form on the slopes of the plateaus and ridgelines to the east of the project site (Figure 5-1). The unnamed tributaries coalesce on the flatter ground that is located between the plateaus and ridgelines and drain towards the Woolgar River. Surface water flow duration, frequency and quality in the drainage features have similar characteristics to the Woolgar River, in that the drainage features exhibit highly ephemeral, short duration, surface water flows that contain elevated suspended

sediment loads. This similarity is expected given the consistent catchment features and geology setting. The unnamed tributaries meet the Water Act definition of a 'drainage feature'.

This surface drainage overview is consistent with observations made during the groundwater site inspection and field surveys undertaken as part of the *Aquatic Ecology Report* (Appendix F) and *Terrestrial Ecology Report* (Appendix E). It is also supported by surface water flow data collected from the Queensland government's surface water gauging stations located downstream on the Woolgar River, which indicate no perennial surface water flows in the vicinity of the project site.

Baseline Groundwater Interactions with Surface Water

As discussed in Section 5.4, the groundwater table is typically located between 2 m, and up to 6 m, below the riverbed. The groundwater table does not intersect the riverbed for the majority of the year.

Ephemeral surface water flows in the Woolgar River recharge the underlying groundwater regime and result in small seasonal variations in groundwater table depth. The groundwater table immediately below and adjacent to the river channel typically rises by approximately 0.5 m, and up to approximately 2 m in response to ephemeral river flows. The groundwater table is typically at its highest (i.e. closest to ground level) during flow events in the river. At this time, the groundwater table may intersect the ground surface in the Woolgar River bed.

Groundwater depth generally increases with distance from the Woolgar River. The groundwater table is typically located 12 m, and up to 66 m, below the bed of the drainage features that traverse the project site. Hence, the groundwater table does not intersect the ground surface in the drainage features and there is no groundwater seepage through the drainage feature beds or banks. On this basis, groundwater seepage does not provide baseflow to the drainage features.

Predicted Effects on Groundwater Interactions with Surface Water

Figure 31 of the *Groundwater Report* (Appendix D) shows that the Woolgar River is located outside the zone of maximum predicted drawdown on the groundwater table due to the project. Hence, drawdown on the groundwater table due to the project is not predicted to have any effect on river baseflow or the natural flow regime in the Woolgar River.

On this basis, the drawdown effects of the project are not predicted to change surface water flows or give rise to adverse impacts on any aquatic habitats and ecosystems associated with the Woolgar River or its tributaries, or any downstream surface water users (e.g. farm dams).

Groundwater monitoring will be undertaken during mining operations. Section 5.7 describes the proposed groundwater monitoring program and management measures.

5.6.4 Impacts on Springs

As discussed in Section 5.4.5, there are three springs within 5 km of the project site boundary (Figure 5-1).

The Queensland Government has undertaken investigations of the springs and their hydrogeology and function are well-understood (DSITI, 2015). The springs are fed by seepage from perched groundwater within the weathered profile in the elevated plateau area to the east of the project site. The regional groundwater table is located approximately 30 m below ground level (in the Proterozoic basement) at the Spring 377 and approximately 45 m below ground level (in the fresh Jurassic strata) at the two unregistered springs. Hence, there is no connection between these springs and the regional groundwater table.

In addition, Figure 31 of the *Groundwater Report* (Appendix C) shows that maximum extents of predicted drawdown on the groundwater table due to the project does not extend to the springs.

On this basis, any drawdown of the regional groundwater table due to the project is not predicted to have any effect on the springs. Hence, the project's effects on groundwater are not expected to give rise to adverse impacts on the spring function or any habitats and ecosystems associated with the springs.

5.6.5 Cumulative Impacts

There are no existing or approved resource projects in the vicinity of the project site that could potentially contribute to cumulative groundwater impacts with the project.

5.6.6 Impacts on Groundwater Quality

The key potential sources of groundwater contamination from the project include:

- Seepage of pit water from the open cut pits and final voids;
- Seepage from the WRDs;
- Seepage from the ore stockpiles;
- Seepage from the TSC;
- Seepage from the heap leach pads and ponds; and
- Spillage of hydrocarbons and chemicals in storage areas.

The groundwater quality effects, and associated impacts, of these sources are discussed below.

Groundwater monitoring will be undertaken to confirm the groundwater quality throughout the proposed mine life and post closure. The groundwater monitoring program is described in Section 5.7 and has been designed to detect any unanticipated groundwater quality issues.

Pit Water Seepage

BVS Pit and Final Void

The BVS Pit will generate pit water comprising direct rainfall to the pit, runoff from the pit catchment and groundwater inflows. The BVS Pit will be actively dewatered during mining operations. Dewatering will create a hydraulic groundwater gradient and induce groundwater flow in the area surrounding the pit towards the dewatered pit. The *Surface Water Report* (Appendix D) describes the management of mine water removed from the BVS Pit during the project operations phase.

Post mining (i.e. following the cessation of mine dewatering) water levels within the BVS Pit final void are predicted to recover to a quasi-equilibrium level of approximately 234 m AHD. The final void water level predictions are presented in the *Surface Water Report* (Appendix D). This difference in groundwater elevation means that there will be a post mining hydraulic gradient that induces groundwater flow towards the final void. On this basis, the final void will remain a permanent groundwater sink. There will be a zone of drawdown around the final void in perpetuity and groundwater flow within this zone will be towards the final void.

The final void lake will comprise runoff from the final void catchment, direct rainfall to the final void and groundwater inflows. The *Geochemistry Report* (Appendix A) characterised runoff from the materials that comprise the final void floor and walls. The *Geochemistry Report* (Appendix A) concludes that these materials will generate pH neutral runoff with low salinity and low concentrations of metals and hence will be similar quality to regional groundwater. Runoff from the final void catchment will be mixed with, and diluted by, direct seasonal rainfall and inflows of natural groundwater to the pit.

Water will evaporate from the final void lake surface. Evaporation from the lake surface will concentrate salts in the lake slowly over time. The final void lake salinity has been modelled as part of the surface water assessment and the results are presented in *Surface Water Report* (Appendix D). The gradual increase in salinity will not pose a risk to the surrounding groundwater systems as the final void will remain a permanent groundwater sink. As a result, surrounding groundwater quality will not be impacted post closure.

BV1 and BV2 Pits and Final Voids

The BV1 Pit and the BV2 Pit are located above the groundwater table and will not receive groundwater inflows. These pits will generate limited volumes of pit water during mining operations due to direct rainfall to the pits and runoff from the pit catchments. These pits may also be used for contingency storage for pit water from the BVS Pit.

The geochemical testing results indicate that runoff from pit catchments will be pH neutral, with low salinity and low concentrations of metals and hence will be similar to regional groundwater.

During operations, any pit water within the BV1 Pit and the BV2 Pit will be reused in the mine water management system as a water supply.

Post mining, a shallow pool of water may accumulate intermittently at the base of the final voids, following sustained rainfall. Evaporation from the water surface will concentrate salts in the voids over time.

A small amount of intermittent void water may dissipate via infiltration through the void floor. However, the volume and rate of infiltration will be limited by the low permeability and low porosity of the Proterozoic basement.

Hence, the proportion of water that infiltrates the void floor and recharges the local groundwater will be negligible and will not pose a risk to the surrounding groundwater quality.

As discussed in Section 5.5.3, the BVS Pit final void will be a permanent groundwater sink. The hydraulic groundwater gradient around the BVS Pit final void will induce groundwater flow in the area surrounding the pit towards the dewatered pit. The BV1 Pit and the BV2 Pit final voids are located hydraulically upgradient of the BVS Pit final void and the associated groundwater sink. Hence, any limited water seepage from the satellite pit final voids into the underlying geology will therefore migrate towards the BVS Pit over time. This will further reduce the likelihood that any seepage from the BV1 Pit and the BV2 Pit final voids will have any adverse effect on groundwater quality.

Waste Rock Dump Seepage

The Central and Southern WRDs will store approximately 130 million tonnes (Mt) of waste rock mined from the BVS Pit. The Northern WRD will store approximately 1.45 Mt of waste rock mined from the BV1 Pit and the BV2 Pit. The Central WRD will include a central co-placement cell for the storage of approximately 18 Mt of PAF mine waste material including dewatered tailings and waste rock. The Central WRD co-placement cell will be surround by NAF waste rock and will be constructed with a seepage collection system that will contain any seepage from the PAF mine wastes and direct it to the mine water management system for storage and re-use. The Northern and Southern WRDs will store only NAF waste rock.

The geochemical testing results presented in the *Geochemistry Report* (Appendix A) show that seepage from the NAF WRDs is likely to be pH neutral to slightly alkaline, with low salinity and low concentrations of metals and metalloids. Seepage from the NAF WRDs is therefore comparable to existing groundwater quality and is not expected to present any significant environmental risks to surrounding groundwater quality.

As discussed in Section 5.5.3, mine dewatering during operations and the subsequent establishment of a post mining final void lake will create a hydraulic groundwater gradient and induce groundwater flow towards the

BVS Pit and its final void. Any seepage from the WRDs into the underlying geology will therefore migrate towards the BVS Pit and its final void.

As a result, surrounding groundwater quality is not likely to be impacted during mining operations or post closure.

Tailings Storage Cell Seepage

The TSC will be a lined containment structure that will store approximately 3.15 GL of tailings (settled solids) produced in the CIL Plant. The TSC will be constructed in the southern part of the project site, south of the BVS Pit.

Geochemical testing results show that water from the stored tailings will be pH neutral to slightly alkaline, with low salinity and low concentrations of metals and metalloids. The TSC liner will prevent seepage of water from the TSC to the underlying groundwater regime. The liner will also include a seepage collection and detection system including underdrainage and seepage collection sumps. This will enable early detection of any leakage from the TSC and implementation of remedial measures should any seepage be detected.

Storm water and tailings supernatant from the TSC, and storm water transferred from the Heap Leach Facility (HLF) Storm Water Pond, will be collected in the TSC Storm Water Pond and returned to the CIL pant over the life of the mine. The TSC Storm Water Pond has been sized with sufficient storage capacity to ensure nil discharge.

The TSC will be rehabilitated and decommissioned at mine closure. This will involve removal of the TSC Storm Water Pond and covering the stored dried tailings with benign capping material (e.g. suitable subsoil) and topsoil and shaping the capped surface to promote runoff and minimise infiltration. These measures, and the liner, will ensure that the stored tailings will not be a source of seepage to groundwater in the long-term following mine closure.

On this basis, seepage from the TSC is not expected to adversely impact groundwater quality.

Heap Leach Facility Seepage

Ore mined from the BV1 Pit and the BV2 Pit during the first two years of mining will be processed at the HLF. The HLF will include three heap leach pads and three heap leach ponds. The pads and ponds will be fully lined to prevent seepage from the HLF. The HLF liner will also include a seepage collection and detection system including underdrainage and seepage collection sumps. This will enable early detection of any leakage from the HLF and implementation of remedial measures should any seepage be detected. The HLF ponds have been designed and will be operated to ensure the HLF is a nil discharge system. The HLF Storm Water Pond has been sized with sufficient storage capacity to ensure nil discharge during the modelled worst case rainfall sequence.

The spent heap leach ore will be fed through the CIL Plant over the life of the mine. The heap leach pads and ponds will be decommissioned and rehabilitated at mine closure. The decommissioning process will include a contamination assessment and decontamination works, where necessary. Hence, there will be no potential for post mining groundwater quality impacts from the decommissioned HLF.

Hydrocarbon and Chemical Storage

Hydrocarbon and chemical storage will be managed in accordance with the measures described in Section 15 – Non-Mining Waste Management. Proposed management measures include adequate bunding or storage areas, and immediate clean-up of any spills. These measures are standard practice at mine sites and are designed to prevent the contamination of groundwater. Given the limited hydrocarbon and chemical storage activities proposed, and the controls that will be adopted, the project is not expected to give rise to groundwater contamination as a result of hydrocarbon and chemical contamination.

5.7 GROUNDWATER MONITORING AND MANAGEMENT

The groundwater monitoring program will comprise:

- A groundwater level monitoring program.
- A groundwater quality monitoring program.

These groundwater monitoring program components are described in Sections 5.7.1 and 5.7.1.

5.7.1 Groundwater Level Monitoring Program

The groundwater level monitoring program will be implemented throughout the life of the project to confirm the actual extent of groundwater impacts and validate the conservative groundwater modelling predictions presented in Section 5.5.3. Figure 5-7 shows the groundwater level monitoring network layout. It comprises 6 existing pairs of co-located bores (12 bores in total). These bores are located at, or outside, the maximum extent of predicted drawdown from the project to enable the identification of unexpected groundwater drawdown effects on the unconfined groundwater table and the underlying strata. Table 5-2 provides the location, construction details and purpose of each groundwater level monitoring bore.

Groundwater levels will be monitored at quarterly intervals during mining operations.

Prior to commencement of mining, groundwater level triggers will be developed for each bore to enable unexpected drawdown effects from the project to be identified. The level triggers will be based on the complete pre-mining baseline groundwater level dataset and developed in consultation with DETSI. The EA will be amended to incorporate the level triggers for operational compliance.

Level trigger exceedances will be investigated to determine the likely cause and to identify appropriate corrective actions, if necessary. This process enables the targeted application of corrective measures to minimise the potential for environmental harm to the groundwater regime in the event of unexpected drawdown effects from the project.

5.7.2 Groundwater Quality Monitoring Program

The groundwater quality monitoring program will be implemented to detect changes in local groundwater quality throughout the life of the project.

Figure 5-7 shows the groundwater quality monitoring network layout. The network includes 20 bores, comprising:

- Two HLF seepage monitoring bores that will monitor background groundwater quality upgradient and downgradient of the HLF.
- Two TSC seepage monitoring bores that will monitor background groundwater quality upgradient and downgradient of the TSC.
- A MIA seepage monitoring bore that will monitor groundwater quality downgradient of the MIA.
- A monitoring bore at the southern ML boundary, downgradient of the TSC, HLF and MIA.
- A dual function monitoring bore downgradient of the Southern WRD and upgradient of the HLF.
- Six bores that will monitor groundwater quality around the Central WRD.
- Three bores that will monitor groundwater quality around the Northern WRD and satellite pits.
- Four monitoring bores that will monitor groundwater quality along the Woolgar River.

Table 5-3 provides the location, construction details and purpose of each groundwater quality monitoring bore.

The groundwater quality monitoring network will target the unconfined groundwater table. The unconfined groundwater table is the shallowest part of the groundwater regime and any potential change in groundwater quality arising from surface/near surface mining operations and infrastructure in the identified monitoring areas will first manifest at the groundwater table. Hence, monitoring the unconfined groundwater table allows for early detection of unexpected changes in groundwater quality in the identified monitoring areas.

The groundwater quality monitoring network will be monitored at quarterly intervals, for the parameters listed in Table 5-3. Groundwater levels will also be monitored as part of the groundwater quality monitoring program for interpretive purposes. These groundwater levels will be used to confirm local flow directions in and around potential sources of groundwater contamination for the purposes of ensuring that the groundwater quality monitoring network remains suitable for identifying potential contamination migration pathways. Groundwater monitoring undertaken for this purpose is not subject to groundwater level compliance monitoring/triggers.

Monitoring and sampling will be conducted by suitably qualified personnel. The collection, storage and transport of water quality samples for laboratory analysis will be undertaken in accordance with the proponent's existing procedures, and in accordance with the relevant guidelines and Australian Standards. A National Association of Testing Authorities (NATA) accredited laboratory will conduct the water quality analyses.

The groundwater quality monitoring bores have been nominated as compliance bores or observation bores depending on their location and purpose.

Compliance bores are located downgradient of key potential sources of contamination. Groundwater quality monitoring data collected from compliance bores will be compared to groundwater quality trigger values to identify exceedances that could indicate potential contamination due to mining activities. In the event of a trigger exceedance, groundwater quality from these bores will be compared to groundwater quality in the relevant upgradient groundwater quality observation bores to confirm whether the trigger exceedance is due to natural variations in background groundwater quality.

Groundwater quality trigger values will be finalised prior to commencement of mining. Final groundwater quality trigger values will be site-specific values calculated from the complete pre-mining baseline dataset, including at least 18 datapoints spanning at least 24 months. Prior to finalisation of the groundwater quality trigger values, interim groundwater quality trigger values based on relevant published default guideline values will be adopted.

Observation bores are provided for interpretive purposes only to assist with groundwater quality trigger exceedance investigations.

Table 5-2 Groundwater Level Monitoring Program

COMPLIANCE BORE ID	EASTING[1] (GDA2020)	NORTHING[1] (GDA2020)	GROUND SURFACE ELEVATION[1] (MAHD)	SCREEN INTERVAL[1] (MAHD)	MONITORING TARGET	LOCATION DESCRIPTION	MONITORING PURPOSE	MONITORING FREQUENCY	LEVEL TRIGGER[2]
MB1A	738458	7807636	369.6	366.6 – 363.6	Groundwater table	Northwestern part of the project site Located at the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the Proterozoic strata.	Quarterly	TBC
MB1B	738458	7807636	369.5	347.5 – 344.5	Proterozoic strata				
MB2A	739430	7810283	373.7	356.2 – 353.2	Groundwater table	Northwest of the project site, adjacent to the Woolgar River channel Located outside the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the Proterozoic strata.	Quarterly	TBC
MB2B	739430	7810283	373.6	306.6 – 303.6	Proterozoic strata				
MB3A	735825	7808080	365.2	363.2 – 360.2	Groundwater table	West of the project site, adjacent to the Woolgar River channel Located outside the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the weathered profile.	Quarterly	TBC
MB3B	735825	7808080	365.1	347.6 – 344.6	Weathered profile				
MB4A	740289	7805621	387.3	377.3 – 374.3	Groundwater table	Eastern part of the project site Located outside the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the Proterozoic strata.	Quarterly	TBC
MB4B	740289	7805621	387.1	330.1 – 327.1	Proterozoic strata				
MB6A	737646	7806507	377.0	370.0 – 367.0	Groundwater table	Northwestern part of the project site Located 200 m outside the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the Proterozoic strata.	Quarterly	TBC
MB6B	737646	7806507	376.8	313.8 – 310.8	Proterozoic strata				
MB7A	740130	7803933	390.9	360.9 – 357.9	Groundwater table	Southeastern corner of the project site Located approx. 2 km outside the predicted maximum extent of groundwater table drawdown from BVS Pit	Groundwater level monitoring of the regional groundwater table and the Proterozoic strata.	Quarterly	TBC
MB7B	740130	7803933	390.7	303.7 – 300.7	Proterozoic strata				

[1] The eastings/northings, screened intervals and surface elevations presented in this table are provisional and based on conceptual bore locations/mine layouts presented in Figure 5-7. Monitoring sites will be determined/refined as part of the detailed engineering designs and finalised based on the as-constructed mine infrastructure layouts.
[2] Prior to commencement of mining, groundwater level triggers will be developed for each compliance bore in consultation with, and to the satisfaction of, DETSI's hydrogeologist. If at the time of level trigger development, the shallower bore from any pair is assessed to be permanently dry prior to mining, a level trigger will not be required for that bore and it will be removed from the compliance monitoring network (it may be retained as an observation bore, if necessary). If both shallow and deeper bores from any co-located pair are assessed to be permanently dry prior to mining, a deeper bore will be installed at that location to confirm the pre-mining baseline groundwater table elevation and enable a level trigger to be established for that location.

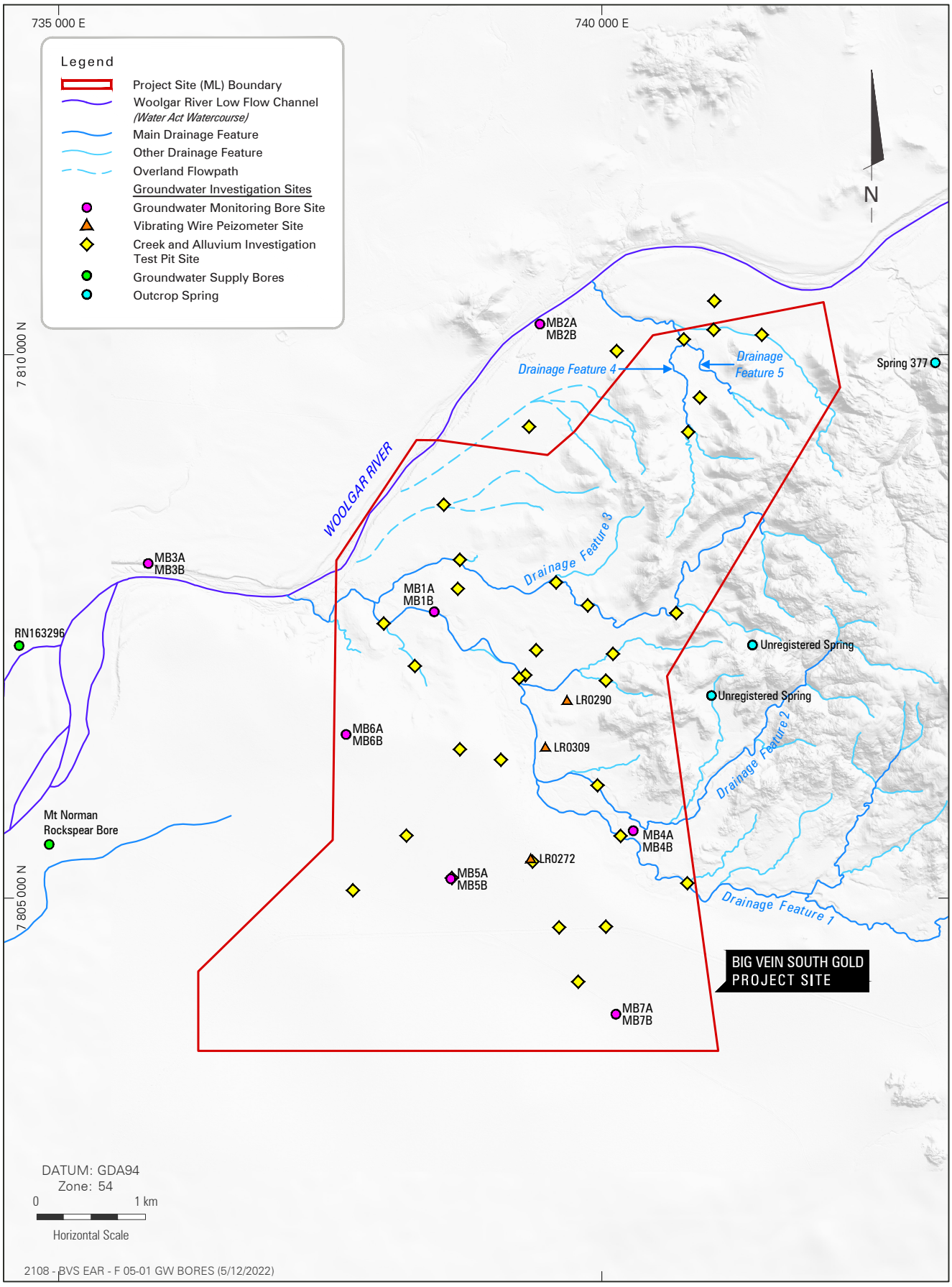
Table 5-3 Groundwater Quality Monitoring Program

BORE ID	EASTING[1] (GDA2020)	NORTHING[1] (GDA2020)	GROUND SURFACE ELEVATION (MAHD)[2]	SCREEN INTERVAL (MAHD)[3]	LOCATION DESCRIPTION	MONITORING PURPOSE	MONITORING TARGET	COMPLIANCE FUNCTION	MONITORING FREQUENCY & PARAMETERS
HLF Seepage Monitoring Bores[4]									
MB_HLF01	739077	7804722	372.8	TBC	50 m northeast (upgradient) of the HLF	Upgradient background monitoring for the HLF	Groundwater table	Observation bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide) - Quarterly laboratory testing for cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
MB_HLF02	738567	7804242	373.6	TBC	Western (downgradient) side of the HLF	To confirm groundwater quality downgradient of the HLF	Groundwater table	Compliance bore	
TSC Seepage Monitoring Bores[4]									
MB_TSC01 (MB7A)	740130	7803933	390.9	360.9 – 357.9	200 m east (upgradient) of the TSC	Upgradient background monitoring for the TSC	Groundwater table	Observation bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide) - Quarterly laboratory testing for cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
MB_TSC02	738590	7803882	378.4	TBC	Southern (downgradient) toe of the TSC	To confirm groundwater quality downgradient of the TSC	Groundwater table	Compliance bore	
MIA Seepage Monitoring Bores[4]									
MB_MIA01	738181	7804124	374.3	TBC	Southern (downgradient) edge of the MIA	To confirm groundwater quality downgradient of the MIA	Groundwater table	Compliance bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide, petroleum hydrocarbons) - Quarterly laboratory testing for speciated petroleum hydrocarbons (including BTEX) and cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
Southern ML Boundary Monitoring Bores[4]									
MB_DS01	737425	7803604	372.6	TBC	At the southern ML boundary downgradient of the TSC, HLF and MIA	To confirm groundwater quality at the southern ML boundary, downgradient of the TSC, HLF and MIA	Groundwater table	Compliance bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide, petroleum hydrocarbons) - Quarterly laboratory testing for speciated petroleum hydrocarbons (including BTEX) and cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
Central and Southern WRD Seepage Monitoring Bores									
MB_CWRD01 (MB6A)	737646	7806507	377.0	370.0 – 367.0	Along the western (cross-gradient) toe of the Central WRD at western ML boundary	To confirm groundwater quality west of the Central WRD.	Groundwater table	Compliance bore	- Quarterly groundwater levels - Quarterly field parameters (pH, EC, dissolved oxygen, redox potential, WAD cyanide) - Quarterly laboratory testing for major ions, salinity indicators, metals/metalloids, and cyanide-related parameters including WAD cyanide, total cyanide and
MB_CWRD02	737639	7805776	364.1	TBC				Compliance bore	
MB_CWRD03	737224	7805115	362.2	TBC				Compliance bore	

BORE ID	EASTING[1] (GDA2020)	NORTHING[1] (GDA2020)	GROUND SURFACE ELEVATION (MAHD)[2]	SCREEN INTERVAL (MAHD)[3]	LOCATION DESCRIPTION	MONITORING PURPOSE	MONITORING TARGET	COMPLIANCE FUNCTION	MONITORING FREQUENCY & PARAMETERS
MB_CWRD04	737520	7804717	368.4	TBC	At the southern (downgradient) toe of the Central WRD in groundwater flowpath from the co-placement area	To confirm groundwater quality south of the Central WRD.	Groundwater table	Compliance bore	cyanide degradation indicators ammonia, nitrate and thiocyanate.
MB_CWRD05	738815	7805902	373.2	TBC	Along the eastern toe of the Central WRD in the downgradient groundwater flowpath following groundwater drawdown	To confirm groundwater quality east of the Central WRD	Groundwater table	Observation bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide) - Quarterly laboratory testing for cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
MB_CWRD06	738978	7806542	370.6	TBC				Observation bore	
MB_SWRD	739610	7804502	377.7	TBC	200 m west (downgradient) of the Southern WRD	To confirm groundwater quality downgradient of the Southern WRD. MB_SWRD also functions as an upgradient background monitoring for the HLF.	Groundwater table	Compliance bore	- Quarterly groundwater levels - Quarterly field parameters (pH, dissolved oxygen, redox potential, WAD cyanide) - Quarterly laboratory testing for cyanide-related parameters including WAD cyanide, total cyanide and cyanide degradation indicators ammonia, nitrate and thiocyanate.
Northern WRD and Satellite Pit Seepage Monitoring Bores									
MB_BV1US	740870	7808477	414.6	TBC	200 m east of BV1 Pit	Upgradient background monitoring for BV1 Pit, BV2 Pit and Northern WRD	Groundwater table	Observation bore	- Quarterly groundwater levels - Quarterly field parameters (pH, EC, dissolved oxygen, redox potential, petroleum hydrocarbons) - Quarterly laboratory testing for major ions, salinity indicators, metals/metalloids, and speciated petroleum hydrocarbons (including BTEX)
MB_BV2DS	739871	7807555	372.3	TBC	200 m southwest of BV2 Pit	To confirm groundwater quality downgradient of the Northern WRD, Northern MIA and the satellite pits (following commencement of BVS Pit).	Groundwater table	Compliance bore	
MB_NWRD	739665	7808418	373.5	TBC	200 m west (downgradient) of the Northern WRD	To confirm groundwater quality downgradient of the Northern WRD, Northern MIA and the satellite pits	Groundwater table	Compliance bore	
Woolgar River Monitoring Bores									
MB2A	739430	7810283	373.7	356.2 – 353.2	Northwest of the project site, adjacent to the Woolgar River channel	Monitoring groundwater effects along the Woolgar River	Groundwater table	Compliance bore	- Quarterly groundwater levels - Quarterly field parameters (pH, EC, dissolved oxygen, redox potential) - Quarterly laboratory testing for major ions, salinity indicators, metals/metalloids
MB2B	739430	7810283	373.6	306.6 – 303.6					
MB3A	735825	7808080	365.2	363.2 – 360.2	West of the project site, adjacent to the Woolgar River channel				
MB3B	735825	7808080	365.1	347.6 – 344.6					

[1] The eastings/northings presented in this table are provisional or TBC and based on conceptual bore locations/mine layouts presented in Figure 5-7. Monitoring sites will be determined/refined as part of the detailed engineering designs and finalised based on the as-constructed mine infrastructure layouts.
[2] For all new bores, the ground surface elevation will be confirmed by survey within 3 months of bore construction.
[3] All new bores will be installed with a nominal 3 m screened interval targeting the unconfined groundwater regime, to be determined in the field during drilling based on the observed standing water level.
[4] The western and southern portions of the Central WRD, the MIA, the HLF, the TSC, the Southern WRD and the northern portion of the Northern WRD and BV1 Pit are located outside the predicted maximum extent of groundwater table drawdown. Hence, groundwater flow directions in and around these areas are not predicted to be materially affected by the project. The design of the groundwater quality monitoring network layout in these areas has been informed by the existing groundwater flow regime. BVS Pit, BV2 Pit and parts of the Central and Northern WRDs are located within the predicted maximum extent of drawdown on the groundwater table and, following commencement of pit dewatering, groundwater in these areas is predicted to flow towards BVS Pit during the remainder of mining operations and post closure.

FIGURES

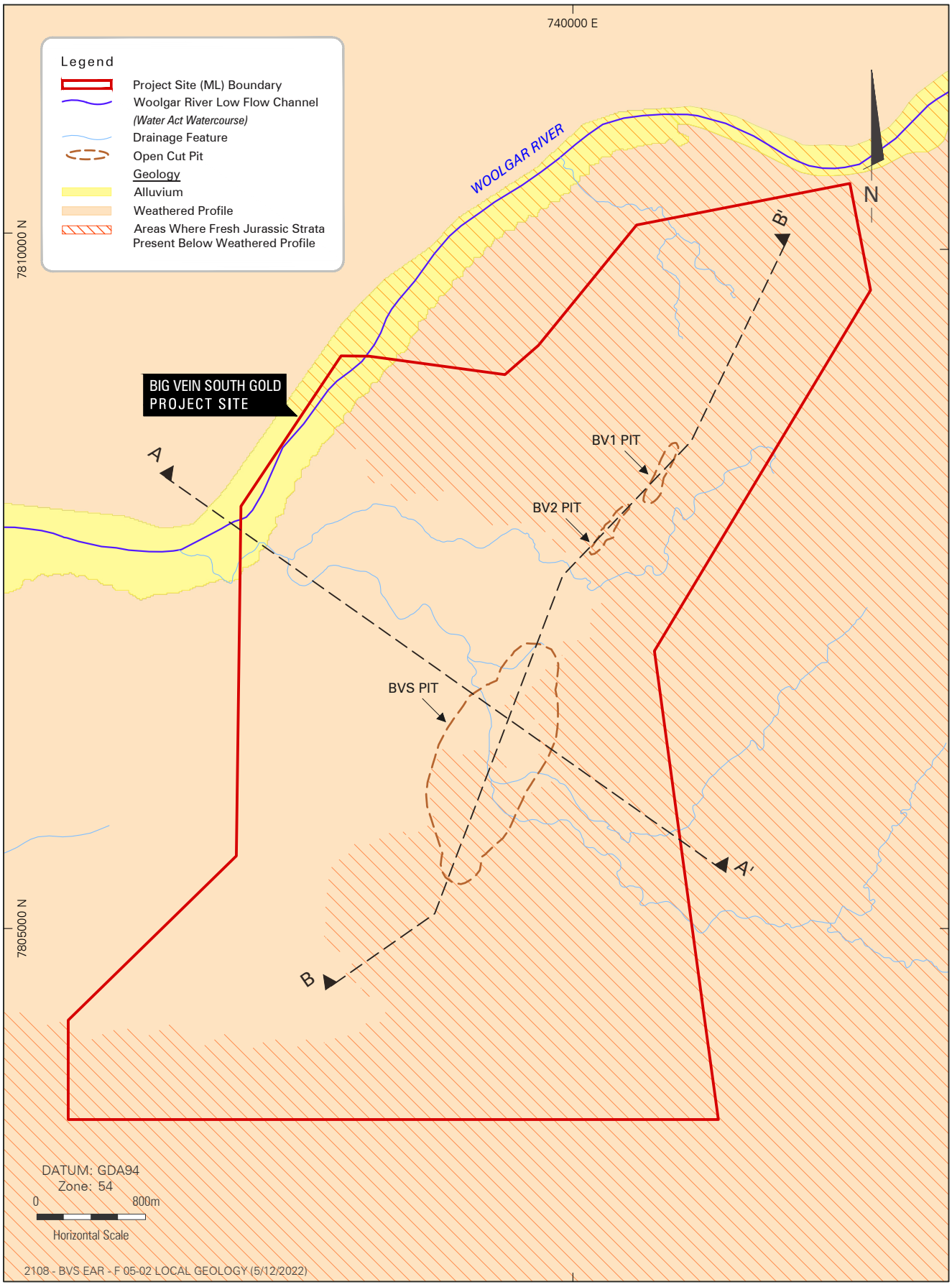


BIG VEIN SOUTH GOLD PROJECT

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Groundwater Bores and Site Investigation Layout

