City of Albany

Albany Motorsports Park
Local Water Management Strategy

January 2020

Table of contents

Table index

Figure index

Appendices

Glossary

(C)EMP	(Construction) environmental management plan
4WD	Four wheel drive
AEP	Annual exceedance probability
AMP	Albany Motorsport Park
ANDRA	Australian National Drag Racing Association
ANZECC	Australian and New Zealand Environment and Conservation Council
APEC	Albany Plantation Export Company
ARI	Average recurrence interval
ARR	Australian Rainfall and Runoff
ARVS	Albany Regional Vegetation Survey
ASS	Acid sulfate soils
ATV	All-terrain vehicle
BMP	Best Management Practices
BoM	Bureau of Meteorology
CAMS	Confederation of Australian Motor Sport
CBD	Central business district
CCW	Conservation Category Weltand
CoA	City of Albany
DBCA	Department of Biodiversity, Conservation and Attractions
DEE	Department of the Environment and Energy
DoP	Department of Planning
DoW	Department of Water
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
EY	Exceedance year
FIA	Federation Internationale de l ’Automobile
FIM	Federation Internationale Motocyclisme
GoWA	Government of Western Australia
GSMG	Great Southern Motorsports Group
GSMG	Great Southern Motorsports Group
HV	High voltage

IECA	International Erosion Control Association
LGSTWSS	Lower Great Southern Towns Water Supply Scheme
LGSTWSS	Lower Great Southern Towns Water Supply Scheme
LWMS	Local Water Management Strategy
MA	Motorcycling Australia
mAHD	metres Australian Height Datum
PDWSA	Public drinking water source area
PMST	Protected Matters Search Tool
RIWI Act	*Rights in Water and Irrigation Act 1914*
SWAA	Surface Water Allocation Area
SWASA	Surface Water Allocation Sub Area
TN	Total nitrogen
TP	Total phosphorus
TPP	Timber processing precinct (Mirambeena)
TSS	Total suspended solids
UV	Ultraviolet
WAPC	Western Australian Planning Commission
WIN	Water Information Network/Reporting
WoNS	Weeds of National Significance
WQPN	Water quality protection note
WSUD	Water sensitive urban design
WWTP	Wastewater treatment plant

1. Introduction

1.1 Background

GHD was commissioned by the City of Albany to prepare a Local Water Management Strategy (LWMS) for the Albany Motorsports Park (the Project Site).

The Project Site is located approximately 20 km to the north of the Albany CBD, at Lot 5780, Down Road South, Drome within the City of Albany municipality. It covers 192.34 ha in total, of which approximately 52 ha at the western end is covered with well-established vegetation and not considered available for development. Under the City of Albany Local Planning Scheme No. 1 the Project Site is currently zoned as '*Priority Agriculture*' and is located within an Industrial Buffer Area (IA4BA) surrounding the Mirambeena Timber Processing Precinct (TPP – i.e. Albany Plantation Export Company (APEC) and Plantation Energy) to the north of Down Road West.

1.1.1 Planning context

This LWMS has been prepared in accordance with *State Planning Policy 2.9: Water Resources* (WAPC, 2006) and *Better Urban Water Management* (WAPC, 2008). The planning framework for land and water planning is illustrated in Figure 1-1.

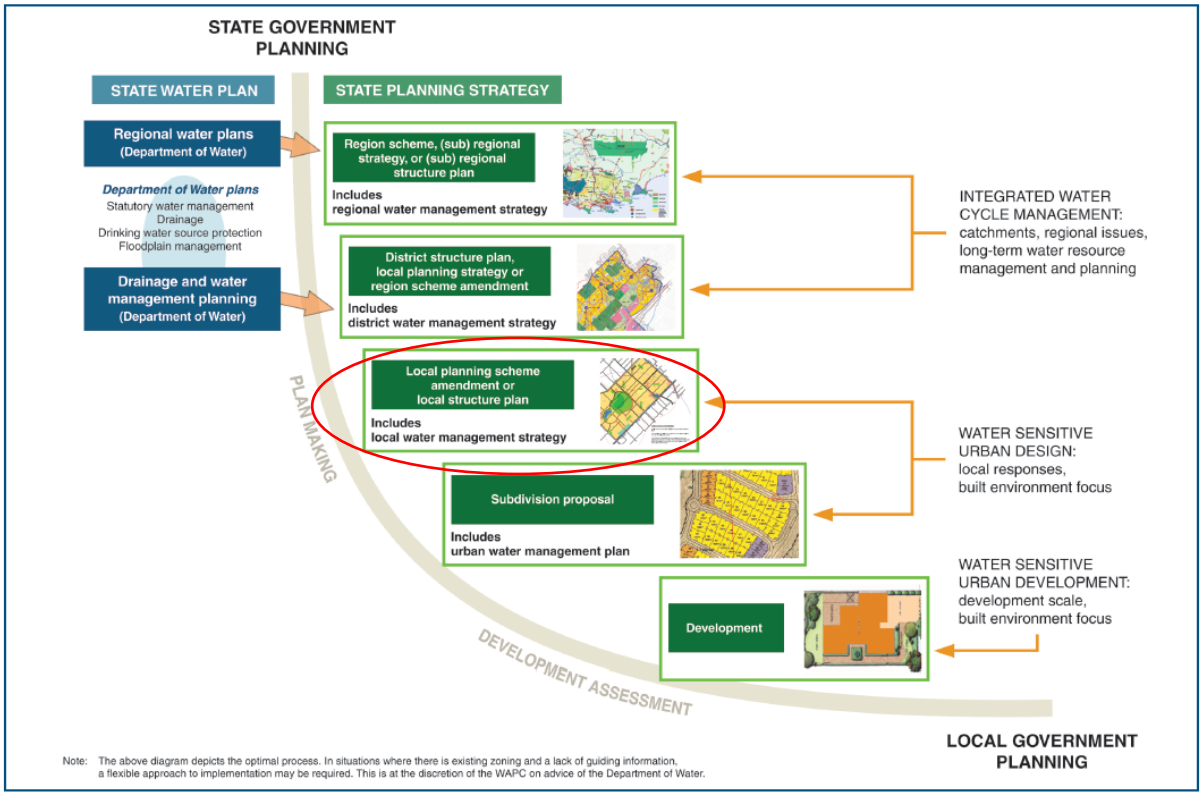


Figure 1-1: Integrated land and water planning processes

SOURCE: *Better Urban Water Management* (WAPC, 2008)

1.2 Purpose of this report

This LWMS has been prepared to support development of the proposed Albany Motorsport Park at Lot 5780 Down Road South, Drome (the Project Site) (Figure 1-2). The strategy provides background to characteristics of the project site, and identifies key principles, design criteria and development requirements, and additional guidance to support development within the Project Site.

1.3 Scope and limitations

This report: has been prepared by GHD for City of Albany and may only be used and relied on by City of Albany for the purpose agreed between GHD and the City of Albany as set out in section 1 of this report.

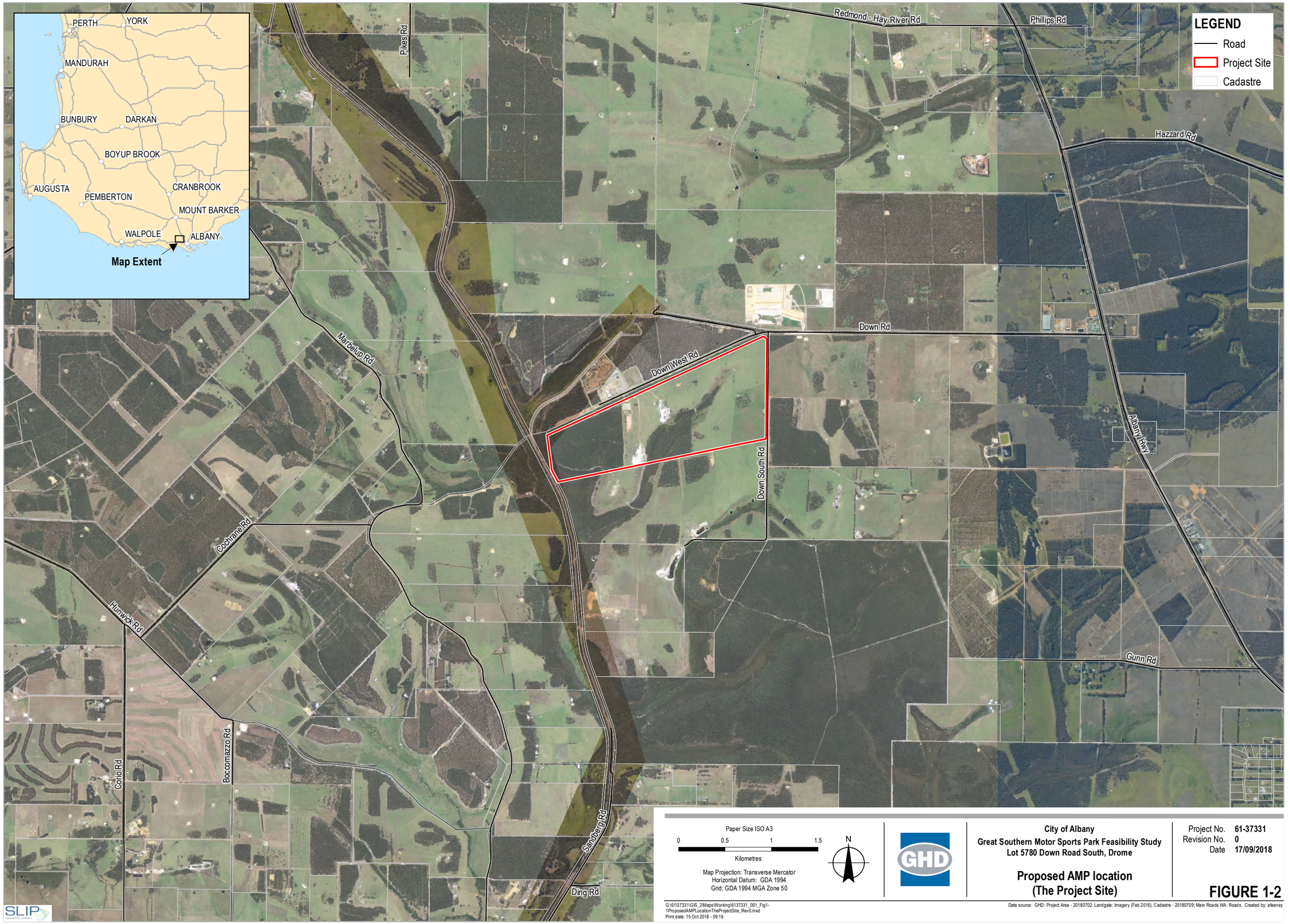
GHD otherwise disclaims responsibility to any person other than City of Albany arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD as described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by City of Albany and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



Paper Size ISO A3

0 0.5 1 1.5

Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

Proposed AMP location (The Project Site)

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 1-2

G:\61\37331\GIS_2\Maps\Working\6137331_001_Fig1-1ProposedAMPLocationTheProjectSite_Rev0.mxd
Print date: 15 Oct 2018 - 09:16

Data source: GHD: Project Area - 20180702; Landgate: Imagery (Feb 2016), Cadastre - 20180709; Main Roads WA: Roads. Created by: afeeney

SLIP

1.4 Previous studies

Numerous studies and investigations have been undertaken to support development planning for the Albany Motorsports Complex. A summary of key documents of relevance to integrated water management of the Site is provided below.

1.4.1 Albany Motorsport Park Site Feasibility Study – Lot 5780 Down Road South, Drome (GHD, 2018)

A site feasibility assessment was completed as part of preliminary planning investigations for the proposed Albany Motorsports Park. The feasibility assessment included a range of desktop technical investigations including review of servicing requirements and traffic impact assessment, and desktop geotechnical, hydrogeological, noise and water management planning.

The feasibility assessment further included a preliminary risk assessment of the key issues identified, and identified a suite of recommended remedial actions based on a hierarchy of controls. A number of recommended remedial and control actions were outlined to provide guidance for the various stages of the development.

1.4.2 Albany hinterland prospective groundwater resources map; Explanatory notes (DWER, 2017)

Hydrogeological report and map for the Albany hinterland developed by the Department of Water and Environmental Regulation (DWER) as part of the *Royalties for Regions South Coast Groundwater Investigation project*.

The Albany hinterland area in the South Coast is known as an important resource for water supply in the Great Southern region. In 2013, DWER undertook some hydrogeological (surface water and groundwater) investigations (as part of South Coast groundwater investigation by Western Australian Government on groundwater availability) and mapped prospective groundwater resources in the Albany hinterland region in order to support regional developments.

This was used as a guide to further investigate and develop a conceptual hydrogeological model for the AMP Project Site as part of this Local Water Management Strategy, in order to understand the groundwater and surface water sources and pathways.

1.4.3 Motorplex Development, Down Road Surface and Groundwater Monitoring 2018 Summary Report (Bio Diverse Solutions 2018)

Bio Diverse Solutions have undertaken groundwater monitoring of shallow groundwater bores installed across the Site commencing in February 2018. The 2018 report summarises preliminary results for the 2018 monitoring period, with additional monitoring completed up to November 2019 which has been reviewed for inclusion in the LWMS.

1.4.4 Proposed Motorsport Park, Lot 5780 Down Road, Drome Reconnaissance Flora and Level 1 Fauna Survey Report (Bio Diverse Solutions 2019)

Bio Diverse Solutions completed a desktop assessment and reconnaissance flora survey and Level 1 Fauna survey of the Project Site in Spring 2018. The survey included identification of habitat trees and threatened fauna dependent hollows, and mapping of vegetation communities (GIS mapping, vegetation condition mapping, fauna habitat types and condition).

2. Proposed development

2.1 Location

The Project Site is located approximately 20 km to the north of the Albany CBD, at Lot 5780, Down Road South, Drome, within the City of Albany municipality (refer Figure 1-2).

The Project Site is bounded by:

- Down Road West to the north,
- Down Road South to the east,
- Lot 5781, Down Road South to the south (private owner), and
- A local road reserve and the Avon-Albany rail reserve to the west.

Lot 5780 is 192.34 ha in size, of which approximately 52 ha at the western end is covered with well-established vegetation and not considered available for development. A small area in the north-west corner of the cleared site is sub-leased by Plantation Energy, for a stormwater retention basin and woodchip storage.

2.2 Current zoning

Under the City of Albany Local Planning Scheme No. 1 the Project Site is currently zoned as '*Priority Agriculture*' and is located within an Industrial Buffer Area (IA4BA) surrounding the Mirambeena Timber Processing Precinct (TPP – i.e. Albany Plantation Export Company (APEC) and Plantation Energy) to the north of Down Road West (1) (DoP, 2014).

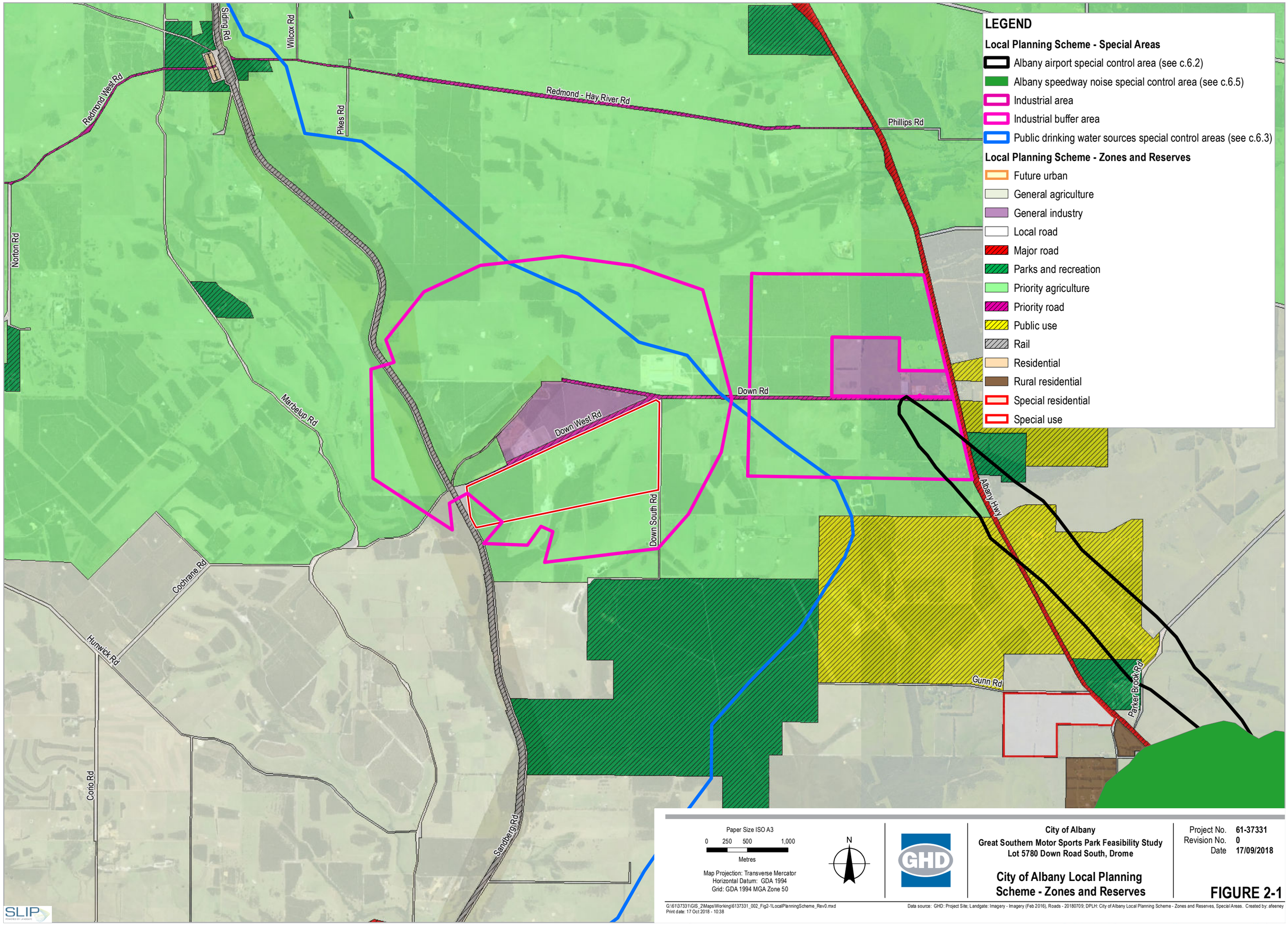
The land immediately adjacent to the Project Site is also predominantly zoned '*Priority Agriculture'* with the exception of the Albany Plantation Export Company (APEC) wood chip mill and Plantation Energy wood pellet production facility, which are zoned '*General Industry'*. The western boundary of the Project Site lies adjacent to a local road reserve and railway line which is zoned '*Major road, Rail'*. Land to the south-west of the railway is zoned '*General Agriculture'* (DPLH, 2018).

The Down Road Nature Reserve (Lot 7388 on P091191 and Lot 7676 on P217695) located approximately 900 m to the south of the Project Site, is zoned '*Parks and Recreation'* (DPLH, 2018).

2.3 Surrounding land uses

The immediately surrounding land uses include a railway to the west of the Project Site, APEC and Plantation Energy wood chip processing facility to the north of Down Road West and '*Priority Agriculture*' to the south and east used for livestock grazing. The CBH Mirambeena grain storage facility is also north of the site, on Down Road.

Further afield land uses are also largely '*Priority Agriculture*', or '*General Agriculture*'. The Down Road Nature Reserve is located approximately 900 m to the south; and the Water Corporation's Gunn Road tree plantation is located approximately 2,500 m to the east. The Mirambeena Strategic Industrial Area (SIA) is located approximately 2,000 m to the east on Albany Highway.



Paper Size ISO A3

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

City of Albany Local Planning Scheme - Zones and Reserves

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 2-1

G:\61\37331\GIS_2Maps\Working\6137331_002_Fig2-1LocalPlanningScheme_Rev0.mxd
Print date: 17 Oct 2018 - 10:38

Data source: GHD: Project Site; Landgate: Imagery - Imagery (Feb 2016), Roads - 20180709; DPLH: City of Albany Local Planning Scheme - Zones and Reserves, Special Areas. Created by: afeeney

SLIP

2.4 Existing land-use

The perimeter of the Project Site is entirely fenced and is currently used for the primary purpose of cattle grazing. Historically the Project Site is likely to also have been used solely for the purpose of agriculture. The western end of the property consists of 52 ha of native vegetation that will be retained. An unnamed creek line runs from the north-east corner of the property through to the south-west corner, from where it joins into Marbelup Brook. A number of small dams are located across the property for stock watering. These will be retained and maintained for the AMP.

The Plantation Energy sub-leased area consists of a small retention basin, connected to their site drainage system on the other side of Down Road West. The sub-lease area is powered, and Plantation Energy operates a pump from the retention basin. This area is unfenced, although there is a locked access gate on the site perimeter fence, off Down Road West.

Adjacent to the Plantation Energy retention basin, there is presently a significant amount of rubbish (comprising of what appears to be decommissioned process vessels, oil drums, scrap metal, electrical cable, plastic, chemical containers, etc.) . The GSMG understand that this area will need to be cleared and made good prior to the sale of the property.

Mr Lindsay Black also has a current Planning Consent over two locations on this site for the purpose of extracting sand. Both sand pits are covered under the same Consent (No. P275225), which was approved on 14 September 2007. Access is via Down Road West, using the same gate as the Plantation Energy sub-lease area. The GSMG understand the Mr Black has ceased the quarrying activities and made good the affected area (as required under the conditions of the Planning Consent).

Figure 2-2: Images of Plantation Energy sub-lease area

2.5 Proposed landuse and zoning

2.5.1 Scheme amendment

The City of Albany (GHD, 2019) has lodged a scheme amendment with the West Australian Planning Commission (WAPC) to rezone Lot 5780 Down Road South, Drome from *Priority Agriculture* to *Special Use,* with appropriate land use and development provisions proposed to be included in Schedule 4 of the LPS1 to guide future development.

The proposed Precinct plan is shown in Figure 2-4.

2.5.2 Layout and facilities

The concept design for the Albany Motorsport Park (AMP) has been developed by the non-for-profit Great Southern Motorplex Group (GSMG) and Roberts Gardiner Architects. The concept design is shown in Figure 2-3 and described below:

Albany Motorsport Park concept design

The proposed AMP will consist of:

1. Sealed, configurable multi-use track (3.5 km long × 12 m wide) for motor car racing, motorcycle racing, drifting, driver training and cycling:
   - –Designed to comply with CAMS' *Track Operator's Safety Guide* (CAMS 2012) and Motorcycling Australia (MA) *Track Guidelines* (MA, 2011), and
   - –To be licensed by Confederation of Australian Motor Sport (CAMS) for FIA Grade 2 and FIM Grade B (i.e. up to second-tier international motor racing).
2. A motocross circuit:
   - –Designed and constructed in association with MA guidelines.
3. A 1,000 ft drag racing strip:
   - –Designed and constructed in accordance with FIA specifications for drag strips and in association with Australian National Drag Racing Association (ANDRA).
4. A 1,300 m^2 burnout area,
5. An off-road four wheel drive (4WD) and all-terrain vehicle (ATV) training area,

At full development, the AMP will also include associated facilities, such as:

- Toilets,
- Medical / first aid station,
- Manager's office,
- Meeting / briefing room
- Kitchen / canteen,
- Storage / grounds maintenance workshop,
- Vehicle scrutineers' workshop,
- Control tower,
- Spectators viewing areas,
- Spectators parking,
- Competitors parking, and
- Grassed spectators' picnic area with shade and BBQs,

Events and usage

For the purposes of sizing facilities and infrastructure GSMG have provided conceptual usage of the AMP, with a typical /frequent site attendance of 500 persons assumed (i.e. competitors + officials + spectators). This was determined through discussion with the GSMG on the nature and size of expected typical events. For special events that anticipate a greater number of site attendees, additional water servicing management measures will need to be implemented (e.g. drinking water carts, port-a-loos).

2.5.3 Landscape concept

Landscaping of the Site will seek to retain existing vegetation where possible, and where additional planting is required it will be undertaken with native vegetation species that have been identified in the Albany Regional Vegetation Survey Extent (Sandiford and Barrett, 2010), and identified within the wetland area on-site. Revegetation with native species will occur within the wetland buffer (refer 5.2.5) with targeted revegetation of degraded land areas where these do not inhibit the proposed use of the Site.

Further detail of the landscaping will be provided at detailed design.

