Albemarle Kemerton Plant

Report

Water Management Plan

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Albemarle Project No. 7421

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REPORT

Water Management Plan

Albemarle Lithium Plant, Kemerton (Albemarle Project Number 7421 / Document Number 606541-4500-DV00-RPT-0004)

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Name	Signature	Date
S. McSweeney		03.12.18

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Note Regarding Design Storm Terminology

As per the recent revisions to the Australian Rainfall and Runoff (ARR) guidelines, this report adopts the following terminology when describing the design level (expected frequency of occurrence) of a rainfall or storm event. The table describes how the new terminology “annual exceedance probability” (AEP) relates to the previous terminology “average recurrence interval” (ARI).

Relative Frequency	ARI (Years)	AEP (%)	EY (Exceedances Per Year)	Adopted Terminology
Most Frequent	1	63	1	1 EY
	9.49 *	10	0.1	10% AEP
Least Frequent	100	1	0.01	1% AEP

*10% AEP equates to 9.49 years ARI. However, for simplicity this report refers to 10% AEP as being equivalent to the previously used criteria of 10 year ARI.

1 Background

1.1 Planning and Approvals Context

The Kemerton Strategic Industrial Area (KSIA) has long been identified as one of the State's designated "strategic industrial" areas intended to facilitate efficient, internationally competitive and environmentally responsible processing of the state's resources. The KSIA is incorporated in the various planning instruments for the area including the Greater Bunbury Region Scheme (GBRS). A formal environmental assessment of the GBRS was undertaken by the EPA and the subsequent ministerial conditions of approval for the GBRS included a requirement for a Drainage, Nutrient and Water Management Plan (DNWMP) to be prepared. This condition was addressed by the preparation of an Overarching Water Management Strategy (OWMS) for the KSIA.

The OWMS was prepared by RPS in 2016 in support of the KSIA Local Structure Plan and details the regional water management issues for consideration by lot owners and provides the integrated water management strategies for future development of the KSIA. The OWMS provides further detail on the unique planning and approvals framework relating to the KSIA which includes the requirement for individual lot owners to undertake their own technical assessments (such as lot-scale Water Management Plans) to support development proposals.

1.2 This Report

Albemarle Lithium Pty Ltd is proposing to construct and operate a Lithium Plant in the KSIA to process spodumene ore from the Talison Greenbushes Mine for the production of lithium hydroxide. The purpose of this report is to provide design information relating to water management at the site.

The objective of the Water Management Plan (WMP) is to ensure that the quality and quantity of surface water and groundwater flows from the site are maintained relative to pre-development conditions, to protect the receiving environment. In order to achieve this, The WMP has been structured to focus on the following areas of management.

- Surface water management
- Ground water management
- Temporary drainage
- Monitoring and implementation.
- Remediation Measures

The purpose of the surface water management and groundwater management sections (Sections 3 and 4 respectively) is to demonstrate the Lithium Plant design measures that will be in place to minimize the risk of potential impacts on the receiving environment. The Lithium Plant design is also linked in to LandCorp's designs for the KSIA permanent drainage along Kemerton Road.

Temporary drainage management measures (Section 5.1) will only be required should there be a requirement to temporarily divert an existing drain before LandCorp has completed the permanent drainage associated with their Kemerton Road. Current planning is that LandCorp will have the permanent drainage infrastructure in place for Albemarle.

The Monitoring and Implementation section confirms the extent of monitoring that has been carried out to date and commits to ongoing monitoring during construction of the Lithium Plant. The purpose of the ongoing monitoring is to develop an accurate understanding of baseline surface and groundwater parameters, so that trigger values can be confirmed prior to operation

Contingency actions have been developed as an appropriate response to trigger values being exceeded. The objective of the contingency actions is to return the exceedance to less than trigger values. The remediation measures will be further refined once the trigger values are more accurately understood, by way of an updated Water Management Plan. Albemarle has committed to submission of the updated WMP prior to the operation of the Lithium Plant.

1.3 References to MS1085 Condition 7

The information requested by Ministerial Statement 1085, Condition 7 is provided throughout the report.

The MS1085, condition 7 (7-1 to 7-3) is shown below:

7-1 *The proponent shall ensure that construction and ongoing operation of the proposal is undertaken in a manner that:*

maintains the quality and quantity of off-site surface and groundwater, to the receiving environment including but not limited to the Threatened Orchid habitat.

7-2 Prior to ground-disturbing activities or as otherwise agreed by the CEO, the proponent shall prepare and submit a Water Management Plan (the Plan) to the CEO, on the advice of the Department of Water and Environmental Regulation.

The Plan shall:

(1) when implemented, substantiate and ensure that condition 7-1 is being met;

(2) specify management actions including but not limited to those from potential impacts from Acid Sulphate Soils, stormwater runoff and sedimentation) that will be implemented during construction and operations to ensure the management objective in condition 7-1 is achieved;

(3) detail the proposed frequency, timing and indicative locations of groundwater and surface water monitoring for potential contamination;

(4) specify trigger criteria that will trigger the implementation of contingency actions to prevent impacts to the receiving environment including Threatened Flora outside of the Albemarle Development Envelope;

(5) specify management or contingency actions to be implemented in the event that the criteria identified required by condition 7-2(4) have been triggered.

7-3 In the event that the monitoring specified in the Plan indicates that the criteria specified in the Plan have been triggered, the proponent shall:

(1) report such findings to the CEO within twenty-one (21) days of the criteria being triggered;

(2) provide evidence to the CEO which allows for determination of the likely cause of the trigger criteria being reached and to identify any additional contingency actions required to prevent the criteria being triggered in the future; and

(3) if the triggering of the criteria is determined by the CEO to be a result of activities undertaken in implementing the proposal, immediately implement the management and/or contingency actions specified in the Plan and continue implementation of those actions until the trigger criteria are met, or until the CEO has confirmed by notice in writing that it has been demonstrated that the objective in

condition 7-1 will continue to be met and implementation of the management and/or contingency actions is no longer required.

The Table below describes where the information may be found.

Table 0 MS1085 Reference Sections

Ministerial Condition	Reference Section
7-2 Prior to ground-disturbing activities or as otherwise agreed by the CEO, the proponent shall prepare and submit a Water Management Plan (the Plan) to the CEO, on the advice of the Department of Water and Environmental Regulation. The Plan shall: (1) when implemented, substantiate and ensure that condition 7-1 is being met;	Section 6 Water Quality Monitoring Plan
7-2 (2) specify management actions including but not limited to those from potential impacts from Acid Sulphate Soils, stormwater runoff and sedimentation) that will be implemented during construction and operations to ensure the management objective in condition 7-1 is achieved;	Section 5 Temporary Drainage Management Section 6.4 Ongoing Monitoring Section 6.10 Contingency Actions
7-2 (3) detail the proposed frequency, timing and indicative locations of groundwater and surface water monitoring for potential contamination;	Section 6.5 Water Quality Monitoring Locations Section 6.6 Monitoring Frequency Section 6.13 Implementation Plan
7-2 (4) specify trigger criteria that will trigger the implementation of contingency actions to prevent impacts to the receiving environment including Threatened Flora outside of the Albemarle Development Envelope;	Section 6.8 Trigger Values Section 6.9 Trigger Responses
7-2 (5) specify management or contingency actions to be implemented in the event that the criteria identified required by condition 7-2(4) have been triggered.	Section 6.10 Contingency Actions
7-3 In the event that the monitoring specified in the Plan indicates that the criteria specified in the Plan have been triggered, the proponent shall: (2) provide evidence to the CEO which allows for determination of the likely cause of the trigger criteria being reached and to identify any additional contingency actions required to prevent the criteria being triggered in the future;	Section 6.11.2 Notifications Section 6.13 Implementation Plan
7-3 (3) if the triggering of the criteria is determined by the CEO to be a result of activities undertaken in implementing the proposal, immediately implement the management and/or contingency actions specified in the Plan and continue implementation of those actions until the trigger criteria are met, or until the CEO has confirmed by notice in writing that it has been demonstrated that the objective in condition 7-1 will continue to be met and implementation of the management and/or contingency actions is no longer required.	Section 6.10 Contingency Actions Section 6.13 Implementation Plan

2 Site Details

2.1 Existing Site Conditions

The subject site comprises an area of approximately 83 ha and is located within the southern portion of the broader KSIA, approximately 3 km east of Forrest Hwy and 500 m north of Marriot Road. The majority of the site has previously been cleared and used for agricultural and/or pine plantation purposes. The central and western portions of the site are covered with vegetation regrowth whilst the eastern, lower-lying portion contains agricultural drains and vegetation associated with high groundwater such as reeds and grasses.

The site generally slopes from west to east with elevations ranging between approximately 13 m AHD in the west and 11 m AHD in the east, with a significant sand dune ridge running north-south at an elevation up to 18 m AHD within the western portion of the site.

There are no high value (Resource Enhancement (REW) or Conservation Category (CCW)) wetlands within the site or in close proximity to the development boundary.

2.2 Development Proposal

Engineering design including clearing plan, bulk earthwork levels, internal road and drainage layouts are provided as Appendix A. The proposed plant area to be filled and graded comprises approximately 75 ha of the total site area.

The earthworks and drainage strategy involve grading the site to the east where drainage basins will manage stormwater flows near the eastern boundary prior to discharging to an external drain along the eastern boundary of the site. The external drain is a realignment of the existing agricultural drain within the eastern portion of the site. The drain and road are currently being designed by LandCorp as part of the essential infrastructure for the broader KSIA and it will service a larger catchment area upstream (north) of the subject site.

The design earthworks levels for the site range from approximately RL13.05m on the eastern boundary to RL14.8m on the western boundary. The site will generally be graded from a west-east aligned ridgeline to either the north-east or the south-east into open drains that will direct stormwater eastwards to the drainage basins.

3 Surface Water Management

Stormwater management and flood immunity are key factors in the site and bulk earthworks design. The site must be capable of managing its own stormwater runoff without discharging excessive flow rates to the external drainage system and contributing to downstream flood risk. The site must also consider the potential peak water levels in the external drainage network during a major rainfall event and ensure that adequate freeboard is provided to habitable floor levels, sensitive infrastructure, potential contaminant sources, etc.

3.1 Stormwater Drainage Design

The site will utilise a network of open drains/swales aligned with the internal road network to collect and convey stormwater to two main drainage basins located near the eastern boundary of the site. The roadside drains will be relatively shallow v-drains approximately 0.5 m deep and will collect and distribute stormwater to larger east-west aligned arterial drains/swales which will convey the flows to the downstream drainage basins.

In accordance with the Overarching Water Management Strategy (OWMS) (RPS 2016) the drainage basins will retain and infiltrate the 10% AEP (10 year ARI) event on site prior to discharging larger rainfall events to the external drainage system. This approach aims to mimic pre-development hydrological conditions at the site where infiltration to the sandy soils is the dominant process and to ensure the site does not increase flood risk to downstream areas.

3.1.1 Design Constraints

The drainage system design must be cognisant of a number of design criteria and constraints including the:

- presence of shallow groundwater at the drainage basin location in the eastern portion of the site
- potential requirement to provide subsoil drainage beneath drainage basins to provide adequate drainage and maintain effective basin storage capacity
- requirement to retain and infiltrate the 10% AEP rainfall event on-site
- potential for peak water levels in the external drainage system to impact the site or restrict discharge from the internal drainage system
- requirement to provide a flow path for the 1% AEP (100 year ARI) event to protect the site from flooding during major events.

The above points have been considered in the stormwater assessment and design, and are addressed in the following sections.

3.1.2 Surface Water Modelling

The stormwater management system design has been modelled in XPSWMM. A hydrological model of the site has been developed with the site broken down into approximate sub-catchment areas contributing to various drain locations. The various catchment area types (i.e. land uses) have been calculated from the current plant layout design and included in the model to accurately estimate the rainfall runoff from the various catchment surface types. The contributing catchment area and adopted initial and continuing loss rates for each catchment type are listed in Table 1 and the catchment surface types are shown on Figure 1.

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Table 1 Catchment Areas and Loss Parameters

Catchment Type	Area (ha)	Initial Loss (mm)	Continuing Loss (mm/hr)
Road (including paved/asphalt areas)	15.06	1.5	0.1
Building	7.66	1.5	0.1
Bunded Plant Areas	9.71	-	-
Open Area (Compacted Fill)	36.10	5	0.3
Drainage Basin	7.07	0	0
Total	**75.60**	**-**	**-**

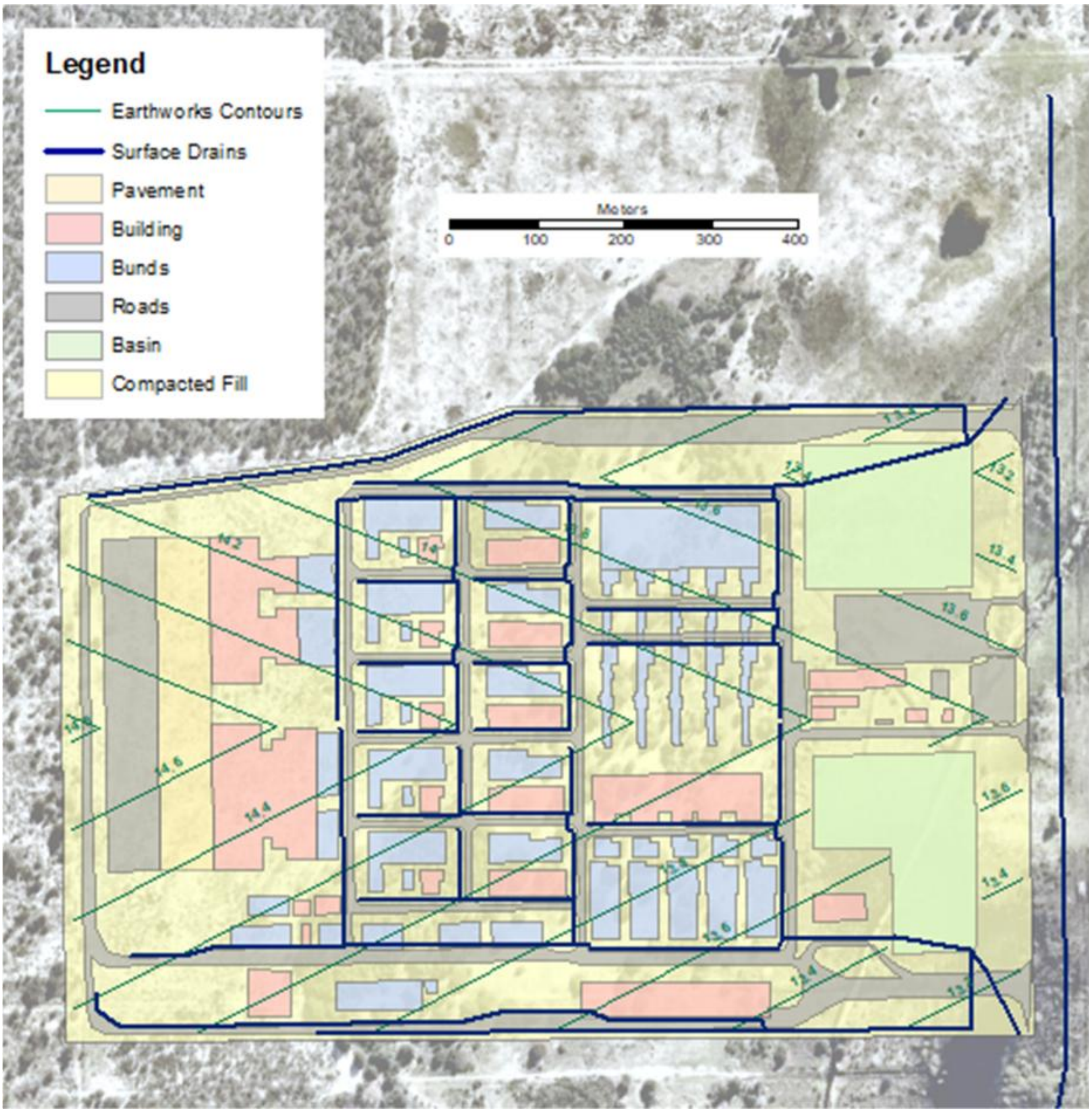


Figure 1 Catchment Surface Types

The loss rates listed above are generally low and considered to provide a relatively conservative estimate of runoff for this assessment. Zero losses are applied to the drainage basins (i.e. 100% of rainfall becomes stormwater runoff) and the continuing loss rate for open areas of 0.3 mm/hr is potentially low given the large contributing area of this catchment type and the likelihood that there will be some losses within these areas from depression storages, zones of higher permeability, etc.

The stormwater drainage system is designed as a clean water system to collect only uncontaminated stormwater from the impervious surfaces of the site where stormwater will not come into contact with process water and potential contaminants. Any stormwater generated within process areas where potential mixing with contaminants could occur will be managed separately to ensure no transport of contaminants off-site. Those areas will be bunded and constructed with specially engineered stormwater containment, treatment and recirculation systems. As such, the model does not include any runoff from the areas designated as "bunded plant areas" in the catchment breakdown.

3.1.3 Drainage Basin Levels

The drainage basins have been designed with invert levels that allow for the installation of subsoil drainage beneath the basins to provide a controlled groundwater level and facilitate effective drainage/emptying of the basins in-between rainfall events. The subsoil drainage system will facilitate emptying of the basins within 96 hours following rainfall events.