FIGURE 5-1

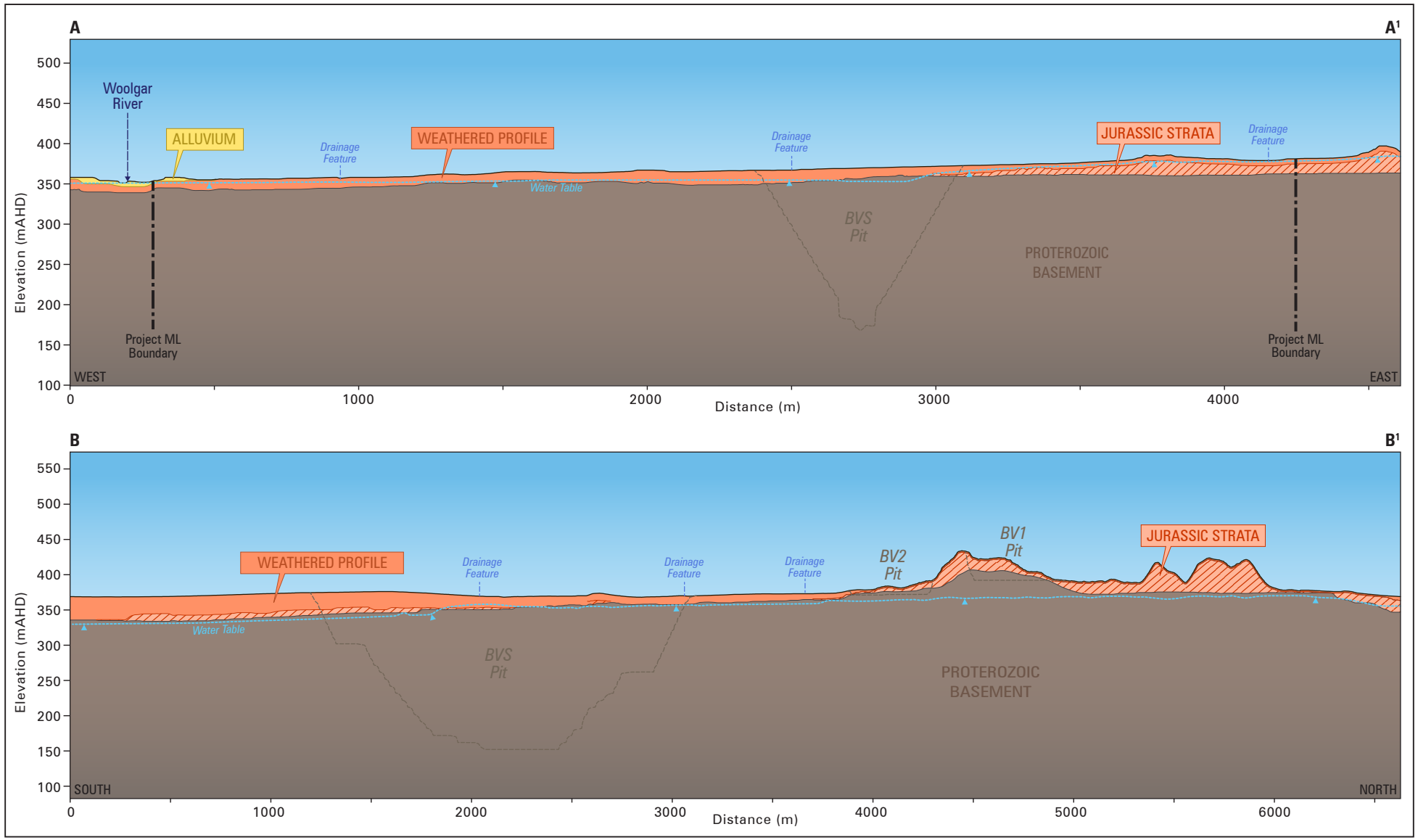


BIG VEIN SOUTH GOLD PROJECT

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Local Geology

FIGURE 5-2

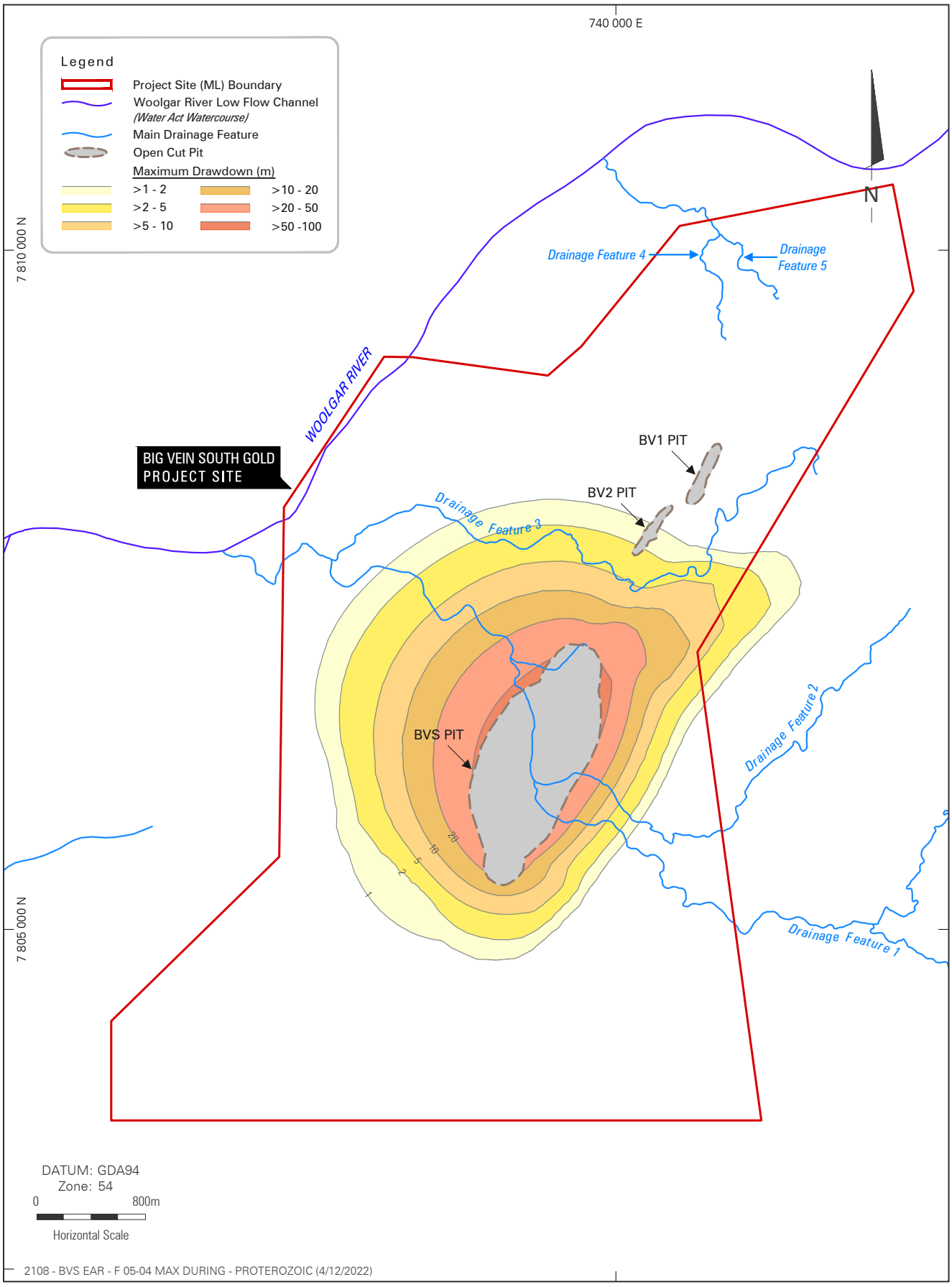


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BIG VEIN SOUTH GOLD PROJECT

Conceptual Groundwater Regime Cross Sections

FIGURE 5-3

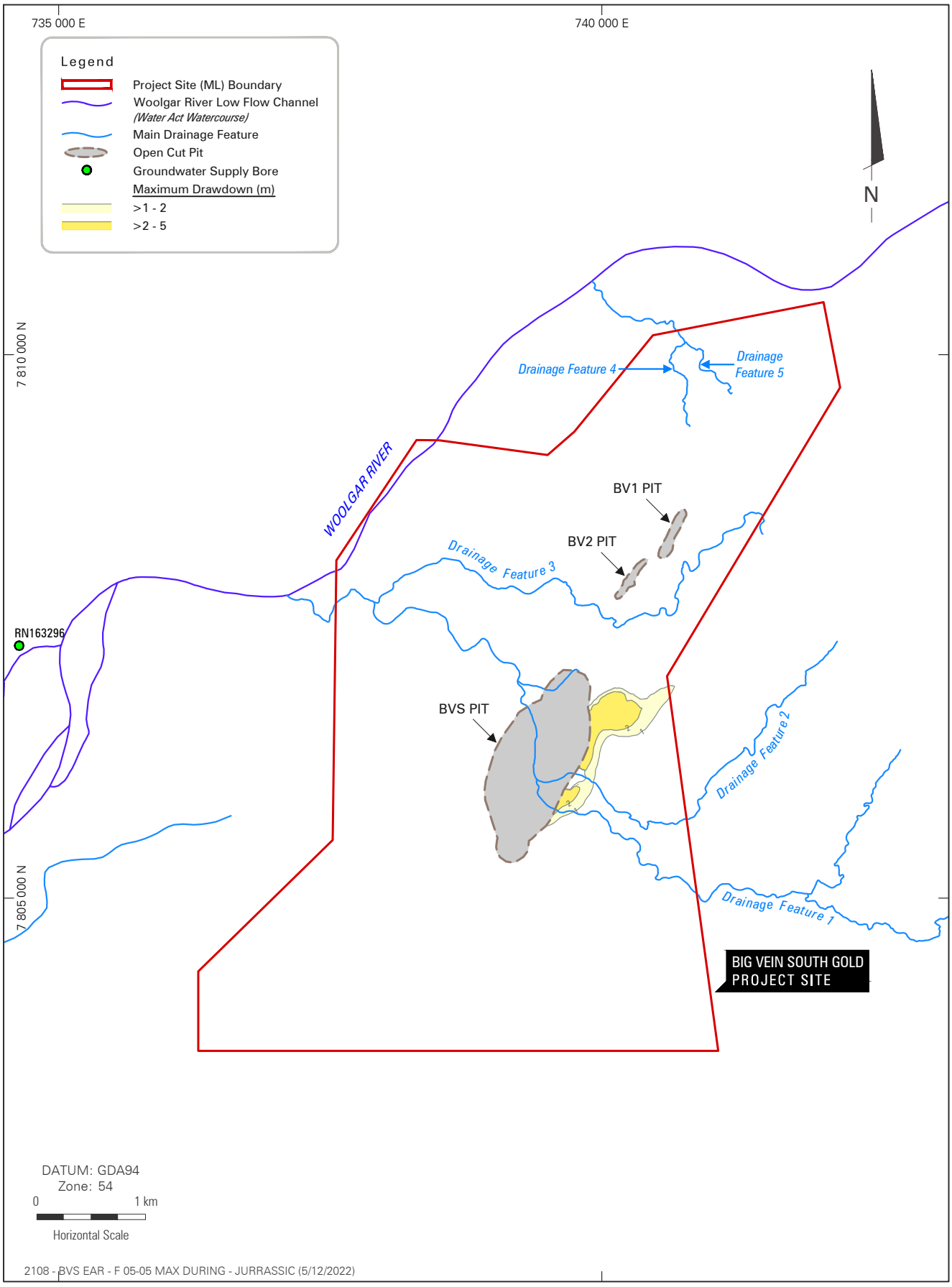


BIG VEIN SOUTH GOLD PROJECT

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Maximum Predicted Drawdown - Proterozoic Basement

FIGURE 5-4

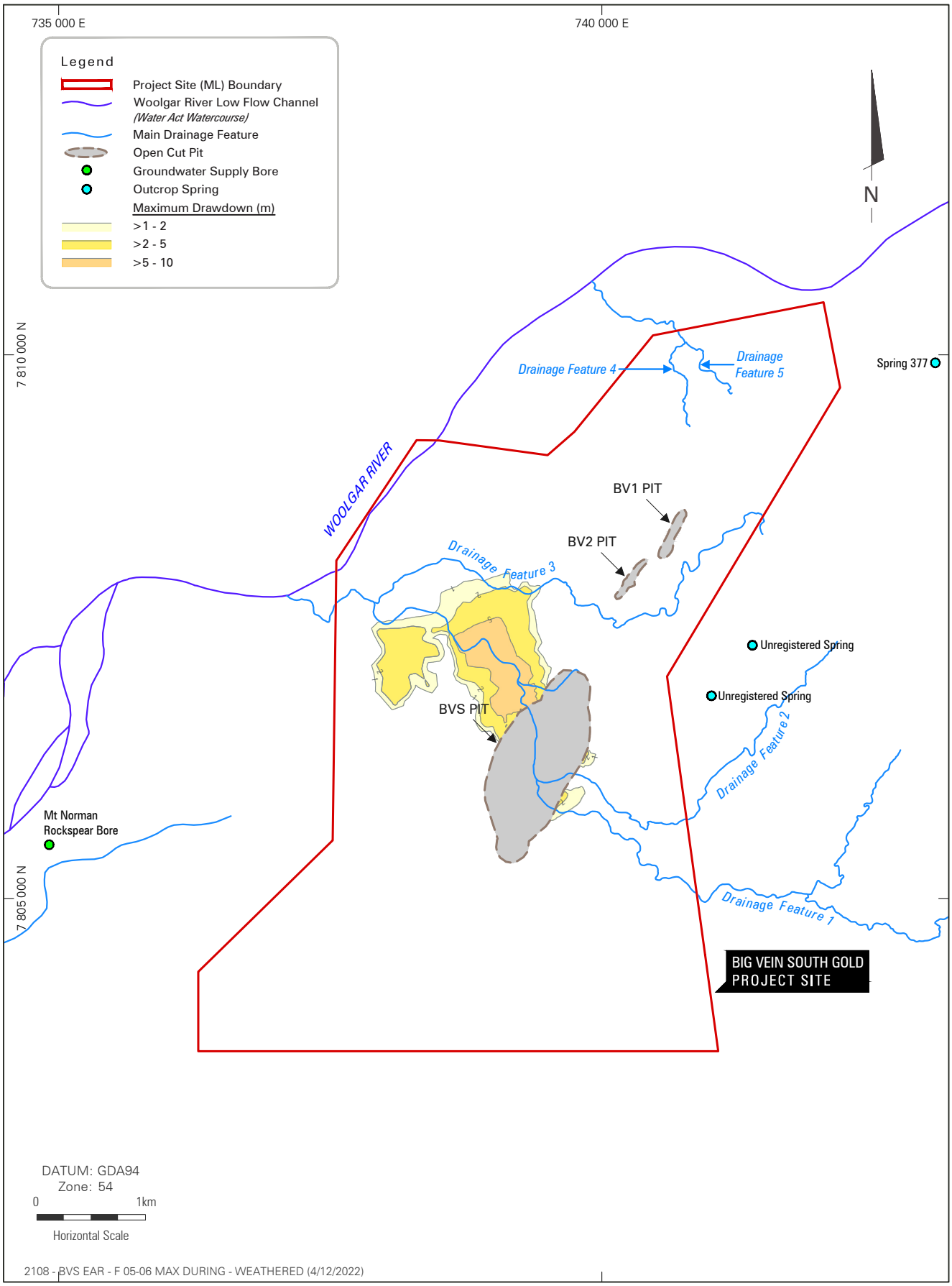


BIG VEIN SOUTH GOLD PROJECT

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Maximum Predicted Drawdown - Jurassic Strata

FIGURE 5-5

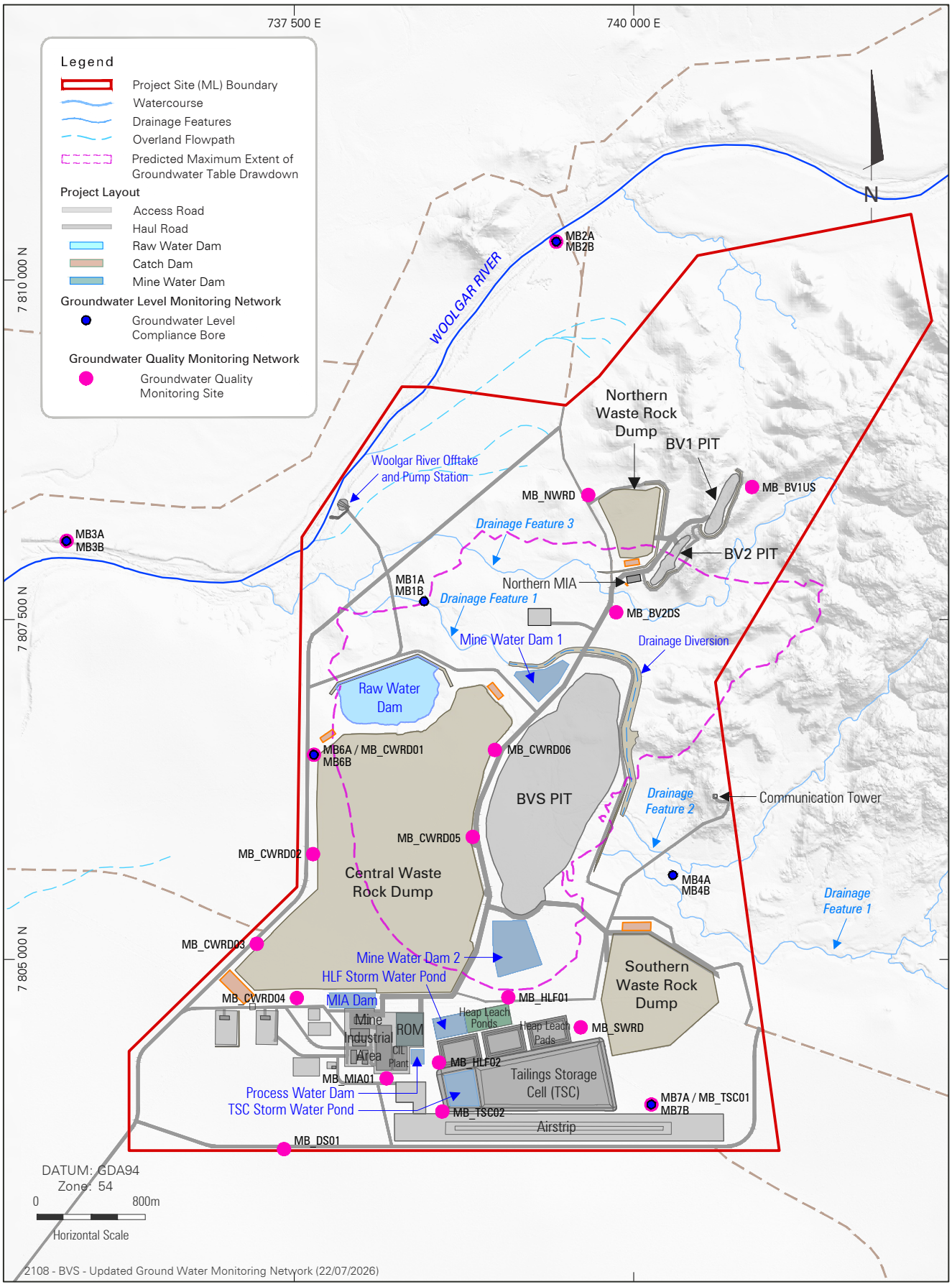


BIG VEIN SOUTH GOLD PROJECT

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Maximum Predicted Drawdown - Weathered Profile

FIGURE 5-6



BIG VEIN SOUTH GOLD PROJECT

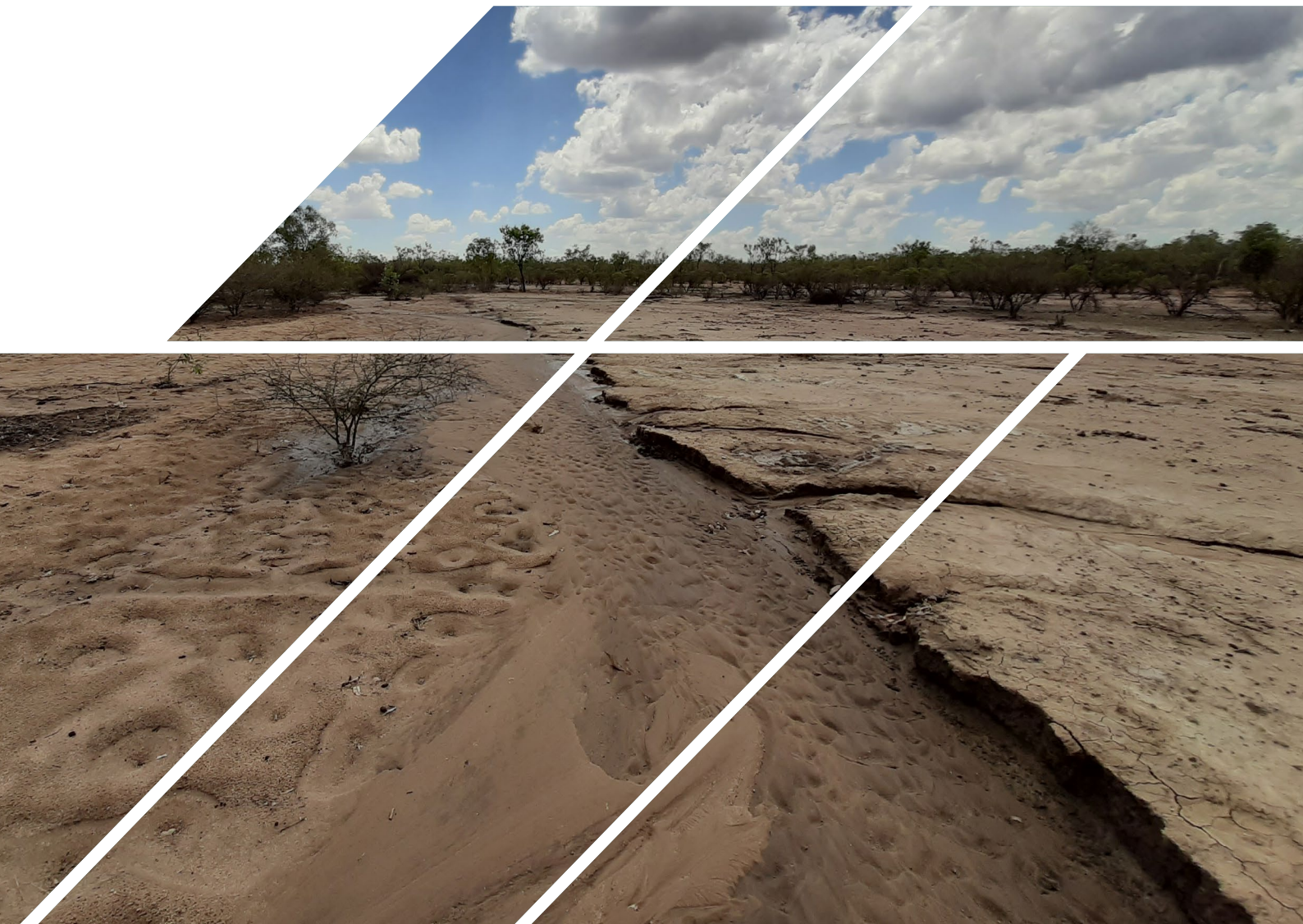
HANSEN ENVIRONMENTAL CONSULTING

Groundwater Monitoring Program Layout

FIGURE 5-7

6

SURFACE WATER



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6 SURFACE WATER

6.1 INTRODUCTION

This section provides a summary of the key findings of the surface water assessment for the Big Vein South Gold Project (the project). The surface water assessment was undertaken by Engeny Water Management and the detailed report is provided in the *Surface Water Report* (Appendix D).

This section provides:

- A description of the surface water setting including the regional catchment, local drainage and surface water quality (Section 6.2);
- A description of the relevant regulatory requirements for surface water (Section 6.3);
- A description of the project operations that could affect surface water (Section 6.4);
- An overview of the water management objectives and water management strategies for the water types that the project is expected to generate (Section 6.5);
- A description of the water management strategies for the project operations (Section 6.6);
- A description of the proposed water management system (WMS), including the project's water supplies and demands, and water discharges from the project site (Section 6.7);
- An assessment of the surface water impacts of the project (Section 6.8); and
- An overview of the environmental management plans relevant to the management of surface water impacts from the project and the surface water monitoring program (Section 6.9).

The scope of work and methodology for the surface water assessment involved:

- A desktop study of available data and mapping relating to drainage, surface geology, vegetation, topography and surface water flow to identify features relevant to the surface water assessment.
- A baseline surface water quality assessment based on site-specific surface water quality monitoring data collected as part of the proponent's baseline surface water quality monitoring program and surface water quality information presented in the *Aquatic Ecology Report* (Appendix F).
- A baseline assessment of flooding conditions in the vicinity of the project site, based on flood modelling.
- Conceptual design of the site drainage arrangements and mine water management system.
- Modelling the performance of the proposed mine water management system.
- Assessing the consequence categories of water storage dams and other relevant structures.
- Modelling the project's effects on surface water flows.
- Assessing the potential impacts of the project on surface water users.

6.2 SURFACE WATER SETTING

This section provides a description of the surface water setting for the project, including the regional catchment and local drainage.

6.2.1 Regional Catchment

The regional catchment setting is shown in Figure 6-1. The project site is located within the Woolgar River catchment. The Woolgar River catchment is a sub-catchment of the larger Stawell River catchment, which is one of several regional catchments that form the upstream end of the Flinders River basin. The Flinders River basin drains to the Gulf of Carpentaria, approximately 375 km north-west of the project site.

The Woolgar River catchment has a total area of approximately 3,318 km^2, which represents approximately 37% of the Stawell River catchment area, and 3% of the overall Flinders River basin area. Approximately 1,312 km^2 (40%) of the Woolgar River catchment area is located upstream of the project site.

The Woolgar River catchment is cattle grazing country and the effects of grazing are widespread. Existing development in the catchment is generally limited to roads and access tracks, and facilities associated with large-scale grazing properties.

There are currently no existing or approved future mining projects in the Woolgar River catchment. The Woolgar River catchment contains numerous historical small scale gold prospecting areas (circa the late 1800s and early 1900s).

There are currently no authorisations to take surface water from the Woolgar River catchment downstream of the project site. In the wider, Stawell River catchment, the only authorisations to take surface water downstream of the project site are water licences 618703 and 618704. These water licences are attached to a rural property located on the lower reach of the Stawell River, approximately 82 km downstream of the project site boundary (Figure 6-1). The water licences authorise the take of up to 12,000 megalitres (ML) annually from the Stawell River for 'rural' uses. Rural uses include stock watering, domestic supply, irrigation and agriculture.

The State government's drainage basin mapping for Queensland shows that the Woolgar River catchment is located within Drainage Basin 915 (i.e. the 'Flinders Basin').

6.2.2 Local Catchment and Drainage

The local catchment setting and existing site drainage are shown in Figure 6-2 and Figure 6-3, respectively.

The project site is situated on the south-western edge of the Gregory Range at elevations of between approximately 360 m and 450 m Australian Height Datum (AHD) (Figures 3-3 and 3-10). The north-eastern portion of the project site is characterised by a mosaic of sandstone scarps dissected by streams and gullies, while the remainder of the project site is gently undulating and sloping to the west (Figure 6-2).

The project site is located adjacent to the Woolgar River and is traversed by several tributaries (Figure 6-3). The key features of the Woolgar River and its local tributaries are discussed in the following sections.

Woolgar River

The Woolgar River commences approximately 46 km upstream of the project site and flows in a south-westerly direction along the northern and north-western boundaries of the project site. The Woolgar River joins the Stawell River approximately 73 km downstream (i.e. along the river channel) of the project site. From the Woolgar River confluence, the Stawell River continues for approximately 56 km and joins the Flinders River approximately 129 km downstream of the project site. The Flinders River flows north-west through the Gulf Country and discharges into the Gulf of Carpentaria approximately 766 km downstream of the project site.

The Woolgar River is a watercourse, as defined under the *Water Act 2000* (Qld) (Water Act) (Figure 6-2).

The Woolgar River is ephemeral and typically flows for approximately 12% of the time (i.e. 44 days per year, on average). The volume and timing of surface water flow in the Woolgar River varies from year-to-year depending on rainfall. Surface water flow monitoring data show that, on average, the majority of surface water flow occurs during the wet season between December and March. Over this period, mean monthly flows in the Woolgar River at the project site are expected to range from approximately 1,700 to 10,300 ML. These flows coincide with the period of highest average monthly rainfall (which occurs between December and March). Hence, flows during this period are dominated by storm events that generate runoff. After the peak of the wet season, surface water flows decrease rapidly as the dry season commences, with low mean monthly flows recorded between April and November.

In the vicinity of the project site, the Woolgar River has a well-defined channel that is set within a narrow, discontinuous floodplain. The river channel contains a braided low flow channel with sand sheet deposits, bars and islands that have been formed by extensive sediment deposition during flow events. The river channel also contains rock bars and a series of seasonal pools that may contain water for extended periods during the dry season.

The banks of the river channel are generally stable and well vegetated. However, cattle grazing has resulted in extensive bank erosion at regular intervals along the river.

The large majority of the project site is above the 0.1 % (1 in 1,000) Annual Exceedance Probability (AEP) Woolgar River flood level (Figure 6-3).

Local Tributaries of the Woolgar River

The project site spans several local sub-catchments of the Woolgar River and is drained by a number of unnamed tributaries of the Woolgar River. The unnamed Woolgar River tributaries are all drainage features, as defined under the Water Act. Figure 6-2 and Figure 6-3 show the local catchment boundaries and drainage features. For ease of reference, the main unnamed drainage features have been numbered Drainage Feature 1 to Drainage Feature 6.

The characteristics of the local catchments and drainage features are summarised as follows:

- The northern part of the project site is located in the Northern Catchment. This Northern Catchment covers an area of approximately 4.2 km^2 and is mainly used for cattle grazing. The Northern Catchment is the catchment area of Drainage Feature 4, and its tributary Drainage Feature 5. Drainage in the catchment originates in the elevated scarps in the east of the project site, flows north-west across the northern part of the project site and enters the Woolgar River approximately 1.1 km downstream of the project site boundary. Drainage Feature 5 joins Drainage Feature 4 at the northern boundary of the project site.
- The central part of the project site is located in the Central Catchment. The Central Catchment covers an area of approximately 19.4 km^2 and is mainly used for cattle grazing. The Central Catchment is the catchment area of Drainage Feature 1, and its tributaries Drainage Features 2 and 3. The drainage features in this catchment originate in the elevated scarps east of the project site, traverse the central part of the project site in a generally westerly direction and enter the Woolgar River approximately 0.7 km downstream of the project site boundary. Drainage Features 2 and 3 join Drainage Feature 1 in the central part of the project site.
- The southern part of the project site is located within the Southern Catchment. The Southern Catchment covers an area of approximately 53.7 km^2 and is mainly used for cattle grazing. The Southern Catchment is the catchment area of Drainage Feature 6. Runoff from the project site and upstream areas of this catchment drains to the south-west as overland sheet flow and ultimately forms a small channel (Drainage Feature 6) in the lower part of the catchment, approximately 14 km downstream of the project site boundary. Drainage Feature 6 flows parallel to the Woolgar River for approximately 1 km before entering the Woolgar River approximately 15 km downstream of the project site boundary.
- The north-western part of the project site drains directly to the Woolgar River, via several undefined overland flowpaths.

The local catchments have been modified by cattle grazing and land disturbance associated with mining exploration, local access roads, and historic gold mining and timber acquisition.

Similar to the Woolgar River, the drainage features within the local catchments are highly ephemeral, with short duration flows that contain elevated levels of suspended sediment. This is expected given the similar geology, catchment topography and land use.

6.2.3 Baseline Surface Water Quality

A baseline surface water quality monitoring program was undertaken to characterise the surface water quality in the Woolgar River and its local tributaries.

Surface water quality data was collected from 11 monitoring sites, including SW1 to SW4 located in the Woolgar River and SW5 to SW11 located in its tributary drainage features (Figure 6-3).

Monitoring was undertaken at each of these sites on 14 occasions between April 2018 and February 2022. In total, 35 samples were collected from the Woolgar River and nine samples were collected from the drainage features. The monitoring sites were typically dry during the post wet season and dry season monitoring rounds. The *Surface Water Report* (Appendix D) provides a detailed description of the baseline surface water quality monitoring program.

The *Surface Water Report* (Appendix D) provides a detailed description of the surface water quality in the Woolgar River and its tributary drainage features. Table 6-1 provides an overview of the surface water quality characteristics. In summary:

- Surface water quality in the Woolgar River and its tributaries have similar characteristics. This is expected given the similar catchment and geology setting of the river and its tributaries.
- A significant proportion of the quality characteristics that were analysed (including organics and the majority of metals and metalloids) recorded results below the limit of reporting.
- Surface water quality is circum-neutral and non-saline.
- Metals are typically present at low concentrations, with the exception of iron, manganese and calcium which are present at slightly higher concentrations due to the naturally enriched geology present within the catchment.
- Surface water turbidity ranged from low to high, depending on flow conditions. Turbidity can increase rapidly during flow events in response to pulses of suspended sediment, as a result of natural erosion processes in the catchment.
- Nutrient concentrations are generally low although increased concentrations can occur in remnant pools at the end of the dry season. Similarly, surface waters typically contain high levels of dissolved oxygen, but oxygen levels can become depleted in remnant pools at the end of the dry season.

Table 6-1 Baseline Surface Water Quality

QUALITY CHARACTERISTICS	UNITS	WOOLGAR RIVER		DRAINAGE FEATURES	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
PHYSICAL PARAMETERS					
pH	pH units	6.4	7.7	6.3	7.6
Electrical conductivity	µS/cm	32	472	32	231
Dissolved oxygen	% sat	51	80	20	89
Turbidity	NTU	1.5	1,060	0.8	1,690
DISSOLVED METALS AND METALLOIDS					
Aluminium	mg/L	<LOR	0.02	<LOR	1.07
Arsenic	mg/L	<LOR	0.001	<LOR	0.004
Barium	mg/L	<LOR	0.06	0.030	0.14
Boron	mg/L	<LOR	0.03	<LOR	0.02
Cadmium	mg/L	<LOR	<LOR	<LOR	<LOR
Chromium	mg/L	<LOR	<LOR	<LOR	<LOR
Copper	mg/L	<LOR	<LOR	<LOR	0.004
Iron	mg/L	0.03	1.4	0.1	3.9
Lead	mg/L	<LOR	<LOR	<LOR	<LOR
Manganese	mg/L	<LOR	0.9	0.002	1.8
Nickel	mg/L	<LOR	0.004	0.002	0.005
Silver	mg/L	<LOR	<LOR	<LOR	<LOR
Uranium	mg/L	<LOR	<LOR	<LOR	0.001
Zinc	mg/L	<LOR	0.005	<LOR	0.03
NUTRIENTS					
Ammonium	mg/L	<LOR	<LOR	<LOR	0.1
Nitrate	mg/L	<LOR	6.9	<LOR	0.2
Total phosphorus	mg/L	<LOR	0.02	<LOR	0.95
IONS AND ALKALINITY					
Calcium	mg/L	8	19	1	9
Total hardness	mg/L	12	80	<LOR	53

Notes Table shows maximum and minimum results recorded in the Woolgar River and its tributaries (drainage features).
<LOR means the recorded concentration is less than the applied limit of reporting.

6.3 REGULATORY REQUIREMENTS

6.3.1 Environmental Protection Act

The EP Act was established to protect Queensland's environment while allowing for development in a way that maintains ecological processes. The Department of the Environment, Tourism, Science and Innovation (DETSI) is the administering authority of the EP Act.

The EP Act requires that mining projects be undertaken in accordance with an approved Environmental Authority (EA). The EA conditions will set the water management performance requirements for the mine. Failure to comply with the EA conditions is a breach of the EA and there are various compliance enforcement actions available to the DETSI under the EP Act.

The EA conditions will also:

- Require the proponent to develop and implement a series of management plans and monitoring programs for surface water, including a Water Management Plan, an Erosion and Sediment Control Plan and a Receiving Environment Monitoring Program (REMP). These monitoring programs and management measures are outlined in Section 6.9.
- Require that the consequences of a containment failure must be assessed for each structure to identify any 'regulated dams'. The EA conditions will impose specific requirements on the design, construction, operation and decommissioning of any regulated dams. An initial consequence assessment is presented in the *Surface Water Report* (Appendix D) and the results indicate that the project will require several regulated dams. Section 6.6 provides a description of the regulated dams required for the project.

The EP Act also establishes an Environmental Protection Policy (EPP) for water. The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (Qld) (EPP Water) provides a framework for the protection of environmental values (i.e. surface water uses) associated with Queensland rivers, streams, wetlands, lakes, aquifers, estuaries, and coastal areas. Under this framework, environmental values for specific catchments and drainage basins have been formalised through a process of statutory declaration. Environmental values formalised in this way are listed in Schedule 1 of the EPP Water. For other waters, a site-specific assessment of the potential environmental values is required.

To date, no environmental values have been declared for the Woolgar River catchment (or its tributary catchments).

The *Aquatic Ecology Report* (Appendix F) and *Surface Water Report* (Appendix D) present site-specific assessments of the potential environmental values relevant to the project. These assessments show that:

- The Woolgar River and its tributaries are slightly disturbed surface water features that support aquatic ecosystems. The physical and chemical characteristics of these waters have been adversely affected by current and historical land use within the catchment, including vegetation clearing and cattle grazing.
- The *Surface Water Report* (Appendix D) shows that the majority of environmental values associated with human use of surface water[1] are not relevant because these uses are not undertaken or currently planned within the project site or the downstream reaches of the Woolgar River. There are no known significant cultural or spiritual values associated with the Woolgar River and its tributaries. The *Surface Water Report* (Appendix D) concludes that the only potentially relevant environmental values associated with the human use of surface water are recreational and aesthetic values and stock watering.