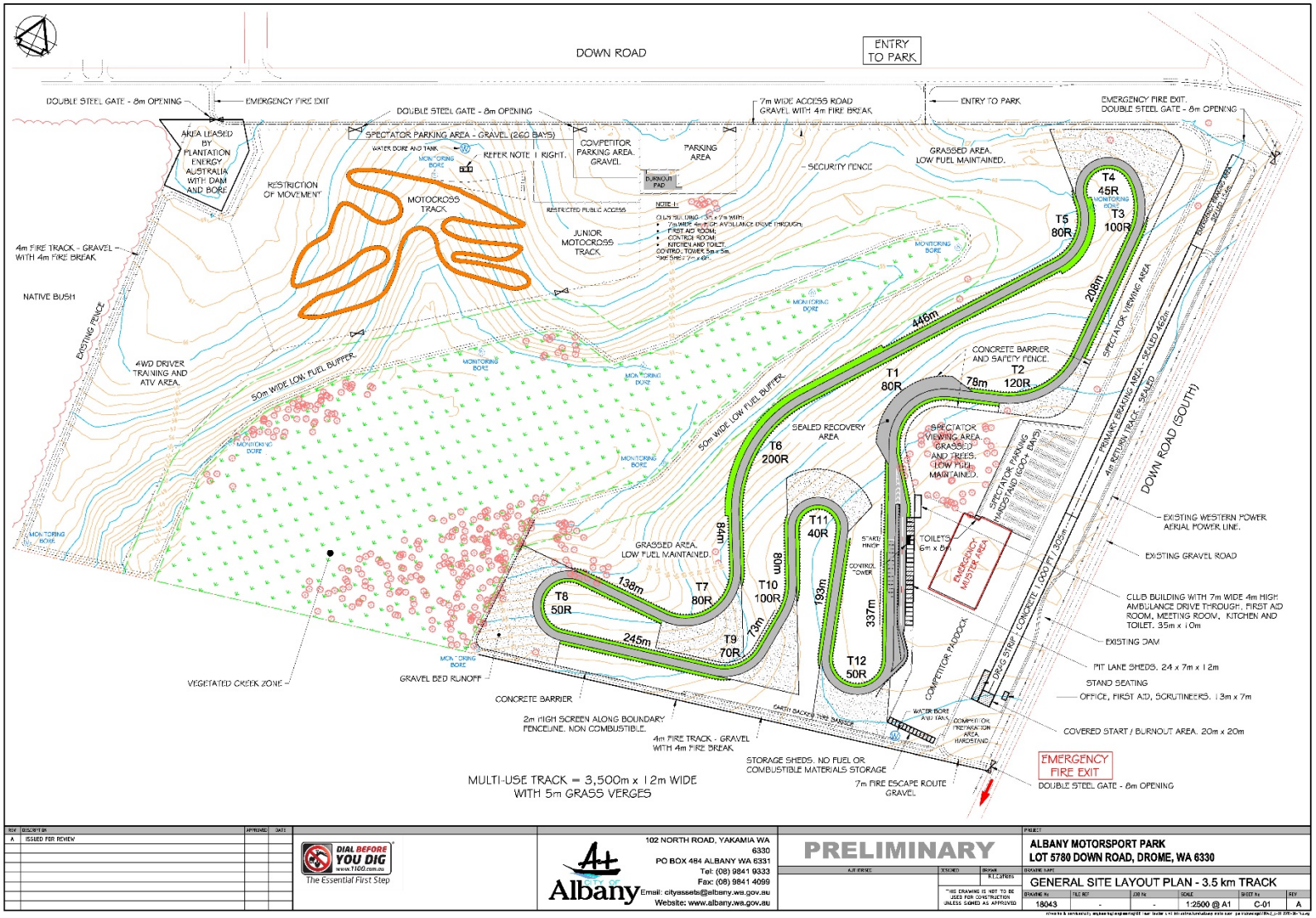
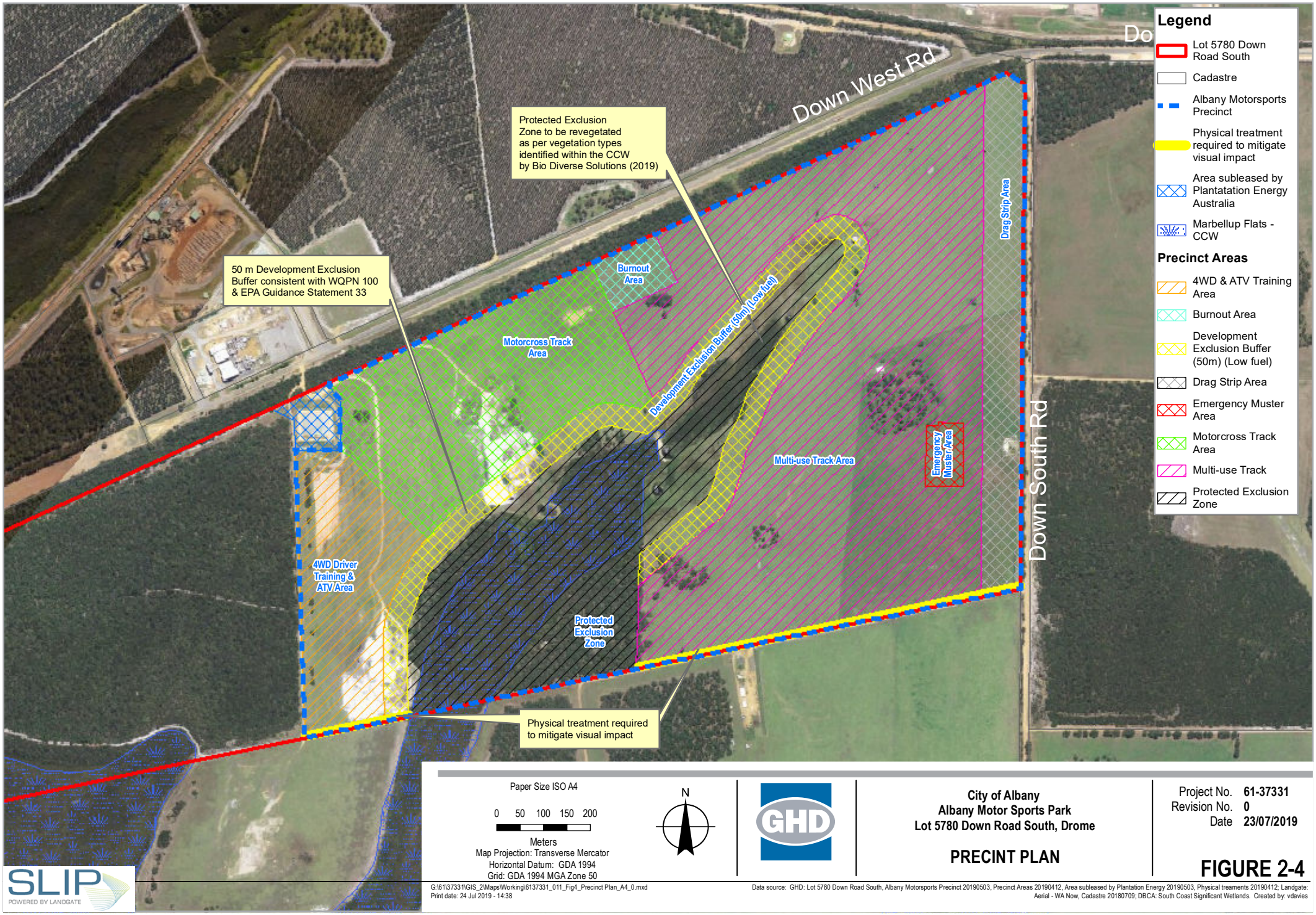


Figure 2-3: AMP concept site layout



Paper Size ISO A4

0 50 100 150 200

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Albany Motor Sports Park
Lot 5780 Down Road South, Drome

PRECINT PLAN

Project No. **61-37331**
Revision No. **0**
Date **23/07/2019**

FIGURE 2-4

SLIP POWERED BY LANDGATE

G:\61\37331\GIS_2\Maps\Working\6137331_011_Fig4_Precinct Plan_A4_0.mxd
Print date: 24 Jul 2019 - 14:38

Data source: GHD: Lot 5780 Down Road South, Albany Motorsports Precinct 20190503, Precinct Areas 20190412, Area subleased by Plantation Energy 20190503, Physical treaments 20190412; Landgate: Aerial - WA Now, Cadastre 20180709; DBCA: South Coast Significant Wetlands. Created by: vdavies

3. Site characteristics

3.1 Climate

Albany is located on the south coast of Western Australia and the climate is broadly described as Mediterranean, with warm dry summers and mild wet winters. The nearest Bureau of Meteorology (BoM) official recording station is Albany Airport (Station No. 9741). A summary of climatic data for this station is provided in Table 3-1 (BoM, 2019).

Table 3-1: Climatic data for the Albany Airport (Station No. 9741) for years 1960 to 2014 (BoM 2019)

Climatic variable	Statistic
Mean annual maximum temperature range	15.8°C in July to 24.9°C in February
Mean annual minimum temperature range	7.5°C in July to 14.5°C in February
Mean annual rainfall	798.1 mm
Mean annual rain days per year	83.1

3.2 Geotechnical conditions

3.2.1 Topography

The surface elevation of the Project Site ranges from approximately 41 m AHD to 73 m AHD. The lowest elevation is on the southern boundary and extends through the centre of the Project Site within a gully (a tributary to Marbelup Brook) that lies in a north-easterly direction. The highest elevation occurs on the eastern boundary of the Project Site.

3.2.2 Soils and geology

Regional geology is described with reference to the 1:50,000 Environmental Geology series map (Albany sheet) and the 1:250,000 Geological Series map (Mt Barker – Albany sheet). These indicate the Project Site is underlain by Cainozoic sand of colluvial origin – “Qc: Colluvium – Sand, silt and clay” on the slopes and within the low lying areas of the Marbelup Brook “QA – Clay, silt, sand and gravel in watercourses” (Allen & Sofoulis, 1984).

The sand is described as pale grey, fine to coarse, angular to sub-rounded quartz that is loose and moderately sorted and contains occasional pebbles of laterite. The thickness of the sand unit is not indicated on the maps, however the 1:250,000 map sheet indicates sand unit generally overlays laterite.

The local geology is further delineated by DPIRD Soil Landscape Mapping identified in Table 3-2 and illustrated in Figure 3-1.

GHD has an appreciation for the general site context in the surrounds, having undertaken previous studies in the Mirambeena Strategic Industrial Area and to the north of Lot 5780. A geotechnical study was undertaken in 2014 and 2015 for CBH Mirambeena grain storage facility to the north (shown on Figure 3-1).

Table 3-2: Soil map units within the Project Site (GoWA, 2018)

Map unit symbol	Name	Landform	Geology	Soil
242KgDMc	Dempster Crest phase	Broad convex crests of sandy and lateritic spurs and ridges	Deeply weathered siltstone	Duplex sandy gravels; Grey deep sandy duplexes; Pale deep sand; Shallow gravels
242KgS7f	Minor Valleys S7 floor phase	Foot slopes and swampy valley floors of minor valleys	Colluvial and alluvial deposits over weathered sedimentary rocks	Wet and semi-wet soils; Pale deep sands; Grey deep sandy duplexes
242KgS7h	Minor Valleys S7 slope phase	Side slopes of minor valleys	Colluvium sedimentary rocks	Pale deep sands; Grey deep sandy duplexes
242ReDMc	Dempster Crest phase	Elongate crests	No information recorded	Sands and laterite

3.2.3 Acid sulfate soils risk mapping

The Project Site has been overlayed onto the DWER ASS risk mapping for the Albany-Torbay region (GoWA 2018) and is presented as Figure 3-2. The DWER ASS risk mapping provides the following mapped ASS risk categories:

- “high to moderate risk” of Actual ASS (AASS) and Potential ASS (PASS) occurring within 3m from the natural soil surface
- “moderate to low risk” of AASS and PASS occurring within 3m from the natural soil surface but high to moderate risk of ASS occurrence beyond 3m of the natural soils surface
- areas that are not mapped are considered to have no known ASS risk

A review of the DWER ASS risk mapping indicates the Project Site is located outside of the boundary extent of the mapped areas. However, given that tributaries of Marbelup Brook located approximately 750 m to the south of the Project Site are mapped as “Moderate to Low Risk” of ASS occurring, GHD has inferred that where these tributaries of Marbelup Brook extend into the Project Site that they would also be considered to represent the same level of ASS risk. This is also consistent with the more broadly mapped risk areas where there are obvious low lying drainage lines, creeks and tributaries.

No “High to moderate ASS risk” areas appear to be mapped within the broader site setting further supporting the expected ASS risk onsite.

Soil Landscape Mapping

242KgDMc - Sands and laterite on elongate crests; Jarrah-Albany Blackbutt-Marri forest.

242KgS7f - Footslopes and swampy valley floors of minor valleys

242KgS7h - Broad valleys in sedimentary rocks; 30 m relief; smooth slopes. Deep sands and iron podzols on slopes; Albany Blackbutt-jarrah-sheoak woodland. Podzols and yellow duplex soils on floors; paperbark woodland, teatree heath.

242ReDMc - Sands and laterite on elongate crests; Jarrah-Albany Blackbutt-Marri forest.

242ReRD - Broadly undulating plateau; scattered lakes and depressions. Yellow duplex soils and laterite on plains. Marri-Jarrah-Albany Blackbutt forest. Yellow solonetzic soils in depressions; Paperbark woodland.

LEGEND

Project Site

Cadastre

242ReRD

242KgS7h

Down Rd

242ReDMc

Down West Rd

Down South Rd

242KgDMc

242KgS7h

242KgS7f

242KgS7h

242KgDMc

242KgDMc

242KgS7h

SLIP

Paper Size ISO A3

0 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

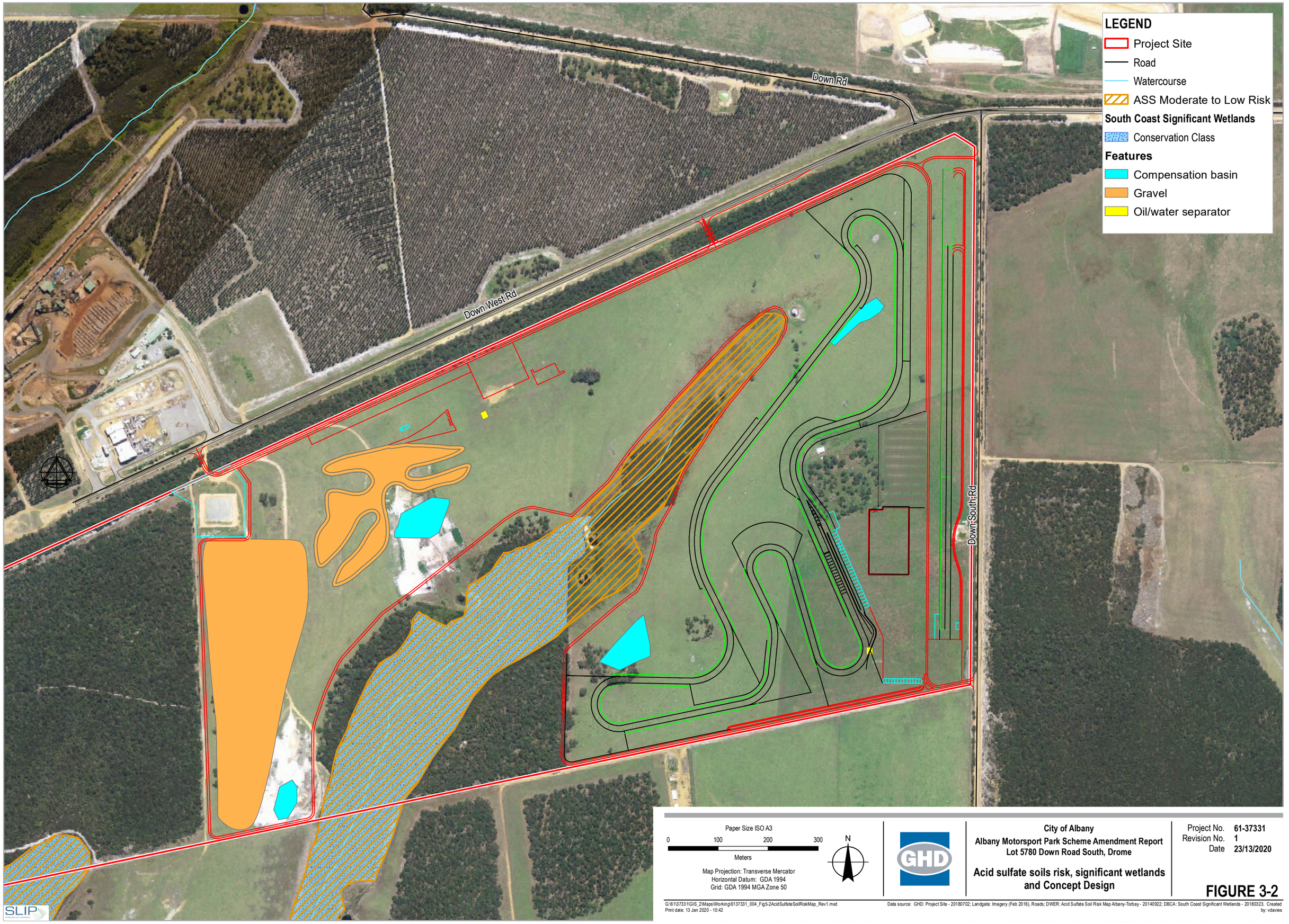
Soil landscape mapping

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 3-1

G:\61\37331\GIS_2\Maps\Working\61\37331_003_Fig5-1SoilLandscapeMapping_Rev0.mxd
Print date: 15 Oct 2018 - 09:27

Data source: GHD: Project Site - 20180702; Landgate: Imagery (Feb 2016), Cadastre, Roads - 20180709; DPIRD: Soil Landscape Mapping (Best Available) - 20171220. Created by: afeeney



Paper Size ISO A3

0 100 200 300

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Albany Motorsport Park Scheme Amendment Report
Lot 5780 Down Road South, Drome

Acid sulfate soils risk, significant wetlands and Concept Design

Project No. **61-37331**
Revision No. **1**
Date **23/13/2020**

FIGURE 3-2

G:\61\37331\GIS_2\Maps\Working\6137331_004_Fig5-2AcidSulfateSoilRiskMap_Rev1.mxd
Print date: 13 Jan 2020 - 10:42

Data source: GHD: Project Site - 20180702; Landgate: Imagery (Feb 2016), Roads; DWER: Acid Sulfate Soil Risk Map Albany-Torbay - 20140922; DBCA: South Coast Significant Wetlands - 20180323. Created by: vdavies

3.3 Environmentally sensitive areas

3.3.1 Reserves and conservation areas

Approximately 900 m to the south of the Project Site, the Down Road Nature Reserve (Lot 7388 on P091191 and Lot 7676 on P217695) is zoned '*Parks and Recreation'* (DPLH, 2018).

There are no DBCA Legislated Lands and Waters intercepted by the Project Site. However there are two sites within 5 km of the Project Site including the following (GoWA, 2018):

- Down Road Nature Reserve located approximately 900 m to the south, and
- Phillips Brook Nature Reserve located approximately 4.4 km to the north east.

The unnamed water course located within the Project Site is a tributary of Marbelup Brook and is a Conservation Category wetland (CCW) (Figure 3-2) (GoWA, 2018). As per DWER guidance (DER, 2014), a CCW is "*a defined wetland and the area within 50 m of the wetland"* and is declared to be an Environmentally Sensitive Area (ESA) under the *Environmental Protection Act 1986.*

There is also one mapped ESA located within 5 km; approximately 4.7 km to the north-east of the Project Site (Figure 3-3) (GoWA, 2018).

3.3.2 Fauna

Fauna diversity

Searches of the EPBC Act Protected Matters Search Tool (PMST) (DEE, 2018) and DBCA *NatureMap* (DBCA, 2018) databases identified 92 vertebrate fauna species (excluding marine species) that have previously been recorded within a 5 km buffer of the Project Site. This total is comprised of 80 native species and 12 introduced and/or naturalised species, including 70 birds, 12 mammals, six fish, three amphibians, and one reptile.

A Level 1 Fauna Survey was completed for the Project Site in spring 2018 by Bio Diverse Solutions (2019). This survey included targeted assessment for fauna of conservation significance. Forty fauna species were identified during the field survey including eight mammals (five native and three non-native), 29 birds, one reptile and two amphibians (Bio Diverse Solutions, 2019).

Conservation significant fauna

Desktop searches, undertaken by Bio Diverse Solutions (2019), of the EPBC Act PMST and DBCA *NatureMap* databases, identified potential presence of 70 conservation significant flora within the Project area. The likelihood of occurrence for each species, undertaken by Bio Diverse Solution (2019), identified 21 species having potentially suitable habitat present within the survey area, including:

- 13 species listed under the EPBC Act and/or the *Biodiversity Conservation Act 2016* (BC Act),
- Two migratory birds protected under international agreement (Schedule 5), and
- Six DBCA Priority listed species.

Four conservation significant species were directly and indirectly observed within the broader survey area by Bio Diverse Solutions (2019), including:

- Baudin's Cockatoo (*Calyptohynchus baudinii*) (Vulnerable, Schedule 2),
- Forest Red-tailed Black Cockatoo (*Calyptohynchus banksia naso*) (Vulnerable, Schedule 3),
- Western Brush Wallaby (*Notamacropus irma*) (Priority 4), and
- Southern Brown Bandicoot, Quenda (Isoodon fusciventer) (Priority 4).

Introduced fauna

Twelve introduced species were identified in the desktop searches with species or species habitat likely to occur within a 5 km radius of the Project Site.

3.3.3 Flora

Flora diversity

The EPBC Act PMST (DEE, 2018) and DBCA *NatureMap* (DBCA, 2018) database searches identified 108 vascular flora species (including subspecies and varieties) that have been previously recorded or have habitat likely to occur within 5 km of the Project Site. This total is comprised of 99 native species and nine introduced and/or naturalised species.

The flora and vegetation values of Lot 5780 and within road reserves adjacent to Lot 5780 on Down Road West and Down Road South, were assessed in a reconnaissance level flora survey in spring 2018 by Bio Diverse Solutions (2019). BDS recorded 141 flora taxa (including subspecies and varieties), representing 41 families and 105 genera during the field survey of Lot 5780 and vegetation within adjacent road reserves on Down Road West and Down Road South. This total comprised 123 native taxa and 19 introduced taxa.

Dominant families recorded within the wider survey area included:

- Fabaceae (24 taxa including five introduced taxa),
- Proteaceae (15 taxa),
- Myrtaceae (13 taxa),
- Poaceae (nine taxa including eight introduced taxa), and
- Cyperaceae (eight taxa).

Conservation significant flora

Desktop searches by Bio Diverse Solutions (2019) of the EPBC Act PMST and DBCA *NatureMap* databases, identified potential presence of 58 conservation significant flora within the Project area. The likelihood of occurrence for each species, undertaken by Bio Diverse Solution (2019), identified 36 species having potentially suitable habitat present within the survey area, including:

- 11 BC Act listed species,
- Two Priority 1 species,
- Four Priority 2 species,
- 10 Priority 3 species, and
- Nine Priority 4 species.

The spring survey did not identify any EPBC Act, BC Act or State Priority listed flora species within the survey area (Bio Diverse Solutions, 2019). The AMP proposal is considered unlikely to impact on conservation significant flora species as it has been designed to lie predominantly within previously cleared agricultural land.

Introduced flora

Eight Weeds of National Significance (WoNS) were identified in the desktop assessment as having habitat likely to occur within 5 km of the Project Site (DEE, 2018).

3.4 Hydrology and hydrogeology

Desktop searches of the DWER hydrology layers were undertaken and are summarised in Table 3-3.

Table 3-3: DWER data queries within the Project Site (GoWA, 2018)

Aspect	Details	Result
Public Drinking Water Source Areas (PDWSA)	PDWSA is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the Metropolitan Water Supply, Sewage and Drainage Act 1909 or the Country Area Water Supply Act 1947.	Project Site lies within the Priority 2 Marbelup Brook Catchment Area (Figure 3-5).
Groundwater Areas	Groundwater areas proclaimed under the Rights in Water and Irrigation Act 1914 (RIWI).	Project Site lies within Albany Groundwater Area (Figure 3-4).
Surface Water Areas	Surface water areas proclaimed under the RIWI Act 1914.	None present.
Irrigation District	Irrigation Districts proclaimed under the RIWI Act 1914.	None present.
Rivers	Rivers proclaimed under the RIWI Act 1914.	None present.
Waterways Management Areas	Areas proclaimed under the Waterway Conservation Act 1976.	None present within the Project Site, however the Albany Waterways Management Area is located approx. 800 m to the north.
Clearing Control Catchments	Country Area Water Supply Act 1947 Part 2A.	None present.

3.4.1 Surface water and drainage

The Project Site lies in the Marbelup Brook sub-catchment which forms part of the wider Torbay Inlet Catchment in the Denmark Coast Basin within the South West Division (GoWA, 2018).

The entire Project Site and surrounds are located within the Marbelup Brook Surface Water Allocation Sub Area (SWASA), which is a sub area of the Albany Coast Surface Water Allocation Area (SWAA) (GoWA, 2018).

An unnamed water course is present within the Project Site, draining from the north-east and centre of the site to the south across the southern boundary to the Marbelup Brook, which ultimately drains to Lake Powell. However the natural drainage of the lower part of Marbelup Brook catchment has been modified which diverts the lower part of Marbelup Brook away from

Lake Powell to the Torbay Inlet (DoW, 2007). Marbelup Brook is located approximately 800 metres west of the site boundary.

During a site visit (June 2018) the watercourse was observed to be in a modified state, with cattle currently having access to the watercourse. Erosion was evident, particularly in the eastern extent of the watercourse. This area was also mostly devoid of native vegetation, with the exception of some sedges (*Juncus* spp) (Plate 3-1). The western section of the watercourse contains native shrubs / sedges and had a defined bed / banks.

Plate 3-1: Eastern extent of the watercourse showing evidence of erosion and cattle access

3.4.2 Wetlands and groundwater dependent ecosystems

International and nationally important wetlands

Desktop searches identified no internationally important (Ramsar) or Nationally Important listed wetlands within 5 km of the Project Site (GoWA, 2018).