The design basin invert is between RL12.25m and RL12.60m which allows for a graded base to provide at least 300mm ground clearance above subsoil drainage pipes and the phreatic line (the design controlled groundwater level and subsoil pipe levels are discussed in Section 4).

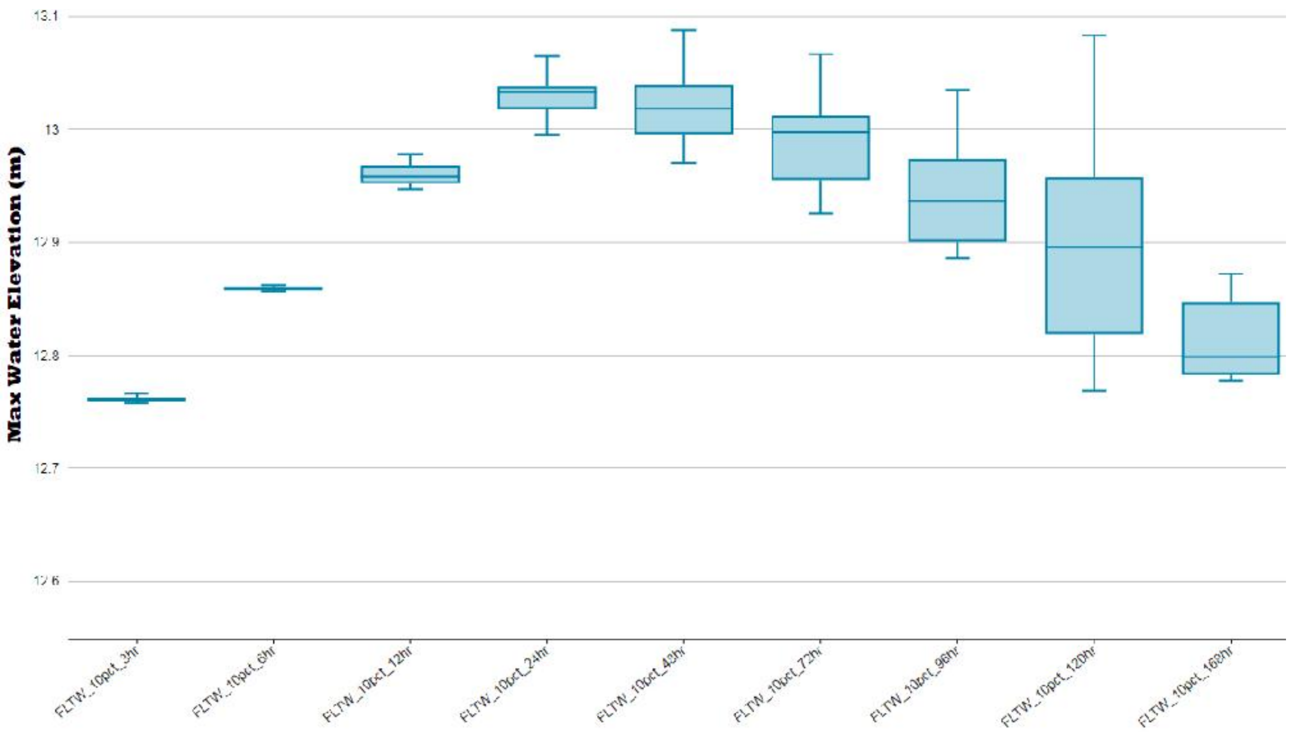
The drainage design proposes to retain and infiltrate the 10% AEP rainfall event within the drainage basins. An overflow pipe or spillway will be provided at the design 10% AEP TWL which will facilitate discharge from the basins during major (e.g. 1% AEP) rainfall events.

Calibre are the consulting engineers undertaking design of the external arterial drainage system for the broader KSIA on behalf of LandCorp. Information provided by Calibre indicates that the 10% AEP and 1% AEP TWLs in the external drainage system adjacent to the site will be RL12.35m and RL12.65m, respectively and that these relate to a critical storm duration of 72 hours. However, no further information on the timing or duration of these peak water levels is currently available.

The high water levels in the external drainage system have the potential to temporarily impact the effectiveness of the site's subsoil drainage. Therefore, this assessment has conservatively assumed that there will be no infiltration through the drainage basins until the TWL in the basins exceeds the predicted 10% AEP TWL in the external drainage system; when water levels in the basins exceed that elevation a low infiltration rate (<0.25 m/d) is applied to the drainage basins. This is likely to be a conservative assumption in the modelling.

3.1.4 Model Results

The model was used to simulate a range of design rainfall event durations up to 168 hours (7 days) and used the recently revised (ARR 2016) rainfall IFD data and temporal pattern ensembles. The modelled 10% AEP top water levels (TWLs) for the drainage basins are shown below.



Graph 1 Modelled 10% AEP TWL (Without Basin Overflow in Model)

Graph 1 shows that the critical event duration is likely to be 24-48hrs resulting in a TWL in the basin of approximately RL13.05m. In accordance with the OWMS, the drainage system will be designed to contain the critical 10 year ARI event on-site by setting the major event overflow level at RL13.05m. This represents a significant degree of stormwater retention and will effectively mitigate potential flood impacts to downstream areas from development of the site.

As detailed in Table 2 below, the modelled 10% AEP stormwater volumes for the northern and southern drainage basins are 21,600 m^3 and 20,300 m^3, respectively. This does not include the additional storage within the network of open drains.

Table 2 10% AEP Design Details for Drainage Basins

Design Criteria	Northern Basin	Southern Basin
Minimum Invert (mRL)	12.25	12.30
10% AEP Volume (m^3)	21,600	20,300
10% AEP TWL (mRL)	13.05	13.05
10% AEP Depth (m)	0.80	0.75

It is also noted that the basin storage volume provided below the overflow level of RL13.05m (~42,000 m^3) equates to a rainfall depth of 56mm over the entire 75 ha site; this amount of stormwater retention far exceeds the 29mm of initial loss that was allowed for over industrial sites in the drainage modelling for the arterial drainage design by Calibre (2018). It should also be noted that these calculations do not include the additional storage capacity within the site's internal network of open drains. Therefore, the risk of stormwater runoff from the site having a detrimental impact on downstream flood conditions is very low.

3.2 Flood Protection

RPS understands that the future Kemerton Road which will be constructed along the eastern boundary of the site (to be designed and constructed by LandCorp) will be at an elevation of RL13.50m. The road will separate the site from the external drainage system. The level of the road makes an overland flow path for the 1% AEP event impractical as it would mean finished floor levels in the site would need to be raised significantly higher than the 1% AEP TWL in the regional drainage system which RPS understands, from information provided by Calibre, to be RL12.65m.

Therefore, the site will be connected to the external drainage system by culverts to be installed beneath the future Kemerton Road. The culverts will be sized and designed by Calibre as part of the Kemerton Road works to facilitate flow of the major (1% AEP) rainfall events from industrial lots into the external drainage system with minimal backwater impacts to the lots.

The 1% AEP TWL within the site will be controlled by the level of the overflow from the basins. The model was used to assess several overflow / spillway configurations and identified that the 1% AEP TWL in the basins is likely to be only marginally higher (~0.1m) than the 10% AEP TWL and overflow level. The peak discharge rate from each basin during a 1% AEP overflow event has been modelled as approximately 0.8 m^3/s. A concept schematic of the relative levels of the drainage infrastructure and overflow arrangement is provided in Figure 2 below.

Based on the estimated 1% AEP TWL within the basins of RL13.15m, the flood protection level for the eastern portion of the site, near the drainage basins, is approximately RL13.45m to provide 0.3 m freeboard to the 1% AEP TWL. Based on the bulk earthworks plan (Appendix A) the majority of the site will be filled to above this level thus providing the required level of flood protection. Only some very minor areas in the north-east and south-east corners of the site have a design level below RL13.45m. However, these areas are associated with driveways and carparks which do not need to be elevated above the 1% AEP TWL in the basins.

The level of vertical separation required from flood levels within the arterial drainage system (i.e. the Kemerton Rd drain) is 0.5m to the 1% AEP flood level, which in this case is RL12.65m. Therefore, the flood protection level in this regard is RL13.15m which is lower than the flood protection levels discussed above in relation to the internal drainage system.

3.3 Conceptual Drainage Design

Figure 3 provides the drainage concept which shows the configuration and elevations of the key drainage elements including drainage basins, open drains, subsoil drainage (beneath the basins only), major event overflow path from the basins and outfall to the external drainage system.

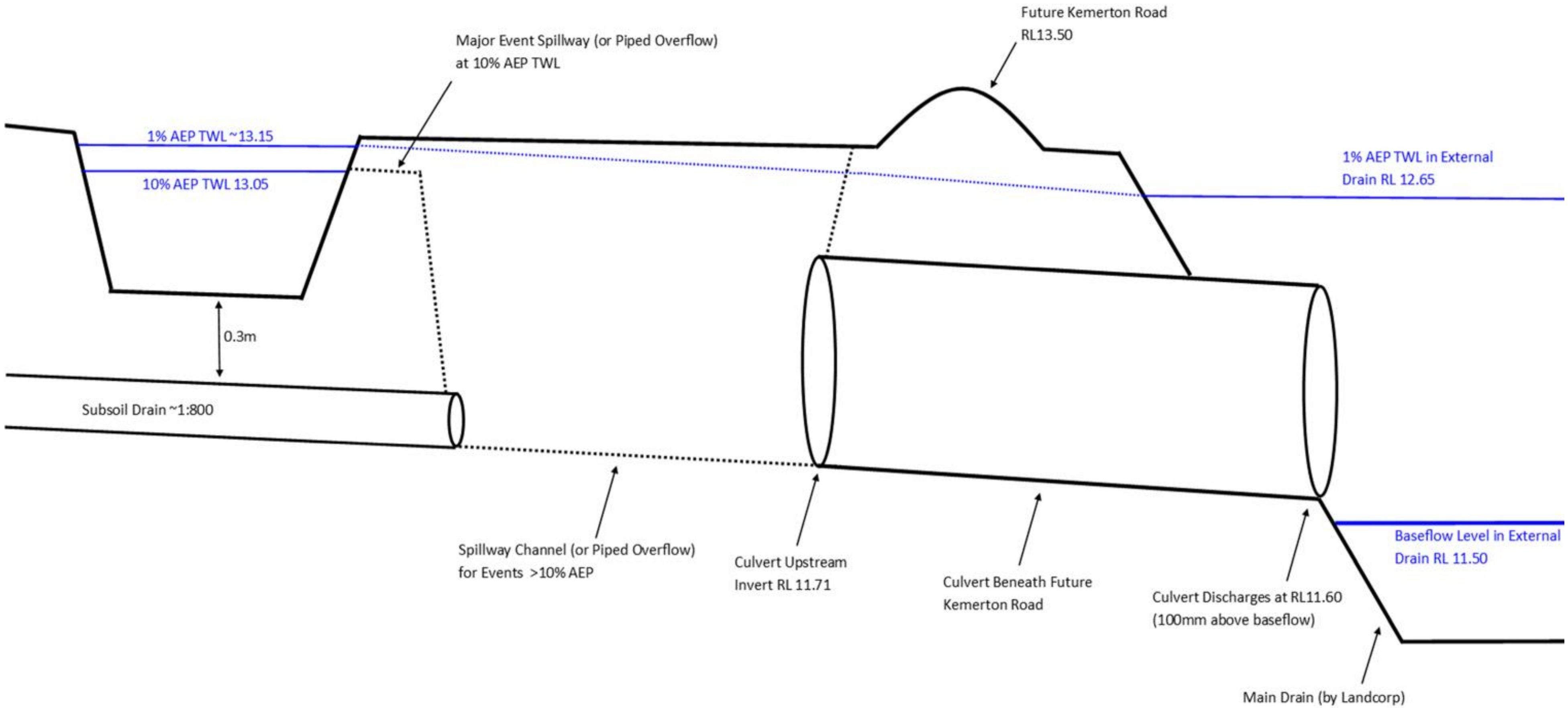


Figure 2 Basin Relative Water Levels and Overflow

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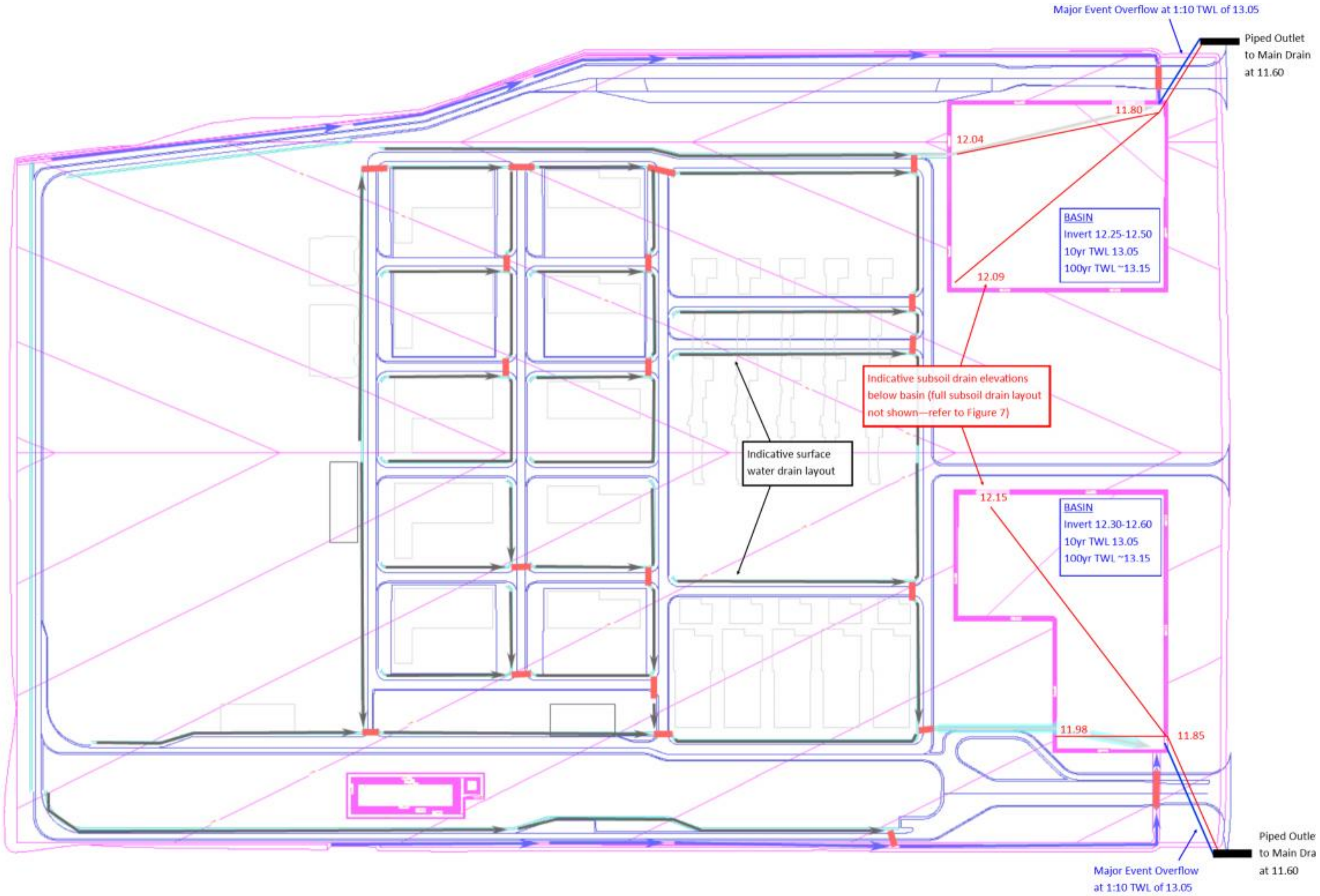

Figure 3 Concept Drainage Design

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3.4 Water Quality Treatment

As detailed in Section 3.1.2 the site's stormwater drainage system collects only "clean" runoff that has not come into contact with process materials or potentially contaminated areas. The water quality treatment for the stormwater drainage system will focus on sediment and nutrient removal via a planted bioremediation area. In line with the DWER's decision process for stormwater management in WA (DWER 2017) the bioremediation area will be sized to retain and infiltrate the first 15mm of runoff.

The bioremediation area can comprise a section of the main drainage basins with a low bund to retain the 15mm event within the planted bioremediation area, whilst larger events will be able to overflow into the main basin area. The bioremediation area will be underlain with amended soil and planted to promote sediment and nutrient removal from stormwater prior to overflowing to the main basin area or, during major events, to the arterial drainage system.

Based on a nominal 400 mm storage depth (i.e. bund height) for the bioremediation area, the required volume and basin area has been calculated to retain and infiltrate the 15mm rainfall event from the whole site (minus the bunded operational areas). The bioremediation volume and basin area requirements are calculated as 2,900 m^3 and 7,000 m^2, respectively (per basin). This equates to approximately 20% of the total basin area to be planted and underlain with amended soils.