[1] Environmental values associated with the human use of surface water include human consumption of aquatic foods, aquaculture, intensive agriculture, recreational uses (including swimming and aesthetic values), drinking water supply and industrial use.

The EPP Water requires that slightly disturbed waters supporting aquatic ecosystems and human use values are maintained at levels that achieve the applicable water quality objectives (WQOs), or the waters are improved to a level that achieves the applicable WQOs.

WQOs are quantitative measures or narrative statements established to protect relevant environmental values. WQOs comprise water quality indicators and corresponding water quality guidelines. Water quality indicators are the physical, chemical or biological properties that can be quantitatively measured, and can include:

- Physico-chemical indicators (e.g. pH, nutrients, suspended solids, water clarity, dissolved oxygen and salinity);
- Biological indicators (e.g. in-steam biota, macroinvertebrates and aquatic macrophytes);
- Toxicant indicators (e.g. metals and pesticides);
- Geomorphic indicators (e.g. creek beds, banks, in-stream habitat, refuge waterholes and ground cover);
- Habitat indicators (e.g. riparian zone properties such as width, continuity and species composition) and
- Hydrological indicators (e.g. surface water flow path, flow rate and seasonality).

Water quality guidelines are the quantitative measure for an indicator (i.e. a specific pH level, toxicant concentration or surface water flow rate). Guideline values may be derived from assessment of ecological effects (i.e. toxicity testing) and/or reference site data.

WQOs have been established for the catchments and drainage basins listed in Schedule 1 of the EPP Water (i.e. the waters that have been formally assigned environmental values). For other waters (not listed in Schedule 1 of the EPP Water), WQOs are determined in accordance with the Queensland guideline *Environmental Protection (Water and Wetland Biodiversity) Policy 2019: Deciding aquatic ecosystem indicators and local water quality guidelines* using site-specific information and other relevant documents including the *Queensland Water Quality Guidelines* (Department of Environment and Resource Management [DERM], 2009), the *Australian and New Zealand guidelines for fresh and marine water quality* (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000), the *Australian drinking water guidelines* (National Health and Medical Research Council, 2011), and the *Guidelines for managing risks in recreational waters* (National Health and Medical Research Council, 2008).

To date, no WQOs have been declared for the Woolgar River catchment (or its tributary catchments).

In the absence of declared WQOs, water quality objectives must be derived from a set of water quality guideline values for all relevant indicators that will protect the environmental values of the water.

Interim site-specific water quality guidelines that meet the management intent of the EPP Water for protection of aquatic ecosystems associated with moderately disturbed waters are presented in the *Surface Water Report* (Appendix D) and are reproduced in Table 6-2. The interim guideline values have been prepared in accordance with the guidelines listed above.

Table 6-2 Interim Surface Water Quality Guideline Values

QUALITY CHARACTERISTIC	UNITS	GUIDELINE VALUE	GUIDELINE VALUE SOURCE[1]
pH (upper limit)	pH units	7.5	Aquatic Ecosystem Protection Guideline
pH (lower limit)	pH units	6.5	Recreation and Visual Amenity Guideline
Electrical conductivity	µS/cm	250	Aquatic Ecosystem Protection Guideline
Sulfate	mg/L	400	Recreation and Visual Amenity Guideline
Dissolved Oxygen	% sat	90 – 120	Aquatic Ecosystem Protection Guideline
Turbidity	NTU	15	Aquatic Ecosystem Protection Guideline
Aluminium	µg/L	55	Aquatic Ecosystem Protection Guideline
Arsenic	µg/L	13	Aquatic Ecosystem Protection Guideline
Barium	µg/L	1,000	Recreation and Visual Amenity Guideline
Boron	µg/L	940	Aquatic Ecosystem Protection Guideline
Cadmium	µg/L	0.2	Aquatic Ecosystem Protection Guideline
Chromium	µg/L	1	Aquatic Ecosystem Protection Guideline
Copper	µg/L	1.4	Aquatic Ecosystem Protection Guideline
Iron	µg/L	300	Recreation and Visual Amenity Guideline
Lead	µg/L	3.4	Aquatic Ecosystem Protection Guideline
Manganese	µg/L	100	Recreation and Visual Amenity Guideline
Nickel	µg/L	11	Aquatic Ecosystem Protection Guideline
Selenium	µg/L	5	Aquatic Ecosystem Protection Guideline
Silver	µg/L	0.05	Aquatic Ecosystem Protection Guideline
Uranium	µg/L	0.5	Aquatic Ecosystem Protection Guideline
Zinc	µg/L	8	Aquatic Ecosystem Protection Guideline
Calcium	mg/L	1,000	Stock Watering Guideline
Hardness	mg/L	500	Recreation and Visual Amenity Guideline
Microalgal Chlorophyll-a	µg/L	5	Aquatic Ecosystem Protection Guideline

[1] Guideline value for protection of the listed environmental value, as sourced from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

6.3.2 Water Act

The *Water Act 2000* (Water Act) is the principal legislation for the sustainable management of Queensland's water resources. The Water Act provides the framework within which surface water resources are planned, allocated and used in Queensland. The surface water provisions of the Water Act are administered by the Department of Local Government, Water and Volunteers (DLGWV).

The management of surface water resources is achieved through the following key measures:

- Granting authorisations for taking or interfering with surface water; and
- Preparing water plans for any part of Queensland, reserving unallocated water resources, as well as prescribing processes for releasing unallocated water.

These surface water management measures are described in the sections below.

The Water Act also defines the properties of watercourses and drainage features. DLGWV has previously assessed the natural surface drainage within the project site and its surrounds and determined that the Woolgar River meets the Water Act definition of a watercourse. Various other smaller drainage features were also identified within the project site and its surrounds.

Water Act Authorisations

The Water Act authorises the take or interference with surface water under specific circumstances (e.g. emergencies, stock watering, etc). For mining activities authorised under an EA, the Water Act authorises:

- The take of overland flow (i.e. only water that is not in a watercourse or lake); and
- Interference with the flow of any surface water by impoundment (e.g. a dam, weir or excavated water storage) or diversion, provided that the impacts have been assessed as part of the EA approval process and the EA contains appropriate conditions.

The take of overland flow associated with site drainage to contained catchments is described in Section 6.6. The impoundment of surface water as part of the project operations is described in Section 6.4.2. The project's surface water flow effects and impacts are described in Section 6.8.3. These activities will be authorised under the EA and a separate authorisation (e.g. a water licence or a riverine protection permit) will not be required for these activities.

A separate authorisation will be required for any surface water take or interference that does not meet these requirements. The proponent will seek a water authorisation to access a share of the available water resources in the catchment to meet the project's raw water demands. The available water resources, and the need for a water authorisation, are discussed below.

Gulf Water Plan

The Water Act allows for the Minister to prepare water plans for any part of Queensland, reserve unallocated water resources and prescribe processes for releasing unallocated water.

The *Water Plan (Gulf) 2007* (Qld) (the Water Plan) manages surface water resources within the Water Plan area. The Water Plan area comprises a total of eight catchments located in north Queensland. The project site is located in the Flinders River catchment as defined in Schedule 3 of the Water Plan.

The Water Plan has reserved 266,000 ML of unallocated water across the Flinders River catchment. The Water Plan provides a breakdown of the unallocated water by reserve type. The unallocated water is held in the following types of reserve:

- An indigenous reserve – Access to the indigenous reserve may be granted to enable indigenous communities in the Flinders River catchment area to achieve their economic and social objectives. The Water Plan indicates that 8,500 ML of unallocated water is held in the indigenous reserve.
- A general reserve – Access to the general reserve may be granted for any purpose. The Water Plan indicates that 239,650 ML of unallocated water is held in the general reserve.
- A strategic reserve – Access to the strategic reserve may be granted for 'State purposes' such as coordinated or regionally significant projects, and other limited uses. The Water Plan indicates that 17,850 ML of unallocated water is held in the strategic reserve for State purposes.

The proponent intends for the project to be formally determined to be a 'Project of Regional Significance' under Section 27 of the Water Plan.

As a Project of Regional Significance, the project will be eligible to apply for a release of unallocated water from the strategic reserve to meet its water supply requirements. In order to access unallocated water from the strategic reserve,

the proponent will obtain an agreed 'terms of release' with the State. The terms of release will specify the terms of any water entitlement. This will be given effect through a water licence issued by DRDMW in accordance with the Water Act.

The regulatory approval process for the Project of Regional Significance application and water entitlement application is set out under the Water Act and its subordinate legislation, and this process is separate to the EA approval process. The proponent will progress the Water Act and EA approval processes concurrently.

6.3.3 Secondary Approvals

Water Supply (Safety and Reliability) Act 2008

The *Water Supply (Safety and Reliability) Act 2008* (Qld) (WSSR Act) is the principal legislation for the regulation of dam safety in Queensland. The WSSR Act provides a framework for the identification, assessment and management of 'referable dams'. Referable dams are dams that pose a risk to human life. The DRDMW is responsible for regulating referable dams under the WSSR Act.

A dam is referable if a failure impact assessment demonstrates there would be two or more people at risk if the dam were to fail. Initial work presented in the *Surface Water Report* (Appendix D) has indicated the project does not involve the construction or operation of any referable dams or require approval under the WSSR Act.

6.4 PROJECT OPERATIONS

This section provides a description of the project mining operations and infrastructure that have the potential to directly or indirectly impact surface water. These include:

- Mining operations;
- Surface water take from the Woolgar River off-take; and
- Road crossings of drainage features.

6.4.1 Mining Operations

Open cut mining operations will involve the mining of waste rock and gold ore from three open cut pits (Figure 6-4). The BVS Pit will be active over the 11 year life of the mine. The BV1 and BV2 pits will be mined during the first two years of the project, concurrent with initial overburden stripping from the BVS Pit.

Open cut mining will be conducted using excavators and trucks. Waste rock will be transported from the pits in haul trucks and stored in three Waste Rock Dumps (WRDs) located in proximity to the pits (Figure 6-4). Waste rock from the BV1 and BV2 pits will be stored in the Northern WRD. Waste rock mined from the BVS Pit will be stored in the Central and Southern WRDs with only non-acid forming (NAF) waste rock to be stored in the Southern WRD.

Mined gold ore will be transported from the pits by haul truck to the Run-of-Mine (ROM) area at the southern end of the project site (Figure 6-4) and either stockpiled prior to processing, or fed directly to the Carbon-in-Leach (CIL) Plant or the Heap Leach Facility (HLF) (Figure 6-4). Both the CIL Plant and the HLF will be fully contained processes with nil discharge of process or tailings water.

The project will also require construction of mine infrastructure to support the mining activities. Figure 6-4 shows the conceptual location of key mine infrastructure.

No mining activities are proposed within the Woolgar River, and mining activities have been designed to avoid interference with this watercourse. Hence, a watercourse diversion will not be required for the project.

The guideline *Structures which are dams or levees constructed as part of environmentally relevant activities* (DETSI, 2025) and the associated *Manual for assessing consequence categories and hydraulic performance of*

structures (DETSI, 2025) require that a levee is constructed to prevent the ingress of flood water into open cut mining areas during flood events up to the 0.1% (1 in 1,000) AEP.

Flood modelling undertaken as part of the surface water assessment indicates that the majority of the project site is above the Woolgar River 0.1% (1 in 1,000) AEP flood level. The three open cut pits and all mine infrastructure are located well above the Woolgar River 0.1% (1 in 1,000) AEP flood level (Figure 6-4). On this basis, no flood protection levees are required for the project due to flooding from the Woolgar River.

The 0.1% AEP flood is a very rare flood event that has a 0.1% chance of occurring in any year and has an average recurrence interval of approximately 1,000 years. There is an extremely low probability (specifically less than 0.1% in any year) that a larger flood will occur during the operating life of the mine. The potential risks of flooding to people and the environment are therefore extremely low.

6.4.2 Woolgar River Off-take

The project will require a raw water supply. Raw water supply for the project will be obtained from an off-take on the Woolgar River.

The Woolgar River off-take and associated infrastructure will be located in the north-western part of the project site, on the southern bank of the Woolgar River channel (Figure 6-4). The off-take will comprise:

- A small, excavated sump in the Woolgar River bank, adjacent to the riverbed. The off-channel sump will be approximately 10 m wide and 20 m long at its base. The internal batter slopes of the sump will be lined with rock and/or concrete. The sump inlet will be a rock gabion weir aligned parallel to the river bank.
- Pump inlet pipes constructed on the riverbank.
- A pump station at the top of the river bank. The pump station will include a hardstand area and pumps and a pump station access track located on the Woolgar River floodplain (outside of the river channel).
- A 10H:1V sump access ramp from the river bed to the pump station.

The off-take will not result in any obstruction to the river channel or flows.

The off-take construction will occur during the dry season when the Woolgar River is not flowing, to ensure dry working conditions. As part of construction activities, vegetation will be cleared from the footprint of the off-take. Topsoil and subsoil will be stripped from this area and stockpiled for reuse in rehabilitation. The off-take construction will require the clearing of approximately 0.25 ha for the sump, pump suction pipes and access ramp. The off-take construction will include stabilisation of the disturbed area of the river bank with rock armouring and/or shotcrete to ensure the bank remains stable and the pumps can continue to operate during wet season flows events.

During mining operations, water will be pumped from the river during wet season flow events to the Raw Water Dam, via a dedicated pipeline. The rate, duration and volume of surface water abstraction will be controlled via a metered valve at the Woolgar River pump station in order to reduce its effects on low flows in the Woolgar River. The surface water abstraction will be undertaken as follows:

- When flows in the Woolgar River are less than or equal to 432 ML/day, there will be no abstraction of surface water from the Woolgar River off-take.
- When flows in the Woolgar River are between 432 and 562 ML/day, the abstraction rate will be adjusted to ensure that flows in the Woolgar River remain greater than or equal to 432 ML/day.
- When flows in the Woolgar River are greater than 562 ML/day, the maximum abstraction rate will be up to 130 ML/day).

On completion of mining, the off-take will be removed, the off-channel sump will be backfilled to reinstate the pre-mining riverbank surface and the disturbed areas will be rehabilitated.

6.4.3 Road Crossings of Drainage Features

No watercourse road crossings are required as part of the project.

The project involves the construction of seven new road crossings of drainage features. The road crossing locations are shown in Figure 6-4 and include:

- One haul road crossing of the BVS Pit Drainage Diversion; and
- Six local access road crossings on Drainage Features 1, 2 and 3.

The haul road crossing will be constructed over a constructed engineered diversion drain. Both the diversion drain and haul road crossing will be designed to minimise any adverse hydrological changes in the natural creeks upstream and downstream of the diversion drain. Conceptually, the haul road crossing will include several culverts within an engineered embankment, approximately 30 m wide at the crest, in order to allow unimpeded low flows. The drainage channel bed and banks upstream of the culvert inlets and downstream of the culvert outlets will be constructed with scour protection and an apron to minimise erosion. Any upstream and downstream embankment slopes (i.e. slopes that form the culvert headwall) will be surfaced with rock lining or other suitable material to prevent erosion.

The access road crossings will be low level rock-fill causeways, approximately 8 m wide, with low flow culverts.The crossings will be designed so that they do not significantly impede channel flow in the relatively small ephemeral drainage features (stream orders 1 to 3). The main potential impact on stream flows due to the causeway crossings will be localised flow velocity increases over the causeway and hence the detailed design of the causeways will include provision of adequate scour protection for the crossing.

Road crossings will be constructed during periods of no flow. The pavement surface specification will be refined during the detailed design process to ensure a suitable scour resistance based upon the design flow velocities for each crossing. During higher flow conditions, excess stormwater will flow over the scour resistant road surface and back into the natural drainage channel on the downstream slope.

Any spillage of waste rock or contaminants, including any spillage on road crossings, will be cleaned up as quickly as practicable to minimise the risk of release of wastes to any stormwater drainage or receiving waters.

6.5 WATER MANAGEMENT APPROACH

The project mining operations described in Section 6.4 will generate a range of water types that require management. This section describes the water types that will be generated and the site water management objectives and strategies that will be implemented for these waters.

6.5.1 Water Management Objectives

The key objectives for site water management are:

- Maximise the re-use of mine-affected water and minimise the need for any discharge of mine-affected water;
- Minimise the demand for external water supply; and
- Ensure all sediment affected water is directed to appropriate sediment control structures to manage the potential for downstream sedimentation.

6.5.2 Water Types

The project operations will generate the following waters that require management:

- Open cut pit water (or 'pit water'), comprising runoff from open cut pit catchments and any groundwater inflows to open cut pits.
- From the third year of mining operations onward – return water from the tailings storage cell (TSC), comprising TSC runoff and water released from the stored tailings.
- Runoff from the HLF.
- Runoff from the Mine Industrial Area (MIA), including the Run of Mine (ROM) ore stockpile area.
- Drainage from the WRDs and temporary ore stockpile area;
- Runoff from other cleared and disturbed areas, including:
  - Runoff from mine pre-stripping areas; and
  - Runoff from soil stockpile areas.
- Runoff from haul roads.
- Runoff from rehabilitated areas.
- Runoff from undisturbed areas.

6.6 WATER MANAGEMENT STRATEGIES

6.6.1 Introduction

Sections 6.6.2 to 6.6.9 describe the water management strategies for each of the waters listed in Section 6.5.2. These sections also provide an overview of the erosion and sediment control measures that will form part of the water management strategies.

6.6.2 Pit Water

BVS Pit Water

BVS Pit water is considered mine-affected water.

The site drainage has been designed to limit the catchment area of BVS Pit, as far as possible.

The BVS Pit footprint is traversed by Drainage Features 1 and 2 (Figure 6-3). Prior to commencement of mining operations, a permanent Drainage Diversion will be constructed to divert Drainage Features 1 and 2 around (and away from) the BVS Pit. The conceptual alignment of the Drainage Diversion is shown in Figure 6-4.
The Drainage Diversion is approximately 2.1 km long and extends around the eastern and northern sides of BVS Pit.

Whilst the Drainage Diversion is not located on a watercourse and does not require authorisation under the Water Act or the EP Act, relevant principles of Queensland guideline *Works that Interfere with water in a watercourse for a resource activity* (DNRME, 2019) were considered as part of the conceptual design. The diversion will be constructed in accordance with a design plan certified by an RPEQ to ensure it is functional and stable in the long term post closure.

Diversion inlet works, including a flood protection levee, will be constructed across Drainage Features 1 and 2 upstream of the BVS Pit. Surface water from upstream reaches of Drainage Feature 1 and 2 will enter the diversion inlet works during seasonal flow events. The inflowing surface water will be directed to the diversion drain located

at the northern end of the inlet works. Surface water will flow along the diversion drain to the diversion drain outlet on Drainage Feature 1.

The BVS Pit Drainage Diversion has been designed with capacity to convey the 0.1% (1 in 1,000) AEP flow event and will remain in place after mine closure. The diversion inlet flood protection levee will be a regulated structure and will be designed in accordance with the DETSI *Manual for assessing consequence categories and hydraulic performance of structures* and the EA regulated structure conditions.

Pit water from BVS Pit will comprise groundwater inflow and incident rainfall and runoff from the contributing pit catchment. The pit catchment is a contained catchment that includes the BVS Pit, as well as areas outside the pit that cannot be drained around or away from the pit.

Pit water captured during mining operations will drain to the lowest part of the BVS Pit and collected in sumps excavated in the pit floor. During mining operations, any pit water within BVS Pit will be pumped to the Mine Water Dam and used as a project water supply. Details of the project water supply arrangements are provided in Section 6.7.1.

BV1 and BV2 Pit Water

BV1 and BV2 Pit water is considered mine-affected water.

Pit water from BV1 Pit and BV2 Pit will comprise incident rainfall and runoff from contributing pit catchments. The *Groundwater Report* (Appendix C) concludes that there will be no groundwater inflow to these pits.

The site drainage has been designed to limit the catchment area of the open cut pits, as far as possible. Prior to commencement of mining operations, permanent clean water drains will be constructed to isolate the BV1 Pit and BV2 Pit catchments and divert runoff from upstream areas around (and away from) the pits (Figure 6-4).

These pits will only generate limited volumes of pit water during mining operations as a result of direct rainfall to the pits and limited runoff from the isolated pit catchments. Pit water captured during mining operations will drain to the lowest part of each pit and collected in sumps excavated in the pit floor. During active mining, pit water will be pumped to Mine Water Dam 1 (MWD1) and used as project water supply. Details of the project water supply arrangements are provided in Section 6.7.1.

Following completion of mining activities in BV1 Pit and BV2 Pit, these pits may be used as a contingency storage for pit water from BVS Pit for the remainder of the mine life.

6.6.3 Heap Leach Facility

HLF water is considered mine-affected water.

On-site ore processing will include a HLF that will operate predominantly in the initial project years prior to the commissioning of the CIL Plant in Year 3. The HLF will include a mobile crusher, three heap leach pads and a series of three heap leach ponds, namely the Barren Pond, the Pregnant Pond and the HLF Stormwater Pond. The heap leach process is described in Section 3 – Project Description.

The HLF will be operated so that the heap leach process solutions are contained within a closed system with no external discharge. Specifically, the Barren Pond and Pregnant Pond have been sized to contain the maximum volumes of heap leach process solutions generated from the heap leach process and also have additional freeboard capacity to ensure total containment.

The HLF will also have a dedicated HLF Stormwater Pond to contain any rainfall runoff from the HLF catchment. The HLF Stormwater Pond will have a storage capacity of 140 ML and has been sized to contain the runoff from the HLF catchment during the modelled worst-case rainfall sequences.

Water collected in the HLF Stormwater Pond will be re-used as make-up water in the heap leach process or pumped to the TSC Stormwater Pond for storage and use as CIL Plant water supply. Details of the project water supply arrangements are provided in Section 6.7.1.

6.6.4 TSC Return Water

TSC return water is considered mine-affected water.

The TSC will be a lined containment cell with nil external catchment, constructed from perimeter embankments (Figure 6-4). The TSC will have an ultimate footprint of approximately 45 ha and a maximum embankment height of approximately 16 m. The TSC will also include a 550 ML Stormwater Pond, separated from the tailings storage area by an internal embankment (Figure 6-4). Preliminary assessment indicates the TSC will have a high consequence category and would therefore be a regulated structure.

Tailings will be pumped to the TSC in a slurry pipeline. Tailings will be discharged from multiple spigot locations around the perimeter embankment in order to optimise emplacement of the tailings and filling of the storage area. A pontoon mounted pump will operate in the decant pond that will form at the low point of the deposited tailings surface. The decant pond will collect tailings supernatant and storm water from the tailings storage area. The decant pond will be dewatered to the TSC Stormwater Pond. This will maintain a low level in the decant pond to maximise consolidation of settled tailings and tailings water recovery. The internal TSC embankment will have a spillway that will allow any excess stormwater in the tailings storage area during extended rainfall periods to overflow to the Stormwater Pond.

The TSC Stormwater Pond will receive tailings supernatant water and storm water from the tailings storage area and storm water transferred from the HLF Stormwater Pond. The TSC Stormwater Pond has been sized with sufficient capacity to contain all inputs during the modelled worst case rainfall sequence. The TSC Stormwater Pond will operate as a nil discharge dam and will be the priority source of CIL Plant water supply. Details of the project water supply arrangements are provided in Section 6.7.1.

6.6.5 Mine Infrastructure Area Runoff

MIA runoff is considered mine-affected water.

The MIA catchment comprises an area of approximately 14 ha including the ROM ore stockpile area, the CIL Plant, the MIA area, a warehouse and office area and a workshop area. The MIA catchment area will remain constant over the mine life. Runoff from the MIA catchment may contain elevated levels of suspended sediment, hydrocarbons, and other potential contaminants associated with the servicing of mine plant and equipment. MIA sub-catchments with special treatment requirements (e.g. workshops) will be isolated with diversion drains and/or bunding as required, with runoff treated using appropriate technologies (e.g. oil separators).

High-grade ore will be stockpiled on a dedicated pad within the MIA catchment. The pad will have a compacted base to minimise seepage. The pad will be graded to direct runoff to a perimeter collection drain to collect drainage and runoff from the ROM ore stockpile.

Runoff from the MIA will be captured in collection drains and directed to the MIA Dam. The MIA Dam is a dedicated containment dam that will have sufficient storage capacity to ensure total containment. Runoff from the MIA catchment that collects in the MIA Dam will be pumped to the Mine Water Dam for use as project water supply. Details of the project water supply arrangements are provided in Section 6.7.1.

6.6.6 Drainage from Waste Rock Dumps and Temporary Ore Stockpile Area

Northern and Southern WRDs

The Northern and Southern WRDs will store only NAF waste rock. The results of the geochemical testing (*Geochemistry Report* [Appendix A]) indicate that drainage (runoff and seepage) from the NAF waste rock will be pH neutral to slightly alkaline, with low salinity and low concentrations of metals and metalloids.

The WRDs will be designed and operated to shed runoff and limit infiltration. The WRDs will have perimeter toe drains and catch dams that will collect and contain drainage from the stored waste rock (Figure 6-4). WRD drainage in catch dams will be re-used for mine water supply. Any excess WRD drainage water will be released in accordance with EA controlled release conditions. Runoff from the Northern MIA, located immediately south of the Northern WRD, will also be collected in a catch dam (MIA CD) and transferred to the Northern WRD catch dam.

The EA controlled release conditions will be designed to ensure any controlled releases do not result in environmental harm to the receiving environment. The controlled release water quality limits will align with the relevant *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) limits for aquatic ecosystem protection and/or baseline receiving water quality. They will also account for the relevant contaminants of concern from the mining activities, in order to ensure the protection of the receiving environment, including downstream aquatic ecology.

Central WRD

The Central WRD will also store predominantly NAF waste rock but will also include a co-placement cell for the storage of potentially acid forming (PAF) mine wastes (PAF waste rock and dewatered tailings). The co-placement cell will be located in the centre of the WRD and will be surrounded by a large volume of NAF waste rock with significant excess acid neutralising capacity (Figure 6-4). The co-placement cell waste materials will make up approximately 15% of the total mine waste stored in the Central WRD. All runoff and seepage from the PAF mine waste stored in the co-placement cell will be collected and transferred to Mine Water Dam 2 (MWD2) for containment and re-use as mine water supply. Drainage from the eastern slope of the Central WRD will also be directed to MWD2 for containment.

Similar to the Northern and Southern WRDs, the NAF waste rock perimeter of the Central WRD, beyond the central co-placement cell, will be designed and operated to shed runoff and limit infiltration. Drainage from the NAF waste rock around northern, western and southern perimeter of the Central WRD will be collected in perimeter toe drains and directed to catch dams for storage (Figure 6-4). WRD drainage stored in collection dams will be re-used for mine water supply. Any excess WRD drainage water will be released in accordance with EA controlled release conditions.

The rehabilitation of the Central WRD will include the installation of a store and release cover on the final surface of the co-placement cell to minimise rainfall infiltration and seepage through the co-placement cell. Any residual co-placement cell seepage in the post mining phase (following rehabilitation of the Central WRD and decommissioning of MWD2) will be directed via gravity pipeline to the BVS final void for containment on site.

Temporary Ore Stockpile Area

Low grade ore will be stockpiled within the temporary ore stockpile area prior to processing during mining operations. The temporary ore stockpile area will be located within the southern end of the Central WRD footprint (Figure 3-11) and will have a compacted base to minimise seepage.

The geochemistry assessment presented in the *Geochemistry Report* (Appendix A) concluded that all of the low grade ore will be NAF with excess acid neutralising capacity. The low grade ore will therefore have a high factor of safety with respect to potential for acid generation and drainage water will not contain any concentrations of contaminants that could pose a risk to the downstream receiving environment.

The temporary ore stockpile area will be constructed with perimeter collection drains to direct stockpile drainage to Central WRD Catch Dam 1 (CD1) for storage and re-use as mine water supply, or release in accordance with the EA controlled release conditions.

6.6.7 Runoff from Soil Stockpiles and Cleared Areas

Runoff from areas cleared in advance of mining operations and topsoil soil stockpiles may contain potential elevated levels of suspended sediment and therefore is considered sediment-affected water.

Runoff from these areas will be allowed to passively drain from site following the control of suspended sediment. This will include collecting runoff and directing it through sediment control structures, as necessary, to limit any potential downstream sedimentation or water quality impacts.

Runoff from these areas will be managed in accordance with an Erosion and Sediment Control Plan.

6.6.8 Haul Road Runoff

Runoff from the haul roads may contain elevated levels of suspended sediment and therefore is considered sediment-affected water.

Runoff from the haul roads will be managed in accordance with an Erosion and Sediment Control Plan. This plan will include measures such as collecting haul road runoff and directing it through sediment control structures to prevent any potential downstream sedimentation or water quality impacts.

6.6.9 Runoff from Rehabilitated and Undisturbed Areas

Wherever possible, the mine layout has been designed to avoid collection of runoff from undisturbed and rehabilitated areas. Runoff from undisturbed and rehabilitated areas is considered 'clean' and, where necessary, will be diverted around (and away from) areas disturbed by mining activities, and allowed to drain from site.

6.7 WATER BALANCE

This section provides a summary of the key findings of the water balance modelling undertaken for the project to date. The *Surface Water Report* (Appendix D) provides a detailed description of the water balance modelling.

Water balance modelling has been conducted in order to simulate the performance of the mine water management system (as illustrated in Figure 6-5) and:

- Confirm the storage capacity required for mine-affected water storages to ensure total containment; and
- Confirm the make-up raw water supply required for the mine.

The model provides a dynamic simulation of the mine water management system water balance across a range of climate conditions. The performance of the WMS was simulated using a series of 133 consecutive 11-year rainfall sequences taken from the historical climate records. The performance of the WMS has therefore been evaluated for all possible combinations of mine development and recorded rainfall sequences. This includes the worst case combinations of mine development staging and high and low rainfall sequences.

The modelling was undertaken using GoldSim software. GoldSim is an operational simulation program used for modelling both natural catchments and industrial water management systems. It is industry recognised, has been used extensively throughout the Australian resource sector and is ideally suited for application to the project water balance.

The containment of mine-affected water is addressed in Section 6.7.1. The proposed project water supply is described in Section 6.7.2.

SMC will update the mine water balance modelling to include the controlled release of mine-affected water (Section 6.6.6) during development of the Water Management Plan, prior to the commencement of mining activities.

The discussion in the following sections relates to the current water balance modelling for mine-affected water, including drainage from the Central WRD co-placement cell and eastern slope. This water balance modelling does not include the collection and controlled release of drainage from the NAF WRDs and temporary ore stockpile area described in Section 6.6.6.

6.7.1 Mine Water Discharges

The management of mine-affected water has been described in Sections 6.6.2 to 6.6.5.

The detailed water balance results for the dams and in-pit water storages, including charts showing the storage capacity required for mine-affected water storages to ensure total containment, are presented in the *Surface Water Report* (Appendix D).

Table 6-3 provides a summary of the predicted median and maximum stored water volumes in each water storage over the life of the mine. Table 6-3 also shows the required storage capacity for mine-affected water storages to fully contain the predicted maximum stored water volume. These modelling results show that:

- On average, over the life of the mine the MIA Dam and BV1/BV2 Pit storages will be empty and the Mine Water Dams, TSC Stormwater Pond and HLF Stormwater Pond will contain relatively small volumes of mine-affected water.
- All mine-affected water storages have sufficient capacity to store the predicted maximum volume of mine water at all times over the life of the mine.
- These results demonstrate that the mine water management system has been designed to operate as a total containment system and that there will be no requirement to discharge mine water during the most extreme wet periods.

Table 6-3 Mine-Affected Water Storage Volumes and Required Design Capacities for Total Containment (ML)

WATER STORAGE	MEDIAN STORED WATER VOLUME[1]	MAXIMUM STORED WATER VOLUME	DESIGN STORAGE CAPACITY	MAXIMUM PREDICTED DISCHARGE VOLUME
TSC Stormwater Pond	36	509	550	0
HLF Stormwater Pond	9	109	140	0
MWD1	157	325	330	0
MWD2	67	413	450	0
MIA Dam	0	67	75	0
BV1 Pit Storage	0	244	271	0
BV2 Pit Storage	4	56	60	0

[1] Peak median volume over the life of mine.

6.7.2 Project Water Supply

The annual project water demands are summarised in Table 6-4.

Table 6-4 Annual Project Water Demands (MLpa)

WATER DEMAND	PROJECT YEARS 1 AND 2	PROJECT YEAR 3	PROJECT YEAR 4 ONWARD
Process Demand	150	642	442
Dust Suppression	300	250	250
Potable Demand	40	40	40
TOTAL DEMAND	**490**	**932**	**732**

The project water supply system is shown in Figure 6-5 and comprises:

- Reuse of mine-affected water from the TSC Stormwater Pond as the priority supply for process water demand.
- Reuse of mine-affected water from MWD1 and MWD2, as:
  - The priority supply for dust suppression; and
  - A secondary supply for process water demand.
- Use of raw water sourced from the Woolgar River off-take to:
  - Make up any shortfall in mine-affected water supply to process water demand and dust suppression; and
  - Supply the project potable water demand.
- Access to a contingency raw water supply from the Sandy Creek Dam in the unlikely event that raw water is not available from the Woolgar River off-take.

Mine-affected water will be pumped from the TSC Stormwater Pond and MWD2 to the Process Water Dam, via dedicated pipelines. The Process Water Dam will be located adjacent to the CIL Plant (Figure 6-4) and will be the priority water source for the plant. The Process Water Dam will have a design storage capacity of approximately 10 ML and nil external catchment. The initial consequence category assessment concludes the Process Water Dam will be a regulated dam. The Process Water Dam has been sized to maintain approximately one week buffer water supply for the CIL Plant. The Process Water Dam has been sized, and will be managed, to ensure nil overflow. Water stored in the Process Water Dam will be pumped to the CIL Plant via a dedicated pipeline and used to supply process water demands.

Water will be pumped from MWD2 to an adjacent water fill point and reused for dust suppression. Water will also be pumped to the Process Water Dam (as a second priority source to the TSC Stormwater Pond).

Raw water will be pumped to the Raw Water Dam from an off-take located on the Woolgar River, via a dedicated pipeline. The operation of the off-take is described in Section 6.4.2. The Raw Water Dam is a dedicated raw water supply dam located to the north of the Central WRD (Figure 6-4). The Raw Water Dam will have a design storage capacity of approximately 1,200 ML and nil external catchment. The design storage capacity is sufficient to ensure a reliable raw water supply for the project. Water stored in the Raw Water Dam will be:

- Pumped to the CIL Plant via a dedicated pipeline and used to supply process water demands, in the event of a mine water supply shortfall.
- Pumped to an adjacent water fill point and reused for dust suppression, in the event of a mine water supply shortfall.
- Pumped to a water treatment plant for treatment and use as potable water supply for the project.

Contingency raw water supply will be provided by the proponent's existing Sandy Creek Dam. Sandy Creek Dam is located in Mining Lease 90044 approximately 9.5 km north-east of the project site (Figure 6-1), and has a storage capacity of approximately 1,700 ML. During the initial stages of the project, prior to initial filling of the Raw Water

Dam, raw water will also be hauled from Sandy Creek Dam by water cart to support construction activities (e.g. for the construction of the off-take and the Raw Water Dam).

The water balance modelling results for the project water supply are presented in the *Surface Water Report* (Appendix D) and summarised in Table 6-5.

Table 6-4 Project Water Supply (MLpa)

ITEM	PROJECT YEARS 1 AND 2	PROJECT YEAR 3	PROJECT YEARS 4 TO 11
ANNUAL WATER DEMANDS			
Total Demand	490	932	732
ANNUAL WATER SUPPLIES			
Mine-affected Water	Minimum: 420 Median: 503 Maximum: 631		
Raw Water	Minimum: 101 Median: 229 Maximum: 312		

The modelling results show that:

- The water management system will generate between approximately 420 MLpa and 631 MLpa of mine-affected water that can be reused as project water supply. On average, approximately 503 MLpa of mine-affected water will be available for reuse (after allowance for evaporative losses).
- Project water demands will exceed the amount of mine-affected water that will be generated by the project from project year 3, and also generally in years 1 and 2 .
- During the project operations, between 57% and 86% of the project water demands will be met by reused mine-affected water on average. The remainder of the project water demands will be met from the raw water supply.