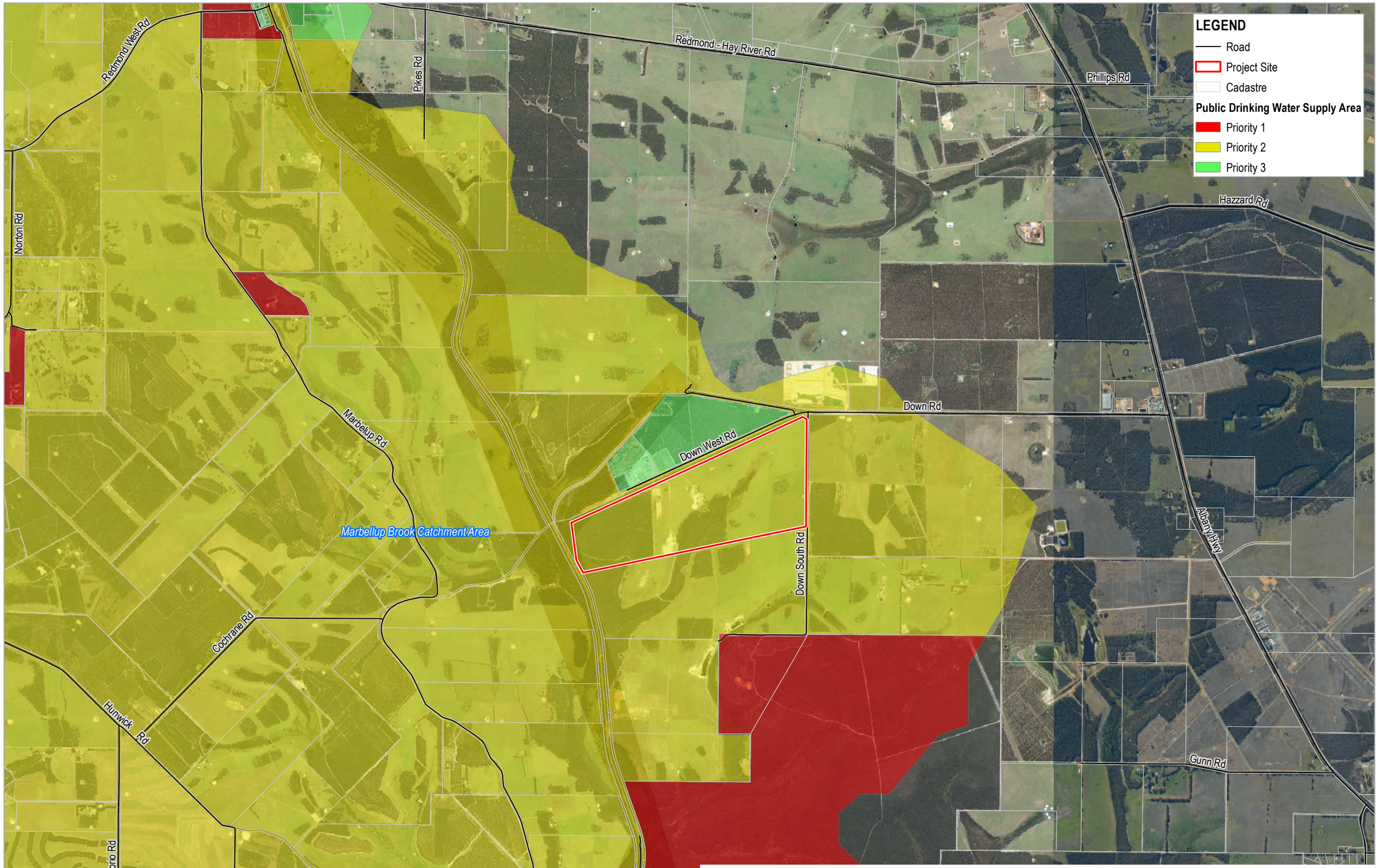
South Coast Significant Wetlands

The unnamed water course located within the Project Site is a tributary of Marbelup Brook and is a Conservation Class wetland (Figure 3-2) (GoWA, 2018).

3.4.3 Public drinking water supply area

The site is located within a Priority 2 (P2) area of the Marbelup Brook public drinking water source area (PDWSA) (DoP, 2014). This PDWSA is gazetted under the *Country Areas Water Supply Act 1947*, however is currently not used. It has been identified as a potential future water source option in the *Great Southern Regional Water Supply Strategy 2014* (DoW, 2014).

The Minister for Water has formally provided advice to the City of Albany (Kelly, 2018) that while a motorsport facility is incompatible with a P2 PDWSA (DoW, 2016), “there are measures that can be put in place to protect water quality should the City proceed to approve the development”. These measures are further discussed in Section 5 and Section 0.



Paper Size ISO A3

0 0.5 1 1.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

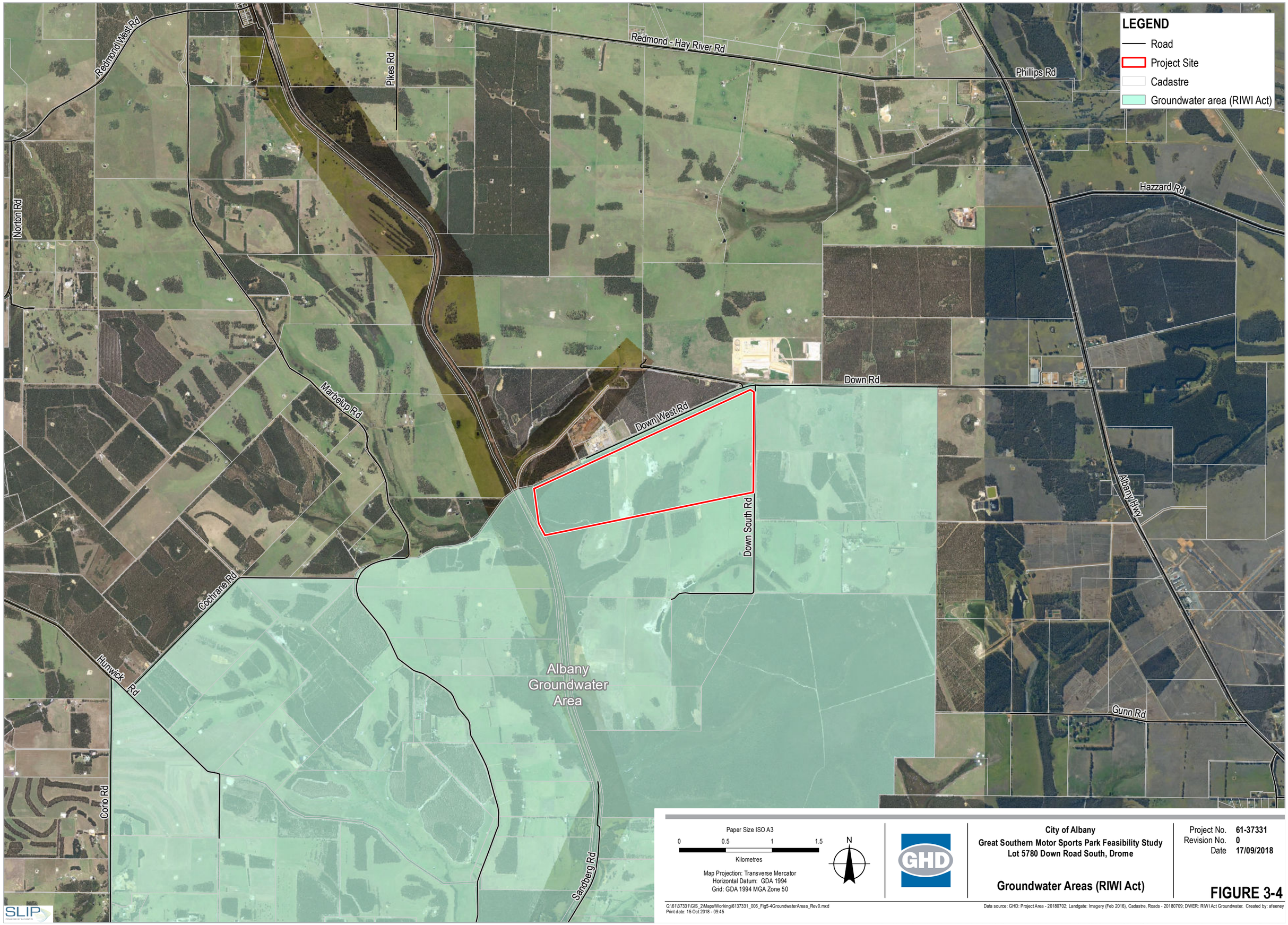
Public Drinking Water Source Areas

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 3-3

G:\61\37331\GIS_2\Maps\Working\6137331_005_Fig5-3PDWSA_Rev0.mxd
Print date: 15 Oct 2018 - 09:38

Data source: GHD: Project Area - 20180702; Landgate: Imagery (Feb 2016), Cadastre - 20180709, Roads; DWER: Public Drinking Water Source Areas. Created by: afeeney



Paper Size ISO A3

0 0.5 1 1.5

Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

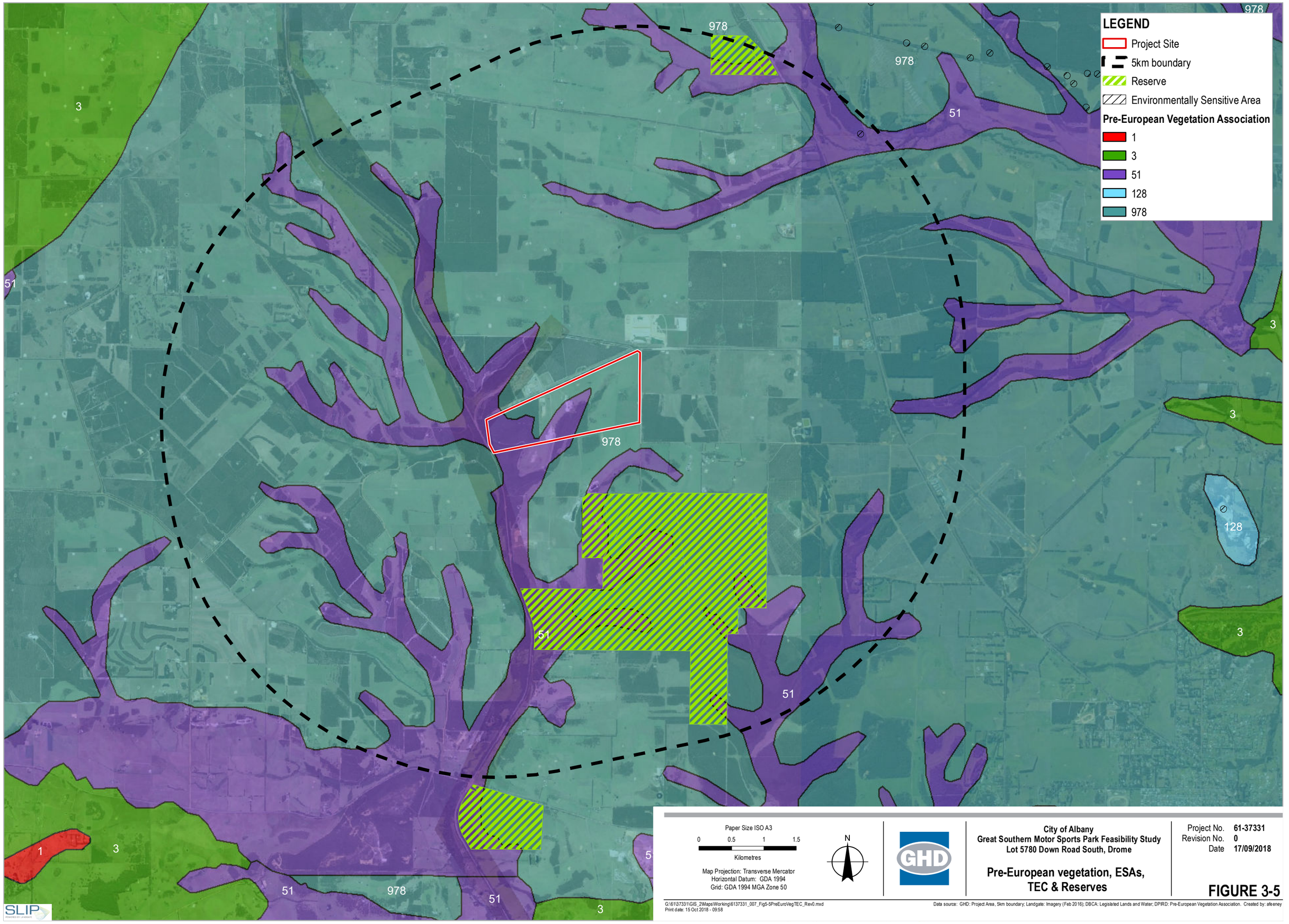
Groundwater Areas (RIWI Act)

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 3-4

G:\61\37331\GIS_2\Maps\Working\6137331_006_Fig5-4GroundwaterAreas_Rev0.mxd
Print date: 15 Oct 2018 - 09:45

Data source: GHD: Project Area - 20180702; Landgate: Imagery (Feb 2016), Cadastre, Roads - 20180709; DWER: RIWI Act Groundwater. Created by: afeeney



Paper Size ISO A3

0 0.5 1 1.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

Pre-European vegetation, ESAs, TEC & Reserves

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 3-5

G:\61\37331\GIS_2Maps\Working\6137331_007_Fig5-5PreEuroVegTEC_Rev0.mxd
Print date: 15 Oct 2018 - 09:58

Data source: GHD: Project Area, 5km boundary; Landgate: Imagery (Feb 2016); DBCA: Legislated Lands and Water; DPIRD: Pre-European Vegetation Association. Created by: afeeney

3.4.4 Groundwater and hydrology

On a regional scale, the 250K Map Series – Hydrogeology identifies a "*sedimentary aquifer within intergranular porosity – extensive aquifers, major groundwater resources*" underlying the Site (DoW, 2002). Groundwater salinity in the local area is in the range of 500 – 1000 mg/L, which is considered to be marginal for productive uses (GoWA, 2018).

Bio Diverse Solutions (BDS) has undertaken surface and groundwater monitoring for the Project Site, key results of which are summarised in Section 3.4.5. A search of DWER's WIN reporting online system for available bore data (within a 3 km radius) revealed no other relevant time series data. The Site is currently in an area under a groundwater licence owned by Plantation Energy Australia Pty Ltd. The licence (number 168308) is valid to 2028 and is allocated 4,000 kL from the Bremer West superficial aquifer.

3.4.5 Monitoring results

Bio Diverse Solutions has completed quarterly monitoring of surface water and groundwater at the Project Site for the period February 2018 to November 2019. The sampling locations, 2018 summary report and field records are provided in Appendix A, with key results summarised in the following sections. Soil profile descriptions for the shallow monitoring bores are provided in Appendix B, with deeper bore log in Appendix C.

It is noted that the monitoring bore installation information from Bio Diverse Solutions includes a basic site lithological description of the soils on site to around 2 m depth, and therefore the groundwater monitoring results are limited by the shallow nature of the investigation (approximately 2 m depth).

Surface and groundwater quality data is compared to the ANZECC and ARMCANZ (2000) default trigger values for South West Australia wetlands for nutrients and pH, and the 95% toxicant trigger for other parameters where relevant.

Surface water flow

Review of BDS field records (Appendix A) identify that both surface water sites were flowing for all monitoring dates during 2018, with flow reported at CS01 (downstream site) on all dates in 2019, and no flow reported for CS02 during the May and August 2019 sampling dates.

Observed depth of flow ranged between approximately 5 cm (Feb 2019) and 20 cm (May 2018) for CS02, and approximately 10 cm (Feb, May, Nov 2019) and 30 cm for CS01.

Surface water quality

Surface water quality results show that pH in the two creek locations (CS01 and CS02) within the Project Site were low and below the default trigger values of 7-8.5. The results are very similar to the pH at most of the groundwater bores within the Project Site.

The reported total nitrogen (TN) levels for both the creek locations were lower than that for many of the groundwater bores. TN concentrations at CS01 ranged from 0.5 mg/L to 2 mg/L, exceeding the default trigger value of 1.5 mg/L on one occasion, and equalling it on another. At CS02 the TN concentrations ranged from 2 mg/L to 6.5 mg/L, exceeding the default trigger value on all monitored occasions.

Total phosphorus (TP) concentrations were below detection levels at CS01. At CS02 the TP concentrations were below detection on one monitoring occasions with remaining samples ranging from 0.22 mg/L to 0.55 mg/L, exceeding the default trigger value of 0.06 mg/L and reflecting the TP concentration of bores in proximity to CS02.

For metals parameters CS01 reported exceedance of the 95% toxicant trigger value for dissolved aluminium and iron on most occasions, and zinc on three occasions, with CS02

reporting a single exceedance of iron (potentially an error due to the very high value reported) and zinc.

Groundwater level

Groundwater levels at most boreholes across the site vary from 0 mBGL (in winter months) in the low lying areas of the site (i.e. SB06), to greater than 2 mBGL in the higher areas across most of the Project Site (Table 3-4). Groundwater levels in the lower lying areas seem to be fluctuating consistent with seasonal rainfall. In 2018 and 2019, measured groundwater levels across the Project Site were observed to range between 0.00 mBGL (SB06, Sep 2018) and 1.93 mBGL (SB03, Nov 2018). Where groundwater was not measured in the bores it was reported as > 2.0 mBGL. Bores SB01, SB02, SB05, SB10 and SB11 were found to be dry during each sampling event. Bore locations are shown on Figure 3-7.

Table 3-4: Site bores and groundwater levels

Bore ID	Easting (m)	Northing (m)	Ground level – est. RL (mAHD)	Depth to Groundwater (mBGL)							
				Feb 2018	May 2018	Sep 2018	Nov 2018	Feb 2019	May 2019	Aug 2019	Nov 2019
SB01	567179	6133615	58.4	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0
SB02	567404	6133889	49.6	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0
SB03	567519	6134401	56.8	> 2.0	> 2.0	1.21	1.93	> 2.0	> 2.0	1.45	> 2.0
SB04	567700	6134179	48.2	> 2.0	0.91	0.30	1.07	1.66	1.11	0.37	1.48
SB05	568056	6134636	60.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0
SB06	568131	6134478	53.6	0.87	0.70	0.00	0.59	1.03	0.73	0.06	0.73
SB07	567939	6134264	51.6	0.64	0.54	0.44	0.64	0.95	0.58	0.52	0.64
SB08	568308	6134637	56.5	> 2.0	1.55	0.18	1.27	1.58	1.42	0.38	1.29
SB09	568032	6134141	50.3	0.66	0.57	0.44	0.78	0.98	0.87	0.61	0.99
SB10	567886	6133756	62.7	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0
SB11	568314	6134267	68.6	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0	> 2.0
SB12	568474	6134781	60.2	> 2.0	> 2.0	1.04	> 2.0	> 2.0	> 2.0	1.1	> 2.0
DB01	-	-	-	-	-	-	-	-	7.10	6.95	6.97

Notes:

BGL – below ground level - Where results shown as "> 2.0", this means the groundwater table was not intersected by the shallow groundwater monitoring bore (being only 2 m deep)

Where results shown in red font, this means the groundwater table was intersected by the groundwater monitoring bore.

Deep bore (DB01) monitoring only commenced from May 2019.

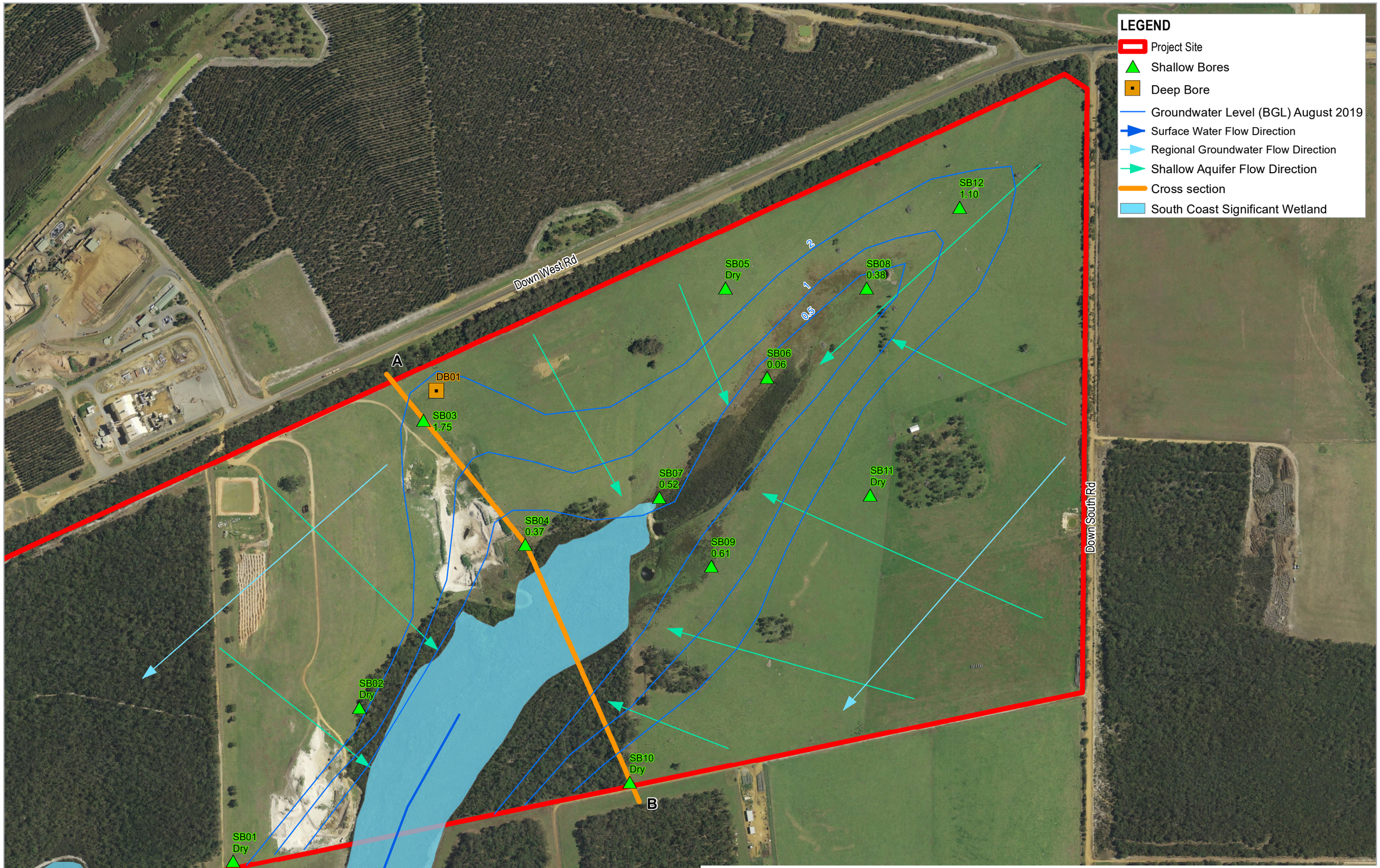
Groundwater quality

Groundwater quality results identified that pH in groundwater bores at the Project Site is generally low and below the default trigger value of 7.0 - 8.5. It was also found that pH at SB06 and SB07 (2.5 and 2.8) were significantly lower in February 2018 sampling event. These bores are in proximity to the lower lying area of the Project Site. Some wetland areas in Western Australia are naturally acidic, however the low pH may be indicative of the presence of acid sulfate soils. As noted in Section 3.2.3, tributaries of Marbelup Brook located approximately 750 m to the south of the Project Site are mapped as “Moderate to Low Risk” of ASS occurring, and GHD has inferred that where these tributaries of Marbelup Brook extend into the Project Site that they would also be considered to represent the same level of ASS risk.

Elevated total nitrogen (TN) was found in the majority of bores, which may be attributed to the historic and current farming practices across the Project Site (2 – 28 mg/L). TN levels were also significantly higher at SB06, SB07 and SB08 in the November 2018 sampling event compared to the other reported concentrations, which may be attributed to sampling following peak groundwater levels in the bores and interception of nutrient rich wetland topsoils.
TN concentrations were exceptionally high in February and May 2019 (110 and 79 mg/L) at SB08, with a high proportion of ammonia-N and organic-N, and further sampling should be undertaken at similar times to establish if they are considered outliers.

Elevated total phosphorus (TP) was reported for bores SB06, SB07 and SB08, with all samples obtained from these bores exceeding the default trigger value of 0.065 mg/L. Exceptionally high TP (16 mg/L) was reported in February 2019 in SB08, coinciding with elevated TN. The orthophosphate concentration in February 2019 was also elevated however the majority of the TP concentration was organic phosphorus or inorganic phosphorus attached to sediment, and further sampling should be undertaken to establish this.

For metals parameters dissolved aluminium, iron and zinc exceed the default 95% toxicant trigger values in the majority of samples for all bores, suggesting background concentrations of these metals are elevated due to the local soil and geological profile. Dissolved chromium was also elevated above the default trigger value in some bores.