A common criterion for sizing bioremediation basins is to provide a basin surface area equivalent to at least 2% of the connected impervious catchment area. The basin sizing details above equate to 2.6% of the effective impervious catchment area (when calculated from the total catchment area with an effective impervious coefficient of 0.8 for the minor 15mm rainfall event). It is proposed that the bioremediation component of the drainage basins be planted with appropriate nutrient stripping vegetation in accordance with the Vegetation guidelines for stormwater biofilters in the south-west of Western Australia (Monash University 2014).

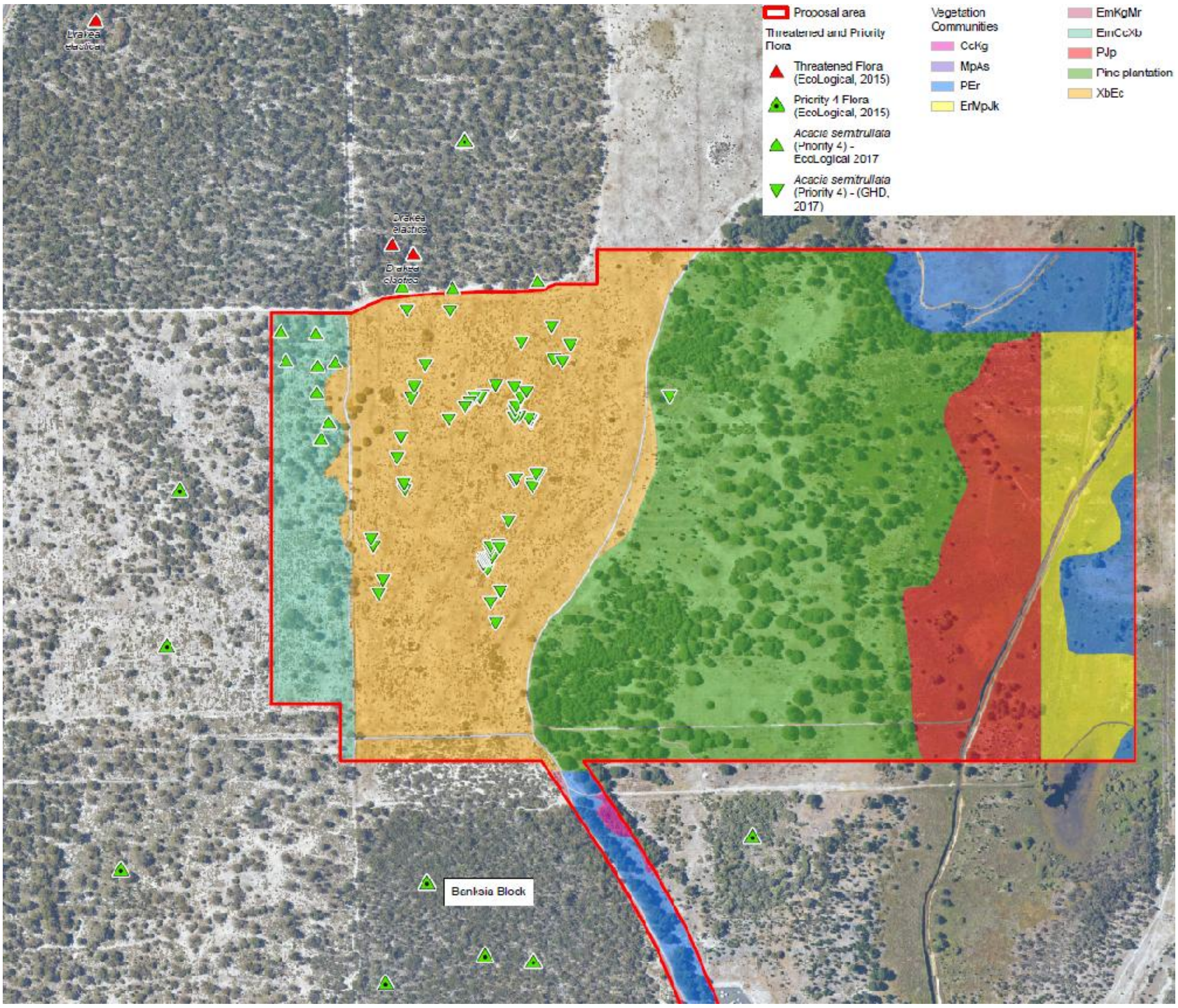
3.5 Surface Water Impacts

As described in Section 1.2, the objective of the stormwater drainage design is to ensure that the quality and quantity of surface water (and groundwater) flows from the site are maintained relative to pre-development conditions, to protect the receiving environment.

There are no high value wetlands within or in close proximity to the site; however, the stormwater drainage design will ensure protection of downstream watercourses and water bodies by retaining and treating stormwater in accordance with the design criteria discussed in the previous sections.

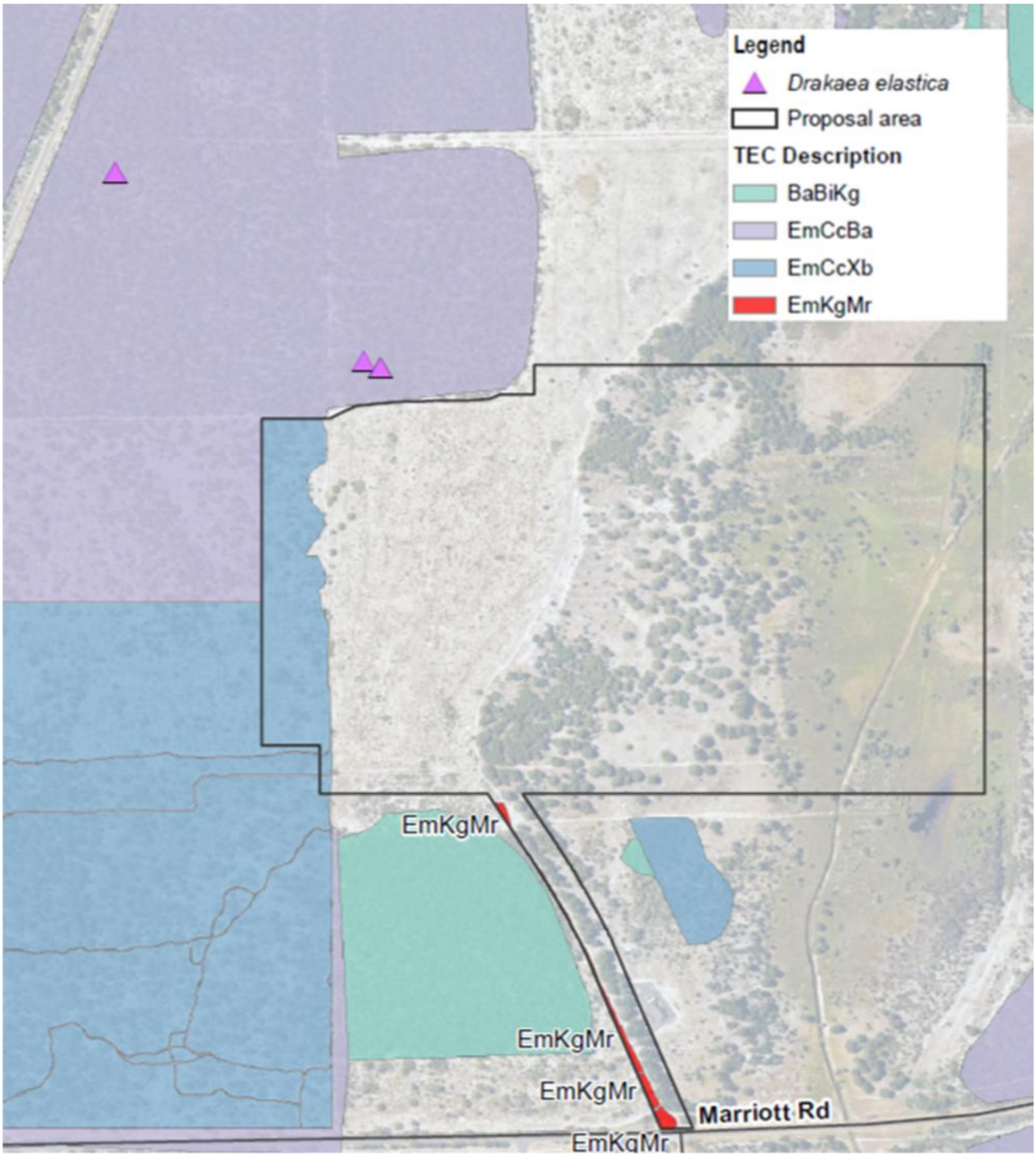
Other sensitive environmental receptors that have been identified in the vicinity of the site include threatened flora (orchids *Drakea elastica* and *Drakea micrantha*) located outside of the development boundary to the north and endangered Banksia Woodland Threatened Ecological Community (TEC) located outside of the development boundary to the west and south. Figures 4-A and 4-B provide the locations of these flora and vegetation communities.

The stormwater drainage design conveys all stormwater generated by the site to the east and does not direct any surface water towards these flora communities. As such there is no risk from the project in terms of altering the surface water regime at, or conveyance of sediments or other contaminants to, these sensitive areas. As the project does not alter than natural hydrological regime (in terms of surface water flows, rainfall infiltration, groundwater elevation) there will be no disturbance of the natural nutrient cycling processes within these habitats.



(source: GHD 2017)

Figure 4-A Conservation Significant Flora Locations



(source: GHD 2018)

Figure 4-B Locations of Threatened Orchids and TECs

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4 Groundwater Management

4.1 Pre-development Groundwater Levels

An assessment of existing groundwater levels has been undertaken to estimate post-development groundwater clearance and the potential requirement for subsoil drainage to provide a controlled groundwater level. The assessment used data from eight on-site monitoring bores as well as 13 additional bores from the surrounding KSIA area and four regional DWER bores for long-term trend analysis.

The Average Annual Maximum Groundwater Level (AAMGL) is calculated to range from approximately 11.25 m AHD at the east and west boundaries, to 11.8 m AHD at the centre of the site. This indicates there is some mounding at the centre of the site, with groundwater flowing to the south, east and west. The Maximum Groundwater Level (MGL) is calculated to range from approximately 11.7 m AHD along the existing drainage line at the eastern part of the site, to 12.5 m AHD at the site's north-central boundary. Refer to Figures 5 and 6 for the mapped AAMGL and MGL contours, respectively.

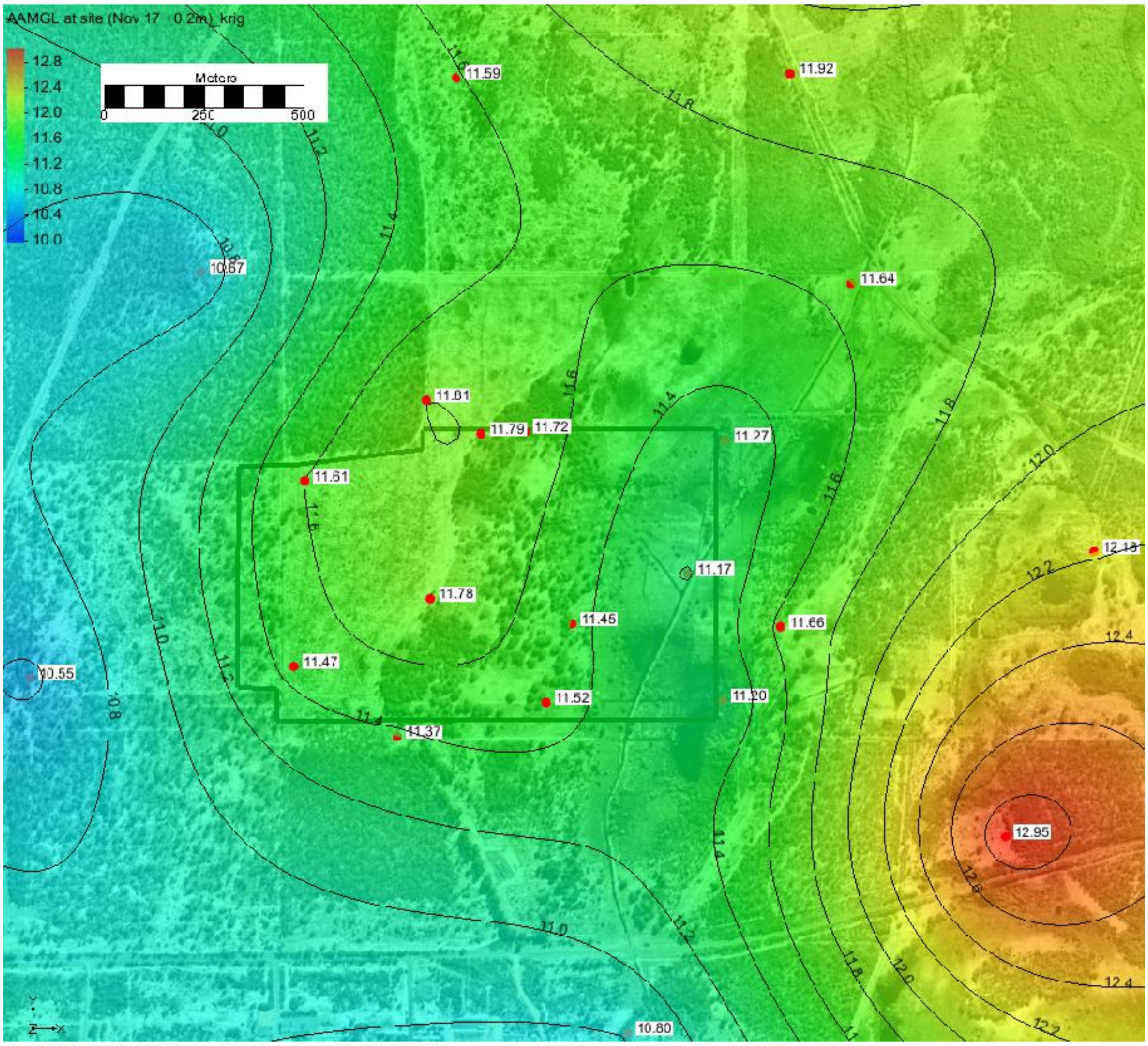

Figure 5 Calculated AAMGL

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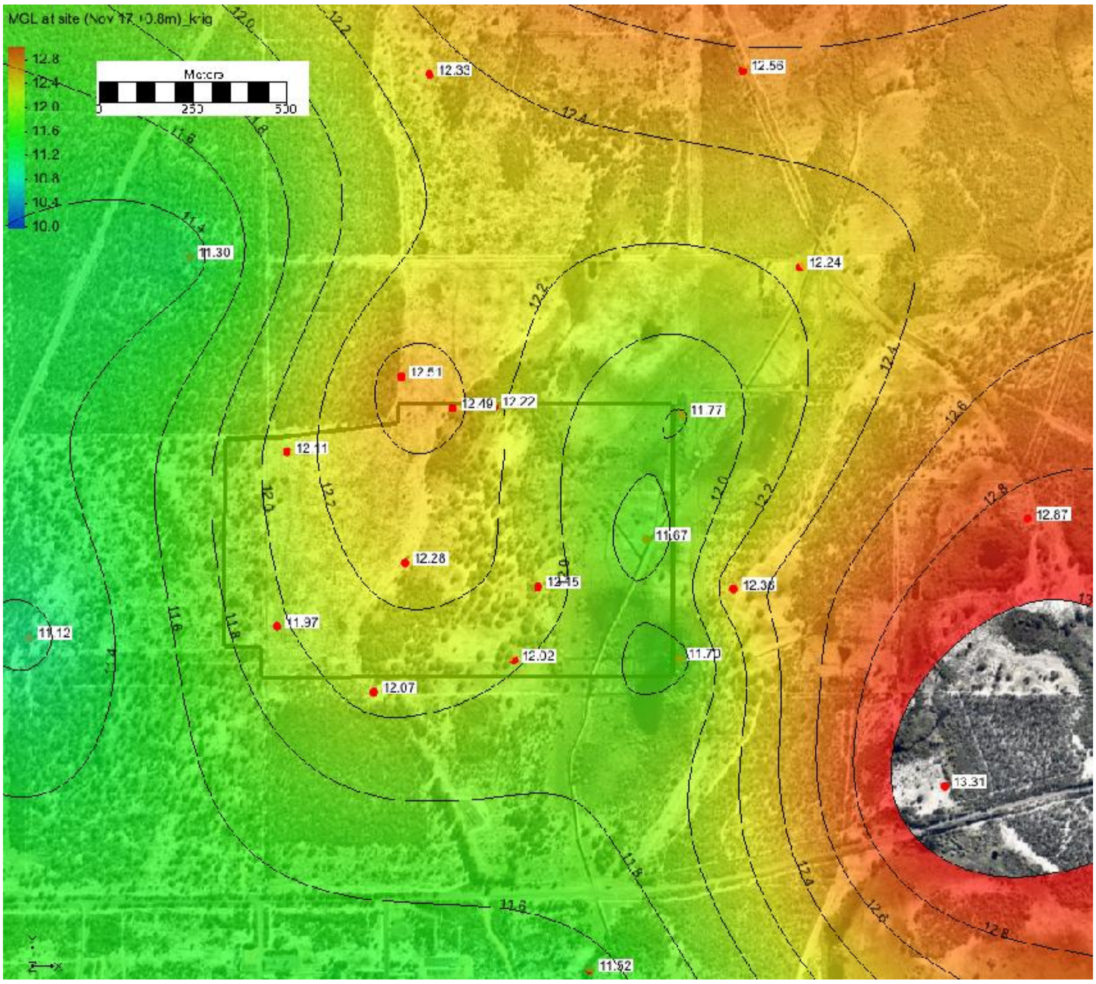

Figure 6 Calculated MGL

4.2 Groundwater Control Strategy

A three dimensional groundwater model has been completed to predict post development groundwater rise at the site and the requirement for groundwater controls such as subsoil drainage. A series of model scenarios were run to assess the requirement and efficacy of the groundwater control system. These include:

- Scenario 1: no subsoil drainage
- Scenario 2: subsoil drainage along road reserves across the entire site
- Scenario 3: subsoil drainage along road reserves across the eastern half of the site.