6.8 SURFACE WATER IMPACTS

6.8.1 Overview of Project Effects and Impacts

Project activities that have the potential to affect surface water flow and quality include:

- Mine water discharges.
- Erosion and sedimentation.
- Open cut mining effects on catchment yield and associated surface flows.
- Water supply abstraction from the Woolgar River and associated effects on downstream flows.

The project's surface water flow and quality effects have the potential to impact downstream surface water users and sensitive environmental features.

The effects of the project on surface water quality are described in Section 6.8.2. Section 6.8.3 describes the project's surface water flow effects. Sections 6.8.4 and 6.8.5 provide an assessment of the potential impacts on downstream users and sensitive environmental features. Section 6.8.6 describes the effects of climate change on

the surface water impacts of the project. Section 6.8.7 provides an assessment of the potential for cumulative impacts on surface water.

6.8.2 Surface Water Quality Effects

Mine Water Discharges

As explained in Section 6.7.1, the mine water management system modelled has been designed to operate as a total containment system for mine-affected water. This design ensures that there will be no requirement to discharge mine-affected water during the most extreme wet periods (recorded historically and/or predicted under a worst-case climate change scenario). As discussed in Section 6.7, SMC is proposing to update the mine water balance modelling to include the collection and controlled release of all drainage from the WRDs and the temporary ore stockpile area. As explained in Section 6.6.6, any controlled release of mine-affected water would be conducted in accordance with the EA controlled discharge conditions. These conditions will be specifically designed to ensure controlled releases do not result in environmental harm to the receiving environment.

Erosion and Sediment Control

The potential surface water quality effects of the project are limited to stormwater runoff from disturbed areas (that are not otherwise captured in the water management system). Stormwater runoff from disturbed areas contains suspended sediments.

Section 6.6 provides a summary of the site drainage arrangements and an overview of the erosion and sediment control measures that will be adopted.

An Erosion and Sediment Control Plan will be developed prior to commencement of construction to address erosion and the control of suspended sediment in drainage from the project site. The Erosion and Sediment Control Plan is discussed further in Section 6.9.2.

With the application of appropriate controls on runoff from disturbed areas and areas at increased risk of erosion, it is expected that the project will not result in any significant change in turbidity or suspended sediment levels in local surface waters.

6.8.3 Surface Water Flow Effects

Catchment Yield Effects from Mining Operations

Open cut mining can potentially affect surface water flows through changes to catchment yield.

The development of the mine and its associated water management system will result in the capture and diversion of runoff. During project operations, this will include runoff from contained catchments in the open cut mine and mine infrastructure area. Post mine closure, runoff to the final void catchments will be retained on site. This will result in a reduction in the total catchment runoff from the project site compared to pre-mining conditions.

During mining operations, the maximum contained catchment area is approximately 670 ha. This represents a negligible proportion (approximately 0.5%) of the upstream Woolgar River catchment area.

The conceptual final landform and post mining drainage arrangement is described in the *Progressive Rehabilitation and Closure Plan* (PRCP) (Appendix J). The final landform will contain open cut pit voids, and rehabilitated WRDs and the TSC. The final landform will be free-draining, with the exception of the final void catchments. Final void modelling undertaken as part of the *Surface Water Report* (Appendix D) shows that a permanent lake will form in the BVS Pit final void. Temporary final void lakes may also form in the BV1 Pit and BV2 Pit intermittently. The final void lake water levels are predicted to remain well below the spill point of the final voids at all times, hence the final voids will be contained catchments. The highwall drainage diversions will remain post mining to limit the final

void catchment areas. The total final void catchment area will be 170 ha (i.e. 0.13% of the upstream Woolgar River catchment area).

Runoff from the contained catchment areas during mining and post closure will therefore represent a negligible proportion of the total yield of the Woolgar River catchment at the project site. This negligible change in catchment yield is not expected to have a measurable effect on the natural surface flow regime in the Woolgar River downstream of the project site and is expected to be indistinguishable within the context of the significant natural year-to-year variations in surface water flow in the river.

Overall, no significant catchment yield effects are expected at downstream areas during mining operations and following establishment of the final rehabilitated landform.

Effects of Water Supply Abstraction

The surface water abstraction from the Woolgar River is described in Section 6.4.2 and the raw water demand is discussed in Section 6.7.2. The total steady-state water demand over the majority of the mine life is 732 MLpa.

A conservative assessment of the effects of the extraction of flow from the Woolgar River for the project has been conducted based on an average annual take of 807 ML (accounting for storage evaporative losses). This is approximately 3.5 times the mean modelled annual raw water demand (229 ML) of the project and corresponds to 2.9% of the mean annual flow in the Woolgar River at the project site.

Modelling has been undertaken to assess the effect of the water supply off-take on downstream flows in the Woolgar River. Figure 7.1 of the *Surface Water Report* (Appendix D) presents the modelling results as a flow rate exceedance graph for the Woolgar River downstream of the off-take. This graph shows the percentage of time (in days) that a daily flow rate occurs (or is exceeded) at this location. The percentage of time is expressed as a percentage of the total number of days simulated in the model. The graph shows the flow rate exceedance percentiles for existing conditions and during the operation of the off-take. The difference between the flow rate exceedance percentiles represents the effect of the off-take operation on downstream flows.

The graphed modelling results are summarised in Table 6-6. Table 6-6 shows the percentage of time that five nominal daily river flow rates occur immediately downstream of the off-take for existing conditions and during the operation of the off-take. The five nominal flow rates range from 86 to 8,640 ML/day and encompass the range of low flows that are likely to be most affected by the off-take. Table 6-6 also shows the predicted change in surface water flow frequency downstream of the off-take for the same daily flow events.

Table 6-5 Summary of Woolgar River Off-take Effects on Downstream Surface Water Flows

FLOW SCENARIO (ML/DAY)	DOWNSTREAM DAILY FLOW EXCEEDANCE (AS A PERCENTAGE OF TIME)		
	EXISTING CONDITIONS	DURING OFF-TAKE	CHANGE
86	7.92%	7.92%	No change
259	5.46%	5.46%	No change
432	4.27%	4.10%	-0.17%
864	2.60%	2.45%	-0.15%
8,640	0.04%	0.04%	No change

The modelling results presented in Figure 7.1 of the *Surface Water Report* (Appendix D) and Table 6-6 indicate that the proposed surface water take is unlikely to result in a significant change in the flow regime of the Woolgar River downstream of the off-take for the following reasons:

- The off-take is temporary and is limited to the relatively short 11 year mine life.

- The operation of the Woolgar River off-take will not change the overall frequency or duration of flows in the Woolgar River (i.e. flows in the Woolgar River are predicted on approximately 12% of all days, under existing conditions and while the off-take is operating).
- Low flow conditions (up to 432 ML/day) currently occur on approximately 8.5% of all days (i.e. 70% of the days that the river is flowing). The off-take will not operate during low flow conditions in the Woolgar River. Hence, the off-take will not have any effect on the frequency or volume of low flow conditions in the Woolgar River.
- For the remaining 30% of days when the river is flowing, the flow rate in the Woolgar River is greater than 432 ML/day. During these flow conditions, the off-take will operate at up to 130 ML/day and is predicted to result in a minor reduction in downstream river flows.
- The percentage reduction in flow will increase to a maximum when river flow is at 562 ML/day and will then proportionately reduce as the receiving flow increases. The modelled off-take corresponds to approximately 2.9% of the mean annual flow in the Woolgar River at the project site. For the 25th percentile wet year (representative of a wet year with higher river flows) the modelled off-take is 1.9% of the annual flow. For the 75th percentile dry year (representative of a dry year with lower river flows) the modelled off-take is 7.1 % of the annual flow. Given the naturally high variability in the rainfall dependent annual flows in the Woolgar River, these relatively minor reductions in flow are unlikely to be discernible from the natural variability in river flow from year to year.
- River flows above bank full flow engage the floodplain. Bank full flows in the river are conservatively estimated to be in the order of 25,920 ML/day, and significantly larger than the maximum abstraction rate of 130 ML/day. Consequently, the proposed 130 ML/day maximum rate of extraction will only represent a 0.5% reduction in bank full flow and hence is unlikely to result in any discernible change to the volume of flood flows or frequency of floodplain engagement in the Woolgar River. On this basis, the off-take will not give rise to any changes to the frequency of flooding events along the riparian zone associated with the Woolgar River.

6.8.4 Impacts on Downstream Surface Water Users

As discussed in Section 6.2, there are no surface water authorisations to take surface water from the Woolgar River downstream of the project site.

Water licences 618704 and 618703 are the nearest approved downstream surface water authorisations. These water licences authorise a combined take of 12,000 MLpa from a property located adjacent to the Stawell River, approximately 73 km downstream of the project site boundary (Figure 6-1).

As discussed in Section 6.8.3, the surface water flow modelling was undertaken to predict the effects of the project on downstream surface water flows. The modelling results show that the project is unlikely to result in a significant change in the downstream surface water flow regime. On this basis, the project is not expected to have any adverse impacts on the downstream surface water take or use at the location of these water licences, or any licensed surface water take further downstream.

Given the lack of any significant effects on downstream flows or surface water quality, the project will not adversely impact any other surface water users (e.g. recreational users).

6.8.5 Impacts on Sensitive Environmental Features

Section 8 – Aquatic Ecology provides a detailed assessment of the impacts of the project's surface water effects on aquatic habitats and species. As discussed in Section 6.6.6, any controlled releases of mine-affected water will be conducted in accordance with EA controlled release conditions that are specifically designed to protect downstream water quality and aquatic ecology.

6.8.6 Effects of Climate Change

The Queensland government has produced climate change predictions for the Gulf Region that are based on the following greenhouse gas emission scenarios:

- A likely emission scenario called the representative concentration pathway (RCP) 4.5 scenario; and
- The highest emission (i.e. worst-case) scenario called the RCP 8.5 scenario.

It should be noted that these are presented in terms of change from the baseline climate conditions. The baseline climate conditions are the average conditions that occurred during the period 1986 to 2005.

For the high emission scenario, the predicted worst case changes in seasonal rainfall over the mine life are summarised as follows:

- Average summer rainfall is predicted to decrease by 0.3%.
- Average winter rainfall is predicted to decrease by 9.4%.
- Average spring rainfall is predicted to increase by 5.4%.
- Average autumn rainfall is predicted to increase by 1.3%.

For context, it should also be noted that:

- The Paris Agreement on climate change came into force in 2016 and aims to hold the increase in the global average temperature to below 2°C above pre-industrial levels, and pursue efforts to limit temperature increase to 1.5°C. An RCP of approximately 1.9 is required to limit temperature increases to 1.5°C. Hence, the high emission scenario discussed above is conservative.
- The project has a limited operating life of approximately 11 years. Hence, longer term climate changes are not relevant to the project operations.
- The project surface water assessment is based on recent climate data up to 2022. Hence, the data used to inform the surface water assessment already includes a proportion of the predicted changes discussed above.

The effects of the predicted climate changes on the proposed water management system will be a potential minor reduction in the long-term accumulated rainfall runoff within the system, but an increase in short-term storm events. Given the nature of the water management system (i.e. it is based on total containment of mine water) changing rainfall patterns could potentially affect the operation of the system. However, the proponent will be required to adaptively manage the effects of these changes throughout the life of the project through regular updates to the Water Management Plan.

As discussed in Section 6.4.1, the guideline *Structures which are dams or levees constructed as part of environmentally relevant activities* (DETSI, 2025) requires that a levee is constructed to prevent the ingress of flood water into open cut mining areas during flood events up to the 0.1% (1 in 1,000) AEP. The open cut pits are located at least 8 m above the 0.1% (1 in 1,000) AEP flood level associated with the Woolgar River (Figure 6-4). Hence, the open cut mine layout has a high factor of safety in relation to flood inundation during the 0.1% (1 in 1,000) AEP flood event. Any future change in the magnitude or frequency of 0.1% (1 in 1,000) AEP flood events (due to high or low emission scenarios) is likely to be within this factor of safety.

The site drainage system has been designed with capacity to convey rainfall generated by large storm events. However, extreme storm events will still exceed this design capacity under current climate conditions. The Erosion and Sediment Control Plan will include a program for monitoring and upgrading the erosion and sediment control measures to ensure that they continue to operate effectively and in accordance with the EA conditions. These measures will be sufficient to manage any effects on the site drainage system due to any changes in the frequency of extreme rainfall events over the life of the project.

Overall, the site drainage arrangements and the conservatism in the flood modelling assumptions ensure that any increase in extreme rainfall events as a result of climate change is not likely to give rise to any additional environmental impacts.

6.8.7 Cumulative Impacts

There are no existing or approved resource projects in the vicinity of the project site or in the Stawell River catchment that could potentially contribute to cumulative surface water impacts with the project. The Stawell River joins the Flinders River approximately 187 km downstream of the project site. The project is therefore not likely to have any significant contribution to cumulative impacts on the Flinders River.

6.9 SURFACE WATER MANAGEMENT AND MONITORING

Sections 6.9.1 and 6.9.2 provide an overview of the environmental management plans relevant to the management of surface water impacts from the project. These management plans are standard EA requirements and will be prepared by the proponent prior to commencement of the project.

The proponent will also implement a surface water monitoring program. The surface water monitoring program components are outlined in Sections 6.9.3 to 6.9.5 and include a WMS monitoring program, a REMP and a dam monitoring program.

6.9.1 Water Management Plan

The EA will include a condition that requires the development and implementation of a Water Management Plan.

The proponent will prepare a Water Management Plan, prior to the commencement of mining activities, that addresses the following standard requirements:

- Provide for effective management of actual and potential environmental impacts resulting from water management associated with the mining activities; and
- Be developed in accordance with relevant guidelines and include:
  - A study of the source of contaminants;
  - A water balance model for the site;
  - A WMS for the site;
  - Uncontrolled release prevention and management measures;
  - Measures to manage and prevent saline drainage;
  - Measures to manage and prevent acid rock drainage;
  - Contingency procedures for emergencies; and
  - A program for monitoring and review of the effectiveness of the Water Management Plan.

The Water Management Plan will be reviewed and updated annually to ensure that it continues to operate effectively.

The annual Water Management Plan reviews will typically involve:

- Inspection of the water management infrastructure and potential sources of contaminants;
- Review of monitoring results;
- Site water balance modelling updates, as necessary; and
- Review and update of management measures and contingency procedures, as necessary.

As discussed in Section 6.7, SMC will update the mine water balance modelling to include the containment and controlled release of mine-affected water, including drainage from the NAF WRDs and temporary ore stockpiles (Section 6.6.6), during development of the Water Management Plan. The EA controlled release condition details will also be finalised at this time including the release points, release and receiving water quality limits, release and receiving water flow rates, and release monitoring program. Indicative controlled release points are shown in Figure 6-6. The final release points will be confirmed during the development of the Water Management Plan.

6.9.2 Erosion and Sediment Control Plan

The proponent will develop and implement an Erosion and Sediment Control Plan for all stages of the project.

The Erosion and Sediment Control Plan will address the management of erosion and sedimentation within the project site and downstream areas.

The Erosion and Sediment Control Plan will be prepared in accordance with the BPESC guideline and a tiered approach to the control of erosion and sediment, including (in order of priority): controlling erosion through soil management, controlling erosion through drainage management, and controlling sedimentation.

The following soil management strategies will be implemented (where practical) to control erosion:

- A Ground Disturbance Permit process will be utilised for all ground disturbance, and includes consideration of the potential for disturbance to cause erosion and sediment issues;
- Vegetation clearing will be conducted progressively so that the minimum area necessary for construction and operations is cleared at any time;
- Earthmoving plant operators will be trained and/or supervised to ensure that ground disturbance is conducted in accordance with erosion and sediment control requirements;
- Earthworks batters will be constructed to stable slopes and revegetated soon after construction;
- Earthworks areas will be landscaped and revegetated as soon as possible after construction is completed; and
- Disturbed mining areas will be progressively rehabilitated once they become available.

The overarching drainage strategies to control erosion are as follows:

- Drainage will be diverted around disturbed areas, where practical, to prevent erosion;
- Erosion protection will be installed where necessary to limit erosion of disturbed areas; and
- Slope drainage controls will be installed where necessary to limit slope lengths and runoff velocities from disturbed areas.

The sedimentation management strategy involves the installation of sediment controls downstream of disturbed areas to collect any suspended sediment prior to stormwater drainage from the site. Proposed sediment controls include:

- Sediment traps and sumps; and
- Settling ponds and sediment dams.

The Erosion and Sediment Control Plan will include a program for regular monitoring and maintenance of all erosion and sediment controls to ensure their continued proper functioning.

6.9.3 Water Management System Monitoring Program

The purpose of the WMS monitoring program is to:

- Comply with the EA monitoring requirements for water storages and regulated structures;
- Monitor the WMS storage capacity and stored water inventory;
- Confirm the site water demands and water supply volumes; and
- Inform future updates to the water balance that enable the ongoing assessment of water supply reliability, containment of mine-affected water and refinement of water management strategies.

The proposed WMS monitoring program includes:

- Daily monitoring of rainfall and evaporation at an on-site weather station;
- Routine (at least monthly) monitoring of all mine water transfer volumes, water storage levels and stored water volumes;
- Routine water quality monitoring (at least quarterly) for mine water storages. Water quality monitoring will include pH, electrical conductivity, total suspended solids, turbidity and a suite of metals and metalloids.
- An annual survey of the project water storage capacity, prior to the onset of the wet season; and
- Monthly monitoring of all project water demands.

The surface water monitoring program is presented in Table 6-6 and shown in Figure 6-6. The monitoring sites include all mine-affected water storages and the raw water dam, the drainage features traversing the project site upstream and downstream of the potential influence from mining activities, and the Woolgar River upstream and downstream of the potential influence of the mining activities. Water quality monitoring parameters will be confirmed during the development of the Water Management Plan. These will be based on a suitable baseline monitoring dataset and with consideration of the relevant contaminants of concern for the mining activities.

Table 6-6 Surface Water Monitoring Program

SITE	WATER TYPE / SOURCE	MONITORING FREQUENCY
DAM/STORAGE/PIT MONITORING		
TSC TSC SWP HLF SWP Process Water Dam MIA Dam MWD1	Tailings water Tailings water, Tailings Storage Cell runoff Heap Leach Facility runoff Process water supply Mine Industrial Area runoff BV1, BV2, BVS pit water	Monthly
MWD2-1 MWD2-2 MWD2-3	C-WRD Co-placement Cell runoff C-WRD Co-placement Cell seepage C-WRD drainage	
MWD2	As above	
CD1 CD2 CD3	C-WRD drainage (NAF waste)	
Raw Water Dam	Woolgar river offtake	
CD4	N-WRD drainage Northern MIA Catch Dam transfers	
CD5	S-WRD drainage	
BV1 Pit	Pit water/stored mine water	
BV2 Pit	Pit water/stored mine water	
BVS Pit	Pit water	
SITE DRAINAGE MONITORING		
DF1-MP1	Drainage Feature 1 – Upstream site	Weekly during flow events
DF1-MP2	Drainage Feature 1 – Downstream site	
DF1-MP3	Drainage Feature 1 – Upstream of Woolgar river	
DF3-MP1	Drainage Feature 3 – Upstream site	
DF3-MP2	Drainage Feature 3 – Downstream site	
WR-US	Woolgar River – Upstream of site	
WR-DS	Woolgar River – Downstream of site	

6.9.4 Receiving Environment Monitoring Program

The Water Management Plan will be operated in parallel with a REMP.

The proponent will develop and implement a REMP in accordance with the EA conditions to monitor, identify and describe any adverse impacts to downstream surface water quality, flows and associated environmental values due to mining activities, including any controlled releases of mine-affected water.

The REMP will address the following standard EA requirements:

- Assess the condition of receiving waters within the REMP area, including background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);
- Be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;
- Include monitoring from background reference sites (e.g. upstream or background sites) and sites located downstream of the release. These will include relevant site drainage monitoring sites from Table 6-7 (Figure 6-6);
- Specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the *Queensland Water Quality Guidelines* (DERM, 2009);
- Include monitoring and assessment of relevant parameters in surface waters and, where appropriate, sediments and macroinvertebrates;
- Describe sampling and analysis methods and quality assurance and control; and
- Incorporate stream flow and hydrological information in the interpretations of water quality and biological data.

The REMP findings will be reviewed and reported annually by an appropriately qualified person and provided to the DETSI upon request. The annual REMP report will specifically:

- Include all monitoring results collected from the REMP;
- Provide analysis and interpretation of the monitoring results;
- Provide an assessment of:
  - Background reference water quality;
  - Downstream water quality;
  - Compliance with relevant water quality objectives; and
  - The suitability of the current discharge criteria to protect downstream environmental values.

The annual REMP report will also include recommended actions and timeframes to ensure actual and potential environmental impacts are effectively managed, and identification of any amendments required to the REMP.

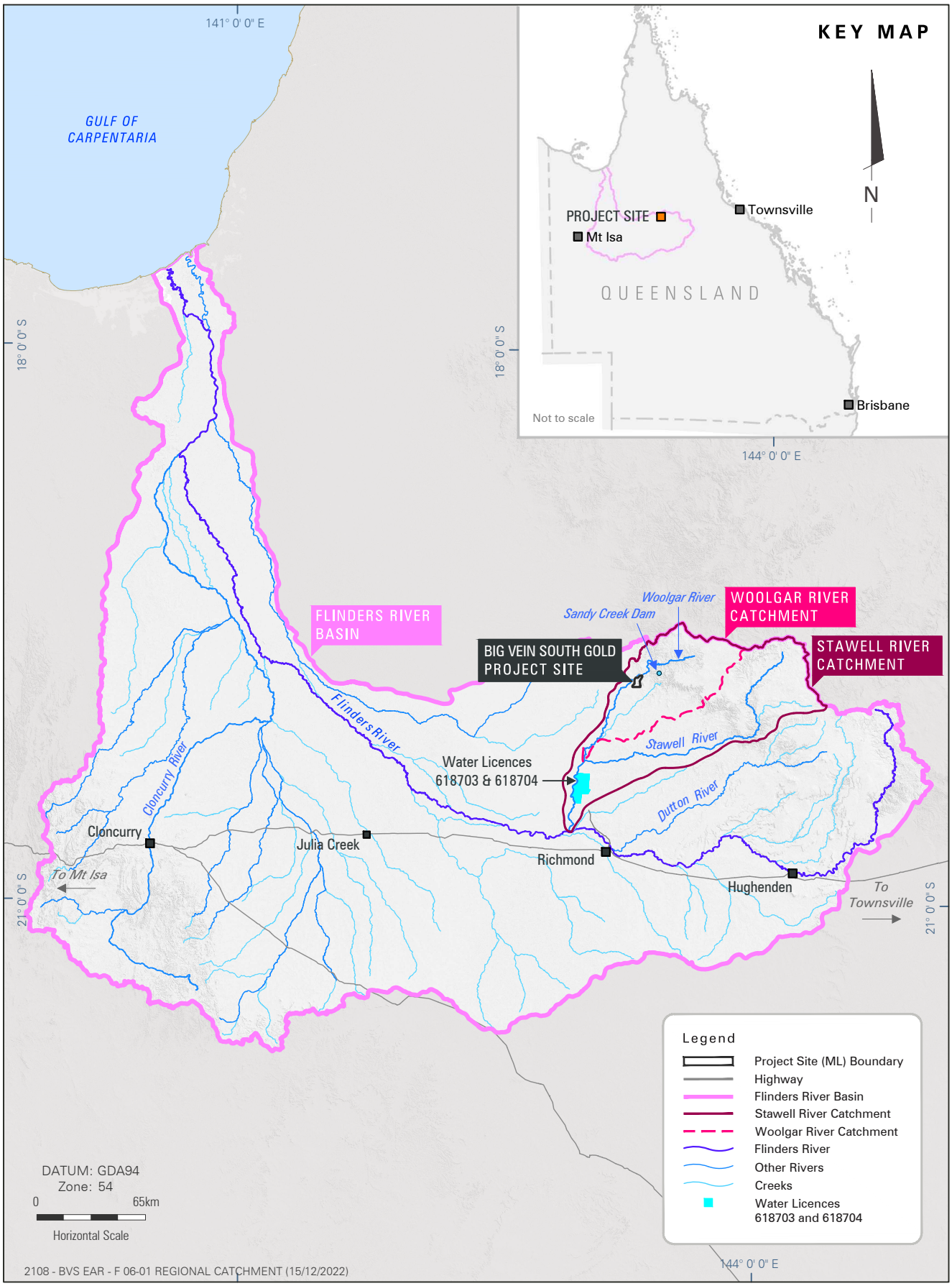
6.9.5 Dam Monitoring Program

A regulated dam monitoring program will be established and maintained throughout the operating life of the mine to maintain the structural integrity of the dams and ensure that there are no significant risks of adverse effects on downstream surface waters. The dam monitoring program will address the EA requirements for regulated dams and will include:

- Regular inspections and annual survey of the dam embankments and storage areas;
- Regular inspection of the dam spillways;
- Annual engineering inspection of the dam embankments and spillways; and
- Surface water monitoring in accordance with the surface water monitoring program, including the stored water volume and level.

If the monitoring program identifies structural issues, the proponent will undertake detailed engineering assessments and corrective actions, as required. This monitoring and management process ensures the early identification of any potential safety and environmental risks associated with the operation of the dams.

FIGURES

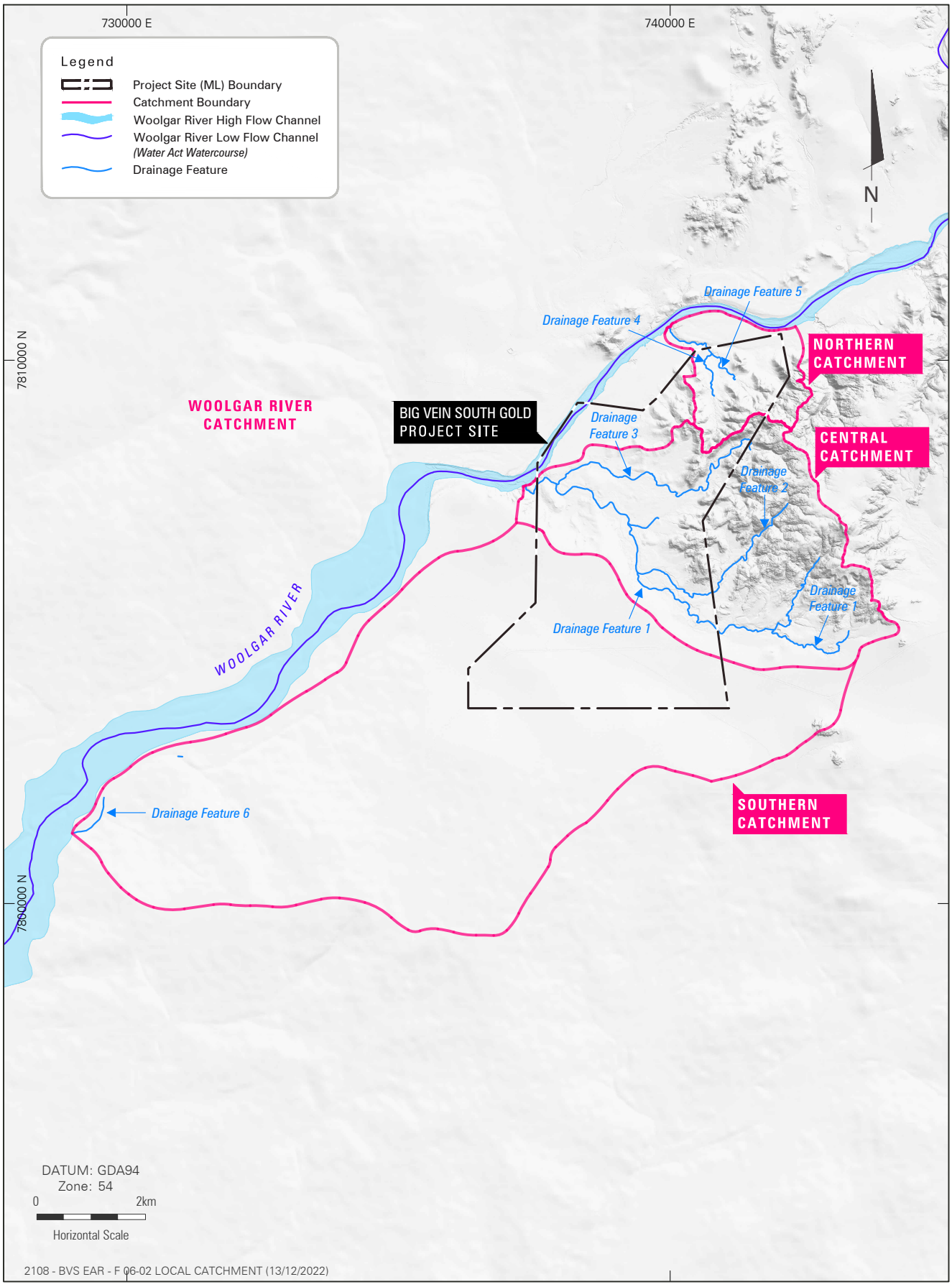


BIG VEIN SOUTH GOLD PROJECT

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Regional Catchment Setting

FIGURE 6-1

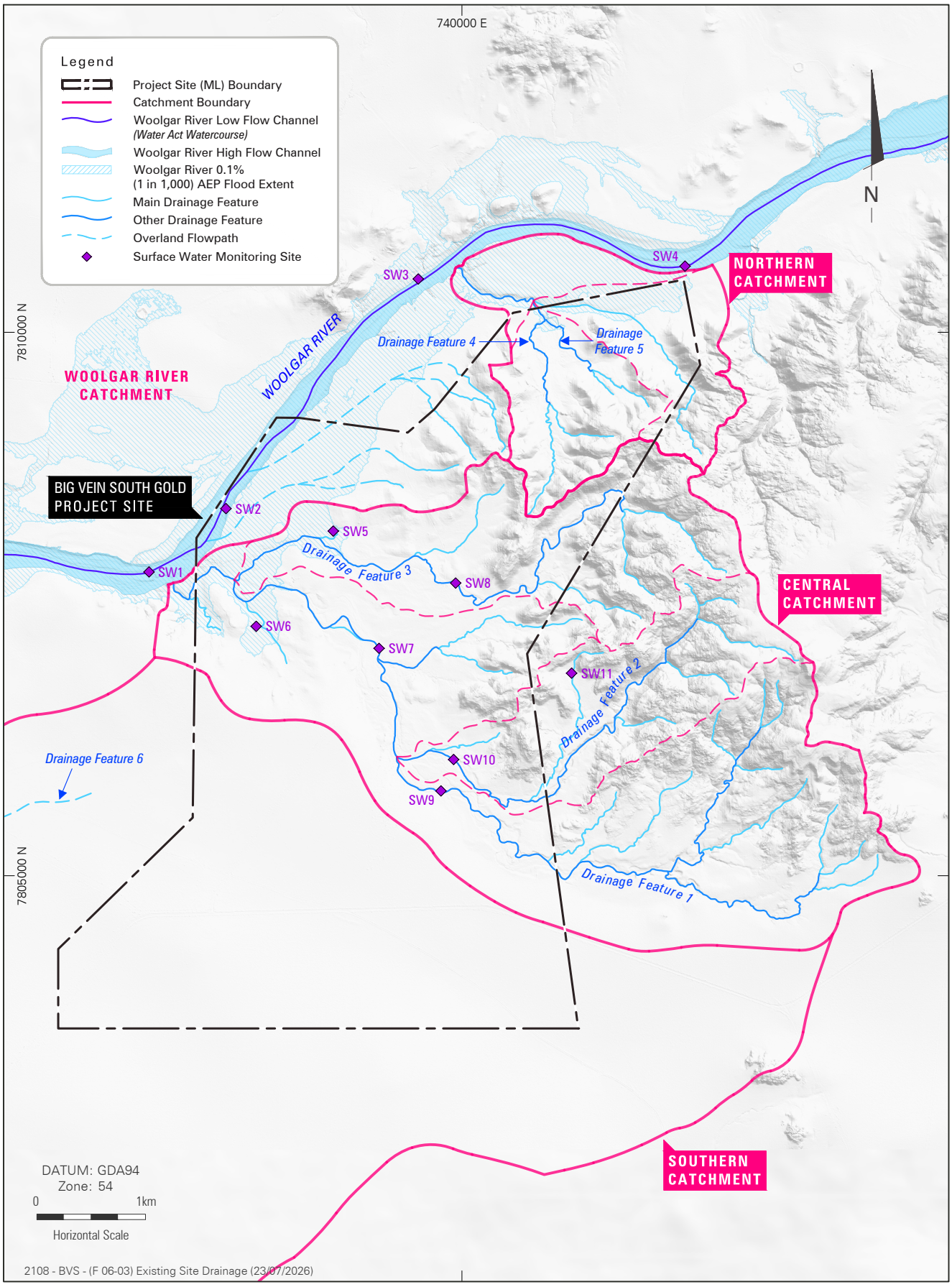


BIG VEIN SOUTH GOLD PROJECT

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Local Catchment Setting

FIGURE 6-2

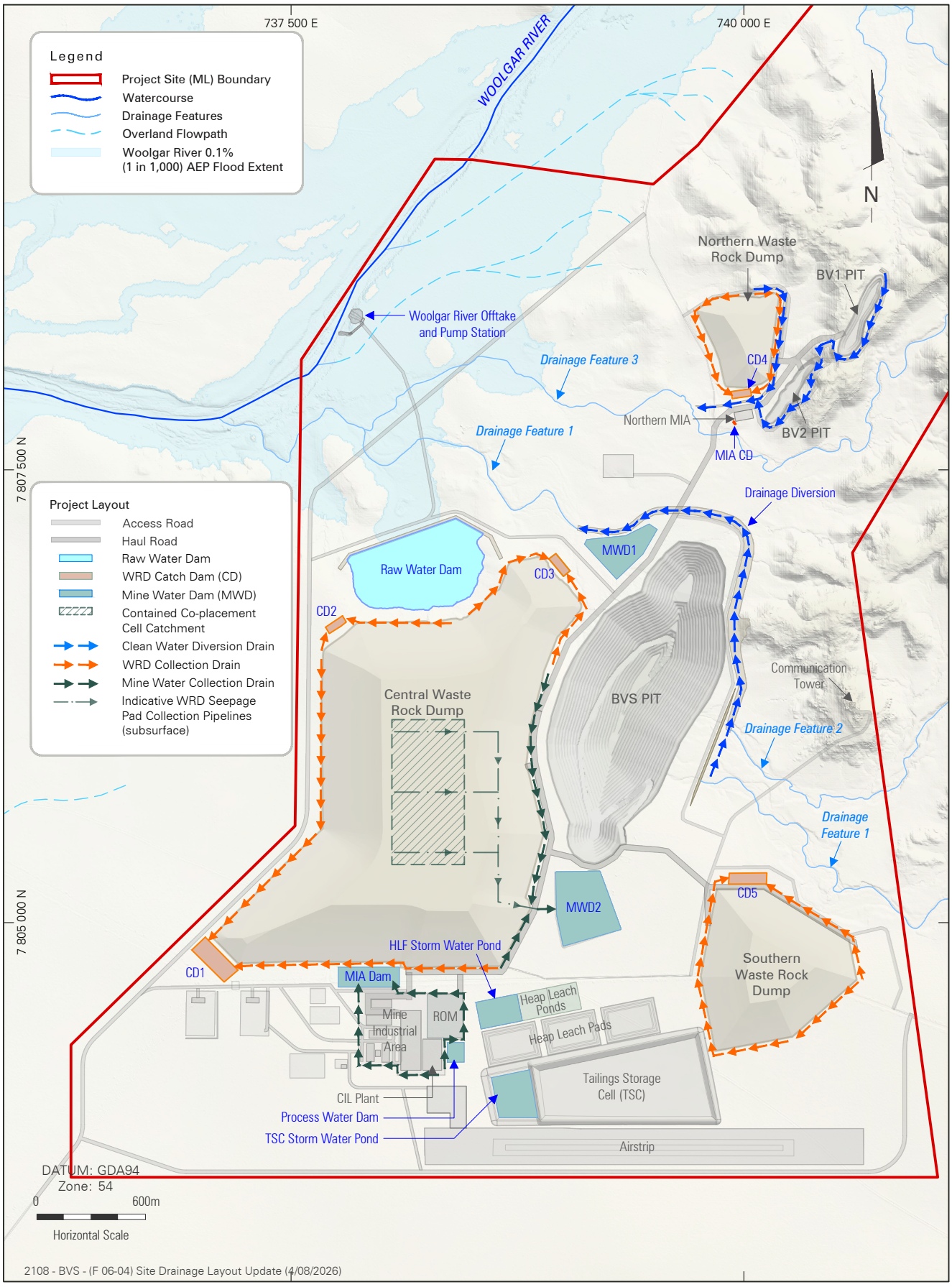


BIG VEIN SOUTH GOLD PROJECT

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Existing Drainage

FIGURE 6-3

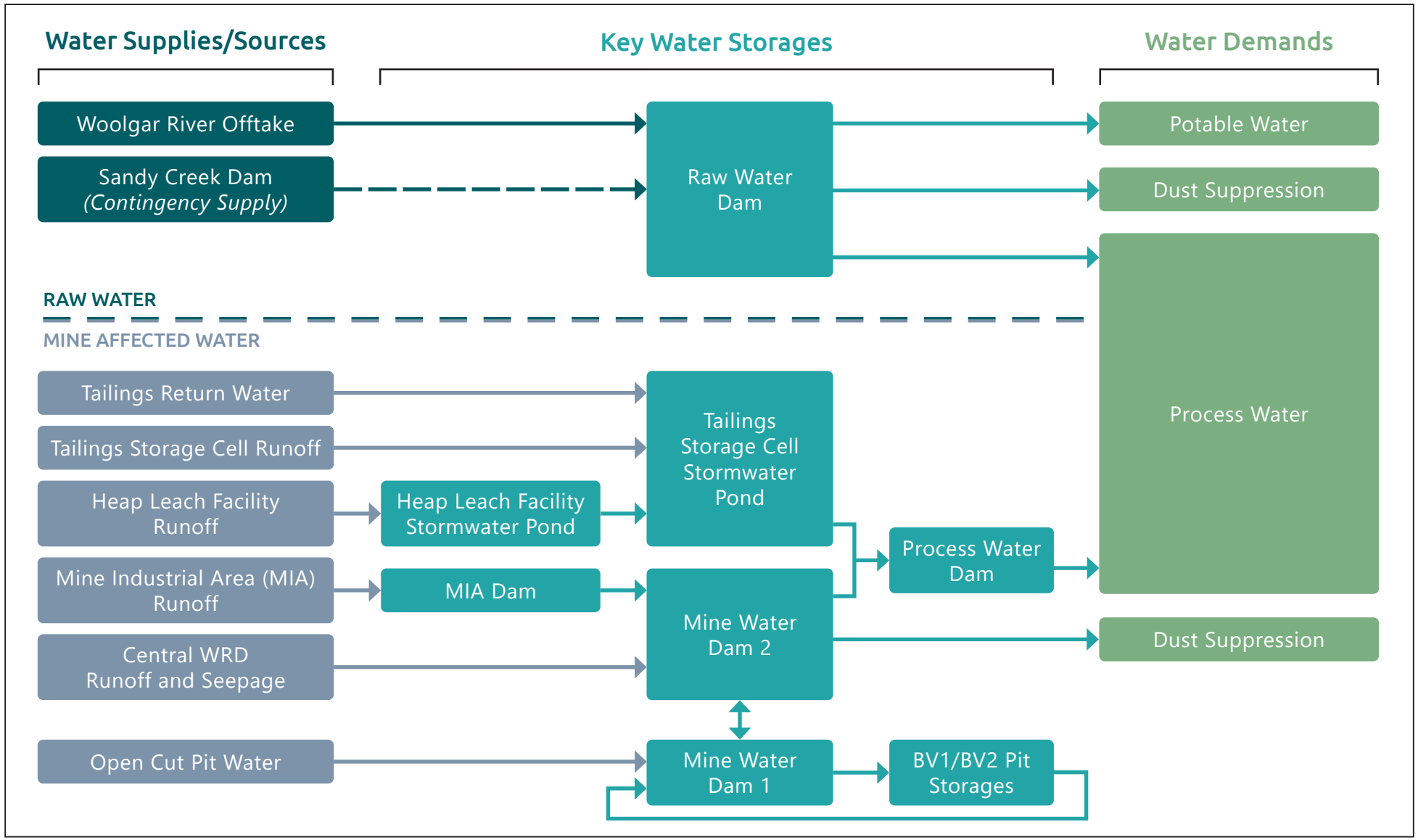


BIG VEIN SOUTH GOLD PROJECT

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Site Drainage and Water Management
Infrastructure Layout