Paper Size ISO A3

0 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

Project No. **61-37331**
Revision No. **0**
Date **19/12/2019**

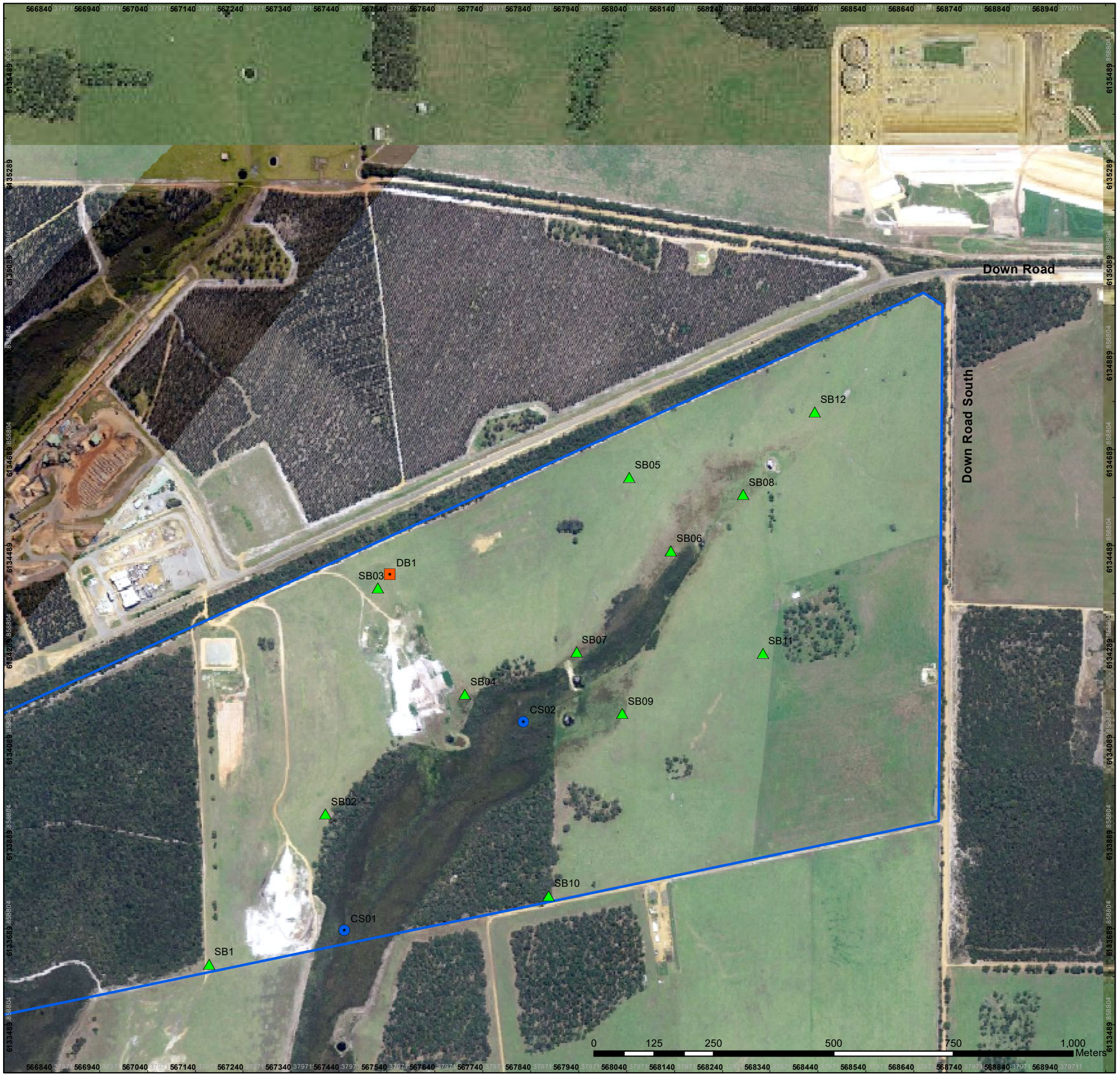
Hydrology and hydrogeology

FIGURE 3-6

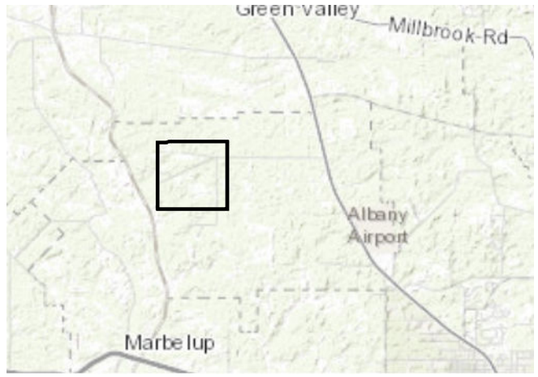
\\ghdnet\ghd\AU\Perth\Projects\61\37331\GIS_2\Maps\Working\6137331_009_Fig3-6_HydrologyAndHydrogeology_ASedits_Rev0.mxd
Print date: 19 Dec 2019 - 14:26

Data source: GHD: Project Site - 20180702, 1m Contours, Catchment boundary - 20180828; Landgate: Imagery - (Feb 2016), Cadastre, 5m Contours, Roads 20180709. Created by: aastevenson

SLIP



Unit 5A, 209 Chester Pass Rd
Albany, WA 6330
Australia
Tel: 08 9842 1575
Fax: 08 9842 1575



Overview Map Scale 1:100,000

Legend

- Subject Site
- Cadastre
- 5m Contours
- Deep Bore
- Shallow Bore
- Creek Sample
- 50m Buffer

Scale
1:7,882 @ A3
GDA MGA 94 Zone 50

Data Sources
Aerial Imagery: SLIP Virtual Mosaic WMS Service, Landgate 2016
Cadastre and Contours: Landgate 2016
Overview Map: World Topographic map service, ESRI 2012

CLIENT
City of Albany
Lot 5780 Down Road
Drome, WA 6330

Figure 3-7 Monitoring Plan

STATUS	*FILE*	*DATE*
FINAL	**MSC0137**	**28/02/2019**

3.4.6 Hydrogeological conceptual model

Sources of information

- Local shallow soil setting from *Motorplex Development, Down Road Surface and Groundwater Monitoring 2018 Summary Report* (Bio Diverse Solutions 2018)
- Regional hydrogeological setting from *Albany hinterland prospective groundwater resources map* (Ryan *et al.* 2017)
- Shallow soil profile descriptions (0)
- Deep groundwater bore (log in Appendix C)

Local shallow hydrogeology

The typical local surficial geology is presented in Figure 3-1 (see Figure 3-8 for cross-section trace), and the shallow groundwater flow plan is presented in Figure 3-6. The Figures show the following features:

- A thin shallow sandy/silty layer up to 1 meter thick overlies the Pallinup formation in areas leading to the creek (e.g. SB04), while on the upper-slopes lateritic gravels/cobbles predominate (e.g. SB03).
- Underlying the sandy/silty layer, the Pallinup formation comprises silty clays (e.g. SB04) which appears to extend to 25 meters blow the ground level (DB01).
- Although not tested, the permeability of the upper sandy/silt is likely higher than the underlying Pallinup Formation (silty clays) which may result in temporary perching of shallow groundwater in the sandy/silt (particularly during winter rainfall).
- Shallow groundwater levels derived from the monitoring of the shallow bores indicates that the levels appear to vary seasonally up to 1 meter.
- Shallow groundwater flow within the sandy/silty layer (and upper parts of the Pallinup Formation) are inferred as towards the creek line where groundwater is inferred to discharge based on Figure 3-6 which shows the depth-to-water contours and groundwater flow direction.

"Deeper" hydrogeology

The deeper hydrogeology setting is presented on the cross section Figure 3-8 and shows the following features:

- The site (shallow hydrogeology) is underlain by approximately 25 metres of the Pallinup formation, deemed to comprise silt, sand and clay (Ryan *et al*. 2017). The Pallinup aquifer is inferred to contain minor water resources and exhibits a low permeability.
- The Pallinup Formation is underlain by the Werillup Aquitard described as comprising clay, silt and sand and which is deemed to hydraulically separate the overlying Pallinup Formation with underling units (Ryan et al, 2017). The drilling logs (Appendix C), indicates that the thickness of the Werillup aquitard is 31 meters and comprises predominantly clay. Based on map notes (Ryan *et al*. 2017) the Werillup aquitard is inferred as extensive throughout the King River area and likely lies below all areas of the site and beyond.
- Werillup aquitard is probably underlain by granite, based on evidence of minor cuttings returned to the surface exhibiting angular quartz and some mica (See Figure 3-8).
- The groundwater levels of the Pallinup formation appears to be similar to the shallow groundwater levels (See Figure 3-8). That is to say that, excluding times when winter

rainfall may perch shallow groundwater, the shallow sandy silts are probably hydraulically connected with the Pallinup Formation.

- The groundwater flow direction of the Pallinup Formation is not well known, however, beneath the Site groundwater it is likely to follow the regional topography, and flow towards the south west where groundwater is likely to discharge into the rivers and creeks, such as dominant surface water feature in areas close to the Site - Marbelup Brook (see Figure 3-6).

Discussion/interpretations on pathway

The hydrogeological setting indicates the following Site Conceptual Model.

- The depth to groundwater plan (Figure 3-6) indicates that in areas adjacent to the surface water creek/ feature, the depth to groundwater is less than 2 metres. In these areas, it is considered that there is an increased risk of impacts to groundwater from surface contaminants and spills given the thin geological profile (e.g. low adsorptive capacity).
- The shallow groundwater migration direction (shallow sands/silt and Pallinup Formation) indicates that any Site based groundwater impacts should migrate towards the creek line (on Site) where groundwater (and any impacted groundwater) is inferred to discharge (Figure 3-6 and Figure 3-8). Any impacted surface water will migrate towards areas off-site and discharge into the major drainage of the area, the Marbelup Brook.
- Any Site based groundwater impacts should preferentially migrate within shallow sands/silts (towards the creek lines) and not migrate downwards into the deeper levels of the Pallinup Formation given the similar groundwater levels between the Pallinup Formation and the overlying shallow sandy silts, and that the shallow sandy silts have a higher permeability than the Pallinup Formation
- Given the low permeability of the Pallinup Formation, any Site based groundwater impacts, which may migrate downwards into the Pallinup formation should be subject to attenuation processes, which should limit the extent and migration rate of the any impacts.
- It appears from the limited drilling information (one monitoring well) that the Pallinup Formation is underlain by the Werillup Aquitard and granite, which should constrain any potential groundwater impacts to the Pallinup Formation.

Potential Receptors

The site hydrogeological conceptual model indicates that given that Site based groundwater impacts will migrate towards the on-site creek, the receptors comprise the following:

- the environment of the onsite creek (flora and fauna)
- creek systems down-gradient of the site (flora and fauna)
- groundwater bore users - where bores are located close to, and are in hydraulic connection, with the creek system
- surface water users/abstraction of surface water; and
- livestock accessing creek.

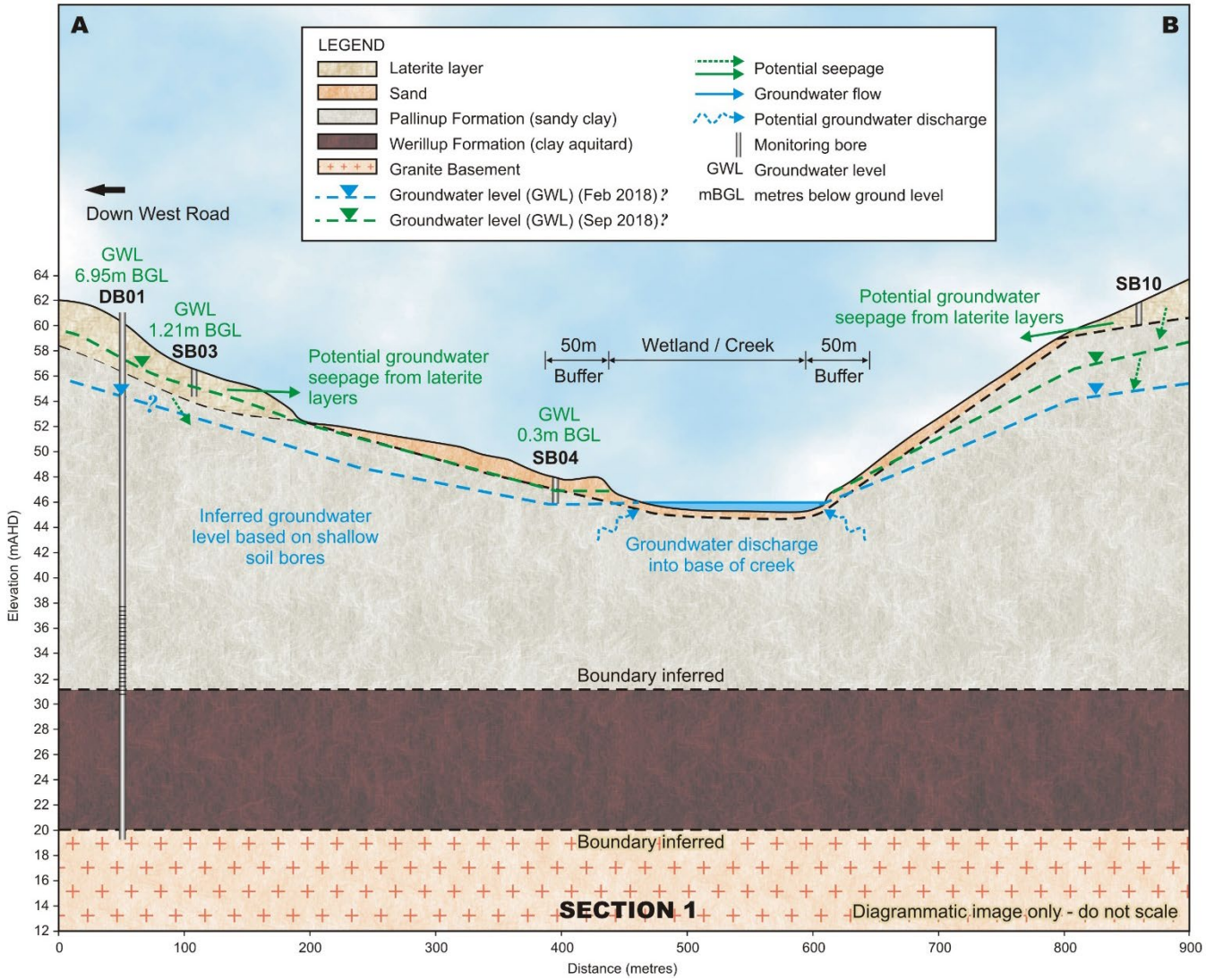


Figure 3-8: Preliminary hydrogeological section 1 (A-B)

3.4.7 Water users

Surface water

Aerial photography was reviewed to identify any surface water abstraction from the Marbelup Brook downstream of the Project Site. The review identified numerous small dams located within the Marbelup Brook and riparian zone (demarcated by the DWER South Coast Significant Wetlands coverage). One potential surface water pumping site was also identified downstream of the Project Site. The locations are identified in Appendix E.

Groundwater

Groundwater allocation in Western Australia is regulated by DWER. The DWER Water Register identifies that the Project Site is located within the Albany groundwater area, Marbelup sub-area.

The Water Register indicates there is one groundwater license for the Project Site, and five groundwater licenses downgradient / downstream of the Project Site along the Marbelup Brook (Table 3-5).

Table 3-5: Licensed groundwater abstractions

Licence No.	Licence allocation (kL/yr)	Expiry date	Location	Aquifer
168308	4000	31/8/2028	Project Site Lot 5780 Down Road, Drome	Bremer West – Superficial
156374	1400	30/09/2024	Lot 7235 Marbelup ~3.5 km downgradient	Bremer West – Superficial
76457	33200	8/04/2020	Lot 500 Marbelup ~6.5 km downgradient	Bremer West – Superficial
160280	1000	13/05/2026	Lot 86 Elleker Crown Reserve ~8 km downgradient	Bremer West – Superficial
155130	26000	20/10/2022	Lot 200 Lower Denmark Rd Elleker ~9.5 km downgradient	Bremer West – Sedimentary
173352	2100	16/05/2021	Wilgie Rd, Torbay	Bremer West – Superficial

4. Fit for purpose water supply

4.1 Water servicing

4.1.1 Potable water

The Water Corporation's Lower Great Southern Towns Water Supply Scheme (LGSTWSS) runs along Albany Highway, with the nearest connection point approximately 4 km to the east at 66 Down Road (fertiliser distribution warehouse) (Water Corporation, 2018). Hence, it is proposed to service drinking water needs on the site through a combination of collected rainwater and water carts.

Uncontaminated rainwater from the AMP buildings will be collected in standard 110,000 litre rainwater tanks. At source treatment by household-scale filtration and ultraviolet disinfection will be undertaken. This will allow a safe drinking water supply to the AMP facilities (i.e. clubrooms, canteen, etc.) and ablutions.

A preliminary water balance for the site suggests that rainfall alone will be insufficient to meet expected demand for regular attendance of 500 people. Where there is a shortfall, the GSMG will need to purchase and cart water to the site. Similarly for large-scale events, additional potable water will need to be carted to site.

4.1.2 Non-potable

Water demands for other external, non-potable uses (i.e. irrigation, dust suppression, etc.) will be met from site dams. The GSMG is also negotiating with Plantation Energy for access to their 4,000 kL Bremer West superficial groundwater allocation (licence number 168308).

4.2 Wastewater servicing

The Water Corporation's Albany sewerage scheme is not in close proximity to the site, with the nearest connection point being at Lancaster Road, McKail (being some 10 km distant). On-site wastewater management will be required, and will need to cater for human sewage, greywater and wastewater from vehicular maintenance activities (e.g. washdown).

On-site wastewater treatment and management will be carried out in accordance with the *Government Sewerage Policy* (DPLH, 2019):

- The size of the Project Site is adequate and capable of accommodating on-site wastewater disposal without putting the environment and public health at risk.
- The on-site wastewater disposal system will be maintained and serviced long-term by trained personnel.
- The on-site wastewater treatment system will meet the following minimum requirements:
  - Have a 100 metres separation from the unnamed water source/wetland (measured from the outer edge of riparian/wetland vegetation)
  - A minimum clearance distance of two metres between the maximum groundwater level and the discharge point of the disposal system will also be required. Therefore, wastewater facilities will be located at higher ground on the site, where a greater clearance to groundwater is to be expected considering seasonal conditions and long-term variability post-development.
- The on-site wastewater disposal land application area will achieve the following minimum requirements in terms of site features:

  - Slope should be within 1:5 ratio. Where proposed disposal sites exceed this slope earthworks will be completed to comply, in order to avoid stormwater discharge, and
  - Will be clear of any temporary or permanent structures, vehicle traffic, pathways etc.
- Wastewater and/or hydrocarbon-impacted stormwater from high risk areas such as the pits and vehicle maintenance areas shall be contained within covered, hardstand areas and directed to oily water separators (OWS) for primary treatment. Treated water from the OWS will be directed into the stormwater drainage system. Collected waste and oily residue from the OWS will be collected and disposed to an approved off-site location, as per DWER's advice.

The proposed use of the motorsports park will be mostly periodic (i.e. events based) with several different groups using the site. On-site wastewater treatment systems will typically consist of both a treatment system and a disposal system. These were preliminarily sized using the Department of Health's (DoH) *Onsite wastewater system assessment tool* for estimation purposes.

The following inputs were used in the assessment:

- System capacity: 500 people (at each of the two main parts of the AMP – i.e. motocross track and multi-use track).
- Site category: Clubs (licensed), with a hydraulic loading of 35 L/person/day.
- Treatment system type: 'Secondary' wastewater treatment plant, with engineering certification to meet effluent quality of BOD < 20 mg/L; TSS < 30 mg/L; TN < 10 mg/L; TP < 1 mg/L; *E. coli* < 10 cfu/100mL; and free chlorine > 0.5 mg/L. This is to meet the requirements of *WQPN 100* (DoW, 2007).
- Site conditions: Clayey loam soil on a flat slope (< 10%), with a design irrigation rate = 3.5 mm/d.

The calculator tool produced a required demand (hydraulic loading) of 17,500 L/day and aided in the sizing of the treatment and disposal systems.

There are many vendors in the WA market for 'off the shelf' package wastewater treatment plants. For the purposes of the concept design and costing, a budget estimate was sought from MAK Water [(1)].

For the purpose of this concept design and costing, sub-surface drip irrigation was chosen as the most suitable on-site disposal option. This will require two disposal/irrigation areas of approx. 5,000 m^2, which are shown on . Based on groundwater level monitoring results from nearby bores (SB11 and SB05 – refer Table 3-4), a minimum clearance of 2.0 m to groundwater will be readily maintained all year round at both proposed disposal sites.

The most suitable arrangement will be to have two wastewater treatment systems, one serving the motocross facilities, the other serving the multi-use track, and drag strip. Numbers in excess of system capacity during larger events (potentially up to 20,000 for national race events) would need to be catered for with temporary waste facilities (i.e. port-a-loos) with waste taken off site for treatment post-event.

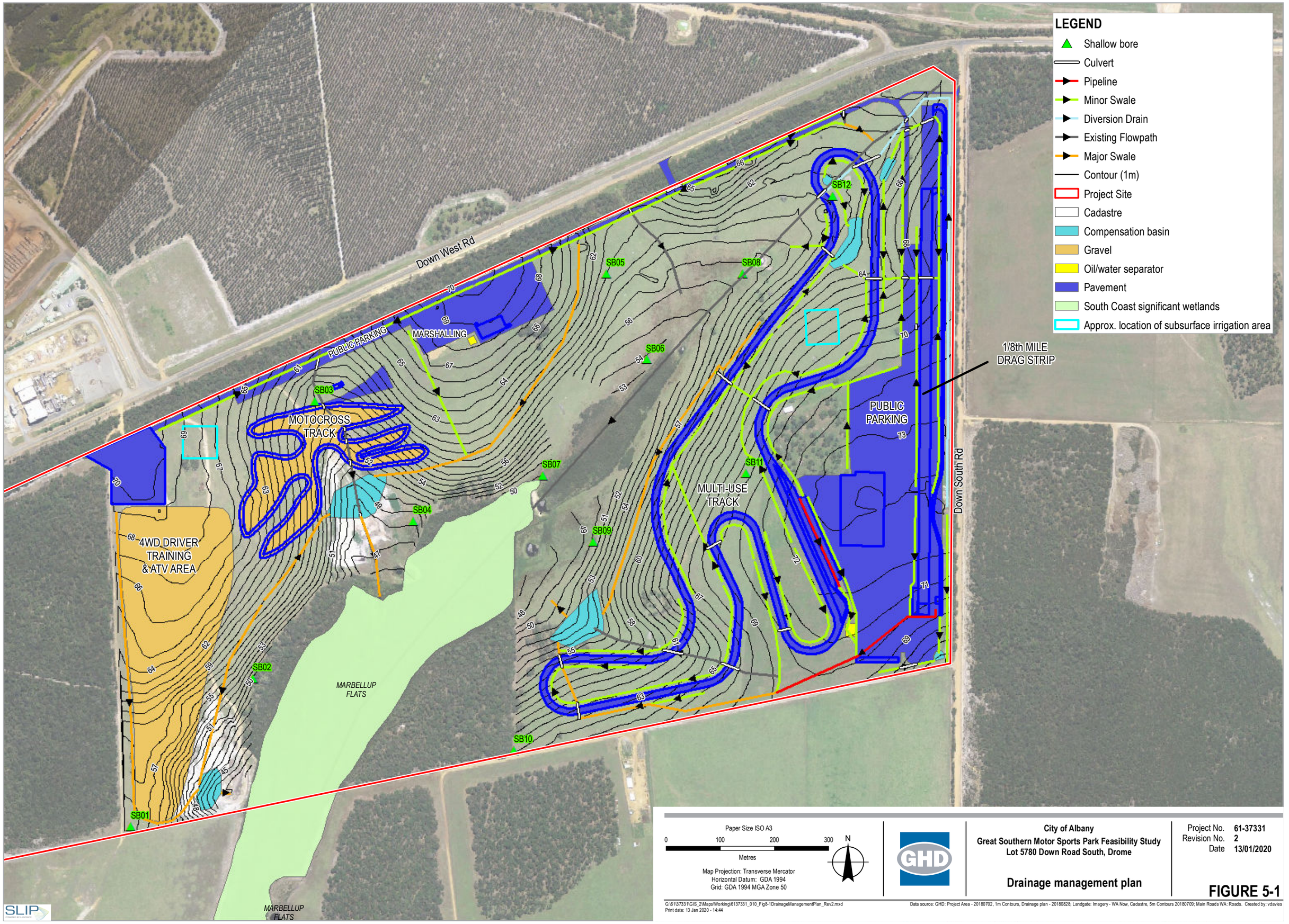
[1] https://www.makwater.com.au/products/activated-sludge-bioreactor-plus/

5. Stormwater management strategy

5.1 Stormwater quantity management

The proposed stormwater management plan for the site is depicted in and consists of the following principles and elements:

- Drainage swales are used to divert the (upstream) eastern boundary catchment around the drag strip and multi-use track, so as to minimise the potential for this water to impact on the site infrastructure.
- Where possible, uncontaminated runoff from impervious areas will be collected for drinking water, or targeted for infiltration near to the source.
- Hydrocarbon-impacted stormwater from high risk areas such as the pits and vehicle maintenance areas shall be contained within covered hardstand areas and directed to oily water separators (OWS) for primary treatment. Treated water from the OWS will be directed into the stormwater drainage system. Collected waste and oily residue from the OWS will be collected and disposed to an approved off-site location, as per DWER's advice.
- Interceptor/sediment traps will be located at points throughout the drainage swales to treat stormwater runoff from tracks.
- Suitable compensating (detention) basins are used to limit post-development peak discharge rates to pre-development rates from areas subject to development.
- The compensating basins are positioned to ensure 2 m vertical clearance from the maximum groundwater level (based on recent groundwater monitoring results).
- Suitable swales, culverts and pipework are used to convey the runoff generated from the site to engineered locations for treatment / compensation before discharge to the waterway.
- Suitable buffer separations to the wetland/creek are used to minimise the potential for impacts of site-generated water impacting on the wetland.



Paper Size ISO A3

0 100 200 300 N

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

Drainage management plan

Project No. **61-37331**
Revision No. **2**
Date **13/01/2020**

FIGURE 5-1

G:\61\37331\GIS_2\Maps\Working\6137331_010_Fig8-1DrainageManagementPlan_Rev2.mxd
Print date: 13 Jan 2020 - 14:44

Data source: GHD: Project Area - 20180702, 1m Contours, Drainage plan - 20180828; Landgate: Imagery - WA Now, Cadastre, 5m Contours 20180709; Main Roads WA: Roads. Created by: vdavies

5.1.1 Plan outline

The following preliminary plan is proposed in accordance with the principles and objectives of the technical feasibility study (GHD, 2018), the *Stormwater Management Manual for Western Australia* (DoW, 2007); and the *Subdivision and Development Guidelines 2018* (CoA, 2018).

1-year ARI event and smaller (1EY)

To retain and treat the 1-year ARI (1EY) event:

- Roofs and other impervious areas will be managed via a range of measures including:
  - Targeted infiltration in areas where there is sufficient separation to groundwater (i.e. soakage pits or infiltration galleries),
  - Targeted rainwater (roof water only) capture for potable (i.e. drinking) and non-potable uses (such as garden irrigation, toilet flushing or vehicle wash down).
- Drainage swales will be sited downstream of the tracks, conveying stormwater to compensation basins and allowing stormwater infiltration as close to source as practical, in accordance with Water Sensitive Urban Design (WSUD) principles. Weirs, and vegetated swales will contribute to achieving WSUD objectives. Culverts will be installed to allow crossings of access tracks and raceway pavements, with some piped sections where site topography doesn't allow overland flow.
- Direction of runoff to compensating basins targeting peak flow management to pre-development levels.
- Compensating basins are positioned to ensure 2 m vertical clearance from the maximum groundwater level.

10-year ARI event (10% AEP)

To maintain site serviceability in the 10-year ARI (10% AEP) event:

- The compensating basins are designed to detain the peak flow to pre-development levels, and maximise opportunities for infiltration prior to discharge from the site.
- Drainage swales will convey stormwater to compensating basins and will allow stormwater to be infiltrated as close to source as practical in accordance with WSUD principles. Weirs, and vegetated swales will contribute to achieving WSUD objectives. Culverts will be installed to allow crossings of access tracks and raceway pavements.