The model results show that groundwater will rise to within 0.1 m of ground surface if subsoil drainage is not installed, hence groundwater control is required. A subsoil drainage system was therefore designed with the following criteria:

- subsoil discharge into the two eastern site culverts at ~11.76mAHD
- subsoils have a grade of 1 in 800 beneath the drainage basins, and 1 in 500 across the remainder of the site

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- subsoils are located in readily accessible areas for maintenance (e.g. roadside)
- subsoil invert levels are above the calculated pre-development AAMGL.

Installation of subsoil drains are predicted to effectively manage post-development groundwater levels in the eastern half of the site. Model results indicate that subsoil drains have the effect of lowering the post-development groundwater level by up to 1m. The subsoils are controlled by the 1:500 grade back from the discharge outlets at the basins, and thus most subsoils in the western portion of the site are unable to be installed at a sufficiently low enough elevation to facilitate drainage, causing the western subsoils to be largely ineffective.

The model results show that the eastern subsoils (Scenario 3) and the two western subsoil lines located along the northern and southern boundaries will control groundwater levels and hence installation of these subsoil lines is recommended. The recommended design is shown on Figure 7.

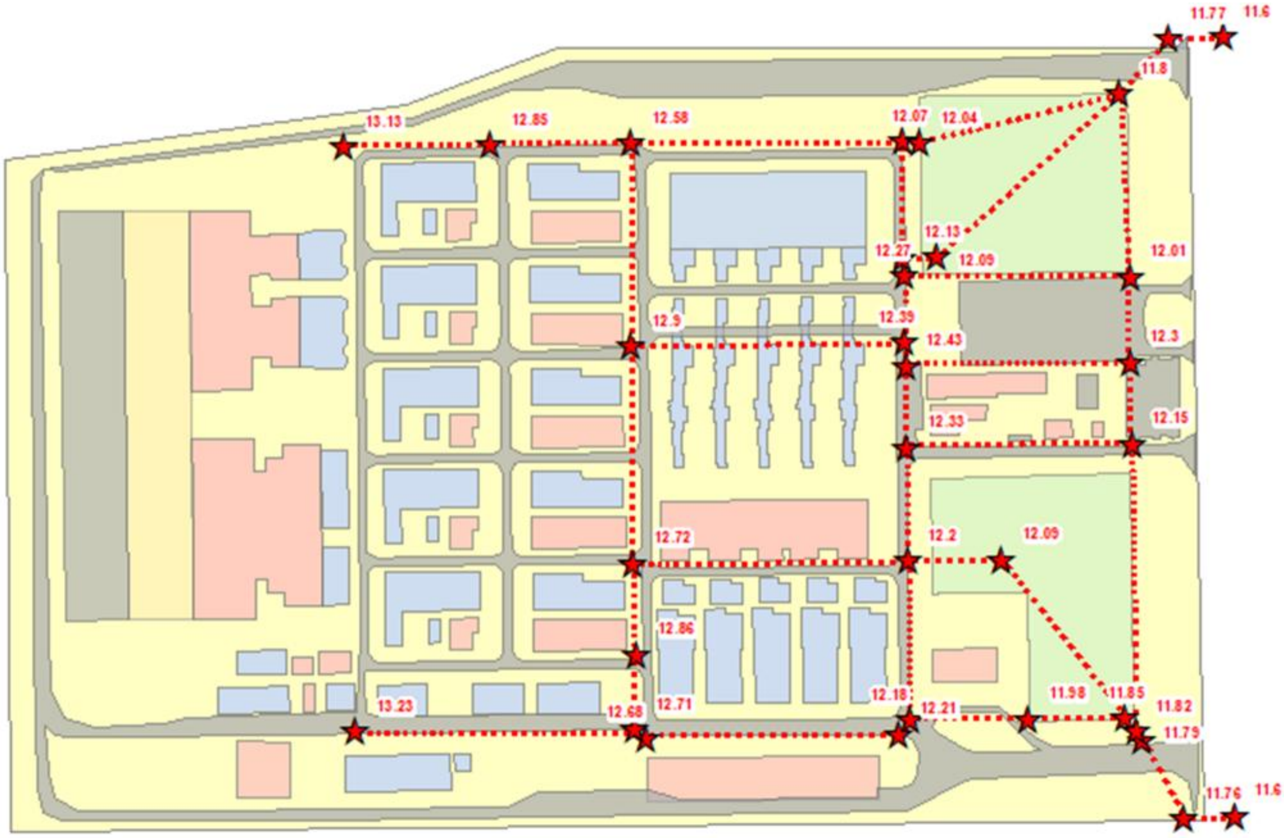

Figure 7 Recommended Minimum Subsoil Installation Design

Should the potential exist for changes to the development at the western end of the site (that may result in increased groundwater recharge rates), it is recommended that consideration be given to “future proof” this area by installing subsoil drainage across the entire site as per Scenario 2.

It is recommended that subsoil drains be installed as close as practically possible (or beneath) surface water drains in order to facilitate drainage beneath the surface drains, minimise potential standing water in the surface drains and reduce localised mounding of groundwater.

It is also recommended that infrastructure design consider the predicted depth to groundwater provided in Scenario 3 to ensure adequate groundwater clearance for infrastructure protection.

4.3 Groundwater Impacts

As described in Section 1.2, the objective of the site's drainage design is to ensure that the quality and quantity of groundwater (and surface water) flows from the site are maintained relative to pre-development conditions, to protect the receiving environment.

The subsoil drainage design described in the previous section includes subsoil drains placed above the pre-development AAMGL, thus ensuring that the subsoil drainage system does not lower the groundwater table below pre-development conditions. Groundwater quality will be maintained via the use of bunds to contain potentially contaminated material and prevent leaching of contaminants to the groundwater system. Stormwater quality will also be treated via the use of amended soils and vegetation in a bioremediation basin to remove nutrients from stormwater prior to infiltration to the groundwater system.

As described in Section 3.5, other sensitive environmental receptors that have been identified in the vicinity of the site include threatened flora (orchids *Drakea elastica* and *Drakea micrantha*) located outside of the development boundary to the north and endangered Banksia Woodland ecological community located outside of the development boundary to the west and south (refer to Figure 4-B).

The calculated AAMGL at the rare orchid location is approximately 11.5 m AHD whilst topographic elevation is estimated to be between 15 to 16 m AHD. Therefore, the clearance to groundwater is likely to be in excess of 3 metres at this location. The groundwater modelling indicates that shallow groundwater control is not required in this north-western area of the site, with no significant increase to groundwater levels post-development. Therefore, the clearance to groundwater at the rare orchid habitat will not be significantly impacted by the project.

The surface water run-off regime within the development area will be altered, but the surface water regime of rainfall infiltration through the sandy lithology, which is external to the development area will remain unchanged. Therefore, no change to the surface water run-off regime or groundwater recharge regime within the *Banksia Woodlands* habitat is proposed. Therefore, the proposed action will not disturb the rainfall infiltration regime and associated nutrient cycling. The proposed action will also not disturb the habitat and the natural nutrient cycling of growth and decline within the ecological community itself.

4.4 Wastewater Treatment

There is no reticulated wastewater collection service within the KSIA. Therefore, all wastewater from buildings will be directed to a collection pit and pumped to the Kemerton Wastewater Treatment Plant for treatment. Construction sewage will be collected and trucked away on a temporary basis until the option to pump to the Kemerton Wastewater Treatment Plant is commissioned.

4.5 Irrigation Water Supply

It is not proposed to use groundwater to irrigate landscaped areas and thus a licence to take groundwater under the *Rights in Water and Irrigation Act 1914* is not anticipated to be required at this stage. However, it is acknowledged that if groundwater use is proposed in the future then the appropriate licence will need to be obtained. Alternative water sources are proposed for irrigation use; this may include use of stormwater from the drainage basins when available. Further details on landscape and irrigation planning are provided in the relevant landscape documentation.

5 Temporary Drainage Management

5.1 Temporary Drainage Requirements

The bulk earthworks constructions staging and schedule would mean that the realignment of the existing agricultural drain on the eastern portion is not required. LandCorp's Kemerton Road drain will be constructed in time to realign and upgrade the current diversion drain and remove the requirement for Albemarle to divert the existing drain.

Temporary drains and/or bunding will still be formed along the northern and southern portions of the site as required to intercept runoff. This will ensure that the post-earthworks site does not impact on the downstream drainage systems in terms of increased runoff or potential sediment mobilisation.

Diversion drainage channels and bunds will be constructed where required along the perimeter of the site to maintain drainage flow paths around the filled site, directing stormwater towards existing low-lying areas and open drains. Additional sediment and erosion management measures during earthworks and construction are likely to include the use of water carts and hydro-mulch for dust suppression. If required, temporary riffles may be installed within the drain network to limit the transportation of sediment to the downstream basins.

6 Water Quality Monitoring Program

6.1 Objective

The objective of the Water Quality Monitoring Program (WQMP) is to outline the water quality monitoring program, the water quality trigger values, as well as the contingency actions to be implemented should the water quality trigger values be breached.

The WQMP aims to ensure the quality of surface water and groundwater flows from the site are maintained relative to pre-development conditions, to protect the receiving environment.

6.2 Drainage Design Principles

The objective of the stormwater drainage design is to ensure that the quality and quantity of surface water (and groundwater) flows from the site are maintained relative to pre-development conditions, to protect the receiving environment. The intent of the drainage design is consistent with the wording of Condition 7-1 of MS1085:

> *Maintains the quality and quantity of off-site surface and groundwater, to the receiving environment including but not limited to the Threatened Orchid habitat.*

6.3 Baseline Water Quality Monitoring

Baseline water quality monitoring has previously been undertaken for the Kemerton Strategic Industrial Area (KSIA) as well as more recent baseline monitoring undertaken by Albemarle for the subject site. The baseline water quality monitoring data is tabulated and presented in Appendix B. The baseline data has been used to inform the development of trigger values to be used for the assessment of future groundwater and surface water quality at the site, to ensure that any potential impacts from site activities are identified through on-going water quality monitoring.

6.4 Ongoing Monitoring

Ongoing monitoring of groundwater quality at the site will be required to ensure that the site activities do not contaminate the underlying aquifer and to ensure that the drainage system functions as intended. Surface water and subsoil drainage monitoring will also be undertaken to ensure there is no impact to downstream waterways and to assess the performance of the site's drainage system. Monitoring locations are shown in Appendix C.

6.4.1 Construction and Operations Phases

The Water Quality Monitoring Program (WQMP) will be undertaken in two distinct phases:

- Construction Phase WQMP
- Operational Phase WQMP

Whilst the construction phase and operational phase monitoring programs will be very similar, a distinction between the two is required for the following reasons:

- Water quality data collected during the construction phase is required to further assess the baseline water quality at the site, particularly with regards to parameters that have not previously been monitored at the site but are related to potential operational phase impacts (e.g. lithium, radium etc).

- Water quality at the site is likely to change as a result of the importation of fill for bulk earthworks and any lime treatment and reuse of ASS, in accordance with the ASSMP; specifically, the importation of calcareous fill will naturally leach alkalinity and thus raise pH and alkalinity. This does not present a risk to human health or the environment and will in fact be beneficial in terms of decreasing acidity (groundwater at the site is currently acidic) and reducing the risk of ASS related impacts. However, this may complicate the assessment of construction versus process related impacts and, as such, it will be necessary to review the water quality dataset and trigger criteria post-construction and prior to operations commencing.

6.4.2 General Monitoring Commitments

The proponent shall ensure that:

- all water samples are collected and preserved in accordance with AS/NZS 5667.1;
- all surface water sampling is conducted in accordance with AS/NZS 5667.4, AS/NZS 5667.6 or AS/NZS 5667.9 as relevant;
- all groundwater sampling is conducted in accordance with AS/NZS 5667.11;
- all sediment sampling is conducted in accordance with AS/NZS 5667.12;
- all laboratory samples are submitted to and tested by a laboratory with current NATA accreditation for the parameters being measured.

The proponent shall ensure that:

- quarterly monitoring is undertaken at least 45 days apart;
- six monthly monitoring is undertaken at least 5 months apart; and
- annual monitoring is undertaken at least 9 months apart.

The proponent shall ensure that all monitoring equipment used on the premises is calibrated in accordance with the manufacturer's specifications.

6.5 Water Quality Monitoring Locations

6.5.1 Groundwater Monitoring Locations

The objective of the groundwater sampling program is to assess the on-going underlying groundwater quality across the project area and to assess the presence, nature, and magnitude of any potential groundwater contamination.

Across the project area eight groundwater monitoring bores were installed by Galt in 2017. These will be used to obtain on-going groundwater quality information for the project area. The existing bores provide monitoring locations across the whole site and will enable assessment of hydraulic gradients, flow directions and comparison of up-gradient and down-gradient groundwater quality.

If the existing monitoring bores need to be decommissioned during the construction phase, they will be replaced with monitoring bores at a location as close to the original as practicable. Several existing bores have been identified as likely to be decommissioned due to their location coinciding with features of the plant; proposed locations for replacement bores are illustrated in Figure B in Appendix C. The coordinates of the existing groundwater monitoring bores are provided in Table 3. The spatial extent of the groundwater monitoring bores provides both upgradient and downgradient monitoring locations to facilitate the on-going assessment of baseline conditions and down-gradient groundwater quality changes due to the project.

RPS

Table 3 Groundwater monitoring locations

Monitoring site	Current location	
C2-S	384663	6325161
MW01	383993	6325512
MW02	384542	6325643
MW03	385042	6325630
MW16	384953	6325289
MW17	384311	6325219
MW27	383970	6325048
MW29	384603	6324960
MW30	385043	6324970

6.5.2 Surface Water Monitoring Locations

A number of open drains have been constructed across the Kemerton SIA to lower the water table in local areas, with most of the flows occurring in winter in response to rainfall and the seasonal rise in the groundwater level. In the eastern portion of the project area an existing agricultural drain drains from north to south. LandCorp is scheduled to realign and upgrade this drain during 2019. Monitoring of the current agricultural drain will occur during construction of the Albemarle project to ensure no impact is occurring during construction. Following realignment of the drain to Kemerton Road, the water quality of the drain will be monitored both upgradient and down gradient of the drainage discharge points to the drain. Figure A in Appendix C illustrates the proposed surface water monitoring locations during construction up until the LandCorp drain realignment progresses (which are consistent with baseline surface water monitoring previously undertaken by Galt). Subsequent to the realignment being finalised by LandCorp, surface water monitoring will be undertaken at one location upstream of the site, one immediately downstream of the drainage discharge points to the realigned drain, and one location further downstream of the Albemarle project area as shown on Figure B in Appendix C.

Table 4 documents the coordinates of the current and proposed future surface water monitoring locations.

Table 4 Surface water monitoring locations

Monitoring site	Current location		Following drain realignment	
	Easting	Northing	Easting	Northing
SW01	385145	6325590	385048	6325608
SW02	384890	6325103	385052	6325217
SW03	384797	6324853	385055	6324895

6.6 Monitoring Frequency

During the construction phase, monitoring will be undertaken at the following frequency:

- Groundwater levels – monthly June to October, quarterly November to May.
- Groundwater quality – quarterly.
- Surface water quality – monthly.

During the operational phase, monitoring will be undertaken at the following frequency:

- Groundwater levels – monthly June to October, quarterly November to May.
- Groundwater quality – quarterly.
- Surface water quality – quarterly.

The WQMP commits to monthly groundwater level monitoring during the peak groundwater level season (June to October) and quarterly for the remainder of the year. This monitoring will commence during the construction phase and continue through the operations phase in order to characterize groundwater levels at the site and their seasonal fluctuation. However, it is not relevant or appropriate to set groundwater level trigger relative to pre-development groundwater levels. The site drainage design utilizes a subsoil drainage system to control groundwater levels. Through detailed groundwater modelling and setting drainage infrastructure at appropriate elevations, it has been demonstrated that the subsoil drainage system will not have an impact on any groundwater dependent ecosystems or significant wetlands etc.

If dewatering is required then groundwater trigger levels will be set specifically in relation to dewatering monitoring and management. These triggers will be set in consultation with DWER using the baseline groundwater dataset available at that time.

6.7 Water Quality Sampling and Analysis Program

Groundwater and surface water sampling and analysis methodology are provided in detail in Section 4.5 and 4.6 of Appendix C.