FIGURE 6-4

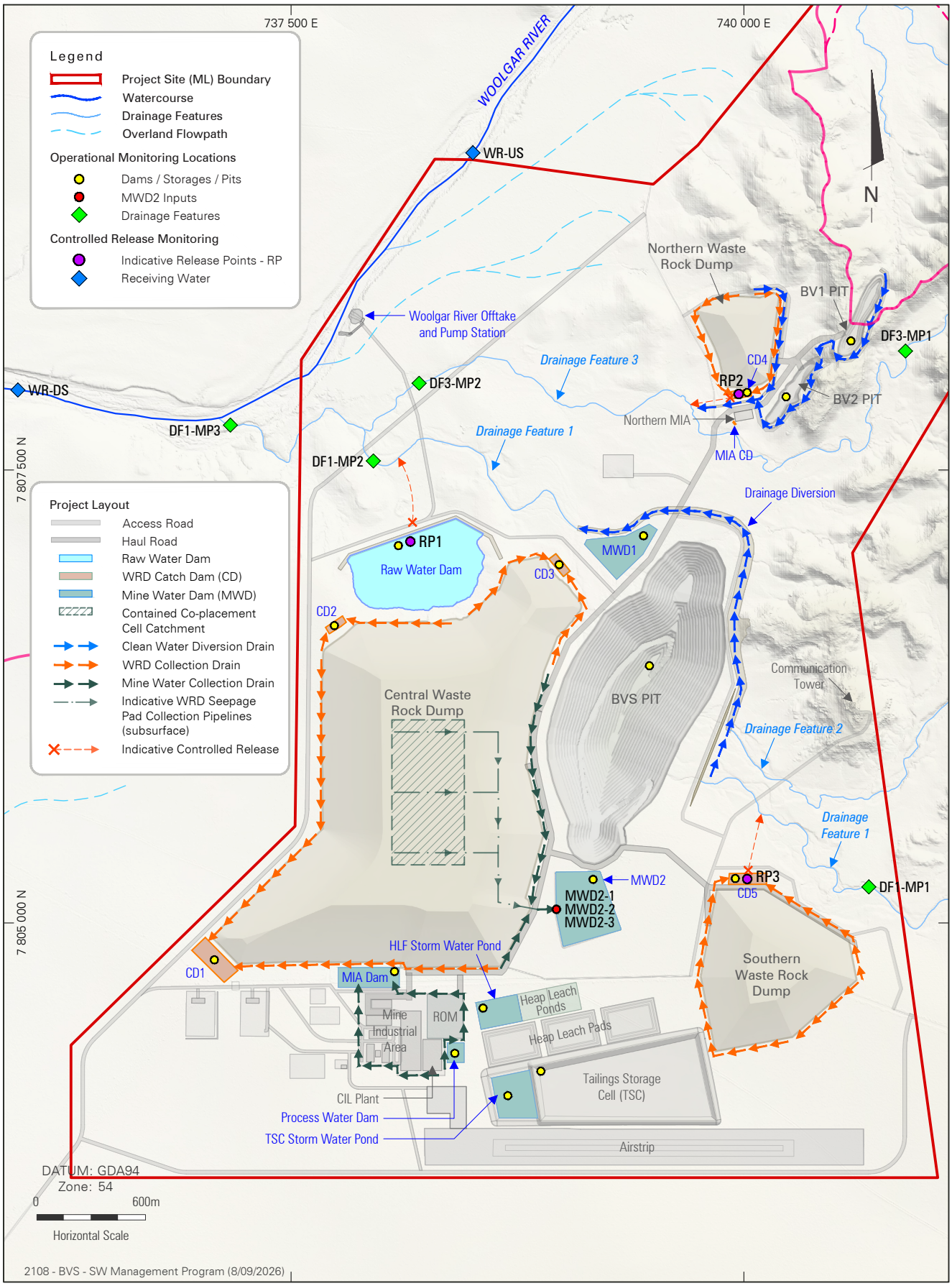


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BIG VEIN SOUTH GOLD PROJECT

Water Supply Schematic

FIGURE 6-5



BIG VEIN SOUTH GOLD PROJECT

Surface Water Monitoring Program

FIGURE 6-6

7

TERRESTRIAL ECOLOGY



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7 TERRESTRIAL ECOLOGY

7.1 INTRODUCTION

This section provides a summary of the key findings of the terrestrial ecology assessment undertaken for the Big Vein South Gold Project (the project). The terrestrial ecology assessment was undertaken by Ecological Survey and Management Pty Ltd and the detailed report is provided in the *Terrestrial Ecology Report* (Appendix E). It also includes a summary of the key findings of the assessment of Groundwater Dependent Ecosystems (GDEs) described in the *GDE Report* (Appendix K).

7.2 PROJECT SETTING

The project site is shown in Figure 7-1 and covers an area of approximately 2,281 ha. The terrestrial ecology study area is the entire project site. The project site is within the Gulf Plains Bioregion. The northern half of the project site is within the Gilberton Plateau sub-region and the southern half of the project site is within the Claraville Plains sub-region.

The project site is located on the south-western edge of the Gregory Range with the eastern part of the project site characterised by an elevated plateau area that slopes down gradually to the west towards the Woolgar River. There are numerous ephemeral drainage lines that traverse the project site and flow to the Woolgar River to the west.

7.3 REGULATORY REQUIREMENTS

7.3.1 Environment Protection Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth government's principal piece of environmental legislation that is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DEECCW). It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, threatened ecological communities, migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes to their survival and provides for the preparation of recovery plans for threatened flora and fauna.

The project was referred to DCCEEW and was determined to be a controlled action under the EPBC Act (EPBC 2025/10252) on 12 September 2025 with listed threatened species and communities being confirmed as the relevant controlling provision. As stated in the Queensland *Environmental Offsets Act 2014* (EO Act), an offset for a prescribed environmental matter which has been assessed under the EPBC Act (i.e. dual listed Matter of State Environmental Significance (MSES)), is not subject to offset conditions under the EO Act. If offsets are required for dual listed species and vegetation communities, they will be provided under the EPBC Act. This assessment, therefore, focusses on the residual MSES (i.e. the MSES that are *not* dual listed under the EPBC Act).

EPBC Act Guidance Materials

A variety of documents have been produced in accordance with the requirements of the EPBC Act to provide guidance on listed threatened species, key threatening processes that may impact those species, and survey techniques for the species. In addition, recovery plans and conservation advice are available for many species. These documents were consulted in assessing the baseline terrestrial ecology values and the potential impacts on EPBC Act listed species.

7.3.2 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) is administered by the Department of Resources. The VM Act, in conjunction with the *Planning Act 2016* (Planning Act), regulates the clearing of native vegetation in Queensland.

The VM Act does not apply to mining activities undertaken on mining leases. It is, however, relevant to the terrestrial ecology assessment because it classifies remnant vegetation into Regional Ecosystems (REs) which form the basis of the assessment of vegetation communities. REs are assigned one of the following three conservation status categories: Endangered; Of Concern; or Least Concern.

The Queensland government also assigns a biodiversity status to each RE, in addition to the status under the VM Act. The biodiversity status has no formal regulatory meaning under the VM Act but is used for a variety of planning and management applications.

7.3.3 Nature Conservation Act 1992

The Queensland *Nature Conservation Act 1992* (NC Act) is the principal legislation which establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Animals) Regulation 2020* (NC Animals Regulation) and the *Nature Conservation (Plants) Regulation 2020* (NC Plants Regulation). The NC Act is administered by the Department of Environment, Tourism, Science and Innovation (DETSI).

It classifies native flora and fauna species into specific categories including Extinct in the Wild; Critically Endangered; Endangered; Vulnerable; Near Threatened; Least Concern; or Special Least Concern.

The NC Act and associated regulations require that the following approvals be obtained, where relevant to the project:

- Where there is an Endangered, Vulnerable or Near Threatened (EVNT) flora species known by the proponent to be present within the project's clearing footprint (or within 100 m), and the project is not an exempt activity, a protected plant clearing permit is required under Section 85 of the NC Plants Regulation.
- Where there is a high-risk area (HRA) within the project's clearing footprint, as identified on the DETSI flora survey trigger map and the project is not an exempt activity, a formal flora survey and/or protected plant clearing permit would be required under Section 141 of the NC Plants Regulation. The flora survey trigger map identifies HRAs where EVNTs are known or likely to occur across Queensland. Projects that require clearing within a HRA must engage a suitably qualified person to undertake a flora survey of the clearing impact area and report to DETSI. If a protected plant is found to occur within the project's clearing footprint or within 100 m, the proponent must obtain a protected plant clearing permit. There are no HRAs within the project site.
- Where the project activities may cause disturbance to animal breeding places, the proponent must prepare a Species Management Program (SMP) under Section 335 of the NC Animals Regulation and obtain approval from DETSI;
- Where it is necessary to remove animals posing a threat to human health or property, a Damage Mitigation Permit is required under Section 166 of the NC Animals Regulation; and
- Any spotter catcher employed for the project must be in possession of a Rehabilitation Permit (spotter catcher endorsement) for managing fauna during clearing activities (Section 335 of the NC Animals Regulation).

7.3.4 Biosecurity Act

The *Biosecurity Act 2014* (Biosecurity Act) provides a framework for the control and management of pests, weeds, diseases, and contaminants, and creates an overarching general biosecurity obligation for the State. The key principle of the Biosecurity Act is shared responsibility amongst all individuals and organisations in Queensland for the mitigation of biosecurity risks.

The Biosecurity Act lists biosecurity matters as either prohibited or restricted. Prohibited matters are biosecurity matters that are not yet found in Queensland. Restricted matters are biosecurity matters found in Queensland that require restrictions to reduce, control or contain the matter. The Biosecurity Act details seven categories of restricted matters, based on the level of mitigation required. Some restricted matters fall into multiple categories, and therefore require several different management measures for their control. The Biosecurity Act is administered by the Department of Agriculture and Fisheries.

7.3.5 Government Mapping of Wetlands and Watercourses

Map of Referable Wetlands

DETSI has prepared a map of referable wetlands that includes Wetland Protection Areas, that comprise wetlands of high ecological significance (HES wetlands) located within Great Barrier Reef catchments, and trigger areas that represent the area of hydrological influence of HES wetlands. Wetland Protection Areas are a MSES. The map of referable wetlands also includes wetlands of general ecological significance (GES wetlands), however, GES wetlands are mapped for the purpose of establishing environmental values and are not protected wetlands. Wetlands are discussed in the *Aquatic Ecology Report* (Appendix F) and EAR Section 8 – Aquatic Ecology.

Vegetation Management Wetlands Map

The Queensland Government has produced a Vegetation Management Wetlands Map that shows wetlands as defined under the VM Act. This map is used primarily to regulate vegetation clearing in areas mapped as wetlands. Remnant vegetation that intersects an area shown as a wetland on the Vegetation Management Wetlands Map, to the extent of the intersection, is considered to be a MSES. There are no vegetation management wetlands mapped within the project site. Two of the mapped REs (RE 2.3.26b and 2.3.50a) are described by DETSI as being riverine REs. These REs may support an occasional depression that holds water for an extended period of time, but they are not wetlands under the VM Act.

7.3.6 Vegetation Management Watercourse and Drainage Feature Map

The Queensland Government has produced a Vegetation Management Watercourse and Drainage Feature Map that shows watercourses and drainage features, as defined under the VM Act. The VM Act definition of a watercourse is the same as the *Water Act 2000* definition of a watercourse. There are several drainage features within the project site as defined under the VM Act and the Woolgar River is the only watercourse within the project site (Figure 7-1). Remnant vegetation located within a defined distance of a VM Act watercourse and/or drainage feature is considered to be a MSES.

7.3.7 Queensland Environmental Offsets Framework

The EO Act, *Environmental Offsets Regulation 2014* (EO Regulation), and *Queensland Environmental Offsets Policy 2020* (Version 1.9) (QEOP) comprise the Queensland Environmental Offsets Framework. According to this framework, it is necessary to provide offsets for any significant, residual impacts on MSES, including regulated vegetation under the VM Act, and habitat for Critically Endangered, Endangered, Vulnerable or Special Least Concern fauna species listed under the NC Act. There is no requirement under the EO Act to offset impacts to NC Act listed Least Concern, Near Threatened or Special Least Concern (migratory) species. The *Queensland*

Environmental Offsets Policy Significant Residual Impact Guideline (SRI Guideline) was developed to assist proponents in determining whether an activity will, or is likely to, have a significant residual impact on a MSES.

For significant residual impacts to any non-dual listed MSES, offsets will be provided under the Queensland Environmental Offsets Framework. Offsets are discussed further in Section 7.6.2. Offset requirements under the EO Act are conditioned in the EA, as provided for under the *Environmental Protection Act 1994*.

7.4 METHODOLOGY

The methodology for the terrestrial ecology assessment included a desktop assessment (comprising database analysis and literature review), field surveys and data analysis. These are discussed in the following sections.

7.4.1 Desktop Assessment

A desktop terrestrial ecology assessment was undertaken prior to the field surveys. The assessment was conducted to obtain background information on the potential presence and distribution of species and ecological communities (listed under the EPBC Act and Queensland legislation) and information on the vegetation and topography of the project site, as well as to understand potential habitat values.

The desktop assessment involved database searches, interpretation of recent high-resolution aerial photography, review of the published vegetation mapping, and reviews of previous flora and fauna studies undertaken within proximity to the project site.

The information from the desktop assessment was used to refine the field survey methodology in order to target a wide range of vegetation communities and terrestrial flora and fauna species, including listed species and communities.

7.4.2 Field Surveys

A summary of the field surveys is provided in the following sections. Further details are provided in the *Terrestrial Ecology Report* (Appendix E).

Survey Effort and Timing

Multi-season terrestrial flora and fauna surveys were conducted for the terrestrial ecology assessment. The field survey program is summarised in Table 7-1. The survey effort consisted of:

- A total of 31 flora survey days in the early dry season of 2016 and 2021 and the early wet seasons of 2015 and 2017; and
- A total of 30 fauna survey days undertaken in the early dry season of 2019 and 2021 and the early wet season of 2017.

Table 7-1 Field Survey Program

SURVEY EVENT	SURVEY PERIOD	TOTAL SURVEY DAYS
FLORA SURVEYS		
Early Wet Season 2015	12 – 22 November	11 days
Early Dry Season 2016	11 – 18 April	8 days
Early Wet Season 2017	19, 21 and 24 November	3 days
Early Dry Season 2021	27 April – 5 May	9 days

SURVEY EVENT	SURVEY PERIOD	TOTAL SURVEY DAYS
FAUNA SURVEYS		
Early Wet Season 2017	13 – 24 November	12 days
Early Dry Season 2019	24 April – 8 May	15 days
Early Dry Season 2021	27 April – 2 May	3 days over the survey period

Terrestrial Flora Surveys

Flora surveys were undertaken in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland, Versions 3.2 and 5.1*, which were current at the time of the surveys. Reference was also made to the *Guidelines for Flora Survey and Assessment in Northern Queensland*.

The flora field survey methods were developed in order to:

- Confirm vegetation mapping (groundtruthed mapping was validated by the Queensland Herbarium);
- Target potential threatened flora species (listed under Commonwealth and State legislation) identified from database searches; and
- Produce a comprehensive floral inventory for all vegetation assessment sites and the study area as a whole.

A total of 174 vegetation assessment sites were surveyed to thoroughly assess Queensland government mapped remnant vegetation throughout the study area. Of these 174 assessment sites, 36 were detailed secondary sites, 83 were tertiary sites, and 55 were quaternary sites. Furthermore, Habitat Quality Plots were also established at 17 of the 36 detailed secondary sites to collect detailed information about vegetation condition, in compliance with the *Guide for determining terrestrial habitat quality, Version 1.3*. The less detailed sampling (tertiary and quaternary assessment sites) was conducted to provide additional information relating to the vegetative structure and composition and to assist in mapping the extent and distribution of the identified REs within the study area. The flora survey sites are shown in Figure 7-2.

Targeted searches were also undertaken for threatened flora species considered to have the potential to occur within the survey area, based on database searches. Random meander surveys were also conducted to ensure adequate site coverage and to establish a comprehensive floral species list for the study area. This method is also essential for the detection of cryptic, pest and other significant species.

Other field characteristics, such as areas of weed infestation, habitat areas for threatened species, and regional connectivity, were also recorded and described.

Terrestrial Fauna Surveys

Fauna field surveys were undertaken in accordance with the *2018 Queensland Fauna Survey Guidelines*, and the various EPBC Act survey guidelines for threatened birds, threatened bats, threatened reptiles, and threatened mammals. Available referral guidelines and the Species Profile and Threats (SPRAT) databases were also utilised, along with the *Recommended Fauna Survey Methodology for Environmental Impact Assessments*.

A large variety of faunal survey methods were used, including the use of Elliot, funnel and pitfall trapping; spotlighting; call playback and active searching; infra-red camera surveys; bird surveys; anabat surveys; harp trapping; Koala transects and Spot Assessment Technique (SAT); and observation (e.g. bird surveys and opportunistic observations). Sites selected for each of the survey methods were determined through desktop review of aerial photography, government mapping and database search results in order to stratify the survey effort across major habitat types for species likely to occur in the study area. The fauna survey sites are shown in Figure 7-3.

Fauna habitat assessments were undertaken at 17 habitat quality plots, and included consideration of indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, deep leaf litter, and grasses. An assessment of the structural complexity of vegetation, the age structure of the vegetation and the nature and extent of disturbance throughout the study area was undertaken and considered. Indirect indicators of fauna use of the survey area such as droppings, diggings, footprints, scratches, nests, and burrows were also recorded.

Habitat mapping for threatened fauna species was also undertaken for the study area based on vegetation mapping in conjunction with fauna habitat values as indicated by the fauna habitat assessments.

7.4.3 Likelihood of Occurrence Assessment

Following the field surveys, the likelihood of the presence of NC Act listed species and VM Act listed REs was assessed. This was based on a consideration of whether the relevant species were detected during field surveys, the availability and condition of potential habitat within the study area, and the species' habitat requirements and ecology (including habitat type, roosting and/or foraging needs, home range and other biological requirements). Three categories were used to classify the likelihood of a species being present, these being: Present; Likely; or Unlikely.

7.5 RESULTS

7.5.1 Vegetation Structure and Connectivity

The vegetation across the study area comprises remnant vegetation. Narrow corridors of cleared areas are associated with the Woolgar River channel and the two existing local access road corridors that provide access to the homesteads in the area surrounding the project site.

The landscape within and surrounding the study area is intact, providing regional connectivity with the surrounding landscape. There is minimal historic clearing in the project site from historic land uses (such as gold mining, timber acquisition and historic intense fires) and the current cattle grazing land use. Other than the open, sandy creek bed of the Woolgar River, the project site is generally characterised by sparse, open, Eucalyptus and Corymbia woodland communities.

7.5.2 Vegetation Communities

The distribution of mapped vegetation communities in the study area is shown in Figure 7-4. The REs that occur within the project site are listed in Table 7-2. All vegetation communities are listed as Least Concern under the VM Act and have a biodiversity status of either Of Concern or No Concern at Present. The project site includes approximately 2,281 ha of remnant vegetation.

Table 7-2 Vegetation Communities in the Study Area

VEGETATION COMMUNITY	CONSERVATION STATUS		TOTAL WITHIN THE STUDY AREA (HA)
	VM ACT STATUS	BIODIVERSITY STATUS	
RE 2.3.21j	Least Concern	Of Concern	218.0
RE 2.3.26b	Least Concern	Of Concern	50.8
RE 2.3.50a	Least Concern	Of Concern	18.8
RE 2.3.40	Least Concern	Of Concern	180.0

VEGETATION COMMUNITY	CONSERVATION STATUS		TOTAL WITHIN THE STUDY AREA (HA)
	VM ACT STATUS	BIODIVERSITY STATUS	
RE 2.3.41	Least Concern	Of Concern	52.3
RE 2.5.18a	Least Concern	No Concern at Present	387.3
RE 2.5.9	Least Concern	No Concern at Present	152.5
RE 2.5.20	Least Concern	No Concern at Present	507.1
RE 2.7.2a	Least Concern	No Concern at Present	79.3
RE 2.10.1a	Least Concern	No Concern at Present	36.9
RE 2.10.2x5a	Least Concern	No Concern at Present	140.9
RE 2.10.4	Least Concern	No Concern at Present	89.5
RE 2.10.13	Least Concern	No Concern at Present	12.5
RE 2.11.1c	Least Concern	No Concern at Present	354.9
TOTAL	-	-	**2,280.7**

Vegetation in Association with Watercourses or Drainage Lines

The following REs were recorded in association with watercourses or drainage features within the project site and are, therefore, MSES (Figure 7-5):

- RE 2.3.21j;
- RE 2.3.26b;
- RE 2.3.40;
- RE 2.3.41;
- RE 2.3.50a;
- RE 2.5.9;
- RE 2.7.2a;
- RE 2.10.1a;
- RE 2.10.2x5a;
- RE 2.10.4;
- RE 2.10.13; and
- 2.11.1c.

7.5.3 Flora Values

Overview

A total of 350 flora species were recorded in the study area during the flora field surveys. This included 315 (90%) native species and 35 (10%) exotic species representing 68 families and 191 genera. The dominant family groups exemplify the overall composition and condition of vegetation within the study area. The dominant family groups were *Poaceae*, *Fabaceae*, *Myrtaceae, Malvaceae*, *Mimosaceae*, *Cyperaceae*, and *Convolvulaceae*.

Threatened Flora Species

Three flora species were assessed as being likely to occur within the project site, namely:

- *Drummondita calida* – Vulnerable;
- *Labichea brassii* – Near Threatened; and
- *Leptospermum pallidum* – Near Threatened.

Near threatened species are not a MSES and, therefore, *Labichea brassii* and *Leptospermum pallidum* are not considered further in this report.

The *Drummondita calida* is a relatively distinctive shrub which occurs in very exposed and sparse low shrubland on bare sandstone plateaus, to low open woodlands on sandstone with large boulders. While *Drummondita calida* was not recorded within the project site or during other surveys of areas to the east of the project site, potential habitat for this species (RE 2.10.2x5a) is present in the north-east of the project site (Figure 7-6). This species is a relatively conspicuous shrub that is up to approximately 2.5 m in height with small, tightly held foliage. Therefore, is it considered likely that it would have been identifiable and is considered very unlikely to be present within the project disturbance footprint. Any large populations of this species are considered likely to have been very conspicuous during the field survey, if present. However, the presence of a small number of scattered individuals within a small area outside of the project disturbance footprint, that could not be comprehensively surveyed due to steep terrain/access limitations, cannot be ruled out. However, the proposed disturbance footprint will not encroach on these areas.

Exotic Species

Thirty-five exotic species were recorded from the study area with exotic flora found primarily along the Woolgar River and the surrounding areas. Overall, weed diversity and abundance was relatively low within the study area.

7.5.4 Fauna Values

Overview

A total of 175 fauna species were recorded during the fauna survey, comprising 103 species of birds, 33 species of mammals, 30 species of reptiles, and 9 species of amphibians (*Terrestrial Ecology Report* (Appendix E)). An additional five introduced species were also recorded. Overall, most of the fauna recorded within the project site are not listed as threatened under Commonwealth or State legislation and are typical of the fauna that occurs in the region surrounding the project site.

Habitat Assessment and Mapping

Fauna habitats throughout the study area were typically in good condition with some exotic grass infiltration on the lower slopes and in the riparian zones. Some areas also displayed the effects of historic activities including intense fires, gold mining and timber acquisition. The following broad habitat types were found to occur in the study area:

- Riparian woodland. This habitat type is associated with the natural levees and riverbeds of the Woolgar River and supports large River Red Gums (*Eucalyptus camaldulensis*). The condition of this habitat is variable, with a discontinuous canopy in some areas and large infestations of Rubber Vine (*Cryptostegia grandiflora*) (an exotic weed) in a number of places.
- Open woodlands. This habitat type is associated with the lower slopes of the project site and is dominated by Eucalypts and Corymbia trees and contains some large, hollow-bearing trees. Malvastrum (*Malvastrum americanum*) (an exotic weed) is prominent in some areas and this habitat is subject to some grazing pressure.

- Low woodlands. This habitat type is associated with the flatter ground between the plateaus in the east of the site and the Woolgar River in the west of the site. The habitat is dominated by Acacia species and there are very few weeds present. Large mature trees, some hollow-bearing, are present throughout this habitat.
- Open Eucalypt woodlands. This habitat type is associated with the steep slopes in the east of the project site with large Eucalypt trees. It is dissected by numerous gullies and there are very few weeds present.

Threatened Fauna Species

There were three NC Act listed fauna species recorded on the project site:

- Squatter Pigeon (Southern) *(Geophaps scripta)*;
- Koala *(Phascolarctos cinereus)*; and
- Short-beaked Echidna *(Tachyglossus aculeatus)*.

The Squatter Pigeon and Koala are also listed under the EPBC Act and the impacts of the project on these species will therefore be assessed as part of the project EPBC Act approval application.

The Short-beaked Echidna is listed as Special Least Concern under the NC Act. The Short-beaked Echidna occurs in almost all terrestrial habitats and shelters in logs, crevices, burrows or piles of litter. They feed on ants, termites and other soil invertebrates, particularly beetle larvae. The Short-beaked Echidna was recorded at three locations in the project site and is likely to occur throughout the entire project site (approximately 2,281 ha) (Figure 7-7).

Exotic/Feral Species

Five introduced species were recorded during field surveys, namely the Cane Toad (*Rhinella marina*), Dingo/Wild Dog (*Canis lupus dingo*), European Rabbit (*Oryctolagus cuniculus*), Feral Cat (*Felis catus*), and Feral Pig (*Sus scrofa*).

7.5.5 MSES Summary

The following terrestrial MSES were recorded or are considered likely to be present within the project site:

- Regulated vegetation: REs within the defining banks of a relevant watercourse or drainage line (Figure 7-5);
- Connectivity Areas; and
- Protected wildlife:
  - An area not shown on the flora survey trigger map that contains Endangered or Vulnerable plants (*Drummondita calida*) (Figure 7-6); and
  - Habitat for Vulnerable or Special Least Concern fauna (Short-beaked Echidna) (Figure 7-7).

The following terrestrial MSES were not recorded and are considered not likely to occur within the project site:

- Regulated vegetation:
  - Endangered REs;
  - Of Concern REs; and
  - An area of essential habitat on the essential habitat map.
- Strategic Environmental Areas;
- Protected wildlife:
  - HRA on the flora survey trigger map;

- Koala habitat area;
- Habitat for Critically Endangered and Endangered fauna;

- Protected areas; and
- Legally secured offset areas.

7.6 IMPACT ASSESSMENT

7.6.1 Overview

The project has the potential to give rise to the following types of impacts:

- Direct impacts from clearing vegetation and potential habitat;
- Indirect impacts such as the effects of fragmentation, noise and vibration, vehicle strike, lighting, dust, erosion and sedimentation, and invasive species; and
- Cumulative impacts.

These impacts and associated management and mitigation measures are described in the following sections.

7.6.2 Direct Impacts

The project will require the clearing of native vegetation that provides habitat for a wide range of flora and fauna species. A total area of approximately 1,341 ha of remnant vegetation is proposed to be cleared. Figures 7-5 to 7-7 show the project disturbance footprint in relation to MSES. Table 7-3 summarises the extent of MSES that are required to be cleared for the project.

Table 7-3 MSES Proposed to be Cleared

MSES	VM ACT/ NC ACT STATUS	DISTURBANCE AREA (HA)	SIGNIFICANT IMPACT (Y/N)
VEGETATION IN ASSOCIATION WITH A DRAINAGE LINE OR WATERCOURSE			
• RE 2.3.21j	Least Concern	7.6	**Yes**
• RE 2.3.26b	Least Concern	14.1	**Yes**
• RE 2.3.40	Least Concern	7.3	**Yes**
• Re 2.3.41	Least Concern	2.7	No
• RE 2.3.50a	Least Concern	0.0	No
• RE 2.5.9	Least Concern	2.2	**Yes**
• RE 2.7.2a	Least Concern	0.9	No
• RE 2.10.1a	Least Concern	0.5	No
• RE 2.10.2x5a	Least Concern	0.8	No
• RE 2.10.4	Least Concern	0.8	No
• RE 2.10.13	Least Concern	0.0	No
• RE 2.11.1c	Least Concern	5.4	**Yes**

MSES	VM ACT/ NC ACT STATUS	DISTURBANCE AREA (HA)	SIGNIFICANT IMPACT (Y/N)
PROTECTED WILDLIFE HABITAT			
• *Drummondita calida*	Vulnerable	13.8	No
• Short-beaked Echidna	Special Least Concern	1,340.6	No
CONNECTIVITY AREAS	Least Concern	1,340.6	No

Assessments of significance have been undertaken for the MSES listed in Table 7-3 in accordance with the SRI Guidelines. The significant impact assessments are detailed in the *Terrestrial Ecology Report* (Appendix E) and the conclusions are shown in Table 7-3.

The assessments concluded that the project is likely to have a significant, residual impact on five REs associated with drainage lines (RE 2.3.21j, 2.3.26b, 2.3.40, 2.5.9 and 2.11.1c). All these REs are sparse REs and, in accordance with the SRI Guidelines, significant impacts to sparse REs in association with a drainage line occur when:

1. More than 2 ha of the RE is cleared; and
2. The clearing is undertaken within 5 m of the drainage lines.

The proposed disturbance of these five REs, in association with a drainage line, meet these thresholds.

The assessments of significance conclude that the project is not likely to have significant residual impacts on the following MSES:

- Remaining REs in association with a watercourse or drainage line: All of the remaining REs in association with a watercourse or drainage line are sparse REs, except for RE 2.3.50a which is designated as 'other' and RE 2.3.41 which is a 'woody grassland'. All of the remaining sparse REs will have less than 2 ha cleared for the project and, therefore, the project's impacts remain below the clearing threshold, and they are not significant impacts. RE 2.3.50a will not be cleared and will, therefore, not be impacted by the project. The threshold for a grassland RE in association with a drainage line is clearing more than 5 ha. Less than 5 ha of RE 2.3.41 will be cleared for the project and, therefore, the project's impacts remain below the clearing threshold and it is not significantly impacted.
- *Drummondita calida*: This species was not recorded during the field surveys, even though it is a distinctive shrub. While 13.8 ha of potential habitat for this species will be cleared for the project, similar habitat will remain within and adjoining the project site. Therefore, clearing for the project is unlikely to lead to a long-term decrease in the size of the population, reduce the extent of occurrence of the species, fragment an existing population or result in a genetically distinct population forming as a result of habitat isolation. Therefore, this species and its habitat are unlikely to be significantly impacted by the project.
- Short-beaked Echidna: The habitat within the project site that is proposed to be cleared is not particularly significant in the larger landscape and substantial similar areas will remain in the broader region. The species mobility, and the maintenance of connectivity with the surrounding areas, makes it unlikely that the project will significantly impact the Short-beaked Echidna or its habitat.
- Connectivity Areas: The DETSI Landscape Fragmentation and Connectivity (LFC) Tool was used to identify and quantify any significant impacts to connectivity areas. The DETSI LFC Tool confirmed that the project will not significantly impact connectivity areas.