100-year ARI event (1% AEP)

To protect from flooding in the 100-year ARI (1% AEP) event:

- Ensure suitable separation is provided between flooding levels and key site infrastructure such that a minimum freeboard of 300 mm is provided to prevent ingress of water into habitable buildings.
- The compensating basins will detain the peak flow to levels that will not adversely impact the downstream system, and maximise opportunities for infiltration prior to discharge from the site.
- Stormwater flows will exceed the capacity of the internal drainage swales, but will be contained within the swales freeboard.
- Ensure suitable overland flow paths are provided to minimise the potential for exposure of publicly accessible areas to flood waters.

5.1.2 Drainage swales

Stormwater runoff discharged from the site access roads and proposed facilities areas will be collected by swales located alongside the access track, and on the downstream of the facilities areas. The design levels of the facilities area are expected to generally follow the natural topography of the site, i.e. falling typically towards the wetland/creek. Any trapped low point, such as that associated with pockets of the motocross track will be captured by pit and piped to discharge into swales or basins as dictated by site topography. Refer to the proposed stormwater management plan in .

Swales are typically expected to be either V type or trapezoidal in design. Overall drains will, where space and topography permit, have batter slopes of 1V:6H. It is expected that side slopes will be limited to no great slopes than 1V:3H in areas restricted by space or topography. Flatter batter slopes are also necessitated by the need for safe vehicle run-off areas from the racetrack.

The widths and depths of swales will be determined by detailed hydraulic modelling. A typical freeboard of 0.3 m (over the 10 year design event water level), which allows additional storage and conveyance beyond the 10 year ARI (10% AEP) serviceability is also expected to be required to ensure drains convey the major event flows to the compensation basins. Dimensions of swales likely to be required are summarised in Table 5-1. Typically Type A, B and C drains would be considered major drain/swales and Type C and D as minor drains/swales.

Table 5-1: Example swale dimensions

Swale	Base width (m)	Top width (m)	Side slope (V/H)	Typical gradient (%)	Max depth (m)
Type A	3	12	1:6	0.5 to 3%	0.7
Type B	3	15	1:6	0.5 to 3%	1.0
Type C	0	12	1:6	0.5 to 3%	1.0
Type D	0	6	1:3	0.5 to 3%	1.0
Type E	3	9	1:3	0.5 to 3%	1.0

Drainage swales are proposed in accordance with the Stormwater Management Manual for Western Australia (DoW, 2007), Subdivision and Development Guidelines (CoA, 2018) and *WQPN 52 – Stormwater Management at Industrial Sites* (DoW, 2006) whereby they provide both conveyance and treatment of stormwater, which is suitable for the site being located in an area with sensitive downstream receptors.

Swales will be broad and shallow, with vegetation covering the side slopes and base, performing an important function in disconnecting the impervious environment from the downstream environment, in this case the wetland/creek, protecting it from pollutants carried by frequent storm events. They do this by improving stormwater quality and reducing the peak flow, velocity and volume reaching the receiving environment.

In small rainfall events, swales detain and retain water, promoting infiltration close to source, and reducing volume and flow. The gentle slope and high hydraulic roughness of the swales also reduces stormwater velocity, attenuate peak flows and also prevent scouring. In larger, less frequent rainfall events, the swales protect infrastructure by conveying stormwater away to central compensating basins and outlets.

The reduced water velocity allows the physical processes for particulate removal to occur; infiltration, deposition and filtration of stormwater through vegetation. As coarse and medium sediments fall out of suspension, associated suspended solids and trace metals are also removed from the stormwater, reducing the pollutant loads from frequent events. Biochemical processes also act to improve water quality reaching the downstream environment, as nitrogen is removed through denitrification, bio storage through plant and bio-film uptake, and changes in soil storage. In addition to their conveyance and water quality functions, swales have the additional benefit over traditional pit and pipe drainage systems, of providing both habitat and aesthetic value to the site.

A summary of the benefits and constraints of swales are listed in Table 5-2.

Table 5-2: Benefits and constraints of swales

Potential benefits	Potential constraints
Provide water conveyance Retain and detain water Allow infiltration Reduces stormwater runoff peak flow, velocity and volume Removes coarse and medium sediments including suspended solids and trace metals Easy access for maintenance Protect downstream surface water bodies and receiving environments from frequent storm events Disconnect impervious environment from downstream environments Habitat value Aesthetic value Biochemical pollutant (nitrogen) removal	Uses more land area than conventional piped system Maintenance – vegetation mowing/replacement/weeding, gross pollutant trap emptying, sediment removal (other systems will also require this) Site topography may limit location and size

5.1.3 Diversion drains

Diversion drains are proposed to divert surface water runoff from catchments external to the Project Site, around the site or through the site such that it does not impact on the site infrastructure. The diversion drains also aim to minimise the interaction of this surface water runoff with site runoff which will require treatment. Due to the nature of the site's use, it will have an increased potential of pollutant generation; in particular sediments and vehicular generated pollutants. Diversion drains may also be utilised to divert external catchments through the site and safely to the wetland/creek.

The external surface water catchments to the site consist of the adjacent APEC and CBH sites to the east and north of site, and areas of uncleared land.

The diversion drains would most likely be similar in size and shape to the major drainage swales proposed in section 5.1.2. The drains are proposed to be earthen utilising in-situ materials.

5.1.4 Compensating basins

Compensating basins are proposed to reduce peak discharge by providing temporary storage for stormwater and encouraging infiltration through permeable walls and floor close to source. The basins are sized such that the post-development peak discharge is maintained at or below pre-development level for the 10% AEP (10-year ARI) and that flows are similar to pre-development flows for the 1% AEP (100-year ARI) event.

Batter slopes of 1V:6H should be adopted where space permits as this will allow for the batter sides and floor to be vegetated and maintained more easily, also reducing potential erosion risks. The purpose of this vegetation is to stabilise banks, and provide water quality treatment by enhancing sedimentation and nutrient removal.

The proposed locations for compensating basins within the site are shown in . Where possible these should utilise the natural topography of the site and generally have low (piped) and high (suitable overflow structure) outlets.

Where possible, depths of basins should be limited to no greater than 1.5 m (at top water level before the spillway activates) and where possible water depths within the basins should be minimised in minor storm events (10 year ARI/ 10% AEP and less) so as to reduce potential risks to the public but also target infiltration via a large base surface areas. Should this not be possible, consideration should be given to increasing basin side slopes (to 1V:3H) to facilitate an increased base infiltration surface in the basin. Basins with these slopes should be assessed for the possible need for appropriate fencing and signage for safety. Standing water in basins is to be minimised so as to assist with mosquito and midge control during risk periods. With this in mind, onsite infiltration testing at proposed drainage basin sites will be needed to support future design. Currently, basins are designed with an assumed 2 m/day infiltration rate.

The location of compensation basins should be such that they are installed out of the flood impacted area of the adjacent creek/wetland. An assessment of this risk should be undertaken during detailed design.

Basins should also be installed such that the base of the basin has a minimum 2.0 m vertical separation to the maximum expected groundwater level in the location, so as to ensure suitable infiltration can be achieved and water quality of the wetland is retained.

5.1.5 Pit and pipe drainage

It is conceptualised that the use of pit and pipe drainage systems will be minimised wherever possible. However it is expected that use of pipework on buildings and within larger hardstand areas is possible (i.e. pit and marshalling areas along with pedestrian concourse areas). It is also expected that a number of culverts will be needed throughout the site to convey stormwater across access roadways and across parts of the proposed multi-use and motocross tracks as shown in . Culverts are expected to be designed to convey events up to and including the minor event (10 year ARI/ 10% AEP) without overtopping. Suitable erosion protection should be provided at culvert outlets to ensure structural stability of any receiving waterway.

A significant culvert is likely to be required on the main internal access road to the multi-use track, where it crosses the main drainage line of the creek in the north-east corner of the Project Site.

For areas subject to higher risks of oil spills and hydrocarbons, installation of covered, fully double-bunded, hardstand areas, connected to suitable oily water separation devices is proposed. Currently, this is expected for the vehicle maintenance and pits areas at both the multi-use track and motocross areas.

5.1.6 Hydrologic and hydraulic assessment

Pre-development

A preliminary hydrologic and hydraulic assessment was undertaken to estimate the pre-development stormwater runoff from the Project Site for the future sizing of stormwater management structures.

The hydrological assessment includes mapping of catchments external to and within the site (). A one-dimensional DRAINS model with ILSAX hydrology was used for calculation of runoff. Model parameters included:

- Paved (impervious) area depression storage = 1 mm,
- Supplementary area depression storage = 1 mm,
- Grassed (pervious) area depression storage = 5 mm, and
- Soil Type 3 (slow infiltration rates).

This assessment was determined in accordance with Australian Rainfall and Runoff (ARR) 2016 (Geoscience Australia, 2016), with design rainfall data from the ARR 2016 data hub and the Bureau of Meteorology (BoM, 2018). The estimated peak flows for pre-development from various catchments are shown below in Table 5-3.

Table 5-3: Estimates of peak flows pre-development

Catchment	Area (ha)	Impervious fraction (%)	Peak flows (m^3/s)			
			1EY (1 yr ARI)	0.5 EY (2 yr ARI)	10% AEP (10 yr ARI)	1% AEP (100 yr ARI)
E1	19.8	3	0.06	0.08	0.43	2.44
E2	17.4	3	0.08	0.10	0.39	2.24
E3	15.3	3	0.01	0.02	0.36	1.97
E4	13.9	0	0.00	0.00	0.45	2.27
E5	36.4	60	0.00	0.00	0.00	0.67
E6	17.4	0	0.00	0.00	0.33	1.81
S1	14.1	0	0.00	0.00	0.31	1.64
S2	23.4	0	0.00	0.00	0.57	3.30
S3	41.6	0	0.00	0.00	1.02	6.07
S4	33.6	0	0.00	0.00	0.65	3.64
S5	25.1	0	0.00	0.00	0.90	4.18
TOTAL	262.7	-	0.03	0.03	1.82	17.0

Note: E denotes an external catchment, S denotes a catchment within the site or with a significant portion of the catchment within the site. TOTAL denotes the flows leaving the site via the creek/wetland which may be different to the individual catchments due to routing and storage within the site/model.

Post-development

A conceptual post-development DRAINS model was also developed to estimate preliminary basin sizes for the development. The basins were sized such that the total post-development flow off the site was equal to or less than the pre-development flow for the minor (10% AEP) design event and targeted appropriate compensation and management of major storms (i.e. the 1% AEP or 100 year ARI). Basin parameters included:

- Nominal depth of 1.5 metres to spillway levels and 2 m to top of wall.

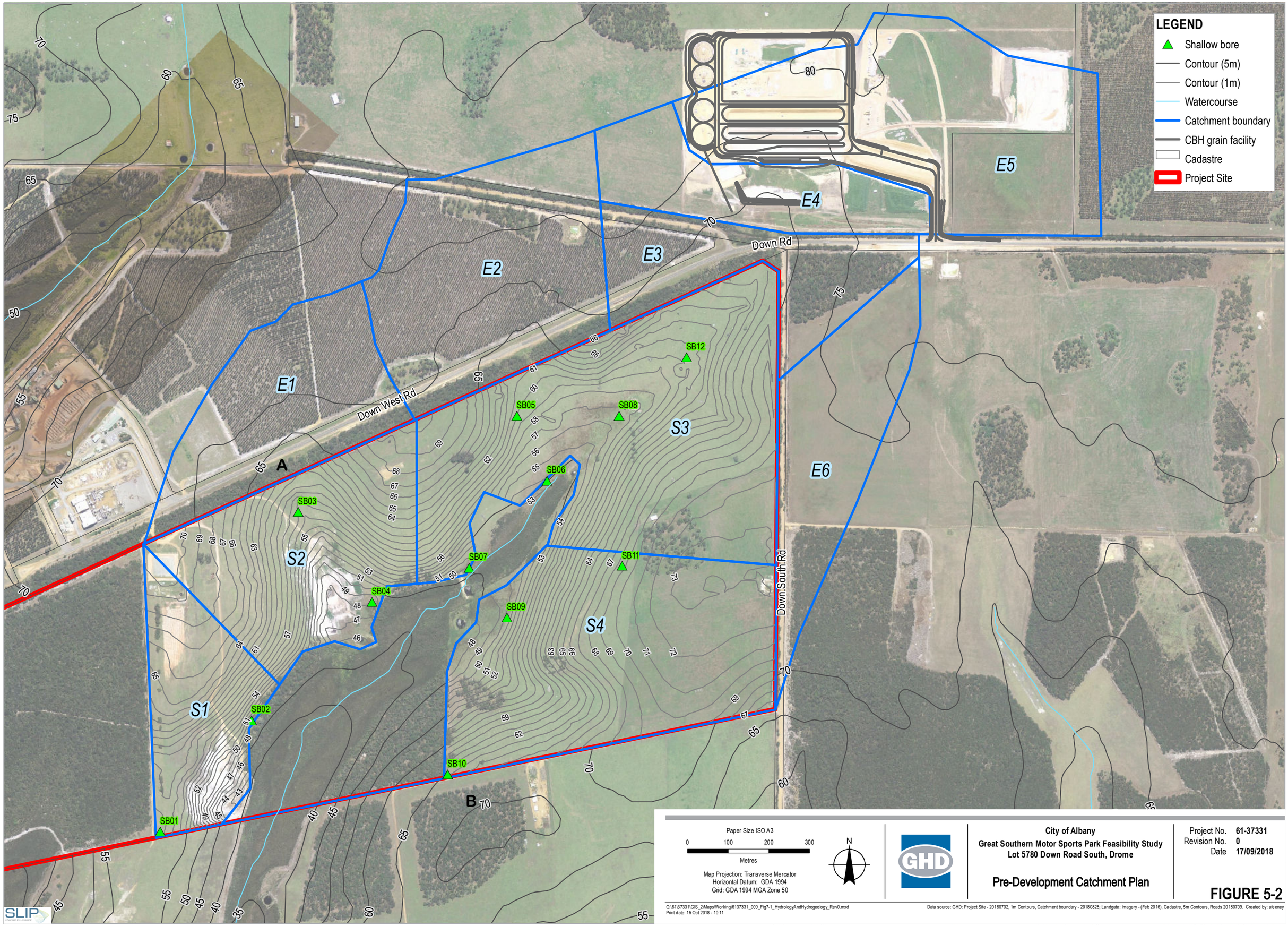
- Basins equipped with a spillway that has sufficient capacity to handle 1% AEP flow.
- 1V:6H side slopes (this could be increased to a max of 1V:3H as required with suitable geotechnical assessment).
- 2 m/day infiltration rate in the absence of testing,
- Each basin would be equipped with a low flow piped discharge, designed to be:
  - Set above the peak 1EY basin water level such that no discharge occurred for water quality management, and
  - Set and sized so as to ensure that the basin spillway didn't activate in events up to and including the 10% AEP.
- The intent is that the basin spillway does not activate in events up to and including the 10% AEP. Upstream external catchments would be directed into each of the basins as detailed in .
- Post development flows are those of the combined catchment areas that contribute to the basin location.

The results of the basin sizing are shown below in Table 5-4.

Table 5-4: Preliminary basin sizing

	Cont. Catch	Catch Area (ha)	Predevelopment Flow (m^3/s)			Post Development Flow (m^3/s)			Approx. footprint (m^2)	Approx. storage volume (m^3)
			1EY	10% AEP	1% AEP	1EY	10% AEP	1% AEP		
S1	S1	14.1	0	0.22	1.64	0	0.13	2.08	2,800	3,000
S2	S2/S3*/ E1	51.5	0	1.06	6.59	0	0.33	6.55	6,200	7,300
S3	S3*	15.3	0	0.29	1.99	0	0.18	2.91	2,600	3,600
S4	S4	35.0	0	0.60	3.55	0	0.18	5.64	6,200	7,200
S5	S4*	1.4	0	0.06	0.29	0.1	0.22	0.42	1,100	700
S6	S3*	0.5	0	0.02	0.12	0	0.07	0.15	500	200
S7	S3*	2.8	0	0.08	0.47	0	0.17	0.57	1,200	800

*Portion of catchment only contributing to basin



Paper Size ISO A3

0 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

City of Albany
Great Southern Motor Sports Park Feasibility Study
Lot 5780 Down Road South, Drome

Pre-Development Catchment Plan

Project No. **61-37331**
Revision No. **0**
Date **17/09/2018**

FIGURE 5-2

G:\61\37331\GIS_2Maps\Working\6137331_009_Fig7-1_HydrologyAndHydrogeology_Rev0.mxd
Print date: 15 Oct 2018 - 10:11

Data source: GHD: Project Site - 20180702, 1m Contours, Catchment boundary - 20180828; Landgate: Imagery - (Feb 2016), Cadastre, 5m Contours, Roads 20180709. Created by: afeeney

5.2 Stormwater quality management

5.2.1 Overview

The Hydrogeological conceptual model (Section 3.4.6) indicates high surface/groundwater connectivity within the Project Site. Any Project Site based groundwater impacts should migrate towards the creek line, where groundwater (and any impacted groundwater) is inferred to discharge, with impacted surface water migrating off-site towards the major drainage in the area, the Marbelup Brook.

Based on the proposed site activities the key stormwater quality issues requiring management within the Project Site include:

- **Sediment load**: Erosion caused by high flow velocity can result in a loss of soil, damage to drainage swales, and increased sediment load to the receiving water body.
- **Nutrient load**: Increased nutrient loading to the receiving water body may result from over-application of fertilisers to landscaped areas.
- **Gross pollutants**: Suspended and dissolved pollutants, and rubbish.
- **Toxicants**: Key pollutants associated with motor sport facilities include leaks and spills of chemical or petroleum hydrocarbons from storage areas, mechanical servicing areas and race tracks. Other toxicant of concern include dissolved metals and pesticides.

If not responsibly managed, the development has the potential to negatively affect stormwater quality discharging from the catchment and impact on the potential receptors and water users (Section 3.4.6 and 3.4.7). The following sections describe the key controls proposed to reduce or minimise risk to stormwater and groundwater quality based on an understanding of the key site risks (Appendix F).

5.2.2 Best management practices

Best management practices (BMPs) are design strategies targeted to manage total suspended solids, gross pollutants, nutrients (TP and TN) within stormwater discharged from urban catchments (DoW, 2007). Frequently occurring rainfall events are targeted, using source, in-transit and end-of-pipe controls to improve water quality. BMPs considered appropriate for the AMP development include:

- Maximising infiltration by adopting a stormwater retention system to contain, and as a minimum, treat the first 15 mm of rainfall on site.
- Construction of compensating basins to reduce peak flow rates and encourage infiltration.
- Construction of suitable bio-retention areas to allow for suitable water quality treatment.
- Swale drains shall be planted with grass for filtering of particulates and uptake of dissolved nutrients. Grass will be mowed with clippings removed from site.
- Use of suitable soils within swales and compensation basins that target the uptake of nutrients.
- Minimising discharge rates, allowing the compensating basin to act as a sediment trap, to capture suspended solids and bound pollutants prior to discharge.

5.2.3 Spill control and pollution management

To achieve spill control and pollution management in the high risk areas of the AMP, the following practices from WQPN 28: *Mechanical workshops and servicing* (DoW, 2013), *WQPN*

52: Stormwater management at industrial sites (DoW, 2006) and *WQPN 100: Motor sport facilities near sensitive waters* (DoW, 2007) will be implemented:

- Separation of uncontaminated stormwater from potentially contaminated stormwater (particularly roof water from other trafficked hardstands).
- Fuel / chemical storage and handling areas to be located within secondary containment areas that allow maximum recovery of any spilt materials.
- Fuel / chemical storage areas shall be secure, bunded, weatherproof compound with impervious flooring to contain any leaks or spills.
- Any fuel storage area should have a minimum volume capacity of 110 per cent of the largest tanks storage capacity in order to prevent any potential overflow into the environment.
- Paved areas exposed to rainfall where dust, litter or spilt substances accumulate should be regularly cleaned with methods that prevent fluid drainage or leaching into the surrounding environment. Litter, oil and sand traps (as appropriate to the site) are recommended at drain entry points. First-flush water diversion for dusty outdoor areas should be considered to capture initial stormwater run-off after any extended dry period.
- Turbidity should be controlled and where practical, stormwater should be treated (if necessary) then (in order of preference) used as a process water source, irrigated onto well-vegetated areas or infiltrated via on-site soak pits.
- Wash down of vehicles should occur on a bunded, impervious pad that is weatherproof to minimise stormwater access.
- Chemical solvents and non-degradable detergents used to clean equipment or pavements should not be released into stormwater systems. High pressure, steam cleaning, scrubbing or quick break detergents are the preferred methods of cleaning vehicles.
- Rainwater should not be released from chemical or fuel storage compounds, unless first tested and found to be uncontaminated.
- Where the groundwater table is within five metres of the surface or soil permeability is poor (less than one metre per day), alternatives to water infiltration may be needed to avoid harmful effects due to water table mounding.
- Any spilt liquids should drain to sealed collection sumps and be either transported off-site or treated prior to disposal.
- Absorbent materials such as sand or inert absorbent litter should always be available on the Project Site for immediate clean up in the event of fluid spills before wash-down. Contaminated materials should then be disposed off-site to an approved location.

Water contamination barriers

The following water contamination barriers are proposed, to prevent any loss of hydrocarbons and chemicals from the site:

- A 50 metre grassed buffer (Development Exclusion Buffer) from the unnamed watercourse and Conservation Class wetland Figure 2-4.
- A 200 metre buffer from the unnamed water course and Conservation Class wetland to vehicle pits/maintenance and refuelling areas (as per DoW *WQPN 100*).
- All fuel, oil and chemical solvents within the Project Site shall be retained within the bunded areas.

- Covered, double bunded impervious pit/vehicle maintenance areas with spill controls in place for hydrocarbon management. Runoff from these areas will drain to a detention area with treatment devices such as oil-water separators and/or interceptor/sediment traps prior to outlet to the site-wide drainage system. Wastes and oily residue will be disposed to an approved off-site location.
- Interceptor traps shall be installed and maintained throughout the swale network for treatment of track stormwater runoff.

It is noted that a swale exists within 200 m of the vehicle pits in the south-east of the site. Whilst water conveyance through the swale will improve water quality when compared to piped conveyance, it can also be considered a direct connection to the watercourse. It is proposed that all runoff from the pits and maintenance areas in this location should pass through an oil/water separator to remove contaminants before they enter the watercourse. Furthermore, the runoff from this area will pass through a compensating basin before entering the watercourse. This retarding effect on the runoff will allow a chance for the contaminants to settle and/or break down.

5.2.4 Emergency response plan

In the event of a vehicle crash and/or fire, first response extinguishment will be via standard, portable dry chemical fire extinguishers (ABE type). The multipurpose ABE powder is a versatile extinguishant, which is used to extinguish Class A (carbonaceous), Class B (flammable liquid) and Class E (electrical) fires. When dry, the powder may be cleaned up with a vacuum cleaner, or similar. No larger firefighting apparatus are proposed for the AMP, and no firefighting foams are proposed.

As part of CAMS Regulations, each flag point (attended by a trained marshal) on a racetrack is required to have 2 × 9 kg fire extinguishers available. The AMP racetrack will likely have 5-6 flag points.

In the case of an emergency in the high risk areas of the AMP, the following actions from *WQPN 100: Motor sport facilities near sensitive waters* (DoW, 2007) will be implemented:

- A contingency plan shall be developed before the operational phase and be available on the Project Site in order to address emergency situations such as accidents, fires and chemical spills that could put local water resources including surface water and groundwater at risk. Relevant staff and contractors shall be familiar with the Project Site emergency response procedures.
- During larger events (potentially up to 20,000 for national race events), adequate emergency response services (e.g. firefighting, security, communications, medical personnel and emergency vehicle access) shall be provided.
- Portable bund kits and clean-up spill kits shall be kept at various locations, including flag points within the Project Site with absorbent material to soak up spilt oil, chemicals and/or fuel. Additionally, sand bags or coir logs will be used in the case of a vehicle accident to block flow to drains.

The plan should be submitted to Water Corporation and DWER for review and approval before implementing.

5.2.5 Non-structural measures

There are a number of temporary and non-structural measures that may also be applied to the development project, as described below.

Construction

Construction sites can be a major source of silt and other pollutants. Proponents and builders shall be encouraged to undertake good practice on building sites. Good practice for construction sites are to be documented in a CEMP and shall include:

- Temporary bunds and silt fences to prevent silt runoff from sites under construction into the drainage system.
- Litter and waste storage bins to prevent litter to be blown by wind or washed by rainfall.
- Establishing a washing-down area behind the bund or silt fence.
- Provide a stabilised entry and exit point to prevent vehicle tracking of soil from the building site onto roads.
- Position stockpiles of sand and soil stockpiles to prevent material being tracked, washed, of blown into roads, and then into the stormwater systems.

Maintenance

Regular maintenance of the drainage system shall be undertaken prior to the start of the wet season. Cleaning of the drainage system and compensating basins will provide an opportunity to remove gross pollutants and silt build up that may enter the receiving water bodies after heavy rainfall. In addition to transporting pollutants, drains with accumulated pollutants may also overflow, leading to localised flooding and erosion, as well as risks to human safety and constructed assets. Unlined open drains may be reshaped at this time if required.

Revegetation and landscape management

Revegetation of the Protected Exclusion Zone (Figure 2-4), which encompasses the CCW and creek line, shall be undertaken as part of the development. Revegetation will occur with suitable native species that were reported by Bio Diverse Solutions (2019) to occur within the CCW.

These include Unit 13, Unit 47 and Unit 49 from the *Albany Regional Vegetation Survey Extent* (Sandiford and Barrett 2010, Appendix D).

In addition, a 50 m wide, low fuel 'Development Exclusion Buffer' comprising managed grass areas will provide a further buffer for stormwater runoff from the development, and any overflow from compensation basins.