6.7.1 Water Quality Assessment Levels

Water quality analytical results will be compared with criteria presented in the following:

- *Assessment and Management of Contaminated Sites (DWER 2014)*
- *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (CRC CARE 2011)*

- *National Environmental Protection (Assessment of Site Contamination) Measure: Investigation Levels for Soil and Groundwater (NEPC 2013).*

The assessment of groundwater is based on the beneficial use and management objectives of the groundwater. The assessment levels adopted will determine whether a potential human health risk exists through vapour intrusion. In addition, the potential impact to receptors located down hydraulic gradient will be assessed, inclusive of irrigation bores. As such, groundwater data will be compared to the following guidance criteria:

- Fresh Water Guidelines (FWG)
- Long-term Irrigation Water Guidelines (LIWG)
- Domestic Non-potable Guidelines (DNPG)

The analyte concentrations will also be assessed against the ecological freshwater guidelines for a slightly to moderately disturbed ecosystem (95% species protection). A slightly to moderately disturbed ecosystem is considered to best represent the prevailing ecosystem. Nutrient concentrations will be compared to guidelines developed for South-west Australia, Upland Rivers (Water Quality Australia Guidelines 2018).

It should be noted that comparison against the criteria listed above will not in itself trigger a contingency response. The site-specific water quality trigger values and associated trigger responses and contingency actions are outlined further below.

6.8 Triggers Values

Proposed interim trigger values for use during the construction phase are based on an assessment of baseline data against relevant guideline values. The trigger values will be reviewed and set following the collection of a more significant baseline dataset during the construction phase; this will be undertaken in consultation with DWER. The interim trigger values are presented in Appendix B.

The most relevant guideline values for the site are ecological (freshwater guidelines (FWG)) as the most relevant receptor is downgradient wetlands. Ecological guidelines will be used to inform the setting of trigger values but some analytes will naturally exceed the FWG due to existing degraded groundwater quality at the site. Hence, trigger values are proposed to be set to baseline median concentrations (+20%). If the baseline concentration is below the FWG and the FWG is assessed to provide an appropriate level of protection for the specific site receptors, then the FWG may be used as the trigger value in place of the baseline concentration, to reduce the frequency of irrelevant trigger exceedances (i.e. trigger exceedances related to natural variability in groundwater / surface water concentrations where no actual risk to the site receptors exists). The review and setting of triggers will also include assessment of the baseline data against other potentially relevant guideline values (e.g. human health, non-potable groundwater use etc).

Interim trigger values for hydrocarbons are set at the laboratory limit of reporting (LoR) due to the non-detection of hydrocarbons in baseline water quality monitoring. Similarly, interim trigger values for cobalt, lithium, thorium, uranium and radium are set to the LoR due to the absence of baseline data for these analytes. The trigger values for these analytes will be reviewed following the collection of baseline data during the construction phase.

The trigger values for hydroxide alkalinity is proposed to be set at the LoR of 20 mg/L hydroxide does not typical occur in natural water except where related to an anthropogenic source.

Post-construction triggers for sulfate and sodium will be set at the baseline median concentration (including construction phase monitoring) plus or minus two standard deviations.

It is also initially proposed that the first annual water quality monitoring report will contain further assessment of the baseline data and in this report the proposed trigger values for the operational phase water quality monitoring program will be documented and available for endorsement by DWER.

Proposed trigger levels for the construction phase are presented in Appendix D and are based on an assessment of baseline data against relevant guideline values. It is proposed to initially set trigger values for the construction phase with these to be reviewed prior to the operations phase based on the larger baseline dataset that will be available at that time. It is also initially proposed that the first annual water quality monitoring report will contain further assessment of the baseline data and in this report the proposed trigger values for the operational phase water quality monitoring program will be documented and available for endorsement by DWER.

This approach is necessary for two reasons:

1) The water quality with respect to pH, alkalinity and major ions will potentially change as a result of the importation of fill/treatment of ASS during construction, as discussed in Section 4.1. Therefore, it is necessary to assess these potential changes post-construction and prior to operations, to set appropriate trigger levels for the operations phase.

2) There is no baseline data for some analytes that are associated with the operations phase (e.g. lithium, uranium, radium). As these may occur naturally at levels above the laboratory limit of reporting, it is necessary to collect baseline during the construction phase to determine to what extent they are naturally present.

6.8.1 Derivation of Trigger Values

6.8.1.1 Nutrients and Dissolved Metals

Baseline groundwater and surface water monitoring for these analytes has been undertaken (nutrients in both the regional KSIA bores and the site bores, and metals in the site bores only). Trigger values for these analytes have been set at the median concentration from the baseline dataset plus a margin of 20% to account for the significant amount of temporal and spatial variability that naturally occurs in concentrations of these parameters. It should be noted that the trigger values cannot reflect the significant spatial variability in concentrations of some analytes that is evident in the baseline dataset. For example, some bores have recorded significantly higher concentrations of particular nutrients than other bores. Therefore, it is highly likely that these bores will exceed the proposed trigger value in the future due to existing concentrations and not from activities at the site. This is an unavoidable outcome when setting trigger values in this manner. It is anticipated that such exceedances will be reported to DWER along with a brief assessment against baseline data for the relevant bore to demonstrate that the exceedances are not related to the proposed action.

6.8.1.2 Process Related Analytes

Several analytes are included in the analysis suite as they are associated (or potentially associated) with the process materials but have not been monitored at the site previously. These include; lithium, uranium, thorium, radium, and cobalt. Preliminary trigger values have been set for these analytes based on irrigation and non-potable guideline values; however, it is proposed that trigger values for these analytes be reviewed prior to the commencement of operations following the collection of additional baseline data during the construction phase.

Some other, more standard, analytes will also be used to monitor for potential impacts from the materials and processes involved during the operations phase. These include pH, calcium, sodium, sulfate and alkalinity (carbonate, bicarbonate, hydroxide) which will be used as proxies for the process materials used at the site (including quicklime, sulfuric acid and sodium hydroxide) which cannot be monitored directly due to the fact they readily dissociate (partially or completely) in water.

The majority of these analytes do not pose a significant risk to the environment and or human health, if released, with the exception of large decreases/increase in pH, i.e. highly acidic or basic water, and hydroxide. If such changes occur then there the potential for the secondary release of other analytes, including metals and sulfate. As such triggers are only proposed for pH, hydroxide alkalinity, sodium and sulfate and will be used as proxies for the various compounds used onsite during processing.

The proposed triggers are in Table 5 below.

Table 5 Proposed Trigger Values for Process Related Analytes

Analyte	Proposed Trigger	Rationale
Hydroxide Alkalinity	>20 mg/L	20 mg/L is the limit of reporting from available analytical results. Hydroxide is typically not observed in the natural waters expect where there is an anthropogenic source
pH	3.7-6.9 pH units	baseline range as of Aug 2018
Sulfate	±2 two standard deviations from baseline	Sulfate concentrations will vary naturally however should a significant decrease in pH be observed then a review of sulfate data should be undertaken, i.e. potential release of sulfuric acid
Sodium		Sodium concentrations will vary naturally however should a significant increase in pH be observed then a review of sulfate data should be undertaken, i.e. potential release of sodium hydroxide

6.8.1.3 Major Anions / Cations

As previously discussed, changes in water quality are anticipated during construction due to the importation of calcareous fill and treatment and reuse of ASS onsite. With the exception of sodium, sulfate and hydroxide alkalinity no site specific triggers are proposed for other major cations and anions. Relevant guidelines, where available, will be used as triggers for these analytes.

6.8.1.4 Hydrocarbons

No hydrocarbons were detected in any sample during the baseline monitoring. Trigger values for hydrocarbons during both the construction and operations phases have been set at the laboratory limit of reporting.

6.9 Trigger Responses

Trigger values are useful for reporting purposes in that they provide a specific criterion for comparing results against and for demonstrating that ongoing assessment of water quality data is being undertaken to identify water quality changes and trends in such. However, it can be problematic setting trigger values and prescribed response actions due to factors such as inadequate spatial and/or temporal resolution of baseline data to characterise natural conditions and variability, limited understanding of related health/environmental risks etc.

Notwithstanding this, trigger values are also an important tool for ensuring that potential impacts are identified, and appropriate responses taken. It is proposed to implement a tiered decision response framework to guide response actions in relation to water quality trigger exceedances.

Monitoring and assessment of potential construction or operations related impacts to water quality will follow a tiered approach whereby a trigger exceedance will be assessed in relation to the following criteria and response actions:

Tier 1 – Is there an exceedance of a water quality trigger?

An exceedance of a trigger value detailed in Table 5 is considered to occur when the trigger value is exceeded at a sampling site over two consecutive monitoring events (with the exception of process related analytes lithium, uranium, thorium, radium and cobalt) for which an exceedance is considered to occur the first time that the trigger value in Table 5 is exceeded).

An exceedance will trigger an initial investigation to confirm the validity of the result in terms of laboratory accuracy and potential sampling artefacts (QA/QC analysis). If an exceedance is confirmed, Tier 2 monitoring and management responses would be initiated to further investigate the cause of the exceedance.

Tier 2 – Is the exceedance due to site activities?

An assessment would be undertaken to determine whether site activities was likely to have caused the exceedance. The assessment would include the following:

- Further validity testing of the result, cross-checking concentration with the laboratory. Retesting sample if the result appears to be an error or silica gel cleanup and or speciation of hydrocarbons.
- Review of sampling procedures (including QA/QC) to determine whether a sampling error or contamination, may have contributed to the result.
- Comparison of the sample against the mean and variance of baseline and up-gradient water quality data.
- Consideration of other potential environmental effects and contaminant sources including flood flows within the drain, changing land uses or activities external to the site.
- If the initial assessment identifies site activities as the likely cause of the exceedance, the monitoring program would move to Tier 3; with notification of the exceedance to be given to DWER (note: notification to DWER is required within 21 days of a trigger exceedance being identified).

Tier 3 – Is there a repeated exceedance of a trigger?

Tier 3 monitoring would be implemented if the Tier 2 assessment identifies site activities likely to have caused an exceedance. DWER will be notified of the likely exceedance along with the findings of the Tier 2 assessment. Depending on the nature of the exceedance, and in consultation with DWER, an additional monitoring event will be undertaken specifically for the analyte(s) that have exceeded and at the relevant location(s). This testing would confirm whether the exceedance represents a short-term ‘spike” or has continued. Parallel to the Tier 3 monitoring, a high-level review of the site activities will be undertaken to identify any potential operational issues / incidents / changes in conditions.

Should the Tier 3 monitoring determine the exceedance to be continuing the program would move to Tier 4 and Tier 3 monitoring would continue.

Tier 4 – Does the exceedance pose a human health or environmental risk?

Assess whether the exceedance poses a risk to either human health or the receiving environment, by considering the following factors:

- extent of the elevated exceedance based on water quality monitoring results for down-gradient bores.
- assessment of the potential effects of the measured concentrations of contaminants by comparison with relevant ecotoxicological literature, considering the derivation and applicability of nominated triggers to the site location and setting.
- Potential for human or ecological exposure.

The results of the investigation would be reviewed in consultation with DWER. If the reported exceedances do appear to pose a risk to either human health or the environment, then the program would move to Tier 5.

Tier 5 – Implementation of operational changes with DWER direction

A review of site activities would be required with reference to the contingency responses detailed in Section 6.10. The appropriate contingency actions (e.g. improved operational practices, mitigation measures etc) will be identified and, in consultation with DWER, a series of responses would be agreed and implemented. Over this period, Tier 3 monitoring would continue until such time that no exceedance was reported, unless otherwise agreed by DWER.

6.10 Contingency Actions

Contingency responses (e.g. remediation of contaminated soil) will be identified and implemented, in consultation with DWER, through the tiered response framework which involves mandatory reporting of trigger exceedances to DWER in accordance with the conditions of the environmental approval.

The reporting of trigger exceedances to DWER will include an associated assessment/investigation of the likely cause/source of the trigger exceedance. If a trigger is identified as being caused by the site activities then further assessment of the environmental risk/impact will be undertaken in accordance with the tiered response framework (this may involve additional monitoring to delineate impacts, ecotoxicological risk assessment etc). Through this process, the appropriate contingency responses will be identified and implemented to ensure that any exceedances are returned to below trigger values.

It is not practical to specify contingency actions in response to trigger exceedances as the nature and underlying cause of any trigger exceedance first needs to be investigated. The WQMP commits to undertaking this assessment in a transparent manner in consultation with DWER and implementing the appropriate response actions to address trigger exceedances that may occur. It should also be noted that contingency responses in relation to contamination events (e.g. hydrocarbon spills, plant failures) will be identified in the appropriate construction and environmental management plans for the proposed action, which will cover aspects such as dangerous goods handling, environmental incident responses etc. Such contingency responses would include spill containment and cleanup, monitoring or assessment of environmental impact and environmental remediation where required. It is anticipated that if a significant contamination event occurs then a remediation action plan will be implemented in consultation with DWER.

As described above, if a trigger exceedance occurs, the proponent will report the exceedance along with results of the monitoring to the DWER within 21 days, in accordance with the Report and Recommendations of the Environmental Protection Authority (June 2018). In addition to the compulsory reporting requirements, a trigger exceedance will also result in an immediate confirmatory monitoring event being undertaken (identified as Tier 3 monitoring in the response framework described in the previous section). If the confirmatory sampling verifies the trigger exceedance, then further investigation will be required. The proposed hierarchy of further investigation is:

1. desktop investigation to identify potential reasons for exceedance (i.e. change of conditions on site, comparison against other monitoring sites / upgradient water quality, heavy rainfall or potentially contaminating events etc.)
2. sampling of regional monitoring bores to confirm background / incoming water quality
3. ecotoxicological assessment to quantify the human health or environmental risk associated with the trigger exceedance
4. installation of additional monitoring bores to confirm and delineate the extent of water quality impacts
5. groundwater contaminant fate and transport modelling to determine environmental risks associated with on-site impacts.

As per the Report and Recommendations of the Environmental Protection Authority (June 2018), if a trigger exceedance occurs and is determined to be as a result of site activities, then management responses and contingency actions will be implemented. These may include:

- identify source and cause of contamination and rectify or modify operational procedures or controls accordingly
- improved maintenance or retrofitting of drainage systems to increase water quality treatment (e.g. replacement of amended soils in drainage basins, installation of additional stormwater capture/treatment systems etc.)
- improve maintenance or retrofitting of the impervious bunding and pads within the process plant to ensure no potential for leakage.
- retrofitting drainage systems to minimise or prevent infiltration to the groundwater system and implement improved water quality treatment methods/systems.

6.11 Water Quality Reporting

6.11.1 Annual Reporting

Monitoring results to be compiled and assessed including tabulation, statistical assessment and trend analysis, with the results to be reported to the DWER annually (report to DWER submitted prior to 1 April each year for monitoring undertaken during the previous calendar year).

Annual reports will detail, at a minimum, the following information:

- Details of the monitoring undertaken including any variation from previous years (e.g. any additional or replacement monitoring bores, any change to the water quality analysis suite, any change in site operations or infrastructure that may be relevant to water quality monitoring etc).
- Tabulated water quality results including assessment against trigger values and relevant guidelines
- Statistical summary and trend analysis of results including all historical data.
- Interpretation and discussion of results, particularly with respect to any observed changes in water quality or trigger exceedances.
- Details of any trigger exceedances during the annual monitoring period along with follow up investigations, outcomes, and demonstrate that contingency responses/actions were implemented.

6.11.2 Notifications

In addition to the annual reporting requirements, the proponent will also notify the DWER within 21 days of a trigger exceedance occurring. An exceedance will trigger response actions in accordance with the tiered response framework described in Section 6.9. This framework includes notifying DWER of the results of the various stages of assessment and further investigation.

The proponent will also notify the DWER of any reportable incidents that may lead to uncontrolled discharge of waste or potentially contaminating material from the site (e.g. significant spills, loss of containment bund integrity etc).

6.12 Quality Assurance and Quality Control

6.12.1 Field and Laboratory QAQC

A procedure to cover project field and laboratory QAQC will be developed.

6.13 Implementation Plan

The aspects in relation to water management at the site are broadly described in Table 6 below. Albemarle has responsibility over all of these aspects. The key aspects associated with the implementation of this water management plan will focus particularly on the maintenance and monitoring requirements related to the drainage system.

Table 6 WMP Aspects

Principle	Aspect	Time-scale
Drainage System Maintenance	Open drains	Annual inspection of drains and culverts, clearing as required.
	Basins	Annual inspection, regular maintenance of bioremediation basin plants etc.
	Subsoil	Annual inspection of subsoil drains, clearing as required.
Construction and Site Management	Construction and site works management	As required during earthworks and construction.
	Dust suppression and erosion control	As required during earthworks and construction.
	Waste and pollution management	As required during earthworks, construction and operations.

The various aspects of the water quality monitoring program at the site are summarised in Table 7 below. The proponent has responsibility over these aspects of the monitoring program.