Impact avoidance, mitigation measures and offsets for the impacts of clearing of MSES are described in the following sections.

Measures to Avoid Impacts

Open cut mining projects cannot readily avoid impacts to biodiversity where mineral resources are located beneath flora and fauna habitats. However, significant habitat has been avoided to the extent possible in the development of the project layout. The project layout has been designed to limit disturbance of the riparian vegetation associated with the Woolgar River and the drainage features traversing the project site to the extent possible. This has been achieved by locating the majority of the mine infrastructure at the southern end of the project site where there are no drainage features and limiting the disturbance footprint within the Woolgar River riparian zone. The riparian vegetation associated with the Woolgar River and the tributary drainage features provides important resources for various terrestrial species and also provides connectivity between habitats in the region.

Management and Mitigation Measures

A range of management measures will be implemented during project construction and operation in order to manage and mitigate potential impacts to MSES. The key management and mitigation measures are summarised in the following sections.

Permit to Disturb

Clearing will be undertaken in accordance with a Permit to Disturb procedure. The procedure will require that approval is obtained from the environmental officer or delegate prior to the commencement of any clearing. The Permit to Disturb procedure will ensure that any clearing is compliant with the relevant requirements of the EPBC Act approval and Environmental Authority and that pre-clearing and clearing activities are conducted in an appropriate and approved manner. Where appropriate, pre-clearing and clearing requirements will be included in a SMP, approved by the Queensland Government under the NC Act. The Permit to Disturb will include the following requirements:

- Checking that proposed clearing is compliant with the approved clearing limits/locations specified in the EPBC Act approval and Environmental Authority.
- Delineation of the approved clearing area prior to clearing (i.e. using survey pegs or flagging tape). This will minimise the risk of unauthorised clearing.
- Pre-clearance surveys conducted by a spotter catcher to confirm the presence of any listed threatened fauna species and any animal breeding places. If listed threatened fauna species or breeding places are detected, the spotter catcher will try to relocate fauna prior to the commencement of clearing. If this is not achievable, the spotter catcher will be present during clearing to ensure appropriate clearing controls are implemented.
- Compliance with the *Queensland Guideline: Activities in a Watercourse, Lake or Spring Associated with a Resource Activity or Mining Operations* for clearing in riparian zones.
- Implementation of any necessary erosion and sediment control works in accordance with the project Erosion and Sediment Control Plan.
- Maintenance of records for cleared areas and any species found during the pre-clearing/clearing process.
- Identification and definition of the roles and responsibilities of employees, in relation to clearing activities.
- Three yearly reviews of the Permit to Disturb, or immediately after an amendment to a key approval, to ensure compliance with the EPBC Act approval and Environmental Authority and to ensure that the Permit to Disturb process is effective in minimising impacts to the environment.

Rehabilitation

Rehabilitation and revegetation of disturbed areas of the project site will be conducted in accordance with the *Progressive Rehabilitation and Closure Plan* (Appendix J). The revegetation of disturbed areas over the life of the

mine, and following mine closure, will mitigate some of the impacts associated with vegetation clearing for the project.

Biodiversity Offsets

The proponent is proposing to provide offsets for significant residual impacts on MSES using financial settlements in accordance with the QEOP. The following residual MSES relevant to terrestrial ecology require offsets for the project:

- Regulated vegetation – REs within the defining banks of a relevant watercourse or drainage feature:
  - 7.6 ha of RE 2.3.21j;
  - 14.1 ha of RE 2.3.26b;
  - 7.3 ha of RE 2.3.40;
  - 2.2 ha of RE 2.5.9; and
  - 5.4 ha of RE 2.11.1c.

7.6.3 Indirect Impacts

The project's indirect impacts such as the effects of fragmentation, noise and vibration, vehicle strike, lighting, dust, erosion and sedimentation, and invasive species have the potential to impact MSES. Indirect impacts are discussed in the following sections.

Fragmentation and Edge Effects

Vegetation clearing can result in the fragmentation of habitat, which can impact MSES. The clearing for the project has the potential to fragment fauna habitat and create barriers (i.e. cleared corridors) that may impair movement of some fauna species, and impact connectivity of habitat. The impacts of fragmentation associated with clearing are unlikely to be significant due to the open characteristics of the dominant woodland community within the project site, the extent of connected habitat remaining in the region, and the continued availability of riparian corridors along the Woolgar River for the dispersal of fauna throughout the landscape.

A further consequence of clearing vegetation is that it can produce 'edge effects'. Edge effects are impacts that can occur at the interface between natural habitats and cleared areas or developed land. Edge effects may cause modification to the local environment in terms of altered species and structural composition due to increased light, wind shear and weed invasion. Edge effects are likely to infiltrate retained areas adjacent to cleared areas and are likely to be more pronounced in the denser vegetation communities fringing creek lines. However, due to the sparse and open nature of the woodland communities within the project site, edge effects are likely to be 'tempered' in comparison with the impacts of edge effects to denser, closed structure communities. In addition, the impacts of edge effects are generally considered manageable using best practice mitigation techniques (e.g. weed control).

Overall, the impacts of fragmentation and edge effects from clearing from the project are unlikely to be significant due to the open characteristics of the woodland communities present, the extent of connected habitat remaining in the region, the control of weeds and the continued availability of riparian corridors along the Woolgar River for dispersal of fauna.

Noise and Vibration

Noise and vibration will be generated by the project from various sources such as vegetation clearing, operation of infrastructure, and vehicle movements.

Most fauna exhibit a high degree of adaptability to the noise from machinery. Noise from mining activities may cause some behavioural modification by birds, potentially altering feeding activity, and sudden loud noises may also startle bird and mammal species. Consequently, depending on the level of construction and mining noise, there may be some species that would be affected by noise and would forgo utilisation of habitat within the noise disturbance zones. The size of the zone would likely be different for individual species and depend on the intensity, nature and duration of the noise sources. It is not possible to quantify the proportion of the local fauna community that would be adversely affected by this issue, but it is expected to be a minority of species, and noise impacts to fauna are unlikely to occur over a significant distance from the noise source.

In addition, fauna are likely to return to noise and vibration affected habitat areas within a short period of time once the noise emissions cease.

Specific noise and vibration mitigation measures will be implemented for the project and are discussed further in Section 10 – Noise and Vibration.

Vehicle Strike

Impacts from vehicle strike may occur due to haul trucks and other mine vehicles operating within the project site. Although some mortality of animals as a result of vehicle strike may occur, it is not expected to be a significant impact given that the haul roads will be located within a larger cleared area and away from remaining habitat. Speed limits along internal roads, appropriate signage and driving policies will also be implemented to increase driver awareness and decrease the risk of vehicles striking fauna. Furthermore, the vibration of approaching haul trucks may also provide animals with warning and prompt fauna to move away from the path of approaching vehicles.

Lighting

Potential impacts of light spill from lighting associated with the project is likely to be limited and restricted to mine infrastructure areas. Many species are generally able to adapt to altered environmental conditions over small areas, such as those created by lighting around proposed infrastructure areas. The impacts from lighting are, therefore, unlikely to significantly impact MSES.

Dust

Vegetation clearing required for the project and the use of heavy equipment (e.g. trucks on unsealed haul roads) is likely to generate dust. Section 9 – Air Quality provides the dust predictions for the project. Dust generation will be reduced through the implementation of dust controls including watering haul roads, stockpiles, plant and equipment areas and the active mining areas and undertaking progressive rehabilitation.

Recent studies on the impacts of dust from unsealed roads, including haul roads, on vegetation and fauna, have found no evidence that dust has any detrimental impacts on vegetation or fauna abundance (Cumberland Ecology 2015 Jones et al. 2016). Furthermore, with the proposed dust mitigation measures, generation of dust is expected to be limited. Dust related impacts will be relatively minor and are therefore, not likely to cause a significant impact on MSES within the project site.

Erosion and Sedimentation

Without control measures, the project has the potential to result in erosion of disturbed areas and sedimentation of downstream waterways. An Erosion and Sediment Control Plan will be developed and implemented for the project (Section 6 – Surface Water). It will include measures to prevent erosion and sedimentation and any resultant impacts on flora or fauna habitat.

Weeds

Weeds have the potential to out-compete native plant species for resources such as nutrients, sunlight and space. Weed diversity and abundance is relatively low within the study area as it is remote and conditions are very dry during extended periods of the year which prevent weeds from becoming established and spreading. Two weeds (Rubber Vine and Parkinsonia (*Parkinsonia aculeata*)) were identified, primarily along the Woolgar River, within the study area.

A weed management program will be implemented for the project. The objectives of the program will be to ensure no new weed species are introduced to the project site and no increase in the distribution and abundance of existing weed species as a result of the project.

Feral Animals

Feral animals can prey on native fauna species or compete with them for food and resources. Five feral animal species were identified in the study area including Cane Toads, Dingos/Wild Dogs, the European Rabbit, Feral Cats and Feral Pigs.

A feral animal management program will be implemented to control feral animals within the project site and prevent the introduction of new feral species due to the project.

Altered Fire Regime

The project has the potential to alter the existing fire regime of the project site through the introduction of weeds which in turn increase biomass. Variation in biomass is the main factor contributing to altered fire regimes in dry climates such as the climate of the project site. Climate change may also increase the frequency and duration of fire weather. An increase in fire frequency or intensity may result in the removal of important fauna habitat features (i.e. mature vegetation, fallen logs, tree hollows).

Fires, and alteration to the existing fire regime, will be managed via water trucks with fire fighting capabilities and an emergency response plan to deal with fires should they occur on the project site. If site operations were to result in the ignition of a fire, it is expected that it would be controlled relatively quickly before it spread to areas of potential habitat. With the implementation of these measures, it is unlikely that an altered fire regime will develop or significantly affect vegetation of fauna within the project site.

7.6.4 Cumulative Impacts

The project will result in clearing approximately 1,341 ha of remnant REs and fauna habitat. It is necessary to consider the cumulative impact of this clearing with other clearing in the Gulf Plains bioregion.

There are no other mining developments or projects in close proximity to the project site. Impacts to remnant vegetation from activities in the region surrounding the project, particularly in the form of direct clearing, are negligible. Any clearing that does occur is most likely thinning and land management for grazing activities.

The proponent will provide offsets for significant impacts to MSES. The purpose of offsets is to compensate for any significant residual impacts from the project. With the application of offsets, the project will not have a significant residual impact on biodiversity values. This will mean that, overall, the project is unlikely to contribute to significant cumulative impacts on biodiversity values in the bioregional landscape.

7.7 GROUNDWATER DEPENDENT ECOSYSTEMS

This section provides a summary of the key finding of the GDE assessment undertaken for the project. The GDE assessment is described in the *GDE Report* (Appendix K) and draws on site-specific data and ground-truthed information sourced from the specialist groundwater assessment described in the *Groundwater Report* (Appendix C), the specialist ecology assessment described in the *Terrestrial Ecology Report* (Appendix E) and the stygofauna sample analysis conducted by C&R Consulting and described in the *Aquatic Ecology Report* (Appendix F).

7.7.1 Introduction

The guideline *Queensland groundwater dependent ecosystem mapping method*, prepared by the Department of Science, Information, Technology and Innovation (2015), defines groundwater dependent ecosystems (GDEs) as *"Ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide"*. This guideline identifies three types of GDEs as follows:

- Terrestrial GDEs where an ecosystem relies on the subsurface presence of groundwater (such as a perched aquifer or a shallow water table). This includes groundwater dependent vegetation communities.
- Aquatic GDEs where an ecosystem relies on the surface expression of groundwater. Aquatic GDEs may include riverine water bodies fed by groundwater baseflow, wetlands, lakes, springs and estuarine coastal, marine ecosystems.
- Subterranean GDEs which include cave and aquifer ecosystems.

The GDE assessment was undertaken in accordance with the *Queensland Groundwater Dependent Ecosystems: EIS Information Guideline* (DETSI, 2024) and the framework set out in the Independent Expert Scientific Committee (IESC) *Information Guidelines Explanatory Note – Assessing Groundwater-Dependent Ecosystems* (Doody, Hancock and Pritchard, 2019) (IESC GDE Guideline). For terrestrial and aquatic GDEs, the assessment methodologies are similar. A tailored assessment methodology is applied to subterranean GDEs.

7.7.2 Subterranean GDEs

As detailed in the *GDE Report* (Appendix K), the subterranean GDE assessment involved the following:

- Conducting a desktop habitat assessment to assess the potential presence of stygofauna and suitable stygofauna habitat within the project site and its surrounds, based on a desktop search of relevant GDE databases, including:
  - Queensland subterranean aquatic fauna database (DES, 2016);
  - GDE Atlas (Bureau of Meteorology (BoM), 2019); and
  - Queensland GDE mapping (DES, 2018).

  This assessment also considered the site-specific geology and groundwater data.
- Undertaking a stygofauna sampling program to verify the results of the desktop habitat assessment and to confirm the presence or absence of stygofauna in the aquifers that will be affected by the project.
- Assessing the potential impacts from the project on any confirmed stygofauna assemblages or stygofauna habitat and identifying any monitoring and management measures required, as necessary.

The subterranean GDE assessment did not identify any stygofauna assemblages or significant stygofauna habitat in any formation that will be affected by the project and concluded that the project is not predicted to give rise to

any significant impacts on stygofauna. On this basis, the projects effects on groundwater are not expected to give rise to any impacts on subterranean GDEs.

7.7.3 Aquatic and Terrestrial GDEs

As detailed in the *GDE Report* (Appendix K), the terrestrial and aquatic GDE assessment involved the following:

- Identifying the GDE study area based on the maximum predicted extent of direct and indirect impacts on terrestrial and aquatic GDEs. For the purposes of this assessment, the GDE study area comprises the project disturbance area and the maximum predicted extent of the project's groundwater drawdown effects on the regional groundwater table. The GDE study area is shown in Figure 7-8.
- Identifying potential GDEs within the GDE study area based on a desktop search of relevant databases and information sources, including:
  - Queensland Springs Database (DES, 2018);
  - GDE Atlas (BoM, 2019);
  - Queensland GDE mapping (DES, 2018);
  - Queensland Wetland*Maps* (DES, 2019); and
  - GDEs registered under the *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017*.
- Rationalising potential GDEs identified in the databases searches with the site-specific groundwater and surface water data and relevant ground-truthed geology and ecology information, to develop a conceptual understanding of the ecohydrogeological regime, assess groundwater dependence and determine the presence of GDEs.
- Assessing potential impacts from the project on any confirmed GDEs and developing a monitoring and management program, as necessary.

Based on the results of the groundwater assessment that confirms the lack of interaction between groundwater and surface water, the GDE assessment concluded there are no potential aquatic GDEs present within the GDE study area, and therefore the project's effects on groundwater are not expected to give rise to any impacts on aquatic GDEs.

The GDE assessment also concluded that woodland vegetation in areas where the groundwater table is located in the alluvium or weathered profile at depths of up to 20 m below ground level is a potential terrestrial GDE. Figure 7-8 shows the extent of potential terrestrial GDEs across the GDE study area.

7.7.4 Impacts on Groundwater Dependent Ecosystems

Potential terrestrial GDEs present within the project disturbance area will be directly impacted by the effects of mining disturbance. The impacts on vegetation, including any GDEs, within the project disturbance area are discussed in Section 7.6.

As discussed in Section 2 of the *GDE Report*, the GDE assessment identified discrete areas of potential terrestrial GDEs that may be indirectly impacted by predicted changes in groundwater levels due to the project. These areas of potentially impacted terrestrial GDEs are outside of the project disturbance area but within the maximum predicted extent of groundwater drawdown from the project. The areas of potential indirect impacts to terrestrial GDEs are shown in Figure 7-8 and comprise a total area of approximately 43 ha of Least Concern vegetation.

7.7.5 Monitoring and Management

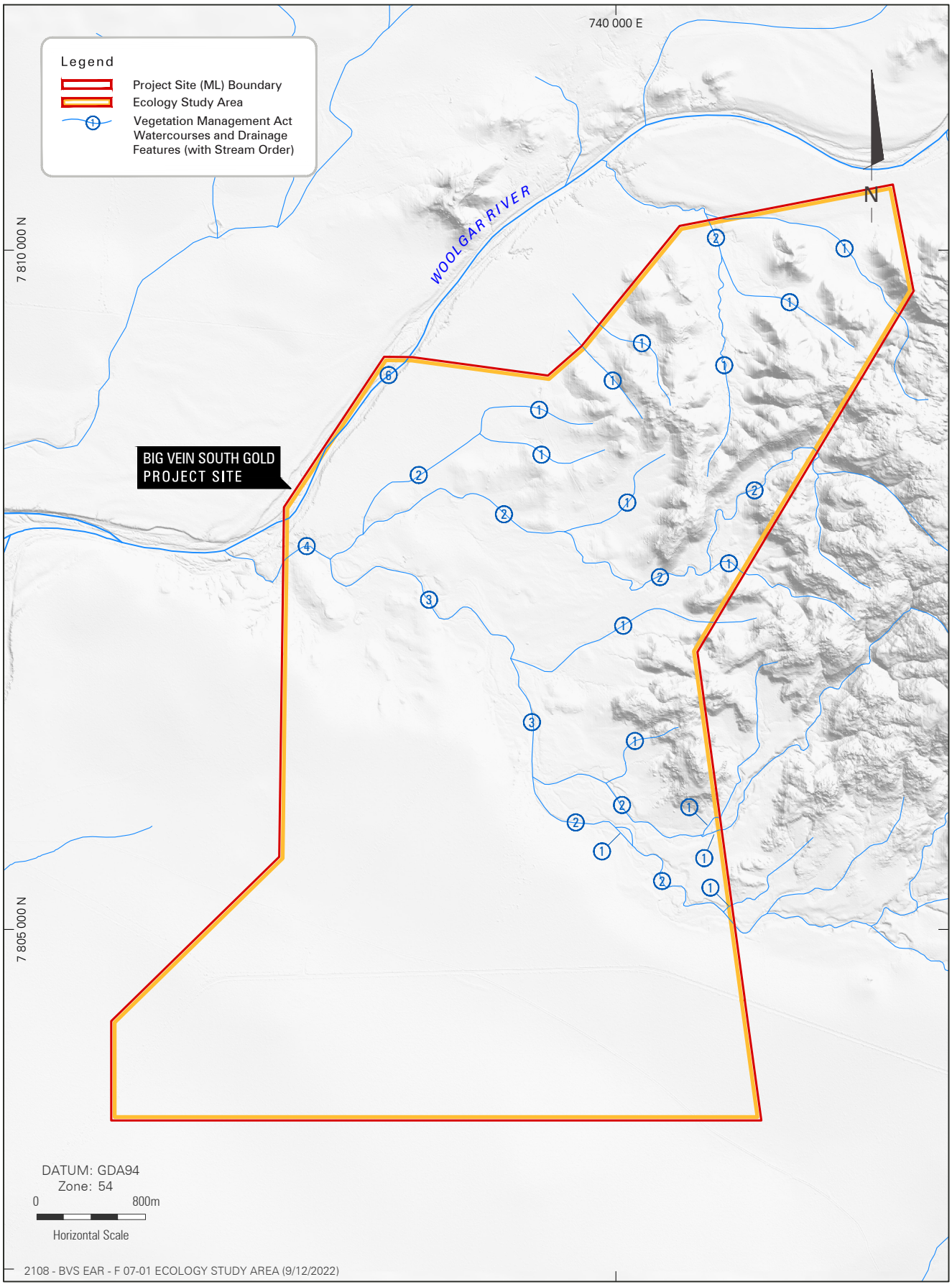
The groundwater monitoring program for the project is described in Section 5 - Groundwater.

Groundwater monitoring will be undertaken during operations and post closure to confirm the actual extent of groundwater drawdown and validate the conservative groundwater modelling predictions presented in the *Groundwater Report* (Appendix C). If the groundwater level monitoring results confirm the groundwater levels and/or changes in groundwater levels due to drawdown from the project could potentially impact GDEs, vegetation surveys will be undertaken to monitor the condition of the potential GDEs in the affected areas. The results of any vegetation surveys would detect any significant impact on the vegetation condition. Offsets would be provided for any associated significant residual impacts on any prescribed environmental matters.

7.7.6 Further Assessment and EPBC Act Approval

SMC recently engaged Watermark Eco to conduct additional GDE technical assessment to address an additional information request from DCCEEW as part of its assessment of the project under the EPBC Act via Preliminary Documentation. SMC is proposing to conduct GDE monitoring in accordance with the EPBC Act approval conditions.

FIGURES

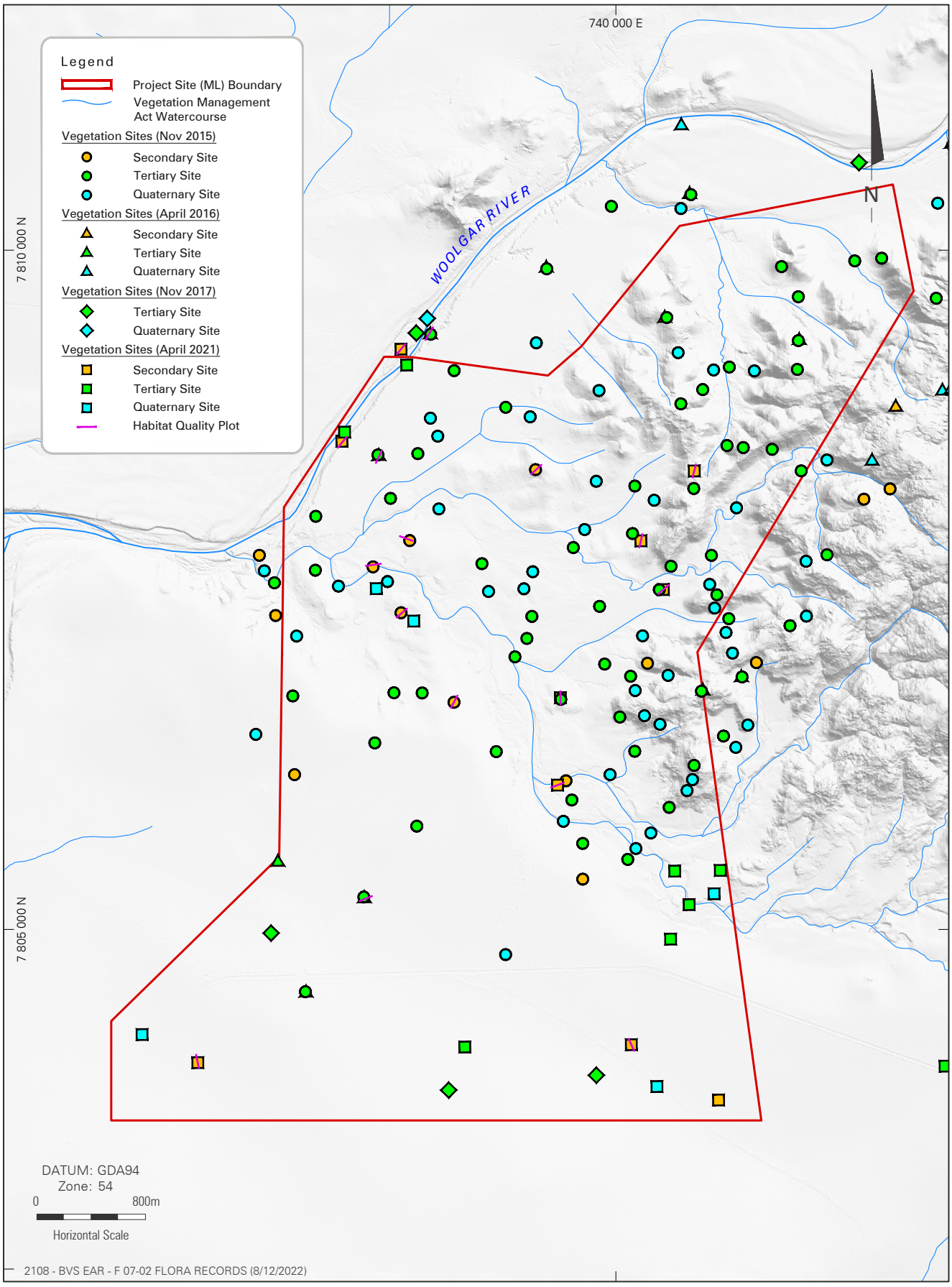


BIG VEIN SOUTH GOLD PROJECT

HANSEN ENVIRONMENTAL CONSULTING

Ecology Study Area

FIGURE 7-1

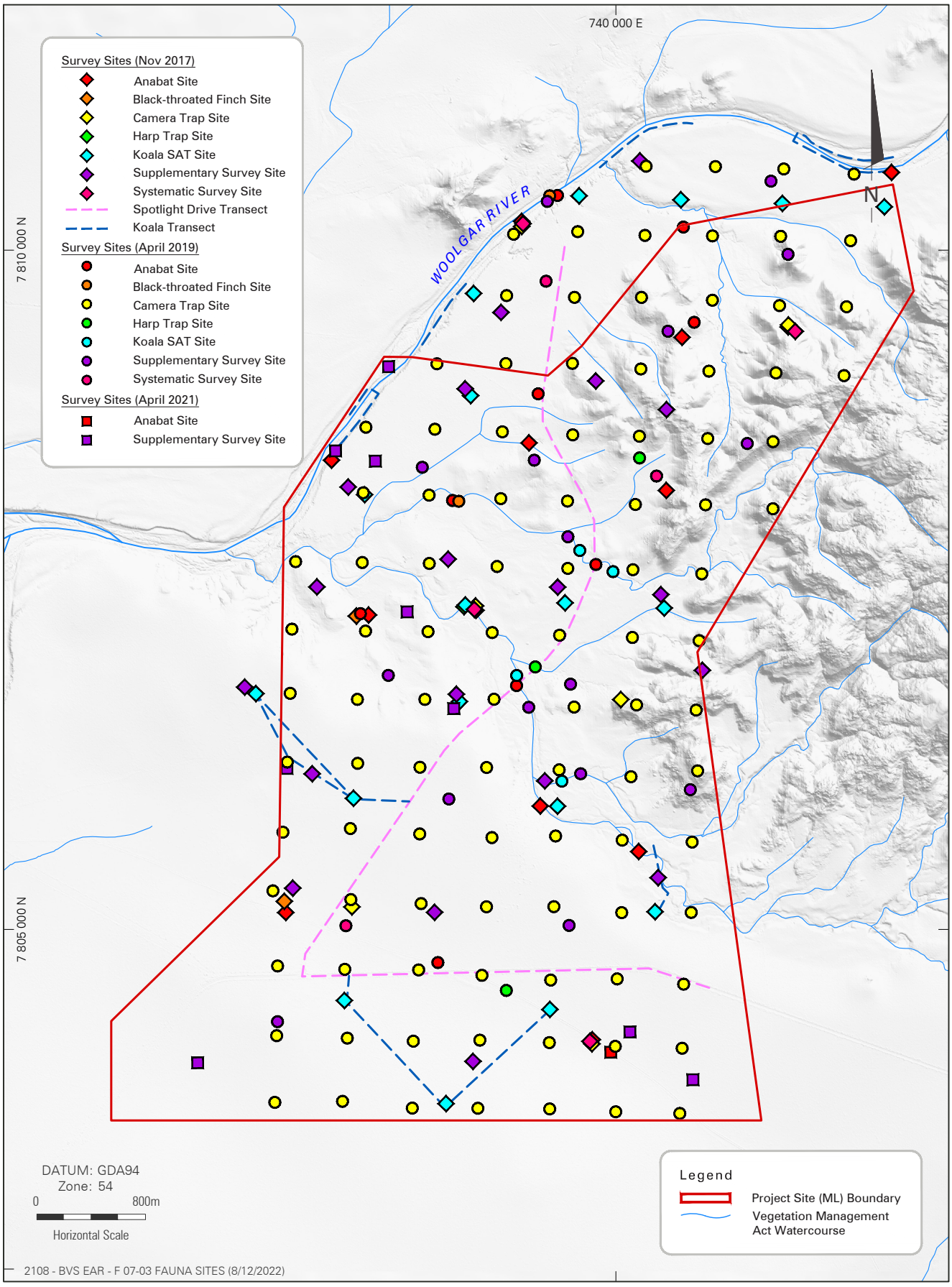


BIG VEIN SOUTH GOLD PROJECT

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Terrestrial Flora Survey Sites

FIGURE 7-2

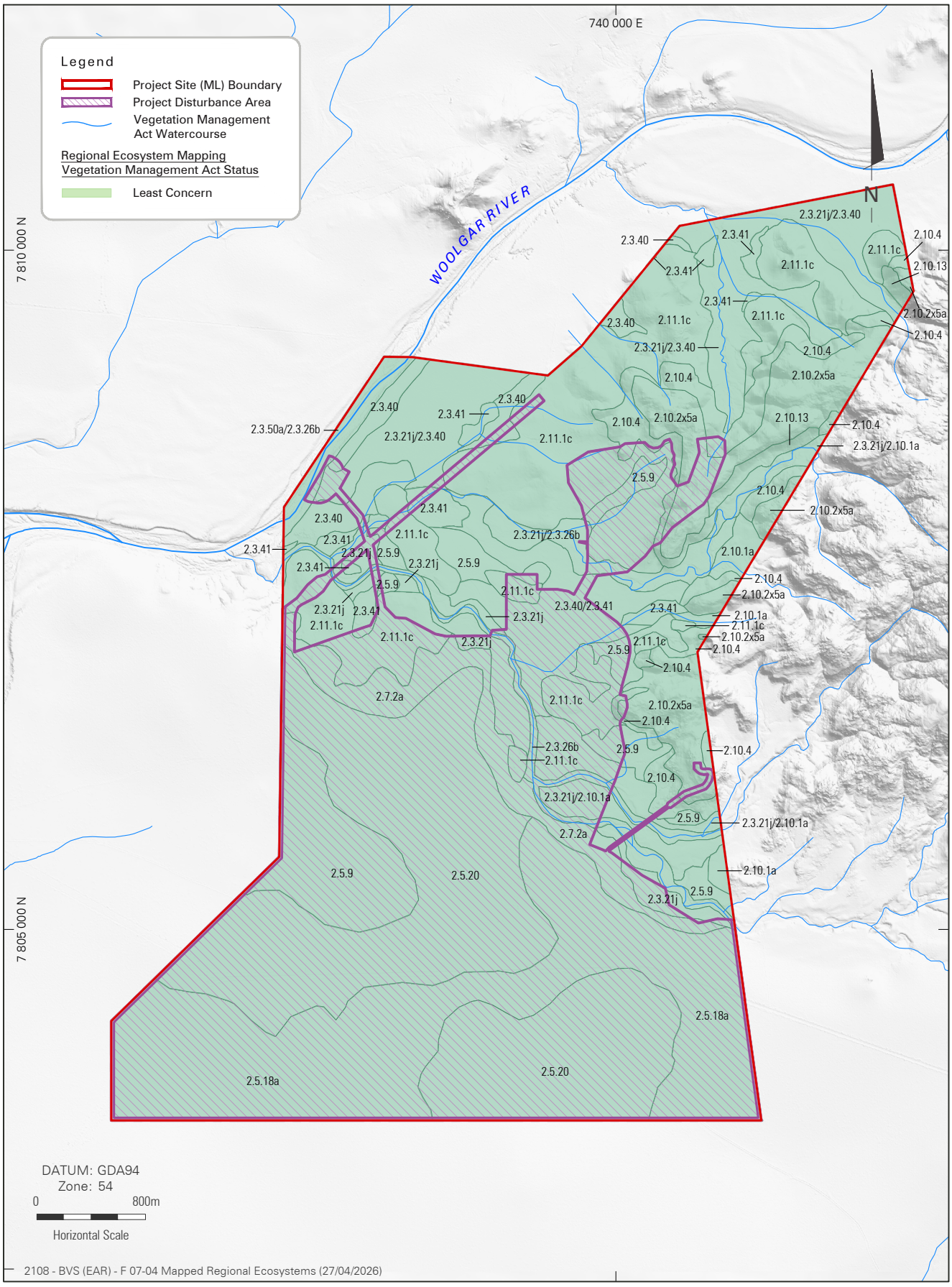


BIG VEIN SOUTH GOLD PROJECT

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Terrestrial Fauna Survey Sites