The managed grass buffer will assist to filter and trap sediments as well as reduce the amount of nutrients that get discharged into the unnamed creek line / wetland. The proposed native wetland revegetation species will assist to uptake nutrients and trap sediment in shallow groundwater discharging to the wetland area. These native species include *Baumea juncea* and *Baumea rubiginosa* which are frequently used in bioretention areas for their nutrient uptake abilities.

Use of pesticides and fertilisers shall be limited, and completely excluded within the Protected Exclusion Zone and Development Exclusion Buffer.

5.2.6 Erosion and sediment control

All reasonable and practicable measures will be taken to protect adjacent properties and downstream environments from the adverse effects of sediment and sediment-laden water displaced from the Project Site (IECA, 2008). Sediment control measures need to be appropriate for the given soil properties, expected weather conditions, required treatment standard, and the type, cost and scope of works.

With these considerations the following sediment control measures shall be incorporated in the AMP site design to prevent sediment displacement from site (IECA, 2008):

- Dust control,
- Sediment fences,
- Coir logs, and
- Stockpile management.

The detailed design for the Project Site will be developed consistent with the requirements for erosion control in consideration of the site topography. When construction is undertaken the Contractor will be required to have a suitable erosion and sediment control plan (within the CEMP) in place prior to works commencing and maintain these during and following construction during the site establishment period.

5.3 Recommended management actions

Since a portion of the AMP Project Site will contain impervious areas, stormwater runoff from these areas shall be managed effectively in order to prevent potential impacts from fuel, oil or chemical solvent spills. To manage stormwater in the high risk areas of the AMP, the following practices from *WQPN 100: Motor sport facilities near sensitive waters* (DoW, 2007) shall be implemented:

- The drainage system within the Project Site shall be appropriately designed to separate good quality stormwater from potentially contaminated stormwater.
- Interceptor / sediment traps shall be used for stormwater runoff which may contain contaminated/spilt fluids.
- Compensating Basins and a low fuel, 50 m wide, vegetated buffer shall be used to minimise runoff from high rainfall events.
- Use of pesticides and fertilisers shall be limited, and completely excluded within the Protected Exclusion Zone and Development Exclusion Buffer.

6. Groundwater management strategy

6.1 Groundwater level management

The existing groundwater levels across the Project Site indicate that adequate clearance to maximum groundwater levels is achieved for most of the Site during the dry summer season.

The Project Site is characterised by clay, silt, sand and gravel layers in the low-lying areas, which result in near-surface groundwater levels for parts of the year during winter periods when there is high rainfall. Depth to groundwater contours, based on maximum recorded water levels in shallow monitoring bores, identify near-surface groundwater levels for parts of the year in the low lying areas (Figure 3-6).

In accordance with *Interim: Developing a local water management strategy* (DoW, 2008) and *Water Quality Protection Note 100: Motor sport facilities near sensitive waters* (DoW, 2007) the design of the development, all development, facilities and infrastructure at the AMP are proposed outside of the low-lying Protected Exclusion Zone and Development Exclusion Buffer.

Further, in accordance with *Interim: Developing a local water management strategy* (DoW, 2008) and *WQPN 100: Motor sport facilities near sensitive waters* (DoW 2007), the design of the development results in all AMP infrastructure located on higher ground, achieving a 2 m vertical separation distance to maximum groundwater levels. The compensating basins are also located appropriately, so that there is a minimum 2 m vertical separation to maximum groundwater levels for infiltration.

The northern loop extension of the Multi-use track (comprising Turn 3, Turn 4 and Turn 5) will require sufficient fill to achieve 2 m vertical separation to maximum groundwater.

Given the Project Site is predominantly cleared there is not anticipated to be a change in the groundwater levels during the post-development period.

6.1.1 Construction management

Given that there is a possibility for groundwater inundation issues within low-lying parts of the Project Site during parts of the year, temporary lowering of groundwater table may be required by using appropriate drainage for excavations during the construction phase of the AMP project. Should dewatering be required, a dewatering management plan must be prepared (generally included within the ASS management plan, if ASS is identified). It is recommended that excavations should take place during summer if possible and not during winter months after heavy rainfall periods which can result in materials being washed downstream into the wetland (creek). No groundwater dewatering will be required during the operational phase of the AMP.

6.2 Groundwater quality management

Groundwater quality issues that may require management within the Project Site include:

- Presence / disturbance of ASS, and
- Shallow groundwater / areas of high nutrients or Site derived contamination.

Based on the recent groundwater monitoring program (refer section 3.4.5), groundwater on the Project Site currently contains elevated nutrient levels, particularly TN and TP, and background concentrations of some dissolved metals (Section 3.4.5).

Groundwater quality will be protected through managing local stormwater as close to source as possible. The quality of stormwater before it gets infiltrated will be maximised via the proposed treatment approaches and water sensitive urban design as detailed in Section 5.2. BMPs and

non-structural controls (Sections 5.2.2 and 5.2.5) will be implemented in order to avoid mobilisation of Site derived contaminations through potential pathways to receiving waterbodies.

In particular BMPs for water management in motor sport facilities will be implemented to ensure water receives appropriate treatment prior to disposal off-site, or release to the proposed stormwater management system (Section 5.2).

It is expected that the post-development groundwater quality be improved compared to pre-development/existing levels (winter concentrations) and, will assist to restore the condition of the ecological system.

6.3 Groundwater monitoring strategy

The site hydrogeological conceptual model indicates that Site derived surface impacts (eg: potential sources derived from spills and impacted runoff) will infiltrate into the subsurface and together with groundwater flow, be directed towards the on-site creek where groundwater should discharge.

A groundwater monitoring network should be established, based on the following spatial considerations:

- Location of potential sources to groundwater impacts (e.g. fuel storage facilities, infiltration/storm water basins)
- Migration direction of groundwater impacts (e.g. groundwater migration direction noted as towards the creek)
- Groundwater monitoring intervals isolated to intervals within the shallow (sands) and intervals within deeper levels (upper Pallinup Formation) of the hydrogeological profile.

The groundwater samples derived from the monitoring wells should be analysed for those potential contaminates that may be derived from the site actives (e.g: nutrients, hydrocarbons, and metals). The proposed groundwater monitoring strategy is summarised in Section 7.2.

6.4 Actions to address ASS or contamination

Potential impacts

As shown in the Precinct Plan (Figure 2-4), the AMP infrastructure, including tracks and compensation basins, is all proposed outside of the Development Exclusion Zone and Development Exclusion Buffer. This is outside the area considered likely to present a *"moderate to low risk" of AASS and PASS occurring within 3 m from the natural soil surface but high to moderate risk of ASS occurrence beyond 3 m of the natural soils surface*, as shown in Figure 3-2.

Further to this, all infrastructure (including the stormwater compensating basins) will be designed to minimise any disturbance to groundwater during construction through maintaining a minimum 2 m vertical separation distance from the maximum groundwater height and through not requiring any dewatering activities during construction.

As a result of the expected low risk of ASS occurrence on the areas where infrastructure is proposed, in addition to the minimal proposed disturbance of soil and groundwater during construction of the onsite infrastructure; it is considered very unlikely that project development will result in disturbance of any ASS bearing soil layers.

Management

No management of ASS risk is proposed during the project development due to the unlikely risk of disturbance. However, given that the GSMG propose to undertake geotechnical

investigations across the AMP site prior to construction, GHD proposes that a review of these findings should be undertaken to confirm the absence of any likely ASS bearing soil layers.

In light of the geotechnical investigation findings, the ASS risk assessment for the project should be reassessed /confirmed and if required an appropriate management plan shall be prepared in accordance with DWER guidelines *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes* (DER, 2015).

6.5 Spill control and pollution management

Measures for spill control and pollution management to groundwater are the same as those outlined in Section 5.2.3 for stormwater quality.

Recommendations

As per Figure 2-4, a Development Exclusion Zone will encompass the existing Conservation Class Wetland (CCW) and unnamed creek line. This will be revegetated with appropriate endemic, native species. In addition, a low fuel, 50 m wide Development Exclusion Buffer will surround the Development Exclusion Zone. To further manage groundwater quality and quantity in the high risk areas of the AMP, the following actions from *WQPN 52: Stormwater management at industrial sites* (DoW, 2006) and *WQPN 100: Motor sport facilities near sensitive waters* (DoW, 2007) will be implemented:

- The AMP facilities will be located at a minimum vertical separation distance of two metres to the maximum (wet season) groundwater table for free-draining soils, to avoid waterlogging and allow for soil contaminant filtration and aerobic microbial action.
- If the motor sport tracks are located on highly permeable soils, they shall (where practical) be amended with clay or other low permeability material to lessen the risk of fuel, hydraulic fluid and coolant seepage into groundwater and aid clean up after accidents.
- As part of the geotechnical investigations during design development, an ASS investigation shall be undertaken to determine the potential impacts the project may have (if any) and an ASS management plan developed (if required).
- An on-going groundwater monitoring program shall be conducted, with annual reporting to DWER and Water Corporation.
- There will be minimal use of pesticides on grass and re-vegetated plant species across the AMP area, and none within the Development Exclusion Zone or Development Exclusion Buffer.

7. Monitoring

Baseline groundwater and surface water quality sampling of the Project Site was undertaken by Bio Diverse Solutions in 2018 and 2019 (Section 3.4.5). DWER has been consulted during the development of this monitoring plan, and has been kept informed of the quarterly results.

7.1 Surface water monitoring

7.1.1 Pre-development and construction monitoring

Ongoing quarterly monitoring of existing Project Site surface water conditions shall be continued prior to development, and during construction of the AMP. In combination with the existing 2018 and 2019 data, the ongoing monitoring will be used as a baseline for ongoing assessment of the potential impact of the development on shallow groundwater and surface water quality.

For surface water monitoring during the construction phase of the development, a CEMP should be prepared by GSMG and the Contractor which will include erosion and sedimentation control measures, as well as drainage and dewatering systems (if required) in order to minimise potential pollution impacts and prevent contamination to surface water and groundwater.

7.1.2 Post-development monitoring

Ongoing quarterly monitoring of surface water conditions shall be continued post-development, with continued monitoring at sites CS01 and CS02, and establishment of a new upstream monitoring location.

The post-development monitoring program will also involve the collection of grab samples from the compensating basins. Sampling of basins should comprise 3-4 events per year, during or immediately following significant rainfall events (1EY, 1 year ARI event). It is assumed the first flush events will have the highest level of nutrients and chemicals, therefore sampling should occur at the time/after the first significant rainfall event of each wet season, and after extended dry periods. Field notes should include details of the rainfall events, site conditions, time of sampling and time of sample testing.

Monitoring of the compensation basin inlet and outlet water quality will be used to assess performance of the basins in improving stormwater quality.

7.1.3 Monitoring program summary

The recommended monitoring parameters for the ongoing pre-development, construction and post-development monitoring program are outlined in Table 7-1.

Table 7-1: Summary of surface water monitoring

Site	Frequency	Duration	Parameters
Surface water - Upstream of the site (TBC) - Mid-stream (CS02) - Downstream of the site (CS01)	Quarterly	On-going, with annual reporting	In-situ: pH, EC, temperature Unfiltered sample: pH, EC, TN, FRP, TKN, ammonia, TP, TRH, PAH, BTEXN, Surfactants
Compensating basin - Inlet (4 No.) - Outlet (4 No.)	3-4 events per year following 1EY rainfall events		Filtered sample: Filtered total nitrogen and filtered total phosphorus (to quantify organic component), NO_2/NO_3, PO_4, dissolved heavy metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg)

7.2 Groundwater monitoring

7.2.1 Pre-development and construction monitoring

Ongoing monitoring of existing Project Site shallow groundwater conditions shall be continued prior to development, and during construction of the AMP. In combination with the existing 2018 and 2019 data, the ongoing monitoring will be used as a baseline for ongoing assessment of the potential impact of the development on shallow groundwater and surface water quality.

7.2.2 Post-development monitoring

A groundwater monitoring network should be established post development, the locations of which will be based on groundwater monitoring strategy (Section 6.3).

Ongoing monitoring of the groundwater monitoring bores shall be conducted in accordance with the groundwater monitoring program in Table 7-2.

In addition if the development proposal seeks approval to install a production bore for abstraction of groundwater as a water supply source for the development, then six-monthly groundwater monitoring for water levels and salinity will be a required.

7.2.3 Monitoring program summary

The program and parameters outlined in Table 7-2 below will provide a suitable representation of groundwater quality at the site. The groundwater bores established for pre-development monitoring will be used for construction phase and incorporated into the post-development monitoring network.

Should any bores be disturbed during construction they should be reinstated in a nearby representative location. Where new bores are constructed it is recommended that they be installed to a depth that intercepts the shallow and deeper hydrogeological profile at the Project Site.

Table 7-2: Summary of groundwater monitoring program

Site	Frequency	Duration	Parameters
Monitoring bores Production bore	Quarterly	Pre-development, during construction, on-going throughout the life of development,	Water level In-situ: pH, EC, temperature Unfiltered sample: pH, EC, TN, FRP, TKN, ammonia, TP, TRH, PAH, BTEXN, Surfactants Filtered sample Filtered total nitrogen and filtered total phosphorus (to quantify organic component),, NO_2/NO_3, PO_4, dissolved heavy metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Hg),

7.3 Ecological condition monitoring

Bio Diverse Solutions completed baseline Reconnaissance Flora and Level 1 Fauna Survey Report for the Project Site during Spring 2018 (BDS 2019).

Ongoing monitoring of flora condition for the Site should be completed through annual review of vegetation condition change through review of aerial photography. Where vegetation condition is observed to change from baseline aerial photography, follow up releve sampling along transects should be completed to quantify changes to vegetation.

A baseline macroinvertebrate sampling program should be completed prior to commencement of any construction activities. Follow up macroinvertebrate sampling should be completed in the event of any major water quality incident at the Project Site.

7.4 Contingency measures

In the event of a major water quality incident at the Project Site, it is recommended that increased monitoring be undertaken to quantify if there is any impact to surface and groundwater quality. Contingency monitoring measures should be developed in consultation with DWER and documented in the post-development monitoring program.

7.5 QA/QC

All samples should be undertaken in accordance with Australian Standards. Samples should be analysed in a NATA accredited laboratory.

Post-development, permanent groundwater monitoring bore locations and sites should be identified and constructed in accordance with industry standards (ASTM D5092/ D5092-16, *Standard practice for design and installation of groundwater monitoring bores*).

7.6 On-going measures

In order to ensure long-term management and protection of the PDWSAs and other sensitive receptors, the following practices should be implemented:

- Water quality monitoring (surface and groundwater)
- Best management practices including minimal use of pesticides and fertilisers
- 50 m Development Exclusion Buffer zone from the unnamed water source (creek line)
- Pesticides and fertilisers should only be used on grass as well as landscaped and re-vegetated plant species with a 50 m buffer zone from the creek line
- Adherence to all relevant WQPN guidelines and standards

7.7 Reporting

A post-development monitoring plan should be prepared in consultation with DWER, including locations of permanent monitoring bores and sites, proposed parameters, timing and frequency of monitoring.

It is recommended that GSMG prepare an annual water quality monitoring report for each year of post-development monitoring, summarising the sampling results from the previous year and submitted to DWER, Water Corporation and City of Albany.

8. Implementation

8.1 Roles and responsibilities

Table 8-1 identifies the roles and responsibilities to be implemented to support detailed design and construction of the Project Site.

Table 8-1: LWMS roles and responsibilities

Strategy element	Role	Responsibility	Requirement and period
Detailed design	Urban Water Management Plan	Proponent	Prior to commencement of construction works
	Landscape Plan		
Stormwater quantity	Design and construction of drainage infrastructure demonstrating compliance with this LWMS	Proponent	Design to be completed prior to commencement of construction works
Monitoring	Pre-development, construction and ongoing monitoring in accordance with this LWMS	Proponent	Refer Section 7
Construction management	Preparation of an Acid Sulfate Soil Management Plan, should excavation be required to support construction.	Proponent	Management of ASS disturbance, if ASS identified
	Preparation of a Dewatering Management Plan should temporary dewatering be required during construction		Management of temporary dewatering activities during construction
	Preparation of CEMP to guide contractors, including dust control plan, construction waste management plan and emergency response plan		Sediment and erosion management during construction Spill management during construction
Wastewater management	Provision and management of on-site wastewater disposal system in accordance with the *Government Sewerage Policy*	Proponent	Ongoing
	Provision of temporary waste facilities (i.e. port-a-loos) to cater for events in excess of site on-site wastewater capacity	Proponent	Ongoing

8.2 Review

Should there be any change to the AMP layout the stormwater management, groundwater management, monitoring and implementation measures identified in this LWMS should be reviewed and revised, and an addendum prepared if required for review by DWER and City of Albany.

9. References

ANZECC, ARMCANZ. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Canberra: Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

ASTM D5092/ D5092-16, *Standard practice for design and installation of groundwater monitoring bores*

(BDS) Bio Diverse Solutions (2018) *Motorplex Development, Down Road Surface and Groundwater Monitoring 2018 Summary Report*, unpublished report prepared for the City of Albany

Bio Diverse Solutions (2019) *Reconnaissance Flora and Level 1 Fauna Survey Report*. Unpublished report for the City of Albany.

BoM (2019, November 11) *Climate Data Online*. Retrieved from http://www.bom.gov.au/climate/averages/tables/cw_009500.shtml

(CAMS) Confederation of Australian Motor Sports (2012). *Track Operator's Safety Guide,* Malvern East, Australia.

CoA. (2018). *Risk & Opportunity Management Framework.* Albany: City of Albany.
CoA. (2018). *Subdivision & Development Guidelines.* Albany: City of Albany.

DBCA. (2018, July 20). *NatureMap: Mapping Western Australia's Biodiversity*. Retrieved from https://naturemap.dpaw.wa.gov.au/

DEE. (2018, July 30). *Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results*. Retrieved from http://www.environment.gov.au/epbc/pmst/index.html

(DER) Department of Environment Regulation (2014). *Assessment and Management of Contaminated Sites.* Perth: Department of Environment Regulation.

DER (2014) *Environmentally Sensitive Areas, Clearing Regulation Fact Sheet 24.* Perth: Department of Environment Regulation.

DER (2015) Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes . Perth: Department of Environment Regulation.

(DoP) Department of Planning (2014) *City of Albany Local Planning Scheme No.1, Updated to include AMD 4 GG 01/06/18*, Perth, Department of Planning.

(DoW) Department of Water (2002) *250K Map Series – Hydrogeology dataset.* Perth: Department of Water.

DoW (2006) *WQPN 52 Stormwater management at industrial sites .* Perth: Department of Water.

DoW (2007) *Stormwater Management Manual for Western Australia .* Perth: Department of Water.

DoW (2007) *WQPN 100: Motor sport facilities near sensitive waters.* Perth: Department of Water.

DoW (2008) *Interim: Developing a local water management strategy.* Perth: Department of Water.

DoW (2013) WQPN 28: *Mechanical workshops and servicing.* Perth: Department of Water.

DoW (2014) *Great Southern Regional Water Supply Strategy*, Perth, Department of Water.

DoW (2016) *Water Quality Protection Note 25: Land use compatibility tables for public drinking water source areas*, Perth, Department of Water.

(DPLH) Department of Planning, Lands and Heritage (2018a) City of Albany Local Planning Scheme datasets - Zones and Reserves, Special Areas, Perth, Department of Planning, Lands and Heritage.

DPLH. (2018b) City of Albany Local Planning Scheme datasets - Zones and Reserves, Special Areas. Perth: Department of Planning, Lands and Heritage.

DPLH (2019) *Government Sewerage Policy*. Perth: Department of Planning, Lands and Heritage.

(DWER) Department of Water and Environmental Regulation (2017) *Albany hinterland prospective groundwater resources map; Explanatory notes.*

GHD (2018) *Albany Motorsport Park Site Feasibility Study Lot 5780 Down Road South, Drome*. Unpublished report for the City of Albany.

GHD (2019) *Planning Scheme No.1 – Scheme Amendment No.35*, Unpublished report for the City of Albany.

(GoWA) Government of Western Australia (2018) *2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis. (Full Report).* 2018: Government of Western Australia.

GoWA (2018, August 20) Retrieved from http://www.data.wa.gov.au/

GoWA (2018), data.wa.gov.au, accessed August 2018 from http://www.data.wa.gov.au/

–Acid Sulfate Soil Risk Map, Albany – Torbay (DWER-054)

–CAWSA Part 2A Clearing Control Catchments (DWER-004)

–Clearing Regulations – Environmentally Sensitive Areas (DWER-046)

–Contaminated Sites Database (DWER-059)

–DBCA Legislated Lands and Waters (DBCA-011)

–Groundwater Salinity Statewide (DWER-026)

–Hydrographic Catchments – Catchments (DWER-028)

–Hydrographic Catchments – Subcatchments (DWER-030)

–Legislated Lands and Waters (DBCA-011)

–Pre-European Vegetation (DPIRD-006)

–Public Drinking Water Source Areas (DWER-033)

–Ramsar Sites (DBCA-010)

–RIWI Act, Groundwater Areas (DWER-019)

–RIWI Act, Rivers (DWER-036)

–RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)

–Soil Landscape Mapping – Best Available (DPIRD-027)

–South Coast Significant Wetlands (DBCA-018)

–Surface Water Allocation Areas (DWAID) (DWER-039)

–Surface Water Allocation Subareas (DWAID) (DWER-040)

–Threatened Ecological Communities (DBCA-038)

IECA (2008). *Best Practice Erosion and Sediment Control.* Picton, NSW: International Erosion Control Association.

(MA) Motorcycling Australia (2011), *Track Guidelines,* South Melbourne, Australia.

Ryan, S A, Yesertener, C, Maughan, A and Thornton, H (2017) *Albany hinterland prospective groundwater resources map*, Department of Water, Hydrogeological map series, map no. S H M12, and Report no. HM 12, Western Australia

Sandiford, E. M., & Barrett, S. (2010). *Albany Regional Vegetation Survey, Extent Type and Status*, Western Australian Planning Commission, South Coast Natural Resource Management Inc. and City of Albany for the Department of Environment and Conservation, unpublished report, Department of Environment and Conservation, Western Australia

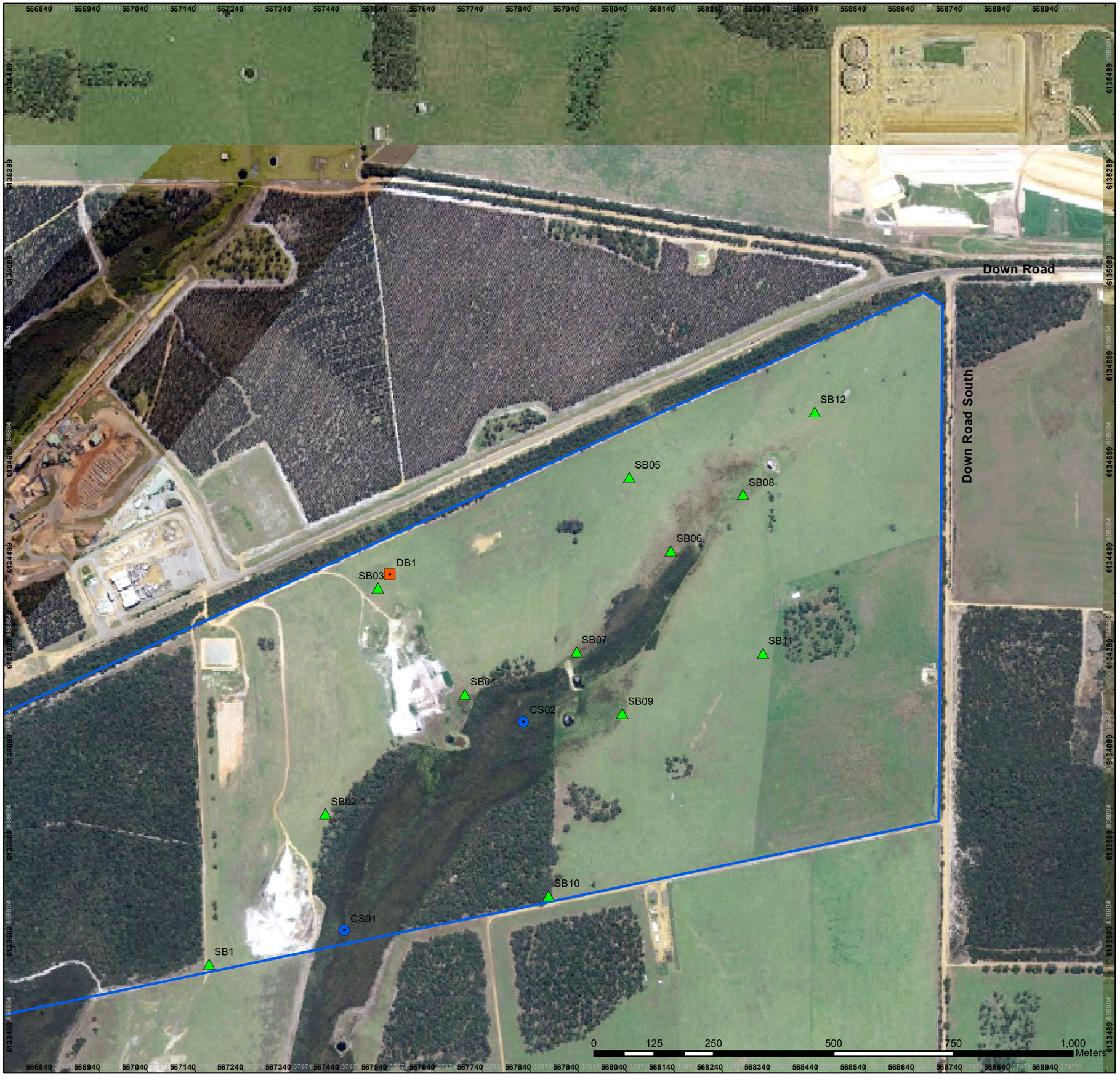
(WAPC) Western Australian Planning Commission (2006) *Statement of Planning Policy No 2.9: Water Resources Policy*, Perth: Western Australian Planning Commission.