Table 7 Summary and Implementation Plan

Principle	Requirement	Details
Monitoring Program	Frequency	Groundwater elevations: monthly June-October, quarterly November-May Groundwater quality: quarterly Surface water quality: monthly
	Methodology	Low-flow sampling methodology for groundwater sample collection, grab sampling for surface water. All sampling to be undertaken in accordance with AS/NZS 5667 and quality control protocols described herein.
	Parameters	Temperature, pH, dissolved oxygen, electrical conductivity, redox Ammonia-N, TKN, NOx-N, TN, FRP, TP Major cations (Ca, Mg, K and Na) Major anions (chloride, sulfate, alkalinity) Acidity and total dissolved solids Dissolved metals suite (Al, As, Cd, Cr, Cu, Fe, Pb, Hg, Li, Mn, Ni, Zn) and cobalt, uranium and thorium Radium 226, radium 228 TRH, BTEX, PAH
Monitoring Locations	Monitor specified sites	The following existing bores are to be monitored: C2-S, MW01, MW02, MW03, MW16, MW17, MW27, MW29, MW30.
	Replace monitoring sites as required	Where necessary to decommission an existing bore, a replacement will be installed as close to the original location as possible
Water Quality Data Assessment	Assess results against triggers after each monitoring event	Water quality results to be assessed by a suitably qualified practitioner against the trigger values and guidelines described herein. Assessment to be undertaken within 21 days of laboratory analysis results being available.
Trigger Exceedance Responses	Assess causes of trigger exceedances	Trigger exceedances to be assessed and appropriate response actions taken as described by the tiered response framework described herein. Undertake reporting of confirmed exceedances to DWER and implement response actions (e.g. further monitoring, investigation, contingency actions) as described herein.
	Report confirmed exceedances to DWER within 21 days (refer to tiered response framework)	
Annual Reporting	Prepare annual report for submission to DWER	Annual reports to be prepared and submitted to DWER to provide tabulated data, analysis, summary and interpretation of results, discussion on exceedances and response actions, comments on future monitoring requirements (e.g. if any changes identified).
Incident Reporting	Trigger exceedances	Report confirmed exceedances to DWER within 21 days.
	Incident reporting	Report potentially contaminating events (spills, uncontrolled discharges etc) to DWER.
Monitoring Program Review	Monitoring program review	Review the suitability of the monitoring program annually. Confirm future monitoring program (e.g. any required modifications) within annual monitoring reports to DWER.

7 Stakeholder Consultation and Reporting

Albemarle will undertake reporting in accordance with regulatory and legislative requirements. It is expected that the Plant will be required to operate in accordance with a Part V EP Act licence which will specify annual reporting requirements. The results of the WMP, including the results of surface and groundwater monitoring, will be reported annually as part of the Project's Compliance Assessment Reports.

This WMP is planned to be altered prior to the operation of the Lithium Plant. Consultation will be undertaken with stakeholders identified in Table 8 as a minimum, prior to submission to EPA as per Ministerial Statement 1085 condition 7.

Table 8 Stakeholder Consultation

Stakeholder	Purpose of Consultation and Outcome
DWER (Water Services)	Confirmation on suitability of any updates to the WMP. Reporting of any non-compliances
DWER (Regulation Services)	Approval applications and discussions on the EP Act Part V licensing requirements focusing on acceptable approaches for surface and groundwater management
DJTSI	Regular engagement undertaken in DJTSI's role as the lead agency for the Project.
LandCorp	Interface with Kemerton Road drainage system and suitability of the WMP.
DoEE	Publication of the WMP and annual compliance reporting in accordance with EPBC 2017/8099 Part B.
Kemerton Industrial Park Coordinating Committee (KIPCC)	Provide updates on the WMP and any findings relating to ground and surface water monitoring.
Shire of Harvey	Provide updates on the WMP and any findings relating to ground and surface water monitoring.
Leschenault Catchment Council	Provide updates on the WMP and any findings relating to ground and surface water monitoring.
South West Catchment Council	Provide updates on the WMP and any findings relating to ground and surface water monitoring.
Local Community	Ensure that the latest WMP is available on Albemarle's website along with any results as part of the Project's Compliance Assessment Reports

8 References

Calibre. 2018. Kemerton Strategic Industrial Area. Stormwater Modelling Report. Prepared for LandCorp. Report number 17-002565. 7 February 2018.

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Environmental Protection Authority. 2018. Report and recommendations of the Environmental Protection Authority. Albemarle Kemerton Plant. Report 1618. June 2018.

Monash University. 2014. Vegetation guidelines for stormwater biofilters in the south-west of Western Australia. Monash University, Clayton, Victoria.

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Appendix A

Engineering Plans

PROJECT : ALBEMARLE KEMERTON PLANT
CLIENT : ALBEMARLE
JOB NUMBER : 606541

No.	BY	DATE	REVISION	CHECKED	APPROV.
B	SC	13.01.18	ISSUED FOR USE	KC	
A	SC	30.01.18	ISSUED FOR INTERNAL REVIEW	KC	

DRAWING No. | REFERENCE DRAWINGS

wood.

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CLIENT: ALBEMARLE

CLIENT PROJECT No. 7421

	BY	DATE
PROJECT APPR.		
DESIGN APPR.		
DESIGNED		
CHECKED		
DRAWN		

SCALE 1:5000

TRUE NORTH

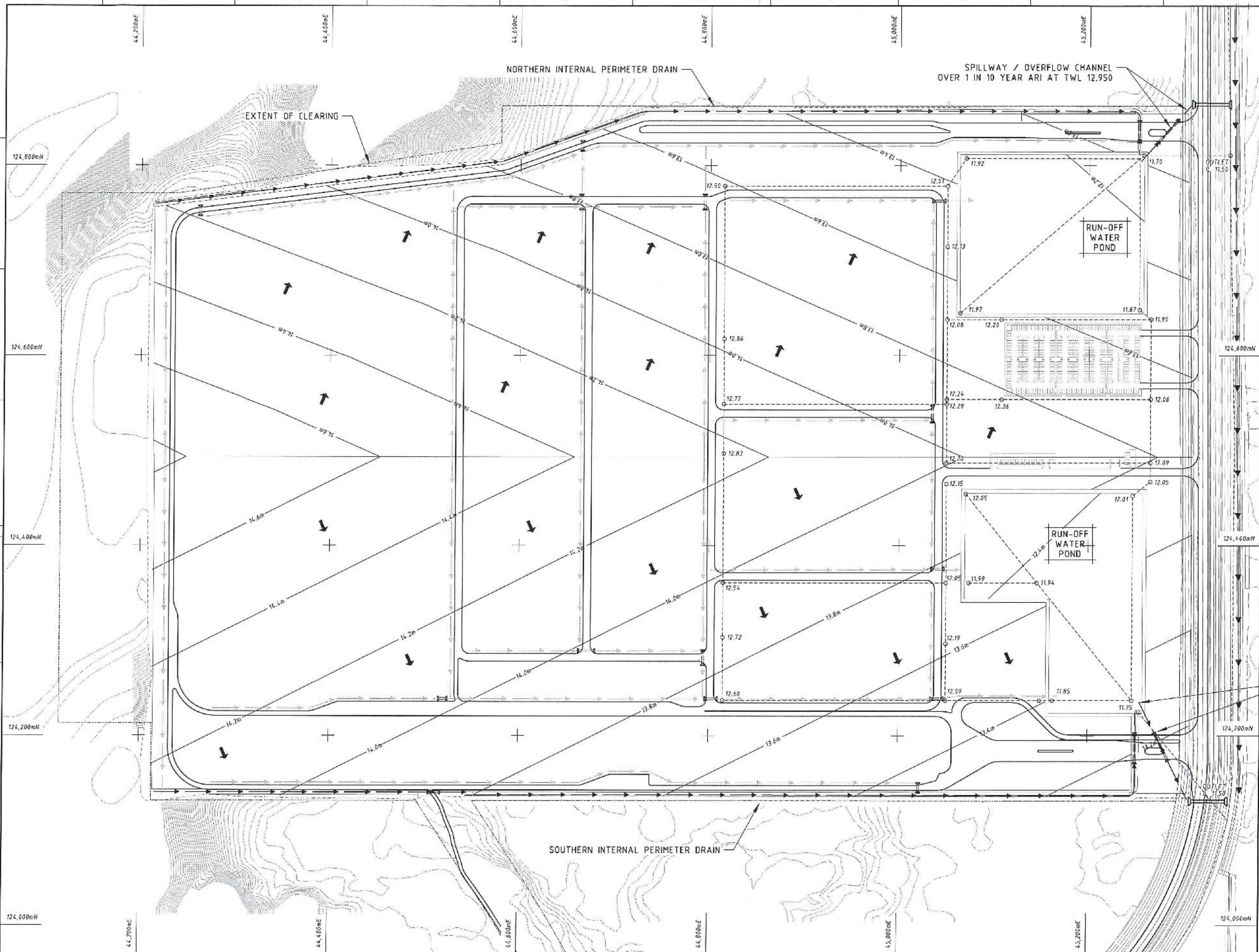
PROJECT No. 606541 | DRG SIZE A1

CLIENT ALBEMARLE

TITLE
ALBEMARLE KEMERTON PLANT PROJECT
OVERALL PLANT
LOCALITY PLAN AND DRAWING LIST

DRAWING No. 606541-4100-DD10-LST-0001 | REV No. B

ISSUE#:



NOTES

1. FOR GENERAL NOTES REF DRG 606541-4110-DD10-GAD-0001

LEGEND

- 14.0m - DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS
- EXISTING CONTOURS
- PROPOSED INTERNAL PERIMETER DRAINS
- ROADSIDE SWALE FLOW PATH
- FUTURE KEMERTON ROAD MAIN DRAIN
- PROPOSED OUTLET CULVERTS (BY OTHERS)
- PROPOSED INTERNAL ROAD CULVERT CROSSINGS
- PAD FALL DIRECTION
- 11.80 11.73 - SUBSOIL DRAIN NETWORK AND INVERT LEVELS

0 20 40 80 120 160 200m

SCALE 1:2000

DRAWING No.	REFERENCE DRAWINGS
4120-DD10-GAD-0001	OVERALL PLANT BULK EARTHWORKS PLAN

wood.

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CLIENT: ALBEMARLE

CLIENT PROJECT No. 7421

No.	BY	DATE	REVISION	CHECKED	APPROV.
C	SC	21.02.18	RE-ISSUED FOR USE		
B	SC	13.02.18	ISSUED FOR USE	KC	AB
A	SC	30.01.18	ISSUED FOR INTERNAL REVIEW	KC	

	BY	DATE
PROJECT APPR.		
DESIGN APPR.		
DESIGNED		
CHECKED		
DRAWN		

SCALE 1:2000

TRUE NORTH

PROJECT No. 606541 | DRG SIZE A1

CLIENT ALBEMARLE

TITLE ALBEMARLE KEMERTON PLANT PROJECT OVERALL PLANT INTERNAL DRAINAGE CONCEPT PLAN

DRAWING No. 606541-4120-DD10-GAD-0002 | REV No. C

Date: 2/21/2018 Time: 7:28:15 AM Plotted By: sally.currie Pentable: LZR.TBL Plotdriver: Follow-You-BWA3.plt Filename: W:\Lithium\606541\Drawings\Civil\606541-4120-DD10-GAD-0002.dgn

Appendix B

Baseline Water Quality Monitoring Data

Groundwater Monitoring By GALT (2017 - 2018)

PRE-DEVELOPMENT GROUNDWATER MONITORING																
Bore	MW01	MW01	MW02	MW02	MW03	MW03	MW16	MW16	MW17	MW17	MW27	MW27	MW29	MW29	MW30	MW30
Date	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018	GALT 30/11/2017	GALT 6/08/2018
TEMP C	19.6	18.5	18.2	15.8	18	15.4	20.3	15.4	20.4	17.1	19.4	19.4	21.3	16.5	17.7	14.3
pH	4.77	5.04	5.27	5.23	5.52	5.84	6.58	5.92	4.28	3.74	5.11	5	4.35	3.95	5.88	5.42
E.C (uS/cm)	89.5	89.7	314.7	558	574	739	1251	730	107.5	113.3	84.4	90.9	172.8	111.5	910	285.6
REDOX (mV)	121.4	132	43.2	80.6	39.3	107.9	13.4	124.4	152.2	222.8	155	140.3	172.8	227.1	-25.7	171.9
D.O. (ppm)	1.47	2.25	1.2	0.47	2.02	4.19	0.71	2	0.51	0.05	3.05	2.27	0.61	1.65	0.7	6.49
Salinity (ppt)																
Total N (mg/L)	0.6	0.44	2.4	3	2.9	1.5	4.3	4.3	1.9	0.64	0.9	1.4	2.1	2.3	2	2.5
Ammonia as N (mg/L)	0.19	0.2	2	2.3	0.51	0.4	0.09	0.05	0.19	<0.01	<0.01	<0.01	0.32	<0.01	0.38	0.04
NOx as N (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.3	2.9	<0.05	<0.05	0.85	1.2	<0.05	1.6	<0.05	<0.05
TKN (mg/L)	0.6	0.4	2.4	3	2.9	1.5	3	1.4	1.9	0.6	<0.2	0.2	2.1	0.7	2	2.5
Phosphorus (as P) (mg/L)		<0.005		<0.005		<0.005		0.3		<0.005		<0.005		0.1		<0.005
Phosphate total (as P) (mg/L)	<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05	
FRP (mg/L)	<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05	
Sulphate (as S) (mg/L)	9.2	7	<5	23	<5	75	10	22	<5	7.1	6.9	8.5	<5	8.6	18	8.4
Acidity (as CaCO3) (mg/L)	60		74		110		39		90		29		100		73	
Chloride (mg/L)	560	21	100	180	170	230	310	200	10	23	17	22	46	21	240	98
Fluoride (mg/L)		<0.5		<0.5		<0.5		<0.5		<0.5		<0.5		<0.5		<0.5
Total Dissolved Solids (mg/L)	92		290		830		1200		170		120		270		720	
Total Alkalinity (as CaCO3)	<20		<20		56		130		<20		<20		<20		80	
Alkalinity : Sulfate	1.1		4		22.4		13		4		1.4		4		4.4	
Chloride : Sulfate	60.9		40		68		31		4		2.5		18.4		13.3	
Aluminium - Total (mg/L)	2.8		3.7		15		11		11		2.4		6.9		1.5	
Aluminium – Dissolved (mg/L)	0.68		0.65		0.12		0.06		1.5		<0.05		2.1		0.002	
Arsenic - Dissolved (mg/L)	<0.001		<0.001		0.002		0.004		<0.001		<0.001		<0.001		0.002	
Cadmium - Dissolved (mg/L)	<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002	
Chromium - Dissolved (mg/L)	<0.001		<0.001		0.004		<0.001		<0.001		<0.001		<0.001		0.003	
Iron - Total (mg/L)	0.3		1.1		-		3.8		0.66		<0.05		0.56		0.31	
Iron – Dissolved (mg/L)	0.19		0.94		1.1		0.1		0.54		<0.05		0.35		0.05	
Manganese - Dissolved (mg/L)	0.009		0.1		0.044		0.063		0.01		0.007		0.012		0.014	
Nickel - Dissolved (mg/L)	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Selenium – Dissolved (mg/L)	<0.001		0.001		0.006		0.003		<0.001		0.001		<0.001		0.002	
Zinc - Dissolved	<0.005		<0.005		<0.005		<0.005		<0.005		0.021		<0.05		0.005	
Arsenic (mg/L)		<0.001		<0.001		0.005		0.002		<0.001		<0.001		<0.001		<0.001
Beryllium (mg/L)		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001
Boron (mg/L)		<0.05		<0.05		0.07		0.06		<0.05		<0.05		<0.05		0.06
Cadmium (mg/L)		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002
Chromium (mg/L)		<0.001		<0.001		0.004		0.001		<0.001		<0.001		<0.001		0.001
Copper (mg/L)		<0.001		0.001		0.002		0.005		0.004		0.001		0.002		0.004
Lead (mg/L)		0.002		0.001		0.022		0.006		0.002		0.002		0.002		<0.001
Manganese (mg/L)		<0.005		0.25		0.095		0.11		<0.005		<0.005		0.079		0.029
Mercury (mg/L)		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001
Nickel (mg/L)		<0.001		0.002		0.003		0.003		<0.001		<0.001		<0.001		0.001
Selenium (mg/L)		0.011		0.003		0.013		0.007		0.002		0.002		<0.001		<0.001
Zinc (mg/L)		<0.005		<0.005		0.005		0.006		0.006		0.007		<0.005		0.029
Benzene (mg/L)		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.004
Toluene (mg/L)		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.004
Ethylbenzene (mg/L)		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.004
Xylenes (mg/L)		<0.003		<0.003		<0.003		<0.003		<0.003		<0.003		<0.003		<0.012
F1 (C6 to C10 –BTEX)		<0.02		<0.02		<0.02		<0.02		<0.02		<0.02		<0.02		<0.08
F2 (>C10 to C16 –		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05
Total PAH (mg/L)		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001
TRH >C10-C16 (mg/L)		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05		<0.05
TRH >C16-C34 (mg/L)		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1
TRH >C34-C40		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1
Phenol (mg/L)		<0.003		<0.003		<0.003		<0.003		<0.003		<0.003		<0.003		<0.003
Pentachlorophenol (mg/L)		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01
Calcium (mg/L)		1.3		3.5		7.3		6.6		1.2		2.8		6.6		5.3
Magnesium (mg/L)		3.5		20		15		12		0.9		2.6		1.5		7.1
Sodium (mg/L)		10		79		150		140		16		11		9.8		57
Potassium (mg/L)		1.7		9.8		9.3		6.5		<0.5		1.1		1.2		4.3
Bicarbonate (mg/L)		<20		<20		57		32		<20		<20		<20		26
Carbonate (mg/L)		<10		<10		<10		<10		<10		<10		<10		<10
Hydroxide ((mg/L)		<20		<20		<20		<20		<20		<20		<20		<20
Total Alkalinity (mg/L)		<20		<20		57		32		<20		<20		<20		26