FIGURE 7-3

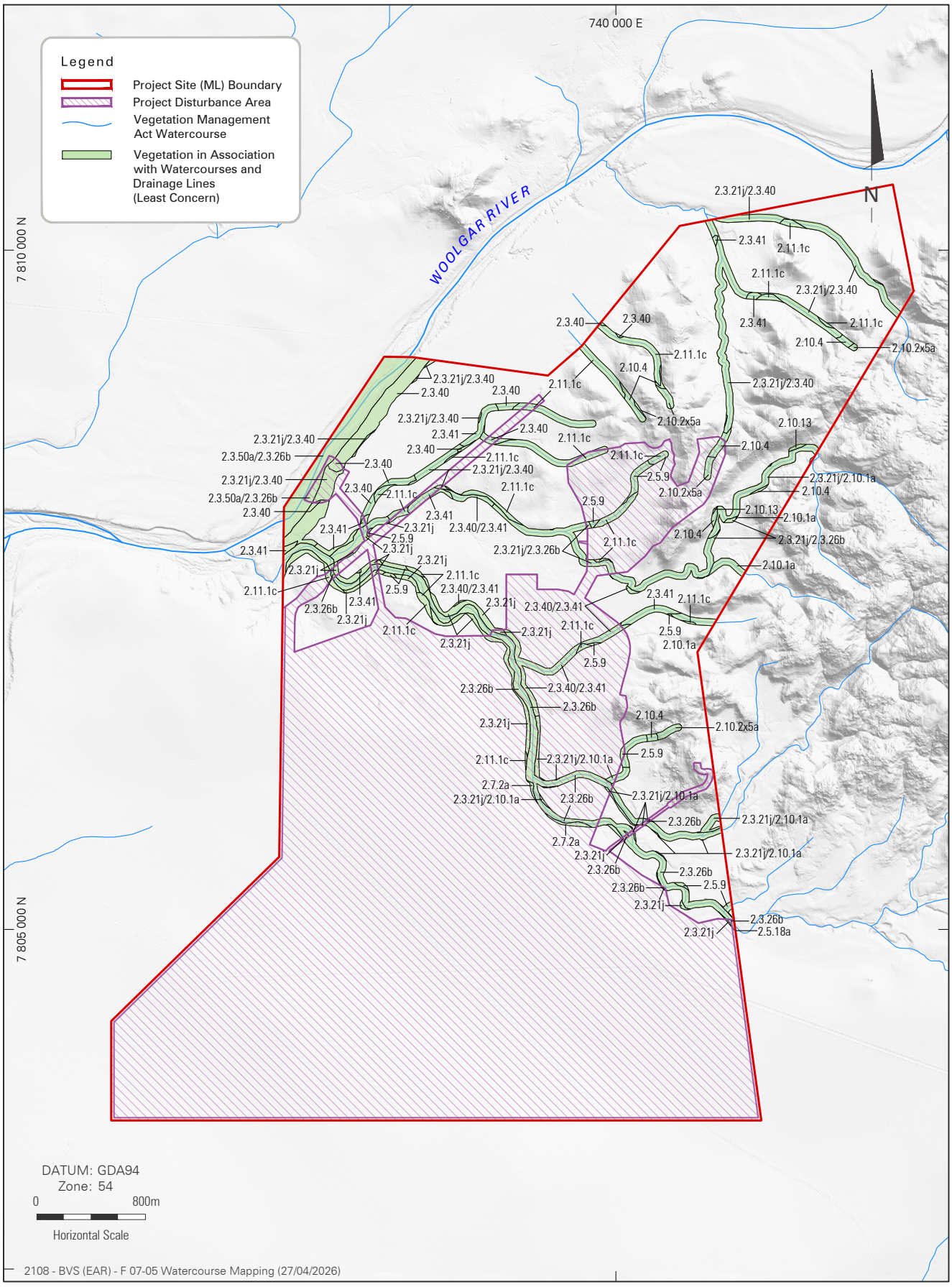


BIG VEIN SOUTH GOLD PROJECT

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Mapped Regional Ecosystems

FIGURE 7-4

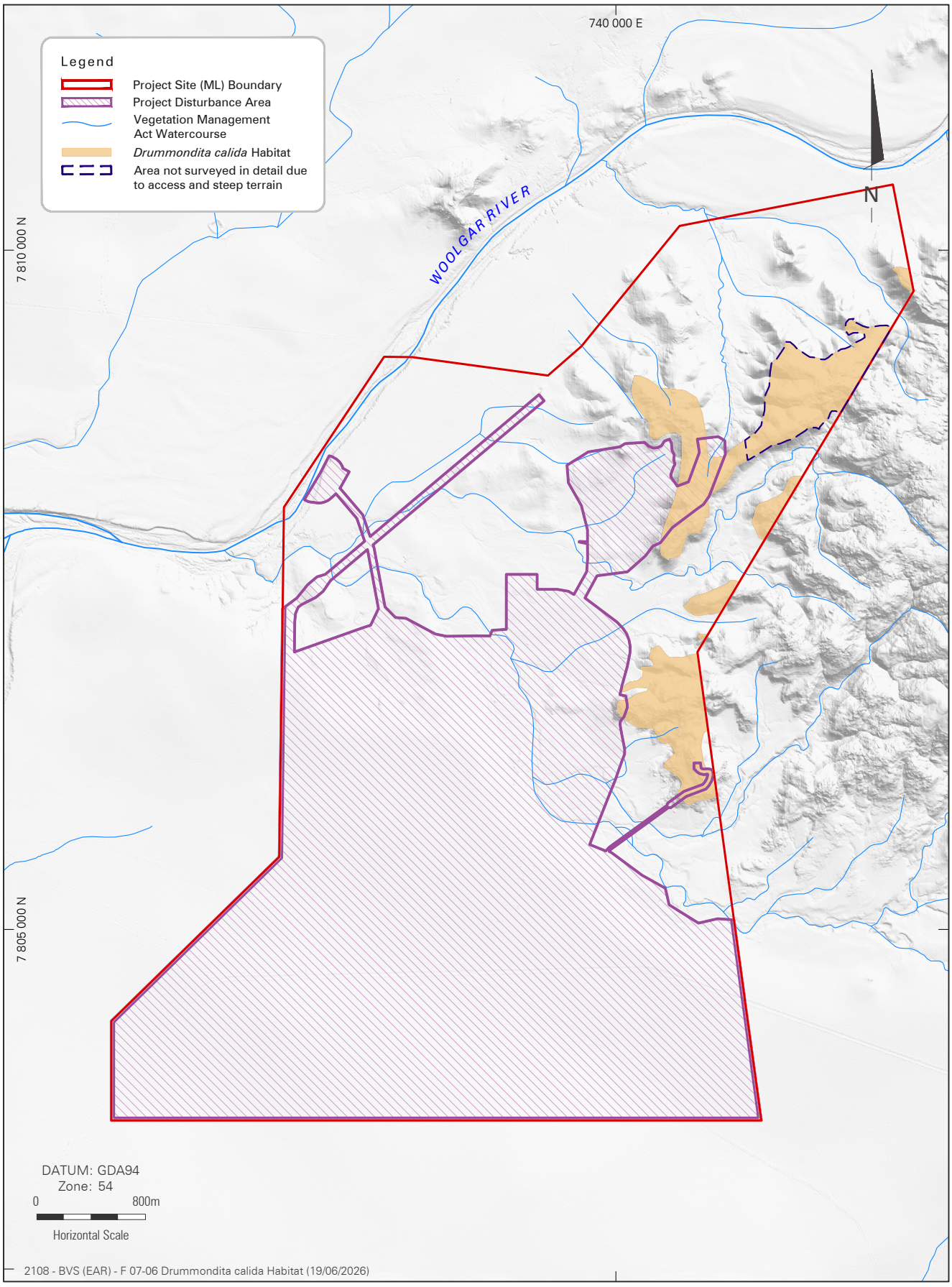


BIG VEIN SOUTH GOLD PROJECT

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Vegetation in Association with Watercourses and Drainage Lines

FIGURE 7-5

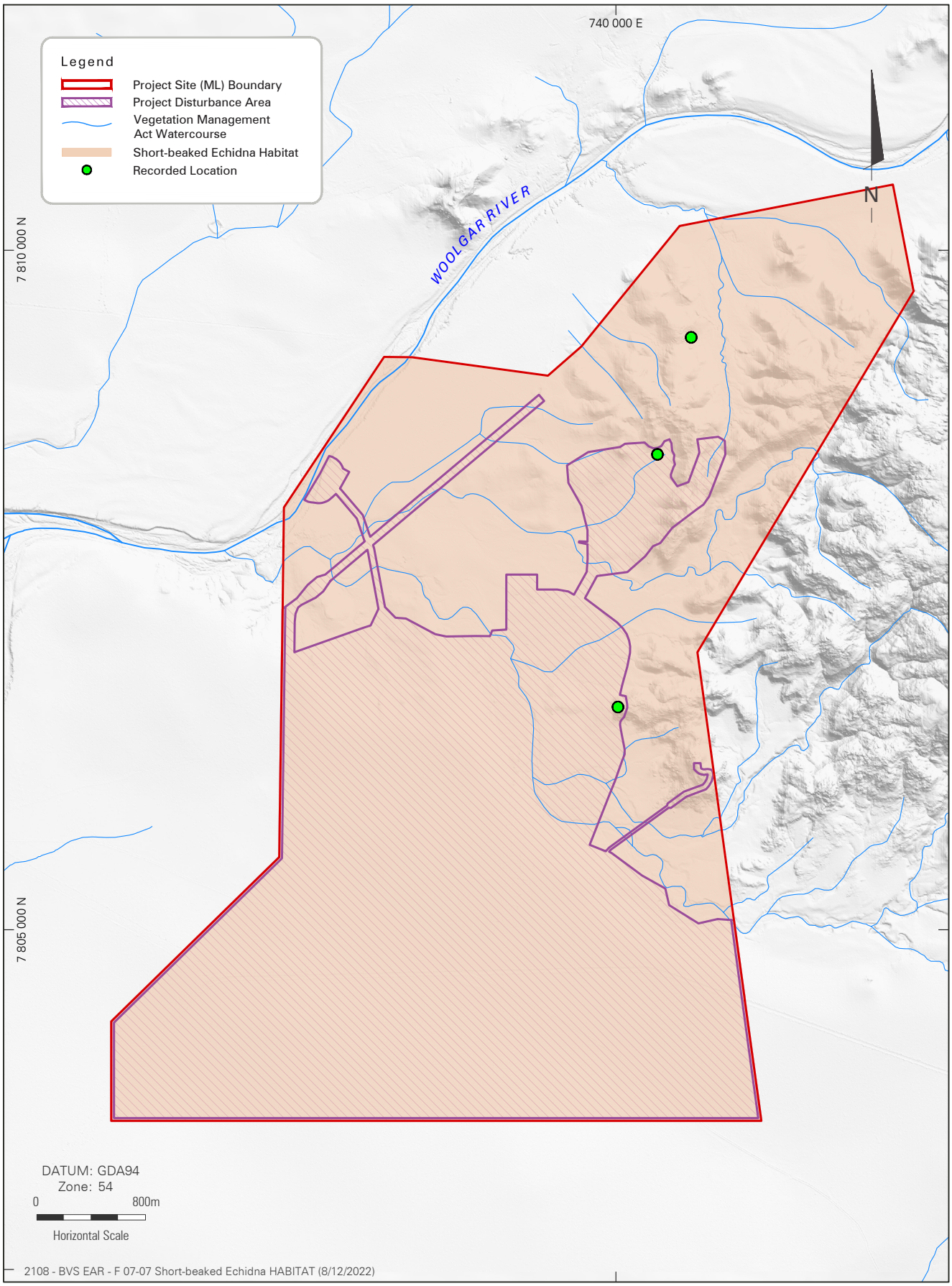


BIG VEIN SOUTH GOLD PROJECT

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Drummondita calida Habitat

FIGURE 7-6

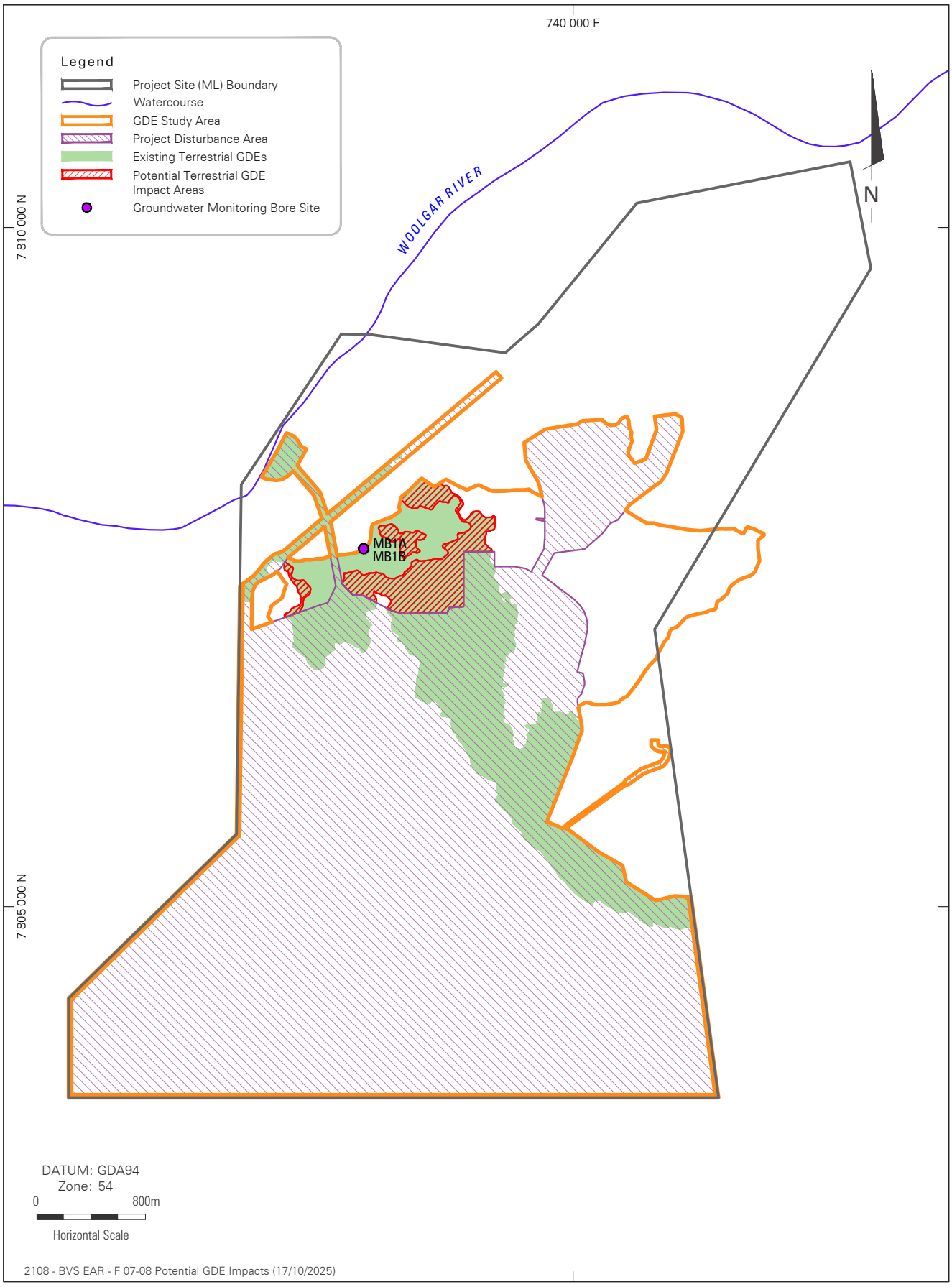


BIG VEIN SOUTH GOLD PROJECT

HANSEN ENVIRONMENTAL CONSULTING

Short-beaked Echidna Habitat and Records

FIGURE 7-7



HANSEN ENVIRONMENTAL CONSULTING

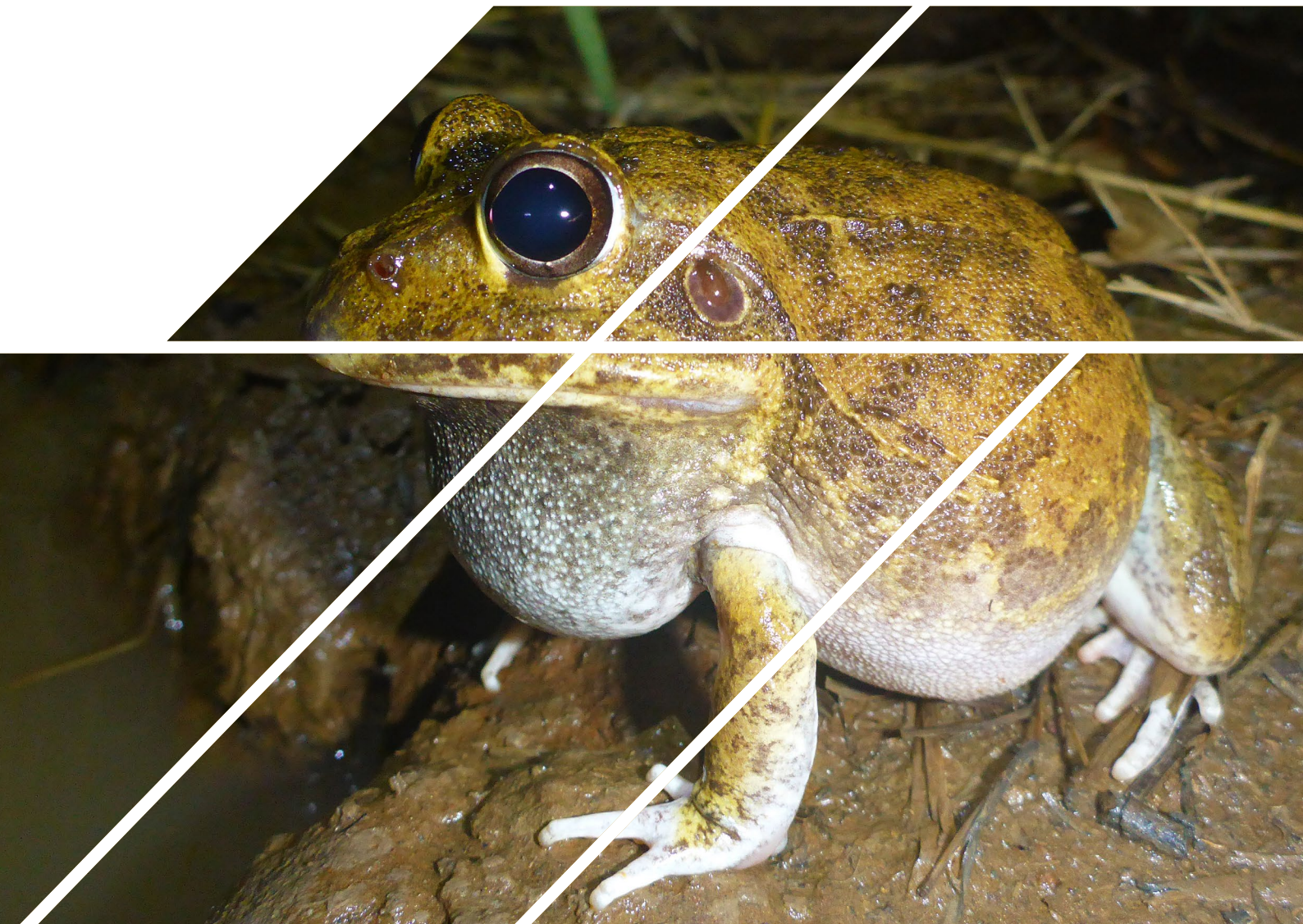
BIG VEIN SOUTH GOLD PROJECT

Potential Terrestrial Groundwater Dependent Ecosystems Impact Areas

FIGURE 7-8

8

AQUATIC ECOLOGY



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8 AQUATIC ECOLOGY

8.1 INTRODUCTION

This section provides a summary of the key findings of the aquatic ecology assessment undertaken for the Big Vein South Gold Project (the project). The aquatic ecology assessment was undertaken by C&R Consulting and the detailed report is provided in the *Aquatic Ecology Report* (Appendix F).

8.2 PROJECT SURFACE WATER SETTING

The catchment setting for the project site is described in detail in Section 6 – Surface Water. The project site is located within the Woolgar River catchment, which is located at the upstream end of the Flinders River basin (Figure 6-1). The predominant land use in the Woolgar River catchment is cattle grazing and existing development is generally limited to access tracks and infrastructure associated with large-scale grazing properties. Current land use in the project area includes cattle grazing and mineral exploration. There are also numerous remnants of historic gold workings in the area (Section 14 – Cultural Heritage).

The Woolgar River traverses the north-western edge of the project site, flowing in a south-westerly direction (Figure 8-1). The Woolgar River is highly ephemeral, exhibiting episodic, short duration flows following rainfall in the catchment. Flows occur predominantly from January to March. The river is a watercourse, as defined under the *Water Act 2000* (Water Act).

The project site is situated on the south-western edge of the Gregory Range. The north-eastern portion of the project site is characterised by a mosaic of sandstone scarps dissected by streams and gullies, while the remainder of the project site is gently undulating and sloping to the west toward the Woolgar River (Figure 8-1). The project site is traversed by several drainage features, as defined under the Water Act, that are tributaries of the Woolgar River. The drainage features are ephemeral, exhibiting short duration flows with high sediment loads.

The project site is located within four local catchments (Figure 6-2), summarised as follows:

- The northern catchment covers an area of approximately 4.2 km^2 and is drained by Drainage Feature 4 and Drainage Feature 5.
- The central catchment covers an area of approximately 19.4 km^2 and is drained by Drainage Feature 1 and its tributaries, Drainage Feature 2 and Drainage Feature 3. There are two stock watering dams within this catchment.
- The southern catchment covers an area of approximately 53.7 km^2. Runoff from this catchment drains to the south-west as overland flow and enters the Woolgar River over 15 km downstream of the project site. There are no defined drainage features in this catchment within the project site or in the immediate downstream area. A small channel forms in the lower part of this catchment area over a length of approximately 1 km, immediately upstream of the Woolgar River.
- A small catchment draining directly to the Woolgar River channel is located adjacent to the northern and central catchments in the north-western portion of the project site.

8.3 REGULATORY REQUIREMENTS

This section describes the key regulatory requirements relevant to aquatic ecology.

8.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth government's principal piece of environmental legislation, and is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, threatened ecological communities, migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes to their survival and provides for the preparation of recovery plans for threatened species and communities.

The project was referred to DCCEEW and was determined to be a controlled action under the EPBC Act (EPBC 2025/10252) on 12 September 2025 with listed threatened species and communities being confirmed as the relevant controlling provision. The aquatic ecology assessment did not identify any aquatic MNES present, or likely to occur, within the study area and hence there are no impacts on any aquatic MNES anticipated due to the project.

8.3.2 Queensland Regulatory Requirements

Nature Conservation Act

The Queensland *Nature Conservation Act 1992* (NC Act) is the principal legislation which establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Animals) Regulation 2020* and the *Nature Conservation (Plants) Regulation 2020* (NC Plants Regulation). The NC Act is administered by the Department of Environment, Tourism, Science and Innovation (DETSI).

The NC Act classifies native flora and fauna species into specific categories including Extinct in the Wild; Critically Endangered; Endangered; Vulnerable; Near Threatened; Least Concern; or Special Least Concern. Aquatic flora listed as Endangered or Vulnerable are Matters of State Environmental Significance (MSES) and aquatic fauna that are listed as Endangered, Vulnerable or Special Least Concern are MSES.

Fisheries Act

The *Fisheries Act 1994* (Fisheries Act) regulates the management, use, development and protection of fisheries resources and fish habitats. The Department of Primary Industries (DPI) is the administering authority for the Fisheries Act. The Fisheries Act contains provisions for the declaration of Fish Habitat Areas (FHAs). FHAs aim to provide long-term protection for fish habitats that are considered essential to sustaining commercial and recreational fisheries. FHAs are MSES however, no FHAs are mapped within, or in close proximity to, the project site.

Government Mapping of Wetlands and Watercourses

DETSI has prepared a map of referable wetlands that includes Wetland Protection Areas (WPAs), which comprise wetlands of high ecological significance (HES wetlands) located within Great Barrier Reef catchments, and trigger areas that represent the area of hydrological influence of HES wetlands. WPAs are MSES. The map of referable wetlands also includes wetlands of general ecological significance (GES wetlands) however, GES wetlands are mapped for the purpose of establishing environmental values and are not protected wetlands. There are no mapped WPAs or HES wetlands within, or in close proximity to, the project site.

Queensland Environmental Offsets Framework

The *Environmental Offsets Act 2014*, *Environmental Offsets Regulation 2014* and *Queensland Environmental Offsets Policy* (Version 1.9) comprise the Queensland Environmental Offsets Framework. According to this framework, it is

necessary to provide offsets for any significant, residual impacts on MSES. MSES relevant to aquatic ecology include:

- Habitat for protected aquatic wildlife, including any mapped essential habitat – there is no mapped essential habitat within, or in near proximity to, the project site. The presence of any protected aquatic wildlife habitat is discussed in Section 8.5;
- FHAs – as stated above there are no FHAs within, or in near proximity to, the project site;
- WPAs or HES wetlands – as stated above there are no WPAs or HES wetlands within, or in near proximity to, the project site;
- Wetland or watercourse designated as High Ecological Value (HEV) waters – there are no mapped HEV waters within, or in close proximity to, the project site; and
- Waterways providing fish passage – these are discussed in Section 8.5.

The *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (SRI Guideline) was developed to assist proponents in determining whether an activity will, or is likely to, have a significant residual impact on MSES. The assessment of impacts from the project on aquatic MSES and the need for offsets are discussed in Section 8.6.5.

8.4 METHODOLOGY

The methodology for the aquatic ecology assessment included a desktop assessment (comprising database analysis and literature review), field surveys and data analysis. These are discussed in the following sections.

8.4.1 Aquatic Ecology Study Area

The study area for the aquatic ecology assessment included the catchments, watercourses, drainage features and aquatic ecosystems (e.g. wetlands and dams) within the project site, and the reaches of waterways 500 m upstream and/or downstream of the project site boundary. Additionally, the southern catchment downstream (south-west) of the project site was inspected to determine the status of the drainage features within it.

8.4.2 Desktop Assessment

A desktop assessment was undertaken prior to the field surveys to obtain background information on aquatic ecology habitats and values, including the potential presence and distribution of threatened species (listed under the NC Act and the EPBC Act). The desktop assessment involved:

- Database searches, including the EPBC Act Protected Matters Search Tool, Wildnet, and Queensland Globe;
- A literature review, including a review of all available aquatic ecology studies in the region. This included the 2013 *Waterhole Ecology in the Flinders and Gilbert Catchments – A Technical Report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment* (2013 Waterhole Ecology Report);
- Review of government mapping, including the map of Queensland wetland environmental values and DPI's waterway mapping; and
- Review of historic aerial photographs of the region and the most up-to-date and finest-scale Geoscience Australia map.

The information from the desktop assessment was used to determine and characterise potential aquatic habitats and refine the field methodology for the aquatic ecology assessment to ensure that a wide range of aquatic habitats were targeted.

8.4.3 Field Surveys

Overview

The aquatic ecology field surveys are summarised in Table 8-1. The aquatic ecology surveys were performed in accordance with the recommended timing outlined in the *Queensland AUSRIVAS Sampling and Processing Manual* for a total of 13 days.

Table 8-1 Field Survey Program

SURVEY EVENT	SURVEY PERIOD	KEY SURVEY AREA	SURVEY DAYS
End of Wet Season 2019	22 – 27 April 2019	Project site	6 days
End of Wet Season 2021	27 – 30 April 2021	Woolgar River	4 days
End of Wet Season 2022	24 – 26 May 2022	Southern catchment	3 days

Sampling Sites

A total of 11 sampling sites were assessed across the aquatic ecology habitats within the study area. Aquatic ecology sampling sites were located based on different habitat types present within the waterways (e.g. pool, deep bend, backwater, or rock bar) and considering the proposed project layout and accessibility for sampling. Sampling sites are shown in Figure 8-1and were as follows:

- Woolgar River (five sites – WR1 to WR5). Sites were evenly spread out along the length of the Woolgar River, both upstream and downstream of the project site. All of the sites were situated within the main channel, with WR5 located at the proposed Woolgar River Pump Station site. Sampling was conducted in residual pools, given that the Woolgar River was not flowing during the field survey.
- Drainage Features (four sites – TRIB1 to TRIB 4). Sites were located along four of the drainage features within the project site. All four of the drainage features were dry at the time of the surveys.
- Farm dams (two sites – FD1 and FD2). Sites were located at the farm dams located near Drainage Features 1 and 3.

Sampling Methods

At each aquatic ecology sampling site, data was collected on:

- Habitat characteristics and condition – assessed in accordance with the methods outlined in *Queensland AUSRIVAS Sampling and Processing Manual*;
- Water quality – at the sites where water was present, surface water quality was tested using an in-situ field meter and water quality samples were taken for further NATA accredited laboratory analysis. Surface water quality data was analysed and compared to the published default guideline values for context;
- Sediment quality – sediment samples were undertaken in accordance with the *Australian Standard AS5667.1 – Guidance on Sampling of Bottom Sediments* and the 2005 CSIRO *Handbook for Sediment Quality Assessment*. Samples were sent to a NATA accredited laboratory for further analysis;
- Aquatic macroinvertebrates – sampling undertaken in accordance with the methods outlined in the 2001 *Queensland AUSRIVAS Sampling and Processing Manual* at the sites where water was present. The data was analysed using four indices, namely taxonomic richness, PET tax richness (i.e. number of Plecoptera, Ephemeroptera and Trichoptera families present at a site), SIGNAL index value, and Shannon-Weiner diversity index;

- Large macroinvertebrates (crustaceans) – at sites where water was present, survey was conducted using baited traps;
- Fish – at sites where water was present, survey was conducted using a combination of backpack electrofishing, baited traps and dip nets;
- Turtles – at sites where water was present, visual surveys conducted with baited cathedral traps also employed at sites with conducive habitats; and
- Aquatic flora – at sites where water was present, flora was assessed using a 100 m long transect at each site, with macrophyte (aquatic plant) species being recorded, along with percent cover of each species.

8.5 RESULTS

This section provides a summary of the results of the aquatic ecology field surveys for each of the significant aquatic habitats within the study area. A detailed description of the field survey results is provided in the *Aquatic Ecology Report* (Appendix F).

8.5.1 Woolgar River

Overview

The Woolgar River is an ephemeral watercourse characterised by a shifting, sand dominated, substrate with occasional vegetated islands as well as rock bars. The Woolgar River channel within the study area is well defined and approximately 50 m wide (Figure 8-1). The river channel contains a braided, low flow channel with sand sheet deposits, bars and islands that have been formed by extensive suspended sediment deposition during flow events. The bank height of the main channel is approximately 10 m. The riparian zones are still largely intact, although the moderately steep high banks still regularly display erosion scars, likely due to cattle grazing.

The ephemeral Woolgar River flows are typically associated with significant rainfall events in the wet season (i.e. November to April). Following the cessation of rainfall, surface water flows rapidly recede and cease. Depressions within the Woolgar River bed likely dry out over the dry season. The Woolgar River is expected to flow for less than 8 weeks per year, on average. There is also significant variation in the volume and timing of surface water flow between years depending on annual rainfall patterns.

Water Quality

Water samples from the Woolgar River taken at the end of the wet season in senescing pools and as such they are not representative of the Woolgar River during flow conditions. Results indicated that electrical conductivity (EC) levels ranged from within, to higher than, the aquatic ecosystem guidelines for northern Australia. This is expected given the significant concentration effects of evaporation on water quality. The dissolved oxygen (DO) levels were mostly below the guideline range, due to eutrophication likely caused by evaporation. Turbidity was significantly lower than the guideline values as a result of samples being taken from stagnant pools where settlement has occurred (i.e. not representative of flowing conditions when turbidity levels during periods of flow is expected to be significantly higher). pH was within the guideline range. Ammonia, total nitrogen and total phosphorous levels were elevated at most of the Woolgar River sampling sites. The elevated levels are from cattle accessing water. Low concentrations of cations, anions and dissolved metals were measured. These results are comparable to other watercourses within the region.

Habitat Condition Assessment

Based on sampling undertaken in accordance with the *Queensland AUSRIVAS Sampling and Processing Manual*, the sampling sites were all rated as having a "fair/moderate" biocondition due to the impacts from cattle.

Sediment Quality

The Woolgar River sediment was dominated by sand. The sediment chemistry of the Woolgar River was naturally variable and the metal and metalloid concentrations in the larger particle size fraction (i.e. sand) were below the applied guideline values. However, in the smaller particle size fraction (i.e. fine sediments) the metal and metalloid concentrations were generally an order of magnitude higher than those recorded in the sand (i.e. larger sediments). This is expected as the smaller fraction sediments have an increased total surface area compared to the larger sediments. In addition, the occurrence of naturally elevated concentrations of certain metals is expected given the extensively weathered geology and enrichment commonly associated with gold deposits.

Aquatic Macroinvertebrates

In general, the macroinvertebrate communities within the Woolgar River were depauperate which is common for ephemeral north Australian rivers at the end of the wet season. Despite this, the Woolgar River system is in good health.

Thirty-one macroinvertebrate taxa were identified in the Woolgar River. The taxonomic richness and abundance levels at each site in the Woolgar River was moderate, with taxonomic richness ranging from 17 to 22 families. The diversity, taxonomic richness and abundance within the Woolgar River were similar to that identified in the 2013 Waterhole Ecology Report indicating that the results are representative of the broader region.

PET richness in the Woolgar River ranged from 2 to 5. This indicates that the Woolgar River is in a similar condition to other tropical north Australian systems. The average SIGNAL index values of the Woolgar River ranged from 2 to 4, indicating that the majority of the macroinvertebrate communities in the river are tolerant of environmental change. The Shannon-Wiener Diversity Index values of the Woolgar River ranged from 2 to 3, with the majority of the scores above 2.5 which indicates that the macroinvertebrate communities in the Woolgar River are typically in excellent condition. The AusRivAs modelling of the macroinvertebrate data indicates that the Woolgar River is within both Band A and Band B which indicates that the Woolgar River macroinvertebrate communities are in relatively good condition.

No decapod species were caught using baited traps in the Woolgar River.

None of the aquatic macroinvertebrate species identified within the Woolgar River are listed under the EPBC Act or the NC Act.

Vertebrates

Four species of native fish were recorded in the Woolgar River and four additional native species are likely to occur within the Woolgar River. None of these eight fish species are listed under the EPBC Act or the NC Act. All fish species potentially present within the Woolgar River have broad tolerances for environmental conditions, which is a common trait of fish that inhabit ephemeral waterways with large natural fluctuations in environmental parameters. All of the fish potentially present in the Woolgar River migrate during their life stages, typically going upstream to lay eggs during the wet season and downstream to permanent pools during the dry season.

The Woolgar River provides passage for fish and has been classified in government mapping as a river where waterway barrier works would pose a "major" risk to fish passage (Figure 8-2).

No freshwater turtles were caught in the Woolgar River during the field surveys. There is the potential for the common Saw-shelled Turtle (*Myuchelys latisternum*) to occur within the region and it may traverse the project site (including the Woolgar River) during periods of flow to access more permanent water downstream of the project site.

The EPBC Act Protected Matters Search Tool states that the range of the Freshwater Crocodile (*Crocodylus johnstoni*) (Least Concern) could extend to the project site, including the Woolgar River. However, there are no

records of Freshwater Crocodiles within 20 km of the project site. The Freshwater Crocodile is not expected to inhabit the upstream reaches of the Woolgar River, near the project site, given the highly ephemeral nature of the river.

Aquatic Flora

Two species of emergent macrophytes were recorded in the Woolgar River. No free-floating or attached floating aquatic plant forms were recorded. The results indicate a relatively depauperate (in diversity) but healthy aquatic vegetation community in the Woolgar River, with only natural processes influencing community structure at each site (e.g. flow rate and riparian cover). The lack of extensive macrophyte beds in the Woolgar River is associated with the ephemeral nature of the river combined with the shifting sediment loads observed during periods of flow.

No aquatic Weeds of National Significance listed under the National Weeds Strategy were observed in the Woolgar River during field surveys. None of the aquatic flora species identified within the Woolgar River are listed under the EPBC Act or the NC Act.

8.5.2 Drainage Features

This section provides an overview of the aquatic ecology field survey results for the drainage features within the project site (Figure 8-1). The drainage features with the project site all have similar attributes, and hence, are discussed collectively.

Overview

The drainage features within the project site have well defined channels that vary in width from approximately 4 m to 10 m. The drainage features are shallow with bank heights of 1.5 m or less. The drainage features are all highly ephemeral and the substrate is dominated by sand with occasional gravel and cobble reaches. The drainage features only flow after significant rainfall events in the wet season and dry up quickly once the rain ceases. All four of the drainage features within the site were dry during the field survey. The drainage features have all been impacted by cattle.

The riparian vegetation of the drainage lines was very limited and, where present, heavily influenced by the surrounding non-riparian vegetation. The key species found along the drainage features included River Red Gum and non-riparian Eucalypt species.

Due to their highly ephemeral nature, short flow duration and the remote location of the project site, there was no water in the drainage features during the field surveys. Consequently, sampling of water quality was not possible and there were no surveys for aquatic macroinvertebrates, aquatic flora and aquatic fauna or *AUSRIVAS* habitat conditions assessments.

Sediment Quality

The drainage features were dominated by sand with small amounts of gravel. Drainage features 1 and 4 also contained very small amounts of fines. The sediment chemistry of the drainage features was naturally variable and the metal and metalloid concentrations for both the larger and smaller particle size fractions were below the applied guideline values. Drainage Feature 3 had naturally elevated concentrations of lead, which is expected given the extensively weathered geology and the enrichment commonly associated with gold deposits.

Vertebrates

The majority of the reach of Drainage Feature 1 traversing the project site is classified in government mapping as a waterway where waterway barrier works would pose a "moderate" risk to fish passage (Figure 8-2). A small reach at the very downstream end of Drainage Feature 1 within the project site is classified as high risk. The very downstream end of Drainage Feature 3 is also classified as moderate risk. All other reaches of the drainage

features within the project site are classified as having either low or no risk (Figure 8-2). No fish were observed in these drainage features during field surveys as they were dry.

8.5.3 Farm Dams

This section provides an overview of the aquatic ecology field survey results for the two stock watering dams on the project site (Figure 8-1).

Overview

The two stock watering dams are man-made earthen dams. Farm Dam 1 is located to the south of Drainage Feature 1 just upstream of the western boundary of the project site. Farm Dam 2 is located on a small tributary of Drainage Feature 3. Both dams are heavily impacted by cattle.

The vegetation surrounding both dams was highly modified and dominated by the invasive species Sweet Acacia (*Acacia farnesiana*).

The aquatic habitat of both dams is highly disturbed. The overall aquatic habitat condition of both dams has been assessed as low as they both have poor biocondition scores, poor surface water quality and low diversity and abundance of macroinvertebrates, fish, and aquatic flora.