WAPC (2008) *Better Urban Water Management*, Perth: Western Australian Planning Commission.

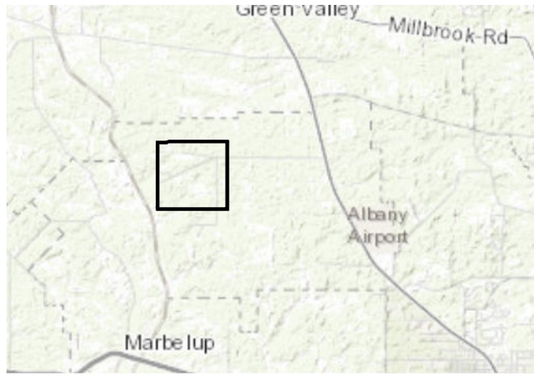
Water Corporation (2018, August 20) *Water Pipe (WCORP-002)* Retrieved from https://services.slip.wa.gov.au/public/services/SLIP_Public_Services/Infrastructure_and_Utilities/MapServer/WMSServer

Appendices

Appendix A – Bio Diverse Solutions monitoring locations, 2018 summary report and field records



Unit 5A, 209 Chester Pass Rd
Albany, WA 6330
Australia
Tel: 08 9842 1575
Fax: 08 9842 1575



Overview Map Scale 1:100,000

Legend

- Subject Site
- Cadastre
- 5m Contours
- Deep Bore
- Shallow Bore
- Creek Sample
- 50m Buffer

Scale
1:7,882 @ A3
GDA MGA 94 Zone 50

Data Sources
Aerial Imagery: SLIP Virtual Mosaic WMS Service, Landgate 2016
Cadastre and Contours: Landgate 2016
Overview Map: World Topographic map service, ESRI 2012

CLIENT
City of Albany
Lot 5780 Down Road
Drome, WA 6330

Monitoring Plan

STATUS	*FILE*	*DATE*
FINAL	**MSC0137**	**28/02/2019**

CS01

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	4.46	6.09	6.09	-	6.46	6.17	5.81
pH lab	7 to 8.5[3]	-	-	-	6.30	6.50	6.10	6.00
Electrical Conductivity (uS/cm)	<1500[3]	897	930	885	890	894	883	434
Electrical Conductivity lab (uS/cm)	<1500[3]	-	923	700	810	940	840	680
Dissolved Oxygen (mg/L)		8.78	9.54	3.93	7.51	7.66	8.16	11.36
Total Dissolved Solids (g/L)	<1000mg/L[3]	0.574	0.59	0.566	0.569	0.572	0.565	0.278
BOD (mg/L)		-	<5	<5	27	<5	<5	<5
Nutrients (mg/L)								
TN	<1.5[3]	1	0.5	2	1	1.5	0.7	1.1
NO2_N	<0.1[3]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NO3_N	<0.1[3]	0.26	0.9	0.2	0.23	0.3	0.23	0.22
NH_3_N	<0.04[3]	<0.005	<0.005	0.036	0.007	<0.005	0.005	0.013
TP	<0.06[3]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
PO_4_P	<0.03[3]	<0.005	<0.005	0.019	<0.05	0.012	<0.005	0.019
Heavy Metals (mg/L)								
Aluminium, Al	<0.055[2]	0.06	0.06	0.14	0.06	<0.001	0.06	0.15
Arsenic, As	<0.013[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Cd	<0.0002[2]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper, Cu	<0.0014[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron, Fe	<0.3[3]	0.86	0.32	0.99	0.46	<0.01	0.34	0.76
Mercury, Hg		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese, Mn	<1.9[2]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickle, Ni		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	<0.008[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc, Zn	<0.008[2]	0.008	0.01	0.008	0.01	<0.001	0.002	0.015
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	7	10	7	12	10	10
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	7	10	7	12	10	10
MBTEXN (µg/L)								
MTBE		<1	<1	<1	<1	<1	<1	<1
Benzene	950	<1	<1	<1	<1	<1	<1	<1
Toluene		<1	<1	<1	<1	<1	<1	<1
Ethylbenzene		<1	<1	<1	<1	<1	<1	<1
m+p-xylene		<2	<2	<2	<2	<2	<2	<2
o-xylene	350	<1	<1	<1	<1	<1	<1	<1
Naphthalene		<1	<1	<1	<1	<1	<1	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<10	<10	<10	<10	<10	<10
TRH C6 - C10		<10	<10	<10	<10	<10	<10	<10
TRH C6 -C10 less BTEX (F1)		<10	<10	<10	<10	<10	<10	<10
TRH C10 - C14		<50	97	<50	<50	<50	<50	<50
TRH C15 - C28		<100	<100	<100	<100	<100	<100	<100
TRH C29 - C36		110	<100	<100	<100	<100	<100	<100
TRH >C10 - C16		<50	71	<50	<50	<50	<50	<50
TRH >C10 -C16 less N (F2)		<50	71	<50	<50	<50	<50	<50
TRH >C16 - C34		140	<100	<100	<100	<100	<100	<100
TRH >C34 - C40		<100	<100	<100	<100	<100	<100	<100
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	40	10	40	40	10	<10
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	10	10	30	70	<10	20
E.coli	<1cfu/100ml[1]	N/A	10	10	30	70	<10	20

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

CS02

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	**6.34**	**5.78**	**5.68**	-	**6.85**	**4.94**	**5.24**
pH Lab	7 to 8.5[3]	-	-	-	**5.60**	**5.20**	**5.00**	**5.10**
Electrical Conductivity (uS/cm)	<1500[3]	623	1050	659	890	781	1170	608
Electrical Conductivity lab (uS/cm)	<1500[3]	-	1100	930	920	1100	1200	990
Dissolved Oxygen (mg/L)		5.14	4.66	7.83	6.71	2.4	4.49	7.94
Total Dissolved Solids (g/L)	<1000mg/L[3]	0.400	0.675	0.422	0.570	0.500	0.748	0.389
BOD (mg/L)		-	7	<5	71	47	14	6
Nutrients (mg/L)								
TN	<1.5[3]	**3.0**	**3.1**	**3.0**	**2.0**	**6.5**	**2.0**	**2.7**
NO2_N	<0.1[3]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NO3_N	<0.1[3]	0.007	<0.5	0.041	0.006	0.012	<0.005	<0.005
NH_3_N	<0.04[3]	<0.005	<0.005	0.019	<0.005	0.009	<0.005	<0.005
TP	<0.06[3]	**0.26**	**0.55**	**0.28**	<0.05	**0.55**	**0.22**	**0.24**
PO_4_P	<0.03[3]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	0.46	0.02	0.03	0.01	<0.01	0.04	0.05
Arsenic, As	<0.013[2]	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001
Cadmium, Cd	<0.0002[2]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001
Copper, Cu	<0.0014[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001
Iron, Fe	<0.3[3]	**40**	0.05	0.26	0.06	0.09	0.1	0.67
Mercury		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese, Mn	<1.9[2]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickle		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead Pb	<0.008[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc, Zn	<0.008[2]	0.002	**0.015**	0.002	0.004	0.041	0.006	0.004
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	N/A	170	7	7	<5	6
Carbonate CO3 2- as CaCO3		N/A	N/A	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	N/A	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	N/A	170	7	7	<5	6
MBTEXN (µg/L)								
MTBE		<1	<1	<1	<1	<1	<1	<1
Benzene	950	<1	<1	<1	<1	<1	<1	<1
Toluene		<1	<1	<1	<1	<1	<1	<1
Ethylbenzene		<1	<1	<1	<1	<1	<1	<1
m+p-xylene		<2	<2	<2	<2	<2	<2	<2
o-xylene	350	<1	<1	<1	<1	<1	<1	<1
Naphthalene		<1	<1	<1	<1	<1	<1	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<10	<10	<10	<10	<10	<10
TRH C6 - C10		<10	<10	<10	<10	<10	<10	<10
TRH C6 -C10 less BTEX (F1)		<10	<10	<10	<10	<10	<10	<10
TRH C10 - C14		<50	220	<50	<50	<50	<50	<50
TRH C15 - C28		<100	<100	<100	<100	<100	<100	<100
TRH C29 - C36		330	<100	<100	<100	<100	<100	<100
TRH >C10 - C16		<50	92	<50	<50	<50	<50	<50
TRH >C10 -C16 less N (F2)		<50	92	<50	<50	<50	<50	<50
TRH >C16 - C34		280	100	<100	<100	<100	120	110
TRH >C34 - C40		220	<100	<100	<100	<100	<100	<100
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	**50**	**80**	**90**	**180**	**160**	<10
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	**260**	**20**	**460**	**400**	<10	<10
E.coli	<1cfu/100ml[1]	N/A	**260**	**20**	**460**	**400**	<10	<10

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB03

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2018	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	N/A	N/A	**6.09**	N/A	N/A	N/A	N/A
pH lab	7 to 8.5[3]	N/A	N/A	-	N/A	N/A	N/A	N/A
Electrical Conductivity (uS/cm)	<1500[3]	N/A	N/A	963	N/A	N/A	N/A	N/A
Electrical Conductivity lab (uS/cm)	<1500[3]	N/A	N/A	1100	N/A	N/A	N/A	N/A
Dissolved Oxygen (mg/L)		N/A	N/A	2.07	N/A	N/A	N/A	N/A
Total Dissolved Solids (g/L)	<1000mg/L[3]	N/A	N/A	0.62	N/A	N/A	N/A	N/A
BOD (mg/L)		N/A	N/A	45	N/A	N/A	N/A	N/A
Nutrients (mg/L)								
TN	<1.5[3]	N/A	N/A	**8.0**	N/A	N/A	N/A	N/A
NO2_N	<0.1[3]	N/A	N/A	<0.005	N/A	N/A	N/A	N/A
NO3_N	<0.1[3]	N/A	N/A	**0.18**	N/A	N/A	N/A	N/A
NH_3_N	<0.04[3]	N/A	N/A	**1.5**	N/A	N/A	N/A	N/A
TP	<0.06[3]	N/A	N/A	**0.2**	N/A	N/A	N/A	N/A
PO_4_P	<0.03[3]	N/A	N/A	**0.2**	N/A	N/A	N/A	N/A
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	N/A	N/A	**0.59**	N/A	N/A	N/A	N/A
Arsenic, As	<0.013[2]	N/A	N/A	0.002	N/A	N/A	N/A	N/A
Cadmium, Cd	<0.0002[2]	N/A	N/A	<0.0001	N/A	N/A	N/A	N/A
Chromium(VI), Cr^{+6}	<0.001[2]	N/A	N/A	**0.006**	N/A	N/A	N/A	N/A
Copper, Cu	<0.0014[2]	N/A	N/A	**0.004**	N/A	N/A	N/A	N/A
Iron, Fe	<0.3[3]	N/A	N/A	**2.0**	N/A	N/A	N/A	N/A
Mercury		N/A	N/A	<0.00005	N/A	N/A	N/A	N/A
Manganese, Mn	<1.9[2]	N/A	N/A	0.24	N/A	N/A	N/A	N/A
Nickle		N/A	N/A	0.003	N/A	N/A	N/A	N/A
Lead Pb	<0.008[2]	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Zinc, Zn	<0.008[2]	N/A	N/A	**0.013**	N/A	N/A	N/A	N/A
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	N/A	170	N/A	N/A	N/A	N/A
Carbonate CO3 2- as CaCO3		N/A	N/A	<5	N/A	N/A	N/A	N/A
Hydroxide OH- as CaCO3		N/A	N/A	<5	N/A	N/A	N/A	N/A
Total Alkalinity as CaCO3	200[4]	N/A	N/A	170	N/A	N/A	N/A	N/A
MBTEXN (µg/L)								
MTBE		N/A	N/A	<5	N/A	N/A	N/A	N/A
Benzene	950	N/A	N/A	<5	N/A	N/A	N/A	N/A
Toluene		N/A	N/A	<5	N/A	N/A	N/A	N/A
Ethylbenzene		N/A	N/A	<5	N/A	N/A	N/A	N/A
m+p-xylene		N/A	N/A	<10	N/A	N/A	N/A	N/A
o-xylene	350	N/A	N/A	<5	N/A	N/A	N/A	N/A
Naphthalene		N/A	N/A	<5	N/A	N/A	N/A	N/A
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH C6 - C10		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH C6 -C10 less BTEX (F1)		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH C10 - C14		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH C15 - C28		N/A	N/A	380	N/A	N/A	N/A	N/A
TRH C29 - C36		N/A	N/A	170	N/A	N/A	N/A	N/A
TRH >C10 - C16		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH >C10 -C16 less N (F2)		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH >C16 - C34		N/A	N/A	500	N/A	N/A	N/A	N/A
TRH >C34 - C40		N/A	N/A	<100	N/A	N/A	N/A	N/A
PAHs in water (µg/L)								
Naphthalene	16	N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Acenaphthylene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Acenaphthene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Fluorene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Phenanthrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Fluoranthene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(a)anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Chrysene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(b,j+k)fluoranthene		N/A	N/A	<0.2	N/A	N/A	N/A	N/A
Benzo(a)pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Indeno(1,2,3-c,d)pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Dibenzo(a,h)anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(g,h,i)perylene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(a)pyrene TEQ		N/A	N/A	<0.5	N/A	N/A	N/A	N/A
Total +ve PAH's		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	N/A	<10	N/A	N/A	N/A	N/A
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	N/A	**10**	N/A	N/A	N/A	N/A
E.coli	<1cfu/100ml[1]	N/A	N/A	**10**	N/A	N/A	N/A	N/A

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in red.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in red.

[4] ADWG (2011) Drinking water astheic value

SB04

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	N/A	**5.78**	**5.38**	-	**5.51**	**5.24**	**4.40**
pH Lab	7 to 8.5[3]	N/A	-	-	**6.30**	**5.40**	**5.50**	**4.60**
Electrical Conductivity (uS/cm)	<1500[3]	N/A	242	328	226	207	229	262
Electrical Conductivity lab (uS/cm)	<1500[3]	N/A	210	340	210	200	190	400
Dissolved Oxygen (mg/L)		N/A	4.66	1.93	5.6	2.04	2.43	5.32
Total Dissolved Solids (g/L)	<1000mg/L[3]	N/A	0.675	0.21	0.147	0.135	0.148	0.168
BOD (mg/L)		-	11	<5	140	240	8	7
Nutrients (mg/L)								
TN	<1.5[3]		0.8	1.2	0.5	0.6	0.9	**2.0**
NO2_N	<0.1[3]	N/A	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NO3_N	<0.1[3]	N/A	<0.5	<0.005	0.013	0.024	<0.005	<0.025
NH_3_N	<0.04[3]	N/A	**0.34**	**0.11**	**0.2**	**0.12**	**0.25**	0.027
TP	<0.06[3]		<0.05	<0.05	<0.005	<0.05	<0.05	<0.05
PO_4_P	<0.03[3]	N/A	<0.005	<0.005	<0.005	<0.005	0.06	<0.05
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	N/A	0.02	**0.56**	**0.12**	**0.07**	0.02	**2.5**
Arsenic, As	<0.013[2]	N/A	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Cd	<0.0002[2]	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	N/A	<0.001	**0.002**	<0.001	<0.001	<0.001	0.003
Copper, Cu	<0.0014[2]	N/A	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron, Fe	<0.3[3]	N/A	0.01	**3.0**	**4.1**	0.05	0.12	**1.7**
Mercury		N/A	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00012
Manganese, Mn	<1.9[2]	N/A	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickle		N/A	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead Pb	<0.008[2]	N/A	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc, Zn	<0.008[2]	N/A	0.008	**0.013**	**0.004**	<0.001	0.008	**0.066**
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	8	6	13	13	12	<5
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	8	6	13	13	12	<5
MBTEXN (µg/L)								
MTBE		N/A	<1	<1	<1	<1	<1	<1
Benzene	950	N/A	<1	<1	<1	<1	<1	<1
Toluene		N/A	8	2	2	2	1	1
Ethylbenzene		N/A	<1	<1	<1	<1	<1	<1
m+p-xylene		N/A	<2	<2	<2	<2	<2	<2
o-xylene	350	N/A	<1	<1	<1	<1	<1	<1
Naphthalene		N/A	<1	<1	<1	<1	<1	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		N/A	<10	<10	<10	<10	<10	<10
TRH C6 - C10		N/A	<10	<10	<10	<10	<10	<10
TRH C6 -C10 less BTEX (F1)		N/A	<10	<10	<10	<10	<10	<10
TRH C10 - C14		N/A	<50	<50	<50	70	<50	<50
TRH C15 - C28		N/A	<100	<100	140	180	<100	<100
TRH C29 - C36		N/A	<100	<100	<100	<100	<100	<100
TRH >C10 - C16		N/A	<50	<50	<50	65	<50	<50
TRH >C10 -C16 less N (F2)		N/A	<50	<50	<50	65	<50	<50
TRH >C16 - C34		N/A	<100	<100	140	250	100	110
TRH >C34 - C40		N/A	<100	<100	<100	<100	<100	<100
PAHs in water (µg/L)								
Naphthalene	16	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ		N/A	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	<10	<10	<10	**30**	<10	<10
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	**20**
E.coli	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	**20**

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB06

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2018	28/09/2019
Physico-chemical								
pH	7 to 8.5[3]	**2.5**	**4.78**	**4.16**	-	N/A	**3.82**	**4.04**
pH lab	7 to 8.5[3]	-	-	-	**3.30**	N/A	**4.60**	**4.10**
Electrical Conductivity (uS/cm)	<1500[3]	311	321	1070	328	N/A	467	242
Electrical Conductivity lab (uS/cm)	<1500[3]	-	320	320	590	N/A	420	350
Dissolved Oxygen (mg/L)		4.53	2.24	8.95	6.7	N/A	4.04	5.0
Total Dissolved Solids (g/L)	<1000mg/L[3]	0.203	0.208	0.69	0.213	N/A	0.304	0.155
BOD (mg/L)		-	29	23	18	N/A	8	65
Nutrients (mg/L)								
TN	<1.5[3]	0.2	**4.9**	**5.2**	**17.0**	N/A	**7.1**	**5.5**
NO2_N	<0.1[3]	<0.005	<0.005	<0.005	<0.005	N/A	<0.005	<0.005
NO3_N	<0.1[3]	0.024	<0.5	<0.05	0.013	N/A	<0.005	<0.005
NH_3_N	<0.04[3]	**0.7**	**1**	**0.67**	**2.4**	N/A	**0.5**	**0.78**
TP	<0.06[3]	**1.3**	**1.2**	**1.1**	**2.2**	N/A	**3.1**	**0.88**
PO_4_P	<0.03[3]	**1.1**	**0.79**	**0.88**	**1.9**	N/A	**2.4**	**0.67**
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	**1.8**	**0.32**	**0.26**	**0.25**	N/A	**0.40**	**0.23**
Arsenic, As	<0.013[2]	<0.001	<0.001	<0.001	<0.001	N/A	0.001	<0.001
Cadmium, Cd	<0.0002[2]	<0.0001	<0.0001	<0.0001	<0.0001	N/A	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	**0.002**	<0.002	**0.001**	**0.002**	N/A	**0.002**	**0.002**
Copper, Cu	<0.0014[2]	<0.001	<0.001	<0.001	<0.001	N/A	0.003	<0.001
Iron, Fe	<0.3[3]	**0.9**	**0.8**	**0.38**	**1**	N/A	**0.41**	**0.61**
Mercury		<0.00005	<0.00005	<0.00005	<0.00005	N/A	<0.00005	<0.00005
Manganese, Mn	<1.9[2]	0.01	<0.005	<0.005	0.006	N/A	<0.005	<0.005
Nickle		0.003	<0.001	<0.001	<0.001	N/A	<0.001	<0.001
Lead Pb	<0.008[2]	0.006	<0.001	<0.001	<0.001	N/A	<0.001	<0.001
Zinc, Zn	<0.008[2]	**0.097**	**0.014**	**0.01**	**0.028**	N/A	**0.046**	**0.009**
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	<5	<5	<5	N/A	5	<5
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	N/A	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	N/A	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	<5	<5	<5	N/A	5	<5
MBTEXN (µg/L)								
MTBE		<1	<10	<3	<3	N/A	<3	<1
Benzene	950	<1	<10	<3	<3	N/A	<3	<1
Toluene		<1	<10	7	30	N/A	<3	<1
Ethylbenzene		<1	<10	<3	<3	N/A	<3	<1
m+p-xylene		<2	<20	<6	<6	N/A	<6	<2
o-xylene	350	<1	<10	<3	<3	N/A	<3	<1
Naphthalene		<1	<10	<3	<3	N/A	<3	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<100	<50	<50	N/A	<50	<10
TRH C6 - C10		<10	<100	<50	<50	N/A	<50	<10
TRH C6 -C10 less BTEX (F1)		<10	<100	<50	<50	N/A	<50	<10
TRH C10 - C14		<50	97	<50	160	N/A	<50	<50
TRH C15 - C28		<100	<100	100	120	N/A	130	150
TRH C29 - C36		110	<100	<100	<100	N/A	<100	260
TRH >C10 - C16		<50	71	<50	150	N/A	<50	<50
TRH >C10 -C16 less N (F2)		<50	71	<50	150	N/A	<50	<50
TRH >C16 - C34		140	<100	140	160	N/A	180	340
TRH >C34 - C40		<100	<100	<100	<100	N/A	<100	120
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	N/A	<0.1	0.2
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	N/A	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	N/A	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	N/A	<0.1	0.9
Microbial Testing								
Faecal Enterococci (cfu/100mL)	<1cfu/100ml[1]	N/A	**10**	**10**	<10	N/A	<10	<10
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	<10	**20**	<10	N/A	<10	<10
E.coli	<1cfu/100ml[1]	N/A	<10	**20**	<10	N/A	<10	<10

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB07

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	**2.82**	**4.77**	**4.50**	-	**5.68**	**4.15**	**4.23**
pH lab	7 to 8.5[3]	-	-	-	**4.70**	**5.60**	**4.20**	**4.40**
Electrical Conductivity (uS/cm)	<1500[3]	337	280	211	449	485	665	1261
Electrical Conductivity lab (uS/cm)	<1500[3]	-	380	210	450	490	410	200
Dissolved Oxygen (mg/L)		3.9	5.34	2.6	4.95	1.22	9.54	4.74
Total Dissolved Solids (g/L)	<1000mg/L[3]	0.224	0.181	0.14	0.291	0.316	0.427	0.807
BOD (mg/L)		-	61	13	110	160	23	29
Nutrients (mg/L)								
TN	<1.5[3]	0.3	**6.1**	**6.5**	**28**	**28**	**8.9**	**4.9**
NO2_N	<0.1[3]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NO3_N	<0.1[3]	**0.27**	<0.5	<0.005	<0.05	<0.005	<0.005	<0.005
NH_3_N	<0.04[3]	**0.22**	**0.77**	**0.19**	**6.4**	**12**	**0.82**	**0.16**
TP	<0.06[3]	**0.65**	**0.81**	**0.45**	**1.9**	**1.7**	**0.63**	**0.25**
PO_4_P	<0.03[3]	**0.52**	**0.73**	**0.23**	**1.3**	**1**	**0.31**	**0.1**
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	**0.86**	**0.14**	**0.18**	**0.1**	**0.07**	**0.21**	**0.18**
Arsenic, As	<0.013[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Cd	<0.0002[2]	0.0002	<0.0001	<0.0001	0.0002	0.0003	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	0.002	0.002	<0.001	0.001	0.001	0.001	<0.001
Copper, Cu	<0.0014[2]	0.002	<0.001	0.002	<0.001	0.001	<0.001	0.002
Iron, Fe	<0.3[3]	**1.1**	**0.51**	**0.21**	**0.54**	0.17	**0.5**	0.17
Mercury		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese, Mn	<1.9[2]	0.009	<0.005	<0.005	0.027	0.011	0.008	<0.005
Nickle		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead Pb	<0.008[2]	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc, Zn	<0.008[2]	**0.065**	**0.013**	**0.01**	**0.023**	0.008	**0.079**	**0.041**
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	<5	<5	11	38	5	<5
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	<5	<5	11	38	5	<5
MBTEXN (µg/L)								
MTBE		<1	<10	<5	<3	<3	<1	<1
Benzene	950	<1	<10	<5	<3	<3	<1	<1
Toluene		<1	11	5	770	150	39	<1
Ethylbenzene		<1	<10	<5	<3	<3	<1	<1
m+p-xylene		<2	<20	<10	<6	<6	<2	<2
o-xylene	350	<1	<10	<5	<3	<3	<1	<1
Naphthalene		<1	<10	<5	<3	<3	<1	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<100	<100	1000	200	51	<10
TRH C6 - C10		<10	<100	<100	1000	220	55	<10
TRH C6 -C10 less BTEX (F1)		<10	<100	<100	260	70	16	<10
TRH C10 - C14		<50	220	<50	360	**170**	57	<50
TRH C15 - C28		<100	<100	<100	240	**1700**	270	110
TRH C29 - C36		330	<100	<100	210	**2100**	470	140
TRH >C10 - C16		<50	92	<50	300	**200**	<50	<50
TRH >C10 -C16 less N (F2)		<50	92	<50	300	**200**	<50	<50
TRH >C16 - C34		280	100	140	380	**3400**	670	210
TRH >C34 - C40		220	<100	<100	100	**800**	160	<100
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing								
Faecal Enterococci (cfu/100mL)	<1cfu/100ml[1]	N/A	**30**	**10**	<10	<10	<10	**10**
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	<10
E.coli	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	<10