Groundwater Monitoring By Aquaterra, Cardno and Parsons Brinckerhof (2001 - 2011)

PRE-DEVELOPMENT GROUNDWATER MONITORING

Bore	C1-D	C1-D	C1-D	C1-I	C1-I	C1-I	C2-D	C2-D	C2-D	C2-I	C2-I	C2-I	C2-S	C2-S
Date	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010
TEMP C	19	19		19	20		19	19		18	19		21	19
pH	5.6	5.45		6.4	6.16		6.6	6.2		5.5	6.15		5.6	6.25
E.C (uS/cm)	200	182		200	201		1000	1222		170	842		130	1500
REDOX (mV)		-81			-110			-161			-14			-125
D.O. (ppm)		0.44			1.21			1.61			1.72			1.92
Salinity (ppt)		0.09			0.1			0.6			0.42			0.75
Total N (mg/L)		1.6	1.8		0.08	0.87		1.8	1.1		1.7	32		1.5
Ammonia as N (mg/L)		0.24	0.035		0.25	0.06		0.32	0.2		0.28	21		0.3
NOx as N (mg/L)		0.04	1		0.04	<0.005		0.05	<0.005		0.03	0.14		0.03
TKN (mg/L)		1.6	0.8		0.8	0.87		1.7	1.1		1.7	32		1.5
TP (mg/L)		0.24	0.05		0.11	0.03		0.05	0.04		0.06	4.7		0.14
Phosphorus (as P) (mg/L)					<0.01									
FRP (mg/L)		0.01	0.005			0.002		0.01	<0.002		0.02	2.4		0.02
Sulphate (as S) (mg/L)	30			15			<10			15			<10	
Chloride (mg/L)	30			25			230			20			20	
Fluoride (mg/L)														
Total Dissolved Solids (mg/L)	130			130			640			110			85	
Iron - Total (mg/L)	2.4			0.35			6.2			14			0.45	
Calcium (mg/L)	4.8			2.8			9.1			1.4			6.8	
Magnesium (mg/L)	7.6			4			24			2.6			3.5	
Sodium (mg/L)	24			25			200			21			15	
Potassium (mg/L)	15			13			8.2			8.4			1.4	
Bicarbonate (mg/L)	15			25			120			20			15	
Carbonate (mg/L)	<1			<1			<1			<1			<1	

Bore	C3-D	C3-D	C3-D	C3-I	C3-I	C3-I	C3-S	C3-S	C4-I	C4-I	C4-I	C4-S	C4-S	C6	C6	C6
Date	AQUATERRA 31/01/201	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 31/01/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 31/01/2001	CARDNO 20/01/2010	AQUATERRA 31/01/2001	CARDNO 20/01/2010	Parsons Brinckerhof 19/01/2011	AQUATERRA 31/01/2001	Parsons Brinckerhof 19/01/2011	AQUATERRA 12/02/2001	CARDNO 21/01/2010	Parsons Brinckerhof 19/01/2011
TEMP C	22	21		22	21		22	21	20	20		20		19	18	
pH	5.2	5.08		5.4	5.27		5.4	5.32	4.9	5.42		4.8		6.8	6.85	
E.C (uS/cm)	110	129		160	0.129		140	265	610	676		680		620	253	
REDOX (mV)		-93			-105			-70		-62					-102	
D.O. (ppm)		1.95			1.63			2.17		1.68					2.15	
Salinity (ppt)		0.06			0.06			0.13		0.33					1.29	
Total N (mg/L)		2.8	1.3		2.6	2.8	4.5	2.1		1.6	2.1		1.9		2.2	2.4
Ammonia as N (mg/L)		0.26	0.3		0.02	1.4	2.9	0.25		0.58	1.2		0.97		0.5	0.56
NOx as N (mg/L)		0.02	0.022		0.02	0.028	0.061	0.03		0.09	0.02		0.03		0.03	0.024
TKN (mg/L)		2.7	1.3		2.5	2.8	4.4	2.1		1.6	2.1		1.9		2.2	2.4
TP (mg/L)		0.18	0.02		0.15	0.04	0.32	0.23		0.03	0.05		0.05		0.07	0.03
Phosphorus (as P) (mg/L)																
FRP (mg/L)		<0.01	0.004		<0.01	<0.002	0.2	0.01		0.03	0.02		0.027		0.03	0.017
Sulphate (as S) (mg/L)	<10			10			15		25			20		<10		
Chloride (mg/L)	25			35			25		160			180		100		
Fluoride (mg/L)																
Total Dissolved Solids (mg/L)	70			100			90		390			440		400		
Iron - Total (mg/L)	1.7			1.9			1.1		1.5			2.2		5		
Calcium (mg/L)	1.4			1.2			4.4		3.4			3.1		2.6		
Magnesium (mg/L)	2.7			2.6			4		10			11		6.8		
Sodium (mg/L)	16			20			12		93			98		130		
Potassium (mg/L)	3.4			5.2			2.6		3.9			4.6		3.2		
Bicarbonate (mg/L)	15			10			10		5			<5		130		
Carbonate (mg/L)	<1			<1			<1		<1			<1		<1		

PRE-DEVELOPMENT GROUNDWATER MONITORING

Bore	C7	C7	C7	C8	C8	C8	C9	C9	C9	C10	C10	C10
Date	AQUATERRA 31/01/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 19/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 31/01/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011
TEMP C	23	21		20	20.57		18	19		24	22	
pH	5.6	5.46		5.6	5.84		4.7	5.2		5.3	5.23	
E.C (uS/cm)	120	489		160	240		320	616		110	241	
REDOX (mV)		-142			-131			-106			-41	
D.O. (ppm)		1.46			1.9			1.96			2.16	
Salinity (ppt)		0.24			0.11			0.3			0.12	
Total N (mg/L)		2.6	2.6		1.4	0.98		1.6	1.8		2	1.4
Ammonia as N (mg/L)		0.73	1.1		0.35	0.53		0.84	0.84		0.27	0.6
NOx as N (mg/L)		0.04	<0.005		0.73	<0.005		0.05	0.083		1.36	0.82
TKN (mg/L)		2.5	2.6		0.7	0.98		1.6	1.7		0.7	0.62
TP (mg/L)		0.01	0.03		0.01	<0.01		0.02	0.08		0.02	0.02
Phosphorus (as P) (mg/L)												
FRP (mg/L)		<0.01	<0.005		<0.01	<0.002		<0.01	0.029		<0.01	<0.002
Sulphate (as S) (mg/L)	<10			<10			<10			25		
Chloride (mg/L)	25			20			70			20		
Fluoride (mg/L)												
Total Dissolved Solids (mg/L)	80			100			210			70		
Iron - Total (mg/L)	0.9			0.3			1.7			0.9		
Calcium (mg/L)	1.2			1.9			1.1			1.5		
Magnesium (mg/L)	2.2			4.3			3.2			3.4		
Sodium (mg/L)	13			19			53			9.1		
Potassium (mg/L)	4.8			2.8			2.8			5.1		
Bicarbonate (mg/L)	10			10			<5			5		
Carbonate (mg/L)	<1			<1			<1			<1		

Bore	C11	C11	C11	C12	C12	C12	S4	S4	S4	S11	S11	S11	KWS3/98	KWS3/98
Date	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 20/01/2011	AQUATERRA 12/02/2001	CARDNO 20/01/2010	Parsons Brinckerhof 21/01/2011	AQUATERRA 31/01/2001	CARDNO 21/01/2010	Parsons Brinckerhof 18/01/2011	AQUATERRA 31/01/2001	CARDNO 21/01/2010	Parsons Brinckerhof 18/01/2011	AQUATERRA 7/02/2001	CARDNO 21/01/2010
TEMP C	19	19		19	20		22	22		22	2		18	20
pH	4.4	5.3		5.3	5.41		5.4	5.97		6.1	6.58		5.6	5.31
E.C (uS/cm)	120	0.61		200	301		390	432		1200	474		680	1165
REDOX (mV)		-85			-84			-57			144			-124
D.O. (ppm)		4.72			2.84			2.98			1.71			2.15
Salinity (ppt)		0.29			0.14			0.21			0.23			0.58
Total N (mg/L)		1.2	0.85		1.9	2.8		8	3.9		1.3	4.3		1
Ammonia as N (mg/L)		0.11	0.45		1.16	1.8		0.21	0.49		0.16	0.35		0.62
NOx as N (mg/L)		0.16	<0.005		0.05	0.034		0.05	0.026		0.03	0.29		0.03
TKN (mg/L)		1	0.85		1.8	2.8		8	3.6		11.3	4		0.9
TP (mg/L)		0.04	0.02		0.02	0.03		0.2	0.05		0.27	0.06		<0.05
Phosphorus (as P) (mg/L)														
FRP (mg/L)		<0.01	<0.002		<0.01	0.0003		0.05	0.042		0.06	0.61		<0.01
Sulphate (as S) (mg/L)	<10			<10			35			90			20	
Chloride (mg/L)	25			50			30			210			210	
Fluoride (mg/L)														
Total Dissolved Solids (mg/L)	80			130			250			770			440	
Iron - Total (mg/L)	0.4			1.8			22			11			1.4	
Calcium (mg/L)	2.8			8.2			3.2			6.4			4.8	
Magnesium (mg/L)	2.8			5.6			7.3			26			11	
Sodium (mg/L)	15			21			74			250			140	
Potassium (mg/L)	0.9			1.8			3.1			3.4			4.7	
Bicarbonate (mg/L)	<5			10			30			140			25	
Carbonate (mg/L)	<1			<1			<1			<1			<1	

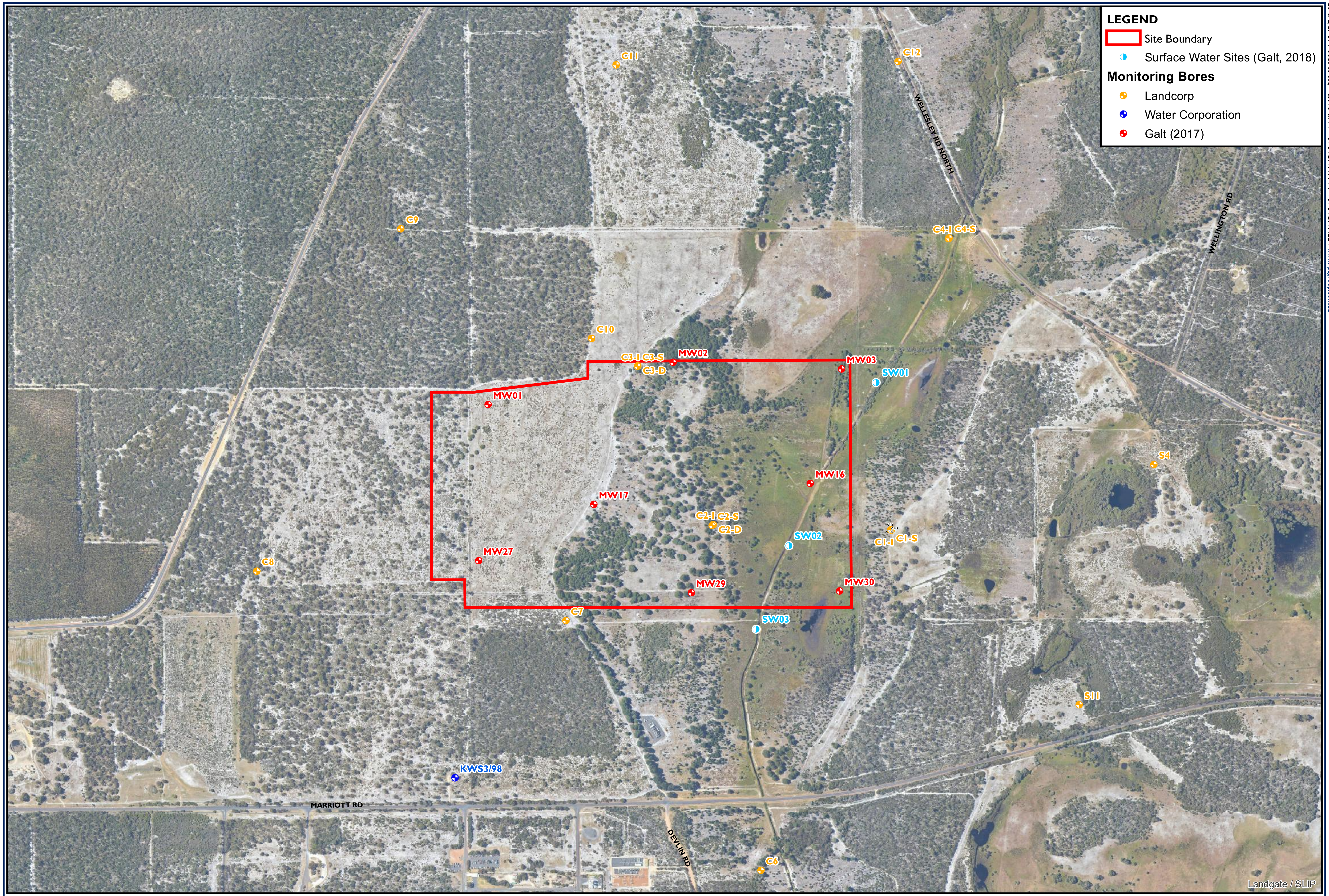
Surface Water Monitoring By GALT (2018)

PRE-DEVELOPMENT SURFACE WATER MONITORING			
Samling Location	**SW01**	**SW02**	**SW03**
Date	**GALT 24/10/2018**	**GALT 24/10/2018**	**GALT 24/10/2018**
TEMP C	16	18.1	21.5
pH	6.68	7.05	6.41
E.C (uS/cm)	124.4	3266	2562
REDOX (mV)	124.5	123	131.3
D.O. (ppm)	0.71	2.2	1.22
Total N (mg/L)	2.7	3.7	3.3
NOx as N (mg/L)	<0.05	<0.05	<0.05
TKN (mg/L)	2.7	3.7	3.3
Phosphate total (as P) (mg/L)	0.18	0.18	0.22
Sulphate (as S) (mg/L)	62	110	82
Acidity (as CaCO3) (mg/L)	85	100	28
Chloride (mg/L)	670	1100	600
Total Alkalinity (as CaCO3) (mg/L)	100	1200	68
Bicarbonate Alkalinity (CaCO3) (mg/L)	100	240	68
Carbonate Alkalinity (CaCO3) (mg/L)	<10	920	<10
Hydroxide Alkalinity (as CaCO3) (mg/L)	<20	<20	<20
Arsenic - Filtered (mg/L)	0.002	0.003	0.002
Cadmium - Filtered (mg/L)	<0.0002	<0.0002	<0.0002
Chromium - Filtered (mg/L)	0.004	0.004	0.002
Copper - Filtered (mg/L)	<0.001	0.001	<0.001
Lead - Filtered (mg/L)	<0.001	<0.001	<0.001
Mercury - Filtered (mg/L)	<0.0001	<0.0001	
Nickel - Filtered (mg/L)	0.001	0.001	<0.001
Zinc - Filtered (mg/L)	0.007	0.008	0.007
Calcium (mg/L)	17	26	18
Magnesium (mg/L)	54	84	46
Sodium (mg/L)	450	740	380
Potassium (mg/L)	8.4	13	10

Note: Hydrocarbon analysis resulted in no detectable amounts.