Surface Water Quality

Water samples taken from the farm dams at the end of the wet season indicate:

- The EC level at Farm Dam 1 was high, but within the aquatic ecosystem guideline values. The higher EC level at Farm Dam 1 is consistent with the low water levels (due to evaporation) recorded at the dam during the survey. The EC level at Farm Dam 2 was low which is consistent with the high water levels recorded at the dam during the survey.
- The DO levels at Farm Dam 2 were within the guideline values but the DO levels at Farm Dam 1 were below the guideline values, which suggests that Farm Dam 1 is influenced by eutrophication.
- Turbidity levels were significantly higher than the guideline values at both farm dams and this was due to the higher quantities of fine sediments in both of the dams combined with high levels of cattle activity. The cattle stir up the fine sediment and keep it in suspension.
- Ammonia, total nitrogen and total phosphorous levels were elevated at both farm dams due to the large presence of cattle accessing the water. Dissolved aluminium and copper levels were also elevated at both farm dams and total aluminium was also elevated in Farm Dam 1. It is common for these metals to be elevated in colloidal form in north Australian ephemeral watercourses.

Habitat Condition Assessment

Based on sampling undertaken in accordance with the *Queensland AUSRIVAS Sampling and Processing Manual*, the farm dams were both rated as being in "poor" condition due to their anthropogenic origins and the high level of disturbance from cattle.

Sediment Quality

The farm dams were dominated by fine sediments which is common for in-channel farm dams where the water flow slows upon entry into the dam allowing the fine sediments to settle out of suspension. The sediment chemistry of the farm dams was naturally variable and the metal and metalloid concentrations in both the larger and smaller particle size fractions were below the applied guideline values.

Aquatic Macroinvertebrates

In general, the macroinvertebrate communities within Farm Dam 1 were depauperate with only five macroinvertebrate taxa identified. Taxonomic richness and abundance were moderate due to only five families of macroinvertebrate being recorded. The low taxonomic richness value at Farm Dam 1 is typical of dams that are impacted by cattle. The diversity, taxonomic richness and abundance of macroinvertebrates within Farm Dam 1 was similar to that identified in the 2013 Waterhole Ecology Report indicating that the results are representative of the region.

The PET richness score in Farm Dam 1 was 0 as no PET taxa were found at this dam. This is potentially the result of the large amounts of fine sediments and relatively poor water quality due to the high amount of cattle activity at Farm Dam 1. The average SIGNAL index value of Farm Dam 1 was approximately 3.5, indicating that the macroinvertebrate communities are tolerant of environmental change. The Shannon-Wiener Diversity Index value of Farm Dam 1 was approximately 1.3 which suggests that the macroinvertebrate community in this farm dam is highly depauperate. The AusRivAs modelling of the macroinvertebrate data indicates that Farm Dam 1 was within Band C and was, therefore, a severely impacted system.

In general, the macroinvertebrate communities within Farm Dam 2 were depauperate with only eight macroinvertebrate taxa identified. Taxonomic richness and abundance were moderate due to only eight macroinvertebrate families being recorded. The low taxonomic richness value at Farm Dam 2 is typical of dams that are highly impacted by cattle. The diversity, taxonomic richness and abundance of macroinvertebrates within Farm Dam 2 was similar to that identified in the 2013 Waterhole Ecology Report indicating that the results are appropriate and representative of the region.

The PET richness score in Farm Dam 2 was 0 as no PET taxa were found at this dam. This is potentially the result of the large amounts of fine sediments and relatively poor water quality due to the high amount of cattle activity at Farm Dam 2. The average SIGNAL index value of Farm Dam 2 was approximately 3.5, indicating that the macroinvertebrate communities are tolerant of environmental change. The Shannon-Wiener Diversity Index value of Farm Dam 2 was approximately 1.7 which suggests that the macroinvertebrate community in this farm dam is in moderate to good health. The AusRivAs modelling of the macroinvertebrate data indicates that Farm Dam 2 was within Band B which indicates that macroinvertebrate communities were in relatively good condition.

One decapod (a species of freshwater crab) was recorded at Farm Dam 2 using baited traps. No decapods were recorded at Farm Dam 1.

None of the aquatic macroinvertebrate species identified within the farm dams are listed under the EPBC Act or the NC Act.

Vertebrates

Two native species of fish were recorded at Farm Dam 2. No fish were recorded in Farm Dam 1, likely due to the cattle impacts. Based on the database searches, four additional native fish species may also occur within either or both of the farm dams. None of the fish species recorded or potentially present within the farm dams are listed under the EPBC Act or the NC Act. All fish species potentially present within the farm dams have broad tolerances for environmental conditions, which is a common trait of fish that inhabit ephemeral waterways with large natural fluctuations in environmental parameters. All of the fish potentially present in the farm dams migrate during their life stages, typically going upstream to lay eggs during the wet season and downstream to permanent pools during the dry season.

No freshwater turtles were caught in the farm dams during the field surveys. There is the potential for the common Saw-shelled Turtle (*Myuchelys latisternum*) to occur within the region and it may traverse the project site (including the farm dams) during periods of flow to access more permanent water downstream of the project site.

Aquatic Flora

There was no aquatic flora recorded at either of the farm dams.

8.5.4 Matters of State Environmental Significance

The MSES that were recorded or are predicted to occur within the aquatic ecology survey area are described in detail in the *Aquatic Ecology Report* (Appendix F). Table 8-2 summarises the potential aquatic MSES within the aquatic ecology study area. The aquatic ecology assessment also did not identify any aquatic MNES present or likely to be present within the study area.

Table 8-2 Summary of Aquatic Matters of State Environmental Significance

MSES	COMMENT
WETLANDS AND WATERCOURSES	
WPA or HES wetlands shown on the map of Queensland wetland environmental values	No HES wetlands, or associated WPAs, are mapped within the project site or within 20 km from the project site. The project will therefore not impact any HES or associated WPAs.
A wetland or watercourse designated as HEV waters	No HEV waters are mapped within the project site or within 20 km of the project site. The project will therefore not impact any HEV waters.
PROTECTED WILDLIFE HABITAT	
Protected wildlife habitat, including habitat for Endangered, Vulnerable or Special Least Concern species	No Endangered, Vulnerable or Special Least Concern aquatic species were recorded in the aquatic ecology study area or are considered likely to occur. The project will therefore not impact any protected aquatic wildlife habitat.
An area of essential habitat on the essential habitat map for an animal or plant that is Endangered or Vulnerable wildlife	No essential habitat areas are mapped within, or immediately adjacent to, the aquatic ecology study area. No Endangered or Vulnerable wildlife were recorded, or considered likely to occur, within the aquatic ecology study area. The project will therefore not impact any essential habitat.
FISH HABITAT AREAS	
FHAs declared under the Fisheries Act	No FHAs are mapped within the project site or within 20 km of the project site. The project will not, therefore, impact any FHAs.
WATERWAY PROVIDING FOR FISH PASSAGE	
Any part of a waterway providing for fish passage is an MSES only if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the waterway	The Queensland government mapping of waterway barrier works risk levels within the waterways traversing the project site are shown in Figure 8-2. The waterway mapping indicates that there is a low risk to fish passage from waterway barrier works in the majority of the ephemeral drainage features traversing the project disturbance footprint. Within the project disturbance footprint (Figure 8-3), Drainage Feature 1 is mapped as having a moderate risk for fish passage and the Woolgar River is mapped as having a major risk to fish passage from waterway barrier works. Potential impacts to fish passage are discussed in Section 8.6.

8.6 IMPACT ASSESSMENT

8.6.1 Overview

The project involves the development of three open cut pits and associated mining infrastructure within the project site (Figure 8-3). The project activities have the potential to give rise to impacts on aquatic ecosystems due to:

- Physical disturbance of aquatic habitats;
- Changes to the surface water setting (i.e. surface water flow or quality);
- Changes to the groundwater regime (i.e. groundwater levels or quality); and/or
- Biosecurity issues.

The farm dams will not be disturbed by the project activities and the project is not predicted to significantly affect the volume or flow of surface water into the dams. Hence, the project is not expected to have a significant impact on the aquatic habitats, flora or fauna present in the farm dams.

The project impacts of physical disturbance on vegetation associated with aquatic habitats (i.e. clearing of riparian and wetland vegetation) has been assessed in the *Terrestrial Ecology Report* (Appendix E) and are summarised in Section 7 – Terrestrial Ecology. Hence, direct vegetation clearing impacts are not discussed further in this section.

The *Surface Water Report* (Appendix D) and Section 6 – Surface Water describe the potential impacts of the project on surface water flow and quality. The large majority of the project layout is above the 0.1% (1 in 1,000) Annual Exceedance Probability (AEP) flood extents associated with the Woolgar River. Hence, there is limited potential for interaction between the project activities and the Woolgar River and its associated floodplain and aquatic ecosystems.

The *Groundwater Report* (Appendix C) and Section 5 – Groundwater describe the project's effects on the groundwater regime. The groundwater assessment concluded:

- The Woolgar River is located outside the predicted extents of drawdown on the groundwater table from the project. Hence, the localised drawdown on the groundwater table is not predicted to have any effect on river baseflow or the natural flow regime in the Woolgar River.
- The groundwater table does not intersect the ground surface in the drainage features that traverse the project site. There is no groundwater seepage through the creek beds or banks, and therefore, groundwater seepage does not provide baseflow to the drainage features.
- Project activities are not predicted to give rise to any significant impacts on groundwater quality.

Hence, the project's effects on groundwater are not expected to give rise to adverse impacts on any aquatic groundwater dependent ecosystems associated with watercourses and drainage features.

The aquatic ecology impact assessment, therefore, focuses on the remaining elements of the project that have the potential to give rise to physical disturbance of aquatic habitats and surface water effects of the project on aquatic habitats. The aquatic ecology impact assessment is structured as follows:

- Section 8.6.2 describes the physical disturbance of aquatic ecosystems due to:
  - Construction of the Woolgar River offtake;
  - Construction of the Big Vein South (BVS) Pit Drainage Diversion; and
  - Construction of drainage feature road crossings.
- Section 8.6.3 describes the project's effects on surface water flow/quality (based on the findings of the surface water assessment (*Surface Water Report* (Appendix D)) due to:
  - Water supply abstraction from the Woolgar River and associated effects on downstream river flows;
  - Open cut mining effects on catchment yield and associated surface flows;
  - Mine water discharges; and
  - Erosion and sedimentation.

- Section 8.6.4 describes the potential for project activities to introduce or spread weeds and feral animals.
- Section 8.6.5 describes the potential impacts of the project's disturbance and surface water effects on aquatic MSES.

8.6.2 Physical Disturbance of Aquatic Ecosystems

Woolgar River Offtake

The project will require a raw water supply. The raw water supply will involve the abstraction of surface water from an offtake located on the Woolgar River. The Woolgar River offtake and associated infrastructure will be located in the north-western part of the project site, on the southern bank of the Woolgar River channel (Figure 8-3).

The offtake will comprise:

- A small, excavated sump for the pump inlet pipes in the Woolgar River bank, adjacent to the riverbed. The off-channel sump will be approximately 10 m wide x 20 m long at its base. The internal batter slopes of the sump will be lined with rock and/or concrete. The sump inlet will be a rock gabion weir running parallel to the riverbank. The rock gabion will reduce sediment accumulation in the sump and will act as a sill that deters fish using the sump during low flows by preferentially guiding fish along the riverbank away from the sump.
- Pump inlet pipes and a 10H:1V access/maintenance ramp from the riverbed to the pump station constructed on the riverbank above the sump.
- A pump station at the top of the riverbank, including a hardstand area and pumps, and a pump station access track located on the Woolgar River floodplain (outside of the river channel).

The offtake construction will occur during the dry season when the Woolgar River is not flowing. As part of construction activities, vegetation will be cleared from the footprint of the offtake infrastructure area. Topsoil and subsoil will be stripped from this area and stockpiled for reuse in rehabilitation.

Once the offtake is commissioned, a shallow pumping pool will form in the sump at the start of the following wet season. The Woolgar River experiences significant flows that will inundate the sump and riverbank. Due to the significant flows in the river, the water level in the river will remain high for extended periods during the wet season. At the end of the wet season, the volume of water flowing in the river will decrease, causing the water level in the river to fall. When the water level in the river falls below the sump inlet, water will cease to flow into the sump. Following the cessation of flow into the sump, the residual pumping pool will rapidly dissipate due to infiltration and evaporation. Hence, the presence of a pumping pool in the sump will be largely limited to the wet season when the Woolgar River is in flow.

During mining operations, water will be pumped from the river to the Raw Water Dam via a dedicated pipeline. Section 8.6.3 describes the take of surface water from the Woolgar River and the associated downstream river flow effects.

The offtake construction will require the clearing of approximately 0.25 ha (along 105 m of the river) for the sump, pump suction pipes and access/maintenance ramp. The offtake construction will include stabilisation of the disturbed area of the riverbank with rock armouring and/or shotcrete to ensure the bank remains stable and the pumps can continue to operate during wet season flows events. The offtake construction will therefore directly impact approximately 0.25 ha of slightly disturbed aquatic habitat. The impacted area does not provide habitat for any listed or threatened aquatic species.

During mining operations, there is potential for a small pool in the offtake sump to persist a short time following cessation of flows in the river channel. However, this type of habitat is naturally occurring throughout the Woolgar

River channel. Hence, the intermittent presence of pooled water in the offtake sump is not expected to have a significant impact on aquatic flora or fauna within the river.

On completion of mining, the offtake will be removed, the off-channel sump will be backfilled to reinstate the pre-mining riverbank surface and the disturbed areas will be rehabilitated. It is expected that aquatic flora will become established on the rehabilitated riverbank. Hence, there is not expected to be a significant residual impact on the aquatic habitats, flora or fauna present in the Woolgar River following decommissioning of the offtake and rehabilitation of the offtake disturbance area.

The offtake will not result in any obstruction to the river channel or flows. It will therefore not have a significant impact on fish passage during flow events in the river.

Overall, the construction and operation of the pump station and offtake point is not expected to result in any significant adverse impact on the aquatic ecology (including aquatic habitats, flora or fauna) of the river.

BVS Pit Drainage Diversion

The BVS Pit footprint is traversed by Drainage Feature 1 and 2 (Figure 8-3). Drainage Feature 1 and 2 join within the BVS Pit footprint. Drainage Feature 1 joins the Woolgar River approximately 3.2 km downstream of the BVS Pit footprint.

Prior to commencement of mining operations, a permanent Drainage Diversion will be constructed to divert Drainage Feature 1 and 2 around the BVS Pit.

The conceptual alignment of the Drainage Diversion is shown in Figure 8-3. The Drainage Diversion is approximately 2.1 km long and extends around the eastern and northern sides of the BVS Pit.

A diversion drain inlet embankment will be constructed across Drainage Feature 1 and 2 upstream of the BVS Pit. Surface water from upstream reaches of these drainage features will enter the diversion inlet works during (and immediately following) seasonal runoff events. The inflowing surface water will be directed to the diversion drain located at the northern end of the inlet works (on Drainage Feature 1). Surface water will flow along the diversion drain to the diversion drain outlet on Drainage Feature 1.

The BVS Pit Drainage Diversion will remain in place after mine closure.

On this basis, construction of the BVS Pit Drainage Diversion will effectively:

- Remove a 0.6 km long reach of Drainage Feature 1 between the diversion inlet works and its confluence with Drainage Feature 2; and
- Replace a 1.8 km long reach of Drainage Feature 1 and 2 with a 2.1 km long drainage channel that exhibits similar characteristics.

Whilst the drainage diversion does not require authorisation under the Water Act 2000, the detailed design of the diversion will consider relevant aspects of the Department of Natural Resources, Mines and Energy (DNRME) *Guideline: Works that interfere with water in a watercourse for a resource activity*, in order to replicate aquatic habitat features of the diverted drainage feature reaches, as far as practicable.

There are no MSES fauna and fauna within these drainage features and therefore the BVS Pit drainage diversion will not adversely impact any aquatic MSES.

As well as direct habitat loss, the construction and operation of the diversion drain has the potential to influence habitats within the length, and immediately downstream of, the diversion drain through increasing flow velocities as well as erosion and sedimentation processes. However, these potential impacts will be minimised by adopting the following mitigation measures:

- Designing the diversion drain in accordance with current best practice standards, where feasible;
- Installing bank and bed armouring, where necessary (i.e. dependent on engineering designs), including, where possible, promoting riparian vegetation growth/rehabilitation; and
- Operating in accordance with an Erosion and Sediment Control Plan.

These measures will limit the potential of any significant impacts from the proposed BVS Pit drainage diversion.

Road Crossings of Drainage Features

No watercourse road crossings are required as part of the project.

The project involves the construction of seven new road crossings of drainage features. The road crossing locations are shown in Figure 8-3and include:

- One haul road crossing of the BVS Pit Drainage Diversion; and
- Six access road / access track crossings on Drainage Features 1, 2 and 3.

Conceptually, the haul road crossing will include several culverts within an engineered embankment in order to allow unimpeded low flows. The drainage channel bed and banks upstream of the culvert inlets and downstream of the culvert outlets will be constructed with scour protection and an apron to minimise erosion. Any upstream and downstream embankment slopes (i.e. slopes that form the culvert headwall) will be surfaced with rock lining or other suitable material to prevent erosion.

The access road crossings will be rock-fill causeways with low flow culverts.

The section of the roads located on the crossings will be paved with scour resistant material to prevent erosion. The pavement surface specification will be refined during the detailed design process to ensure a suitable scour resistance based upon the design flow velocities for each crossing. During higher flow conditions, excess stormwater will flow over the scour resistant road surface and back into the natural drainage channel on the downstream slope.

Drainage feature 1 is mapped as a moderate risk for fish passage due to waterway barrier works. The haul road over the BVS Pit drainage diversion and two access roads cross Drainage Feature 1. For these crossings, appropriate mitigation measures for fish passage will be considered during detailed design and construction, including consideration of State Code 18. The culverts are predicted to have minimal influence on the resident fish communities inhabiting the site drainage features.

All other drainage features crossed by mine roads are mapped as low risk from waterway barrier works and mitigations are therefore not being considered for those crossings.

Construction of the road crossings could potentially alter any aquatic habitats at, and immediately surrounding, the crossing locations due to the alteration of the bed habitat and removal of riparian vegetation. However, the bed habitat at the road crossing locations exhibits extensive shifting, sandy substrates, with no significant stable, complex aquatic habitat features (such as pools, undercut banks, riffles, etc.). Mitigation measures will be adopted during construction to limit the potential for significant impacts on aquatic habitats, these will include:

- Designing each crossing to allow unimpeded flows;
- Installing bank and bed armouring, where necessary (i.e. dependent on engineering designs); and
- Operating in accordance with an Erosion and Sediment Control Plan.

Impacts due to the loss of riparian vegetation are addressed in the *Terrestrial Ecology Report* (Appendix E).

Impacts to fish passage from the crossings of Drainage Feature 1 will be minimised through the consideration of appropriate mitigation measures from best practice guidelines, during detailed design. With appropriate mitigation measures in place, the Drainage Feature 1 crossings are not expected to have a significant impact on fish passage.

The haul road crossing is proposed over the BVS Pit drainage diversion and therefore the construction of the haul road crossing will not cause any significant aquatic habitat impacts in addition to those incurred by the diversion drain.

8.6.3 Project Effects on Surface Water Flow and Quality

Abstraction of Surface Water from the Woolgar River

The project will require a raw water supply from the Woolgar River offtake. The effects of Woolgar River offtake on downstream river flows were evaluated in the surface water assessment (*Surface Water Report* (Appendix D)). The surface water assessment concluded that the proposed surface water take is unlikely to result in a significant change in the flow regime of the Woolgar River downstream of the off-take for the following reasons:

- The off-take is temporary and is limited to the relatively short 11 year mine life.
- The operation of the Woolgar River off-take will not change the overall frequency or duration of flows in the Woolgar River (i.e. flows in the Woolgar River are predicted on approximately 12% of all days, under existing conditions and while the off-take is operating).
- Low flow conditions (up to 432 ML/day) currently occur on approximately 8.5% of all days (i.e. 70% of the days that the river is flowing). The off-take will not operate during low flow conditions in the Woolgar River. Hence, the off-take will not have any effect on the frequency or volume of low flow conditions in the Woolgar River.
- For the remaining 30% of days when the river is flowing, the flow rate in the Woolgar River is greater than 432 ML/day. During these flow conditions, the off-take will operate at up to 130 ML/day and is predicted to result in a minor reduction in downstream river flows.
- The percentage reduction in flow will increase to a maximum when river flow is at 562 ML/day and will then proportionately reduce as the receiving flow increases. The modelled off-take corresponds to approximately 2.9% of the mean annual flow in the Woolgar River at the project site. For the 25th percentile wet year (representative of a wet year with higher river flows) the modelled off-take is 1.9% of the annual flow. For the 75th percentile dry year (representative of a dry year with lower river flows) the modelled off-take is 7.1 % of the annual flow. Given the naturally high variability in the rainfall dependent annual flows in the Woolgar River, these relatively minor reductions in flow are unlikely to be discernible from the natural variability in river flow from year to year.
- River flows above bank full flow engage the floodplain. Bank full flows in the river are conservatively estimated to be in the order of 25,920 ML/day, and significantly larger than the maximum abstraction rate of 130 ML/day. Consequently, the proposed 130 ML/day maximum rate of extraction will only represent a 0.5% reduction in bank full flow and hence is unlikely to result in any discernible change to the volume of flood flows or frequency of floodplain engagement in the Woolgar River. On this basis, the off-take will not give rise to any changes to the frequency of flooding events along the riparian zone associated with the Woolgar River.

Therefore, it is expected the offtake's flow effects will have negligible influence on the overall aquatic ecology values of the Woolgar River downstream of the offtake.

Mining Effects on Catchment Yield

Open cut mining can potentially affect catchment yield by altering the contributing catchment to downstream areas. The project's open cut mining activities will create contained catchments. Runoff from the contained catchments will drain to open cut pits and dedicated water storages during mining operations.

The effects of these activities on surface water flows in downstream drainage features has been addressed in the *Surface Water Report* (Appendix D). The surface water assessment concluded that the contained catchments are not expected to have a measurable effect on the natural surface flow regime in watercourses traversing the project site and any change is expected to be indistinguishable within the context of the significant natural year-to-year variations in surface water flow in these creeks.

Hence, the creation of contained open cut mining catchments is not expected to result in a significant loss of catchment yield in downstream surface waters.

Surface Water Quality Effects

The mine water management system includes the provision for the controlled release of any excess mine affected water in accordance with proposed Environmental Authority (EA) controlled release conditions. The proposed EA controlled release conditions, to be approved by DETSI, will be designed to ensure any controlled releases do not result in any significant environmental harm to the receiving environment, including downstream water quality and aquatic ecology. The controlled release water quality limits will align with the relevant *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) limits for aquatic ecosystem protection or baseline receiving water quality, in order to ensure the protection of downstream aquatic ecology.

Stormwater runoff from disturbed areas typically contains suspended sediments. The *Surface Water Report* (Appendix D) provides an overview of the erosion and sediment control measures that will be adopted. An Erosion and Sediment Control Plan will be developed prior to commencement of construction to address erosion and the control of suspended sediment in drainage from the project site.

With the application of appropriate controls on runoff from disturbed areas and areas at increased risk of erosion, it is expected that the project will not result in any significant change in turbidity or suspended sediment levels in local surface waters.

8.6.4 Project Effects on Biosecurity

Several invasive species, and cattle, with the potential to impact native aquatic flora and fauna communities already inhabit the area, including feral pigs, feral dogs, feral cats and cane toads. Feral animal management is proposed to be undertaken within the project site. It is therefore expected that impacts of feral animals will be controlled as a result of the project, particularly in local ecosystems along the Woolgar River and its associated drainage features.

No aquatic pest species were observed inhabiting the project site during the field surveys. The potential for invasive aquatic pest species to be spread to the project site or downstream aquatic habitats is not increased by the development of the project given the development and implementation of a weed and feral animal management plan.

8.6.5 MSES Impact Assessment

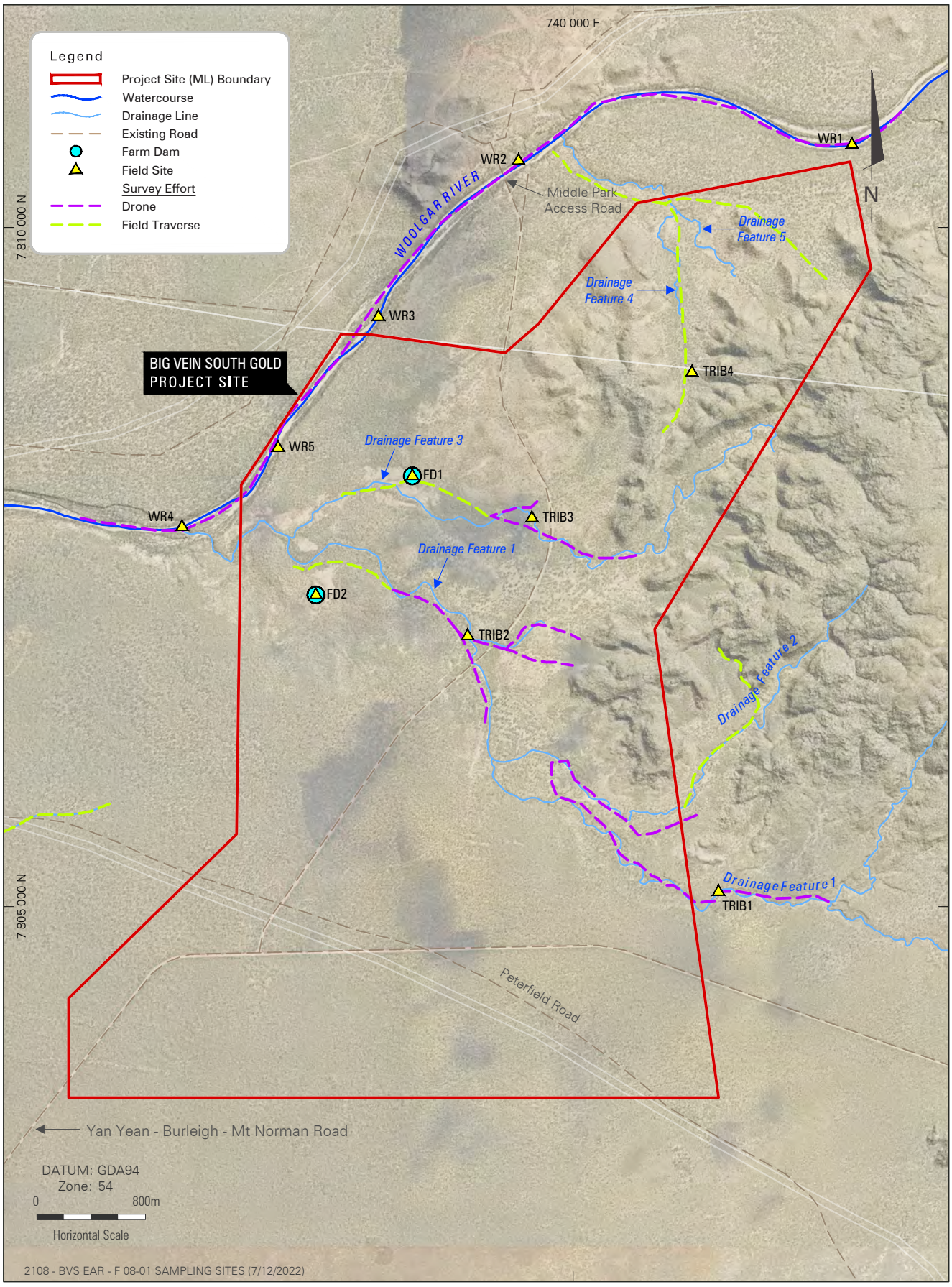
The *Aquatic Ecology Report* (Appendix F) includes an assessment of the potential impacts of the project on aquatic MSES using the SRI Guidelines. The assessment concluded that the project is not likely to give rise to any significant impacts on aquatic MSES and consequently, offsets are not required.

As discussed in Section 8.5.4, the aquatic ecology assessment did not identify any aquatic MNES present, or likely to be present, within the study area. Consequently, the project is not expected to have any significant impacts on aquatic MNES.

Monitoring

The proponent will develop and implement a Receiving Environment Monitoring Program (REMP) prior to the commencement of the project, in accordance with the EA conditions. A REMP is required to monitor the effects of the mine on the receiving environment and identify any adverse impacts to surface water environmental values, including aquatic ecology, water quality and flows. For the purposes of the REMP, the receiving environment will include the Woolgar River downstream of the project site. Annual reports are required to be prepared describing the monitoring results and findings of the REMP.

FIGURES

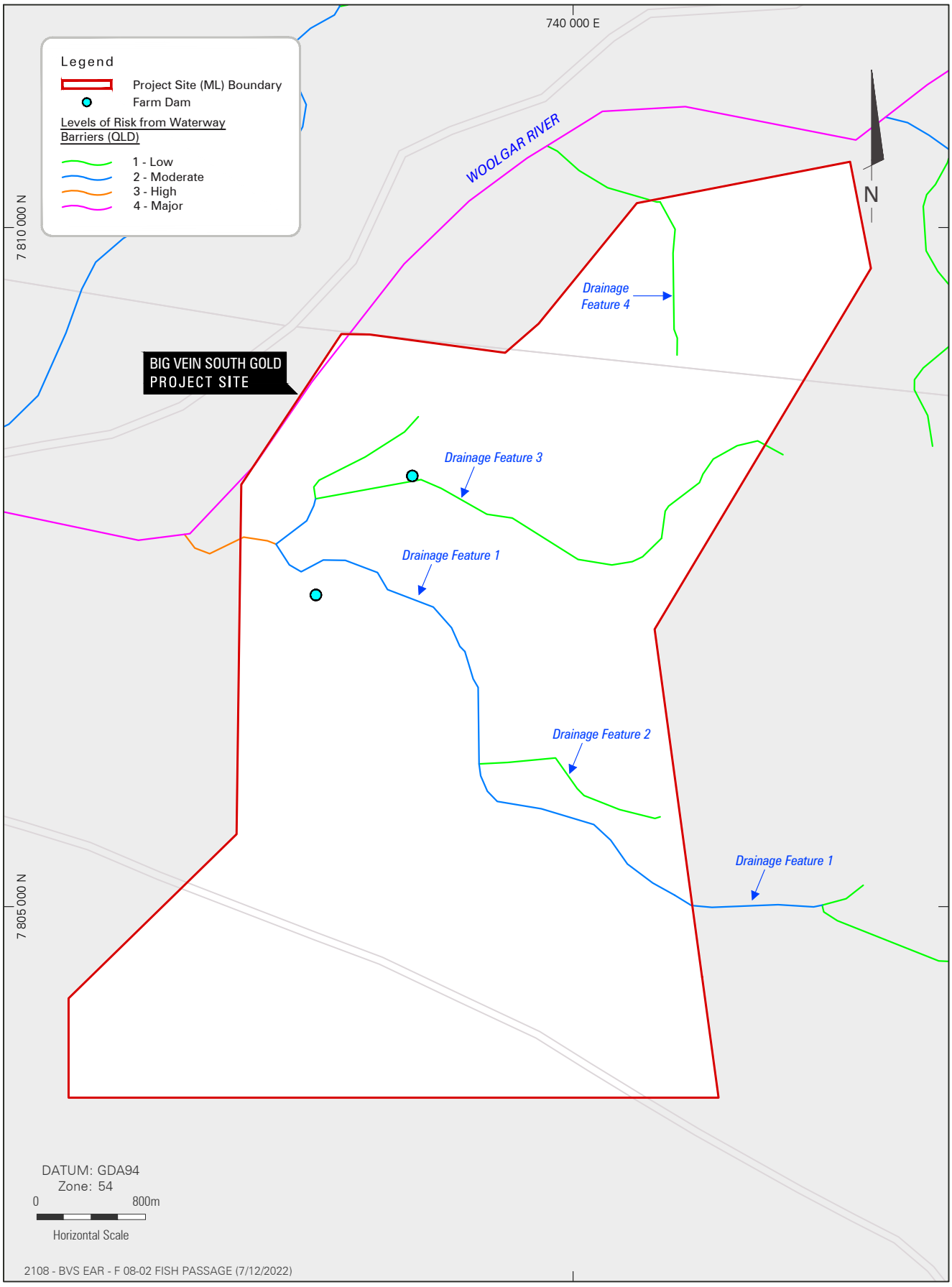


BIG VEIN SOUTH GOLD PROJECT

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Aquatic Ecology Sampling Sites

FIGURE 8-1

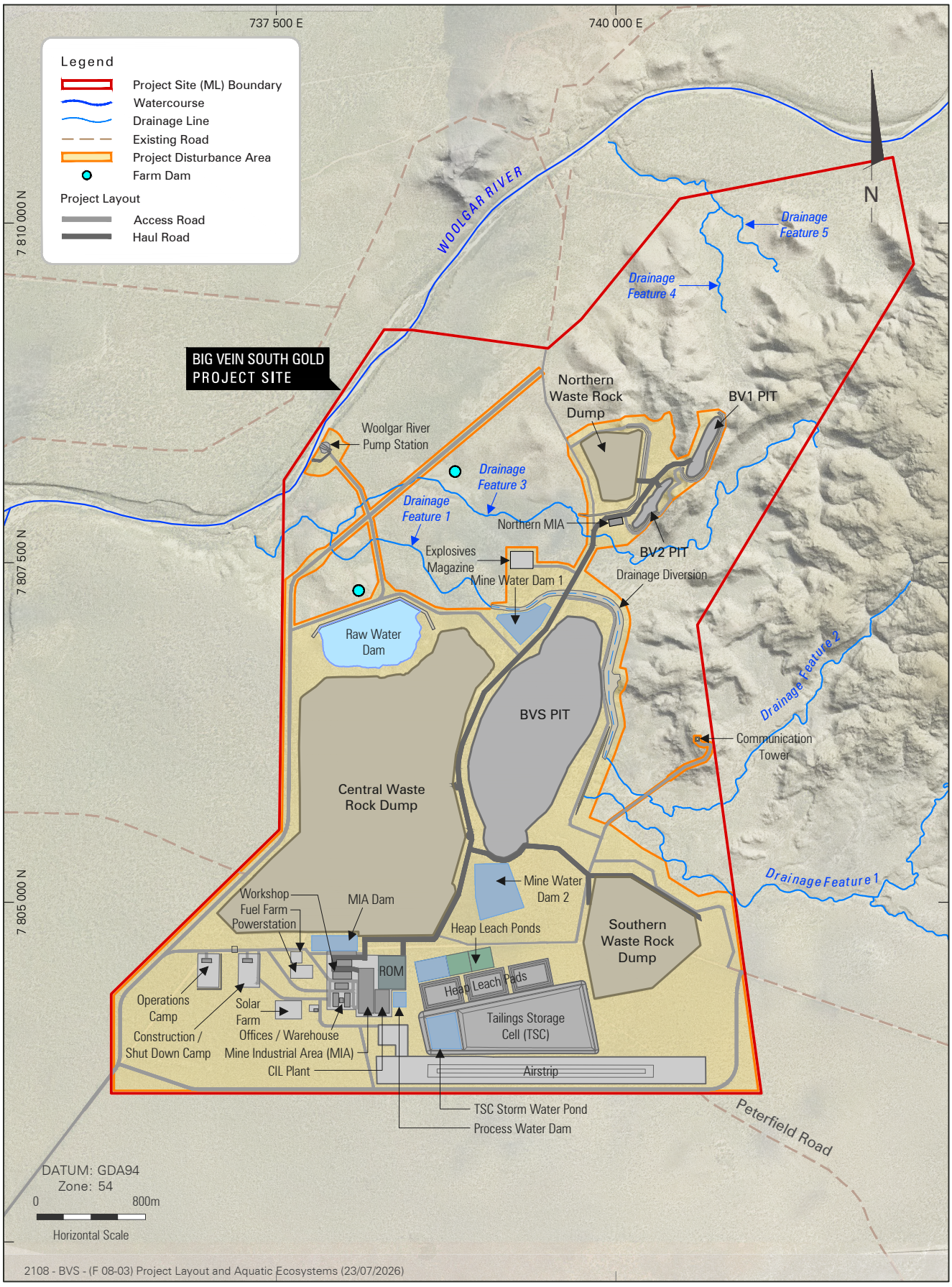


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Fish Passage

FIGURE 8-2



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Project Layout and Aquatic Ecosystems

FIGURE 8-3