Appendix C

Water Quality Monitoring Locations



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RPS

Job Number: EWP72723.001
Doc Number:
Date: 30.11.18
Scale: 1:10,004 @ A3
Created by: JS
Source: Orthophoto - Landgate, Nov 2017

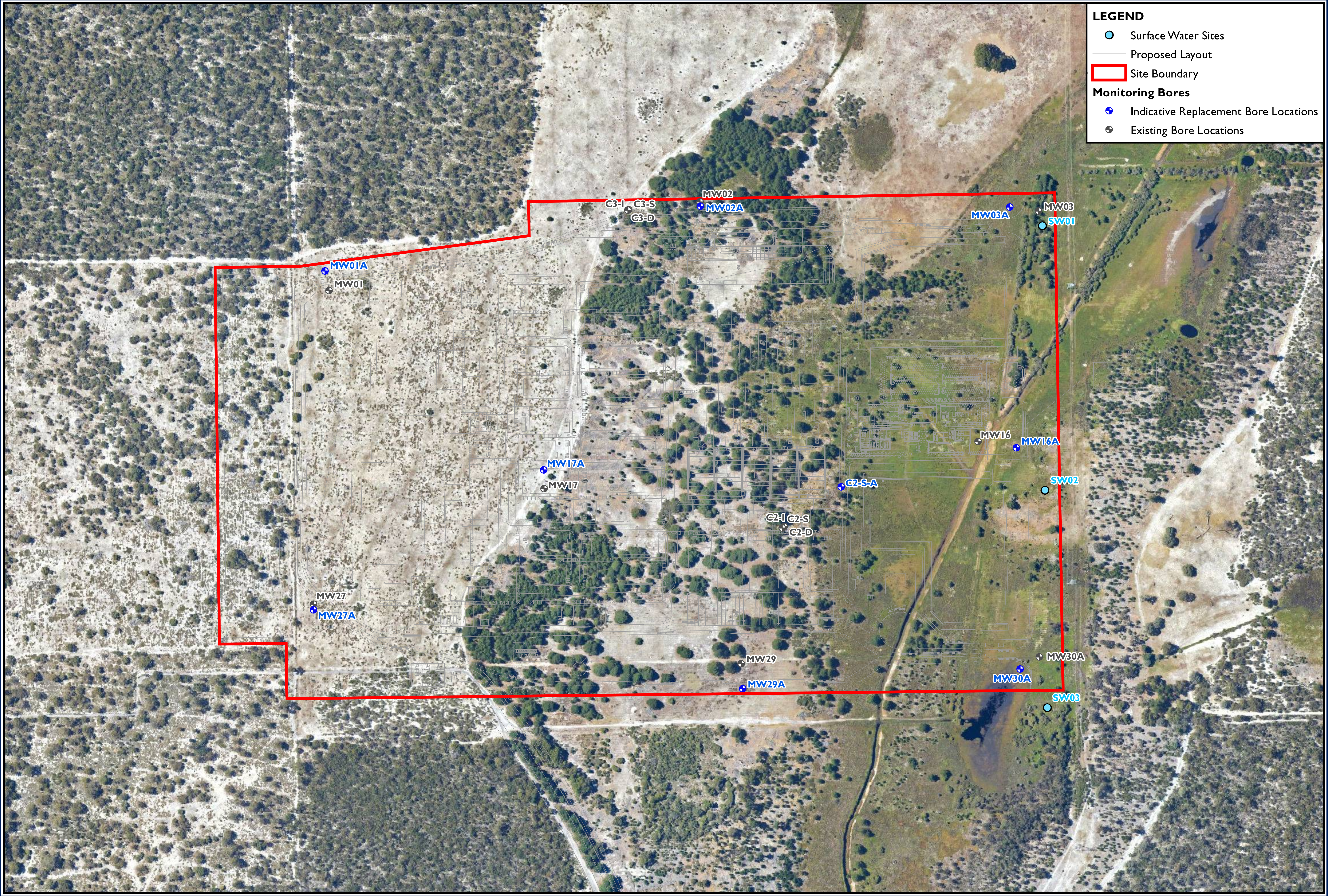
GDA 1994 Perth Coastal Grid 1994

0 30 60 120 180 240 m

Figure A

Baseline Water Quality Monitoring Locations

Document Path: W:\Jobs\EWP72723.Q01 Kemerton WMP wood plc\300 - Data\GIS\EWP72723-001_G_FigA_BaselineWQMonitoringLocations.mxd



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RPS

Job Number: EWP72723.001
Doc Number: 002
Date: 03.12.18
Scale: 1:5,000 @ A3
Created by: RA
Source: Orthophoto - Landgate, 2017

Figure B

Post-Construction Water Quality Monitoring Locations

Document Path: G:\Jobs\E_Jobs\EWP72723 Kemerton WMP wood plc\Figures EWP72723.001\EWP72723_001_G_002_FigB_PostConstructionWQMonitoringLocations_181203.mxd

Appendix D
Trigger Value Tables

Groundwater Baseline Data / Proposed Interim Trigger Values

Definitions:

FWG (Freshwater Guidelines) for slightly - moderately disturbed systems, ADWG (Drinking Water Guidelines), SIWG (Short Term Irrigation Guidelines), LIWG (Long Term Irrigation Guidelines) and NPUG (Non-Potable Usage Guideline) from NEPM (2013) or ADWG (2017)

NG denotes no guideline.

TBD denotes trigger value to be determined following additional baseline monitoring during construction phase (trigger value to be confirmed with DWER prior to operational phase)

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L. All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

					Anions						Cations				Nutrients					
Baseline dataset / Guideline	**pH**	**Electrical Conductivity**	**TDS**	**Acidity**	**Alkalinity (total)**	**Bicarbonate**	**Carbonate**	**Hydroxide**	**Chloride**	**Sulfate**	**Calcium**	**Magnesium**	**Sodium**	**Potassium**	**Total N**	**Ammonia as N**	**NOX as N**	**TKN**	**TP**	**FRP**
FWG	6.5-8.5	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.5	0.04	0.1	NG	0.06	0.03
ADWG	6.5-8.5	NG	NG	NG	NG	NG	NG	NG	250	250	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
SIWG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
LIWG	6.0-8.5	NG	1500	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
NPUG	NG	NG	NG	NG	NG	NG	NG	NG	250	1000	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
LOR	-	-	10	20	20	20	10	20	5	5	0.5	0.5	0.5	0.5	0.2	0.01	0.05	0.2	0.01	0.05
Albermarle / Galt bores (median)	5.2	229	280	74	<20	<20	<10	<20	99	25	4	5	37	3	2.1	0.19	<0.05	1.7	<0.01	<0.05
KSIA bores (median)	5.5	253	140	-	<20	<20	<10	<20	30	38	3	4	23	4	1.8	0.45	<0.05	1.7	<0.01	<0.05
Combined / All bores (median)	5.4	253	210	74	<20	<20	<10	<20	41	30	3	4	23	4	1.9	0.32	<0.05	1.7	<0.01	<0.05
Proposed Interim Trigger	**3.7-6.9**	**TBD**	**TBD**	**>40**	**TBD**	**TBD**	**TBD**	**20**	**NG**	**±2STD**	**TBD**	**TBD**	**±2STD**	**TBD**	**2.5**	**0.23**	**0.05**	**2.0**	**0.01**	**0.05**

Notes

1 pH based upon observed baseline range

2 Acidity - DWER ASS guideline

3 Where the median anlaytical result is less than the limit of reporting, the intrim trigger has been set at the limit of reporting

4 Where no analytical data is available the intrim guideline has been set at the limit of reporting

Groundwater Baseline Data / Proposed Interim Trigger Values

Definitions:

FWG (Freshwater Guidelines) for slightly - moderately disturbed systems, ADWG (Drinking Water Guidelines), SIWG (Short Term Irrigation Guidelines), LIWG (Long Term Irrigation Guidelines) and NPUG (Non-Potable Usage Guideline) from NEPM (2013) or ADWG (2017)

NG denotes no guideline.

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L. All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

	Dissolved Metals															
Baseline dataset / Guideline	**Aluminium**	**Arsenic**	**Cadmium**	**Chromium (III+VI)[1]**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Lithium**	**Manganese**	**Mercury**	**Nickel**	**Selenium**	**Thorium**	**Uranium**	**Zinc**
FWG	0.055	0.013	0.0002	0.001	NG	0.0126	0.3	0.0034	NG	1.9	0.00006	0.011	0.005	NG	NG	0.008
ADWG	0.2	0.01	0.06	0.05	NG	NG	0.3	0.01	NG	0.5	0.001	0.02	0.01	NG	0.017	NG
SIWG	20	2	0.05	1	0.1	0.1	10	5	2.5	10	0.002	2	0.05	NG	0.1	3
LIWG	5	0.1	0.01	0.1	0.05	0.05	0.2	2	2.5	0.2	0.002	0.2	0.02	NG	0.01	3
NPUG	0.2	0.1	0.02	0.5	NG	20	0.3	0.1	NG	5	0.01	0.2	0.1	NG	0.17	3
LOR	0.05	0.001	0.0002	0.001	0.001	0.001	0.05	0.001	0.0005	0.005	0.0001	0.001	0.001	0.0005	0.001	0.005
Albermarle / Galt bores (median)	0.39	<0.001	<0.0002	<0.001	-	0.002	0.27	0.002	-	0.022	<0.0001	0.001	0.002	-	-	0.005
KSIA bores (median)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined / All bores (median)	0.39	<0.001	<0.0002	<0.001	-	0.002	0.27	0.002	-	0.022	<0.0001	0.001	0.002	-	-	0.005
Proposed Interim Trigger	**0.46**	**0.001**	**0.0002**	**0.001**	**0.001**	**0.0024**	**0.3**	**0.0034**	**0.0005**	**0.026**	**0.0001**	**0.0012**	**0.0024**	**0.0005**	**0.001**	**0.008**

Notes

1 pH based upon observed baseline range

2 Acidity - DWER ASS guideline

3 Where the median anlaytical result is less than the limit of reporting, the intrim trigger has been set at the limit of reporting

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Groundwater Baseline Data / Proposed Interim Trigger Values

Definitions:

FWG (Freshwater Guidelines) for slightly - moderately disturbed systems, ADWG (Drinking Water Guidelines), SIWG (Short Term Irrigation Guidelines), LIWG (Long Term Irrigation Guidelines) and NPUG (Non-Potable Usage Guideline) from NEPM (2013) or ADWG (2017)

NG denotes no guideline.

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L. All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

	Concentration		BTEX				TRH			Other Organics
Baseline dataset / Guideline	**Radium 226 (Bq/L)**	**Radium 228 (Bq/L)**	**Benzene**	**Toluene**	**Ethyl Benzene**	**Xylenes**	**F1 (C6 to C10 BTEX)**	**TRH >C16-C34**	**TRH >C34-C40**	**Total PAH**
FWG	NG	NG	0.95	NG	NG	0.2	NG	NG	NG	NG
ADWG	0.5	0.5	0.001	0.8	0.3		NG	NG	NG	NG
SIWG	5	2	NG	NG	NG		NG	NG	NG	NG
LIWG	5	2	NG	NG	NG		NG	NG	NG	NG
NPUG	NG	NG	NG	NG	NG	0.02	NG	NG	NG	NG
LOR	0.005	0.05	0.001	0.001	0.001	0.003	0.02	0.1	0.1	0.001
Albermarle / Galt bores (median)	-	-	<0.001	<0.001	<0.001	<0.003	<0.02	<0.1	<0.1	<0.001
KSIA bores (median)	-	-	-	-	-	-	-	-	-	-
Combined / All bores (median)	-	-	<0.001	<0.001	<0.001	<0.003	<0.02	<0.1	<0.1	<0.001
Proposed Interim Trigger	**0.005**	**0.05**	**0.001**	**0.001**	**0.001**	**0.003**	**0.02**	**0.1**	**0.1**	**0.001**

Notes

1 pH based upon observed baseline range

2 Acidity - DWER ASS guideline

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Surface Water Baseline Data / Proposed Interim Trigger Values

Definitions:

FWG (Freshwater Guidelines) for slightly - moderately disturbed systems, ADWG (Drinking Water Guidelines), SIWG (Short Term Irrigation Guidelines), LIWG (Long Term Irrigation Guidelines) and NPUG (Non-Potable Usage Guideline) from NEPM (2013) or ADWG (2017)

NG denotes no guideline.

TBD denotes trigger value to be determined following additional baseline monitoring during construction phase (trigger value to be confirmed with DWER prior to operational phase)

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L and EC (µS/cm). All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

				Anions						Cations				Nutrients					
Baseline dataset / Guideline	**pH**	**Electrical Conductivity**	**TDS**	**Alkalinity (total)**	**Bicarbonate**	**Carbonate**	**Hydroxide**	**Chloride**	**Sulfate**	**Calcium**	**Magnesium**	**Sodium**	**Potassium**	**Total N**	**Ammonia as N**	**NOX as N**	**TKN**	**TP**	**FRP**
FWG	6.5-8.5	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.5	0.04	0.1	NG	0.06	0.03
ADWG	6.5-8.5	NG	NG	NG	NG	NG	NG	250	250	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
SIWG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
LIWG	6.0-8.5	NG	1500	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
NPUG	NG	NG	NG	NG	NG	NG	NG	250	1000	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
LOR	-	-	10	20	20	10	20	5	5	0.5	0.5	0.5	0.5	0.2	0.01	0.05	0.2	0.01	0.05
SW01	6.68	124	85	100	100	<10	<20	670	62	17	54	450	8.4	2.7	-	<0.05	2.7	-	0.18
SW02	7.05	3266	100	1200	240	920	<20	1100	110	26	84	740	13	3.7	-	<0.05	3.7	-	0.18
SW03	6.41	2562	28	68	68	<10	<20	600	82	18	46	380	10	3.3	-	<0.05	3.3	-	0.22
Median	6.68	2562	85	100	100	<10	<20	670	82	18	54	450	10	3.3	-	0.05	3.3	-	0.18
Proposed Interim Trigger	**6.5-8.5**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**20**	**TBD**	**±2STD**	**TBD**	**TBD**	**±2STD**	**TBD**	**4.0**	**0.01**	**0.05**	**4.0**	**0.06**	**0.22**

Notes

1 pH based upon freshwater guideline

3 Where the median anlaytical result is less than the limit of reporting, the intrim trigger has been set at the limit of reporting

4 Where no analytical data is available the intrim guideline has been set at the limit of reporting

Surface Water Baseline Data / Proposed Interim Trigger Values

Definitions:

FWG (Freshwater Guidelines) for slightly - moderately disturbed systems, ADWG (Drinking Water Guidelines), SIWG (Short Term Irrigation Guidelines), LIWG (Long Term Irrigation Guidelines) and NPUG (Non-Potable Usage Guideline) from NEPM (2013) or ADWG (2017)

NG denotes no guideline.

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L and EC (µS/cm). All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

	Dissolved Metals															
Baseline dataset / Guideline	**Aluminium**	**Arsenic**	**Cadmium**	**Chromium (III+VI)[1]**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Lithium**	**Manganese**	**Mercury**	**Nickel**	**Selenium**	**Thorium**	**Uranium**	**Zinc**
FWG	0.055	0.013	0.0002	0.001	NG	0.0126	0.3	0.0034	NG	1.9	6E-05	0.011	0.005	NG	NG	0.008
ADWG	0.2	0.01	0.06	0.05	NG	NG	0.3	0.01	NG	0.5	0.001	0.02	0.01	NG	0.017	NG
SIWG	20	2	0.05	1	0.1	0.1	10	5	2.5	10	0.002	2	0.05	NG	0.1	3
LIWG	5	0.1	0.01	0.1	0.05	0.05	0.2	2	2.5	0.2	0.002	0.2	0.02	NG	0.01	3
NPUG	0.2	0.1	0.02	0.5	NG	20	0.3	0.1	NG	5	0.01	0.2	0.1	NG	0.17	3
LOR	0.05	0.001	0.0002	0.001	0.001	0.001	0.05	0.001	0.0005	0.005	0.0001	0.001	0.001	0.0005	0.001	0.005
SW01	-	0.002	<0.0002	0.004	-	<0.001	-	<0.001	-		<0.0001	0.001	-	-	-	0.007
SW02	-	0.003	<0.0002	0.004	-	0.001	-	<0.001	-		<0.0001	0.001	-	-	-	0.008
SW03	-	0.002	<0.0002	0.002	-	<0.001	-	<0.001	-			<0.001	-	-	-	0.007
Median	-	0.002	0.0002	0.004	-	0.001	-	0.001	-		0.001	0.001	-	-	-	0.007
Proposed Interim Trigger	**0.055**	**0.0024**	**0.0002**	**0.0048**	**0.05**	**0.0012**	**0.05**	**0.0010**	**0.0005**	**0.005**	**0.0012**	**0.0012**	**0.001**	**0.0005**	**0.001**	**0.0084**

Notes

1 pH based upon freshwater guideline

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Surface Water Baseline Data / Proposed Interim Trigger Values

Definitions:

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NG denotes no guideline.

Notes:

All values in mg/L except Ra 226 and 228: concentrations in Bq/L and EC (µS/cm). All guideline values from NEPM (2013) or ADWG (2017)

Calculated baseline median values derived assuming non-detections are equal to laboratory limit of reporting

	Radionuclide		BTEX				TRH				PAH
Baseline dataset / Guideline	**Radium 226 (Bq/L)**	**Radium 228 (Bq/L)**	**Benzene**	**Toluene**	**Ethyl Benzene**	**Xylenes**	**F1 (C6 to C10 BTEX)**	**TRH >C10-C16**	**TRH >C16-C34**	**TRH >C34-C40**	**Total PAH**
FWG	NG	NG	0.95	NG	NG	0.2	NG	NG	NG	NG	NG
ADWG	0.5	0.5	0.001	0.8	0.3		NG	NG	NG	NG	NG
SIWG	5	2	NG	NG	NG		NG	NG	NG	NG	NG
LIWG	5	2	NG	NG	NG		NG	NG	NG	NG	NG
NPUG	NG	NG	NG	NG	NG	0.02	NG	NG	NG	NG	NG
LOR	0.005	0.05	0.001	0.001	0.001	0.003	0.02	0.1	0.001	0.003	0.001
SW01	-	-	-	-	-	-	-	-	-	-	-
SW02	-	-	-	-	-	-	-	-	-	-	-
SW03	-	-	-	-	-	-	-	-	-	-	-
Median	-	-	-	-	-	-	-	-	-	-	-
Proposed Interim Trigger	**0.005**	**0.05**	**0.001**	**0.001**	**0.001**	**0.003**	**0.02**	**0.1**	**0.0**	**0.003**	**0.001**

Notes

1 pH based upon freshwater guideline

3 Where the median anlaytical result is less than the limit of reporting, the intrim trigger has been set at the limit of reporting

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