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB08

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	N/A	4.56	4.41	-	6.28	5.22	4.38
pH lab	7 to 8.5[3]	N/A	-	-	4.60	6.40	5.30	4.40
Electrical Conductivity (uS/cm)	<1500[3]	N/A	217	1200	888	1010	525	1020
Electrical Conductivity lab (uS/cm)	<1500[3]	N/A	350	1400	920	930	500	1600
Dissolved Oxygen (mg/L)		N/A	4.68	2.57	5.72	2.42	1.16	5.86
Total Dissolved Solids (g/L)	<1000mg/L[3]	N/A	0.14	0.77	0.565	0.645	0.336	0.653
BOD (mg/L)		-	50	23	82	-	480	36
Nutrients (mg/L)								
TN	<1.5[3]	N/A	7.1	11	13	110	79	9.5
NO2_N	<0.1[3]	N/A	<0.005	<0.05	<0.05	<0.1	<0.1	<0.025
NO3_N	<0.1[3]	N/A	<0.5	<0.05	<0.05	<0.005	<0.1	<0.005
NH_3_N	<0.04[3]	N/A	0.69	0.24	4	55	14	0.2
TP	<0.06[3]	N/A	<0.05	0.33	0.52	16	1.1	0.25
PO_4_P	<0.03[3]	N/A	<0.005	0.075	0.21	1.9	0.4	0.098
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	N/A	4.8	5.5	4.5	8.2	6.9	5.5
Arsenic, As	<0.013[2]	N/A	<0.001	0.002	0.004	0.008	0.004	0.003
Cadmium, Cd	<0.0002[2]	N/A	<0.0001	0.0001	<0.0001	0.0016	0.0002	0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	N/A	0.01	0.007	0.013	0.04	0.024	0.008
Copper, Cu	<0.0014[2]	N/A	<0.001	0.003	0.001	0.007	0.002	<0.001
Iron, Fe	<0.3[3]	N/A	1.4	2.4	2.7	2.5	2.1	4.2
Mercury		N/A	<0.00005	<0.00005	<0.00005	0.00013	0.00013	<0.00026
Manganese, Mn	<1.9[2]	N/A	0.012	0.041	0.048	0.038	0.03	0.043
Nickle		N/A	0.001	0.001	0.002	0.002	<0.001	<0.001
Lead Pb	<0.008[2]	N/A	<0.001	<0.001	0.036	0.004	0.001	<0.001
Zinc, Zn	<0.008[2]	N/A	0.039	0.031	<0.001	0.064	0.02	0.034
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	<5	<5	9	190	46	<5
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	<5	<5	9	190	46	<5
MBTEXN (µg/L)								
MTBE		<1	<10	<5	<3	<3	<3	<10
Benzene	950	<1	<10	<5	<3	<3	<3	<10
Toluene		<1	11	5	210	980	310	35
Ethylbenzene		<1	<10	<5	<3	<3	<3	<10
m+p-xylene		<2	<20	<10	<6	<6	<6	<20
o-xylene	350	<1	<10	<5	<3	<3	<3	<10
Naphthalene		<1	<10	<5	<3	<3	<3	<10
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<100	<100	280	990	540	<2000
TRH C6 - C10		<10	<100	<100	290	1100	580	<2000
TRH C6 -C10 less BTEX (F1)		<10	<100	<100	84	140	270	<2000
TRH C10 - C14		N/A	85	<50	260	760	190	60
TRH C15 - C28		N/A	190	<100	140	10000	450	<100
TRH C29 - C36		N/A	130	<100	<100	5300	450	<100
TRH >C10 - C16		N/A	74	<50	230	990	200	50
TRH >C10 -C16 less N (F2)		N/A	74	<50	230	990	200	50
TRH >C16 - C34		N/A	270	<100	160	16000	840	130
TRH >C34 - C40		N/A	<100	<100	<100	1600	<100	<100
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	<0.8	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	<10	90	-	<100	<10	70
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	<10	80	-	<100	<10	30
E.coli	<1cfu/100ml[1]	N/A	<10	80	-	<100	<10	20

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB09

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	**4.03**	**6.28**	**5.86**	-	**5.85**	**5.43**	**5.33**
pH lab	7 to 8.5[3]	-	-	-	**5.80**	**5.60**	**5.70**	**5.60**
Electrical Conductivity (uS/cm)	<1500[3]	296	250	390	322	263	275	206
Electrical Conductivity lab (uS/cm)	<1500[3]	-	280	320	260	250	260	300
Dissolved Oxygen (mg/L)		2.22	4.84	4.6	5.54	2.05	0.8	4.95
Total Dissolved Solids (g/L)	<1000mg/L[3]	0.192	0.161	0.25	0.208	0.171	0.179	0.132
BOD (mg/L)		-	6	7	<5	8	<5	<5
Nutrients (mg/L)								
TN	<1.5[3]	1.1	0.4	1	0.5	0.9	0.5	0.7
NO2_N	<0.1[3]	<0.005	<0.5	<0.05	<0.005	<0.005	<0.005	<0.005
NO3_N	<0.1[3]	<0.005	<0.005	<0.05	<0.005	0.016	0.005	<0.005
NH_3_N	<0.04[3]	**0.11**	**0.13**	**0.1**	**0.26**	**0.51**	**0.074**	**0.12**
TP	<0.06[3]	<0.05	<0.05	<0.05	<0.05	**0.14**	<0.05	<0.05
PO_4_P	<0.03[3]	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	**1.2**	**0.04**	**0.09**	<0.01	<0.01	0.02	**0.09**
Arsenic, As	<0.013[2]	0.006	0.003	0.002	<0.001	0.002	0.001	0.002
Cadmium, Cd	<0.0002[2]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium(VI), Cr^{+6}	<0.001[2]	0.003	<0.001	0.001	<0.001	<0.001	<0.001	0.001
Copper, Cu	<0.0014[2]	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron, Fe	<0.3[3]	**2.8**	**5.6**	**6.3**	**1.3**	**0.96**	**1.6**	**4.9**
Mercury		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001	0.00034
Manganese, Mn	<1.9[2]	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickle		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead Pb	<0.008[2]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc, Zn	<0.008[2]	**0.069**	0.006	0.006	0.003	0.008	0.004	0.008
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	25	19	26	16	22	18
Carbonate CO3 2- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Hydroxide OH- as CaCO3		N/A	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO3	200[4]	N/A	25	19	26	16	22	18
MBTEXN (µg/L)								
MTBE		<1	<1	<1	<1	<1	<1	<1
Benzene	950	<1	<1	<1	<1	<1	<1	<1
Toluene		<1	7	<1	<1	13	2	<1
Ethylbenzene		<1	<1	<1	<1	<1	<1	<1
m+p-xylene		<2	<2	<2	<2	<2	<2	<2
o-xylene	350	<1	<1	<1	<1	<1	<1	<1
Naphthalene		<1	<1	<1	<1	<1	<1	<1
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		<10	<10	<10	<10	20	<10	<10
TRH C6 - C10		<10	<10	<10	<10	26	<10	<10
TRH C6 -C10 less BTEX (F1)		<10	<10	<10	<10	13	<10	<10
TRH C10 - C14		<50	66	<50	<50	<50	<50	<50
TRH C15 - C28		<100	140	<100	<100	180	<100	120
TRH C29 - C36		<100	<100	<100	<100	<100	<100	<100
TRH >C10 - C16		<50	69	<50	<50	<50	<50	<50
TRH >C10 -C16 less N (F2)		<50	69	<50	<50	<50	<50	<50
TRH >C16 - C34		<100	140	<100	<100	190	100	130
TRH >C34 - C40		<100	<100	<100	<100	<100	<100	<100
PAHs in water (µg/L)								
Naphthalene	16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	<10	**10**	<10	<10	<10	<10
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	**10**
E.coli	<1cfu/100ml[1]	N/A	<10	<10	<10	<10	<10	**10**

[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in **red**.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in **red**.

[4] ADWG (2011) Drinking water astheic value

SB12

Parameters	Guideline	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
Physico-chemical								
pH	7 to 8.5[3]	N/A	N/A	7.52	N/A	N/A	N/A	N/A
pH lab	7 to 8.5[3]	N/A	N/A	-	N/A	N/A	N/A	N/A
Electrical Conductivity (uS/cm)	<1500[3]	N/A	N/A	80	N/A	N/A	N/A	N/A
Electrical Conductivity lab (uS/cm)	<1500[3]	N/A	N/A	160	N/A	N/A	N/A	N/A
Dissolved Oxygen (mg/L)		N/A	N/A	2.7	N/A	N/A	N/A	N/A
Total Dissolved Solids (g/L)	<1000mg/L[3]	N/A	N/A	0.05	N/A	N/A	N/A	N/A
BOD (mg/L)		N/A	N/A	13	N/A	N/A	N/A	N/A
Nutrients (mg/L)								
TN	<1.5[3]			**13**	N/A	N/A	N/A	N/A
NO2_N	<0.1[3]	N/A	N/A	<0.005	N/A	N/A	N/A	N/A
NO3_N	<0.1[3]	N/A	N/A	**0.12**	N/A	N/A	N/A	N/A
NH_3_N	<0.04[3]	N/A	N/A	**0.15**	N/A	N/A	N/A	N/A
TP	<0.06[3]	N/A	N/A	**0.16**	N/A	N/A	N/A	N/A
PO_4_P	<0.03[3]			0.009	N/A	N/A	N/A	N/A
Alkalinity (mg/L)								
Bicarbonate HCO3 as CaCO3		N/A	N/A	35	N/A	N/A	N/A	N/A
Carbonate CO3 2- as CaCO3		N/A	N/A	<5	N/A	N/A	N/A	N/A
Hydroxide OH- as CaCO3		N/A	N/A	<5	N/A	N/A	N/A	N/A
Total Alkalinity as CaCO3	200[4]	N/A	N/A	35	N/A	N/A	N/A	N/A
Dissolved Metals (mg/L)								
Aluminium, Al	<0.055[2]	N/A	N/A	**0.2**	N/A	N/A	N/A	N/A
Arsenic, As	<0.013[2]	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Cadmium, Cd	<0.0002[2]	N/A	N/A	<0.0001	N/A	N/A	N/A	N/A
Chromium(VI), Cr^{+6}	<0.001[2]	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Copper, Cu	<0.0014[2]	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Iron, Fe	<0.3[3]	N/A	N/A	0.13	N/A	N/A	N/A	N/A
Mercury		N/A	N/A	<0.00005	N/A	N/A	N/A	N/A
Manganese, Mn	<1.9[2]	N/A	N/A	<0.005	N/A	N/A	N/A	N/A
Nickle		N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Lead Pb	<0.008[2]	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Zinc, Zn	<0.008[2]	N/A	N/A	0.003	N/A	N/A	N/A	N/A
MBTEXN (µg/L)								
MTBE		N/A	N/A	<1	N/A	N/A	N/A	N/A
Benzene	950	N/A	N/A	<1	N/A	N/A	N/A	N/A
Toluene		N/A	N/A	<1	N/A	N/A	N/A	N/A
Ethylbenzene		N/A	N/A	<1	N/A	N/A	N/A	N/A
m+p-xylene		N/A	N/A	<2	N/A	N/A	N/A	N/A
o-xylene	350	N/A	N/A	<1	N/A	N/A	N/A	N/A
Naphthalene		N/A	N/A	<1	N/A	N/A	N/A	N/A
Total Recoverable Hydrocarbons (µg/L)								
TRH C6 - C9		N/A	N/A	<10	N/A	N/A	N/A	N/A
TRH C6 - C10		N/A	N/A	<10	N/A	N/A	N/A	N/A
TRH C6 -C10 less BTEX (F1)		N/A	N/A	<10	N/A	N/A	N/A	N/A
TRH C10 - C14		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH C15 - C28		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH C29 - C36		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH >C10 - C16		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH >C10 -C16 less N (F2)		N/A	N/A	<50	N/A	N/A	N/A	N/A
TRH >C16 - C34		N/A	N/A	<100	N/A	N/A	N/A	N/A
TRH >C34 - C40		N/A	N/A	<100	N/A	N/A	N/A	N/A
PAHs in water (µg/L)								
Naphthalene	16	N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Acenaphthylene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Acenaphthene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Fluorene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Phenanthrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Fluoranthene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(a)anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Chrysene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(b,j+k)fluoranthene		N/A	N/A	<0.2	N/A	N/A	N/A	N/A
Benzo(a)pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Indeno(1,2,3-c,d)pyrene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Dibenzo(a,h)anthracene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(g,h,i)perylene		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Benzo(a)pyrene TEQ		N/A	N/A	<0.5	N/A	N/A	N/A	N/A
Total +ve PAH's		N/A	N/A	<0.1	N/A	N/A	N/A	N/A
Microbial Testing (cfu/100mL)								
Faecal Enterococci	<1cfu/100ml[1]	N/A	N/A	**330**	N/A	N/A	N/A	N/A
Thermotolerant Coliforms	<1cfu/100ml[1]	N/A	N/A	**12000**	N/A	N/A	N/A	N/A
E.coli	<1cfu/100ml[1]	N/A	N/A	**8000**	N/A	N/A	N/A	N/A

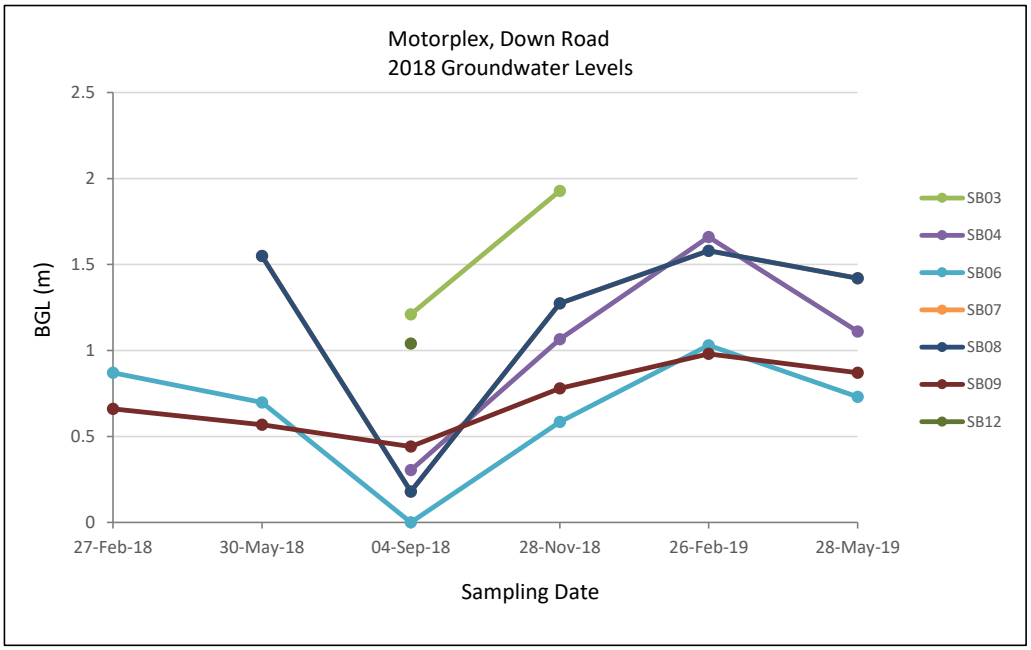
[1] Practical Quantitation Limit (PQL) defined as the lowest concentration at which an analyte can be detected in a sample within a reasonable degree of accuracy and precision.

[2] ANZECC and ARMCANZ (2000) Trigger values for toxicants in freshwater ecosystems at 95% level of protection, stated otherwise; target exceedance printed in red.

[3] ANZECC and ARMCANZ (2000) Trigger values for South-west Australia for slightly-disturbed wetlands ecosystems; target exceedance printed in red.

[4] ADWG (2011) Drinking water astheic value

	27/02/2018	30/05/2018	4/09/2018	28/11/2018	26/02/2019	28/05/2019	28/08/2019
SB03			1.21	1.928			1.45
SB04			0.304	1.066	1.660	1.11	0.37
SB06	0.87	0.698	0	0.585	1.030	0.73	0.06
SB07	0.64	0.535	0.44	0.64	0.950	0.58	0.52
SB08		1.55	0.18	1.274	1.580	1.42	0.38
SB09	0.66	0.568	0.441	0.78	0.980	0.87	0.61
SB12			1.04				1.1
DB1						7.1	6.95



Appendix B – Shallow soil profile description

Soil Profile Sampling

BIO DIVERSE SOLUTIONS

Location: Lot 5780 Down Road

Date tested: 27/02/2018

Sampled by: Kathryn Kinnear

Weather: Windy, cool 21 degrees Overcast

Location	Site description	Depth of profile (mm)	Soil Description
SB1	South west corner Open Paddock	0-150 150-300 300-500 500-1200 1200-1500 1500-2000	Dark grey sandy top soil, veg matter. Grey silty sand. Orange, light brown sandy gravel pebbles 10-30mm. Laterite rock . Light brown pebbles 10-30mm, orange sandy silty gravel. Light brown sandy clay, slightly moist. No WT.
SB02	Paddock near creek west side Jarrah/Cas/Marri Forrest adjacent	0-50 50-200 200-800 800-1200 1200-1500 1500-2000 2000-2500	Dark grey sandy top soil, veg matter. Grey sandy silt. Light grey sandy silt, slightly moist. Cream sandy silt, slightly moist Laterite rock. Moist light brown orange sandy silt gravel, pebbles 10-30mm, minor clay. Light grey silty sand. No WT.
SB03	Open paddock North in minor Drainage swale	0-50 50-500 500-1000 1000-1200 1200-1600 1600-1800 1800-2000	Light brown slightly moist silty sand top soil, veg matter. Light brown silty gravel, pebbles 5-10mm. Brown silty gravel pebbles 20-30mm. Dark brown gravelly silt pebbles 20-30mm. Grey silty sand. Light grey moist silty sand. Light brown/orange silty sand, gravel pebbles 10-30mm. No WT.
SB04	Paddock near Creek in Depression area.	0-50 50-200 700-900 900-1300 1300-1500 1500-1800 1800-2000	Dark brown peaty organic matter. Dark grey silty sand slightly moist. Light grey silty sand moist. Laterite rock, moist dark brown gravelly silt (coffee rock) mottled orange. Light brown silty clay wet. Light grey moist clay. White clay not wet. No WT.
SB05	North paddock Area	0-50 50-200 200-700 700-900 900-1500 1500-1800 1800-1900 1900-2000	Slightly moist dark brown peaty sandy silt top soil, veg matter. Dry dark grey silty sand. Dry light grey silty sand. Dry gravelly silty sand orange pebbles. Dry cream quartz gravelly silty sand pebbles 30-50mm. Pink/orange silty sand gravel, cemented compacted gavel pebbles 10-30mm. Moist dark clayey sand. Dry compacted silty gravel orange/pink. No WT.

Location	Site description	Depth of profile (mm)	Soil Description
SB06	Near creek North side In reed beds	0-100 100-400 400-700 700-1800 1800-2000	Dark brown peaty organic matter moist. Dark grey silty sand moist. Grey silty sand moist. Light grey slty sand wet (smell). Wet brown silty sand (smell) WT 870mm BGL
SB07	Near creek Crossing North side	0-200 200-400 400-600 600-1800 1800-2000	Dark brown/black peaty moist. Black/dark grey peaty sand moist. Dark grey silty sand moist. Light brown silty sand smell. Cream wet silty sand smell. WT 640mm BGL
SB08	Mid creek near dam	0-50 50-200 200-500 500-900 900-1200 1200-1400 1400-1800 1800-2000	Slightly moist dark brown peaty silt, veg matter. Dark brown sandy peaty silt moist. Dark grey silty sand moist. Grey slightly moist silty sand. Dark brown cemented silt, coffee rock. Dark grey moist to wet silty sand. Grey silty sand wet. Dark brown silt minor pebbles 10mm. No WT.
SB09	South side of creek	0-50 50-200 200-600 600-700 700-1100 1100-1300 1300-2000	Dark brown peaty organic matter moist. Dark grey silty sand. Grey silty sand. Light brown gravelly silt. Laterite rock. Wet silt pebbles 30-40mm. White moist clayey silt. WT 660mm BGL
SB010	South boundary east of bush line in paddock	0-50 50-300 300-500 500-1200 1200-2000	Brown silty sand organic matter dry. Brown silty sand gravels 40-50mm, boulders 200mm Laterite, dry. Brown/orange silty sandy gravel cemented Laterite. Light brown/orange cemented silt. White mottles sandstone dry. Light brown/orange cemented silt. White mottles sandstone dry. No WT.
SB011	Mid paddock, top of hill eastern side of site	0-50 50-300 300-400 400-1200 1200-1800 1800-2000	Dark brown silty sand dry. Grey silty sand dry. Light brown silty gravel pebble 30-50mm. Light brown cemented silt Laterite. Light brown, mottles pink * white clay dry. Orange mottled red dry clay. No WT.
SB012		0-400 400-1000 1000-1500 1500-1800 1800-2000	Grey sandy silt organic matter dry. Light grey silty sand. Cream silty sand slightly moist. Dark brown sandy silt, slightly moist gravel minor pebbles. Light brown silty clayey slightly moist boulder Laterite gravels 40mm. No WT.

Appendix C – Deep bore log

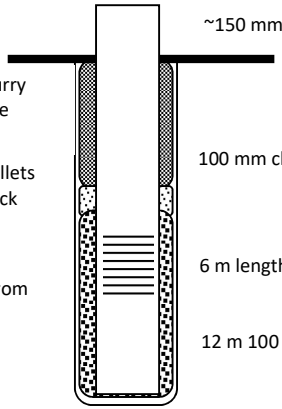
Bore ID: Down Road Motorsports complex site
Driller: Phil Putland, WA Drilling
Method: Mud rotary, ~200 mm bit
Logged by: Andrew Maughan

From (m)	To (m)	Lithology	Lithological Description	Geology	Aquifers
0	2	SAND, GRAVEL, SANDY CLAY	Topsoil and laterite, sandy clay, orange-brown	Pallinup Formation, Siltstone facies	Possible surficial aquifer, seasonally saturated
3	5	SANDY CLAY	Clay with medium sand, light orange-brown		
6	9	CLAYEY SAND	Clay with medium - fine sand, light orange-brown		
10	12	SILTY SANDY CLAY	Clay with medium - fine sand and silt, light yellow-brown and grey		
13	28	SILTSTONE/SANDSTONE	Consolidated silt and fine sand, with minor very fine sand from 13 m grading to minor medium sand to 28 m (fining-upwards sequence), grey 13-14 m, light red-brown 15-28 m with some ~orange/red-white banding. Sand grains sub-rounded. Drilled as sand with v. minor consolidated chips. Silt was minor to not evident in cuttings but possibly suspended in drilling fluid.		Semi-confined Pallinup aquifer
29	32	CLAY	Clay, dark grey	Werillup Formation, Werillup Clay	Werillup aquitard
32	40	CLAY AND SHALE/SILTSTONE	Clay interbedded with bands of very fine sand/siltstone or shale, dark grey. Shale/siltstone bands drilling as chips ~1-2 mm to max 5 mm.		
EoH	41	GRANITE	Apparent basement granite. Rig refusal. No weathered granite profile returned from cuttings which is very uncommon and difficult to explain. Initially unsure whether very hard sandstone however the minor cuttings returned were angular quartz and some mica with no chips of consolidated silt/sand - suggesting igneous/crystaline granitic rock.	Proterozoic Granite	Basement aquiclude

Airlifted for only ~ 1/2 hour and apaprently cleaned up fairly quickly. Then pumped with submersible at 2 l/s for several hours. Some silt still evident in discharge suggesting bore not developed for long enough, although pump is placed in sump which may have accumulated silt.

SWL = TBA. Maybe 1.5 m bgl
Drawdown = TBA. Possibly to ~21 m, so 19.5 m
EC = 1090 µs/cm ~ 600 mg/L TDS
pH = 5.5

Bore construction



~150 mm round galvanised steel lockable headworks to be concreted into surface seal/block

5% bentonite cement slurry tremie grouted to surface

100 mm class 12 PVC casing to surface

20 litres of bentonite pellets to ~ 1 m above gravel pack

6 m length 0.5 mm slotted 100 mm class 12 PVC screen 23 - 29 m bgl

0.8 - 2 mm gravel pack from base of hole to ~2-3 m above screen

12 m 100 mm class 12 PVC sump 29 - 41 m bgl

Appendix D – Revegetation species list

Source: *Albany Regional Vegetation Survey Extent, Type and Status Report* (E.M. Sandiford & S.Barrett 2010)

Unit 13

Floristic Summary

Lifeform	%cover	Species
Trees<10m	S	*Allocasuarina fraseriana. Eucalyptus marginata, Eucalyptus staeri, Banksia attenuata, Banksia ilicifolia*
Shrubs >2m	V	*Banksia grandis, Taxandria parviceps, Hakea ruscifolia, Persoonia longifolia, Beaufortia decussata*
Shrubs 1-2m	V-M	*Isopogon longifolia, Melaleuca thymoides, Agonis theiformis, Gompholobium scabrum, Isopogon formosus, Acacia myrtifolia*
Shrubs 0.5-1m	V-M	*Adenanthos cuneatus, Xanthosia rotundifolia, Leucopogon glabellus, Allocasuarina humilis, Daviesia flexuosa, Daviesia incrassata, Tetratheca setigera, Hypocalymma strictum, Beaufortia anisandra, Leptomeria squarrulosa, Gompholobium knightianum, Gompholobium venustum, Acacia browniana, Acacia luteola, Acacia robiniae, Xanthorrhoea preissii, Adenanthos obovatus*
Shrubs <0.5m	V	*Astroloma baxteri, Petrophile rigida, Boronia spathulata, Boronia crenulata, Dampiera pedunculata, Synaphea polymorpha, Hibbertia depressa, Dampiera leptoclada ,Rinzia schollerifolia,+/- Banksia goodii*
Sedges/rushes	M	*Anarthria scabra, Cyathochaeta equitans, Tricostularia neesii* var *elatior, Lepidosperma densiflora, Hypolaena exsulca, Desmocladus fasciculatus, Anarthria prolifera, Mesomelaena gracilipes, Schoenus sublateralis, Schoenus caespititius, Mesomelaena tetragona*
Herbs	V	*Dasypogon bromeliifolius, Conostylis setigera, Conostylis serrulata, Conospermum caeruleum, Stylidium scandens, Logania serpyllifolia, Scaevola striata, Lindsaea linearis, Patersonia umbrosa*

Unit 47

Floristic Summary

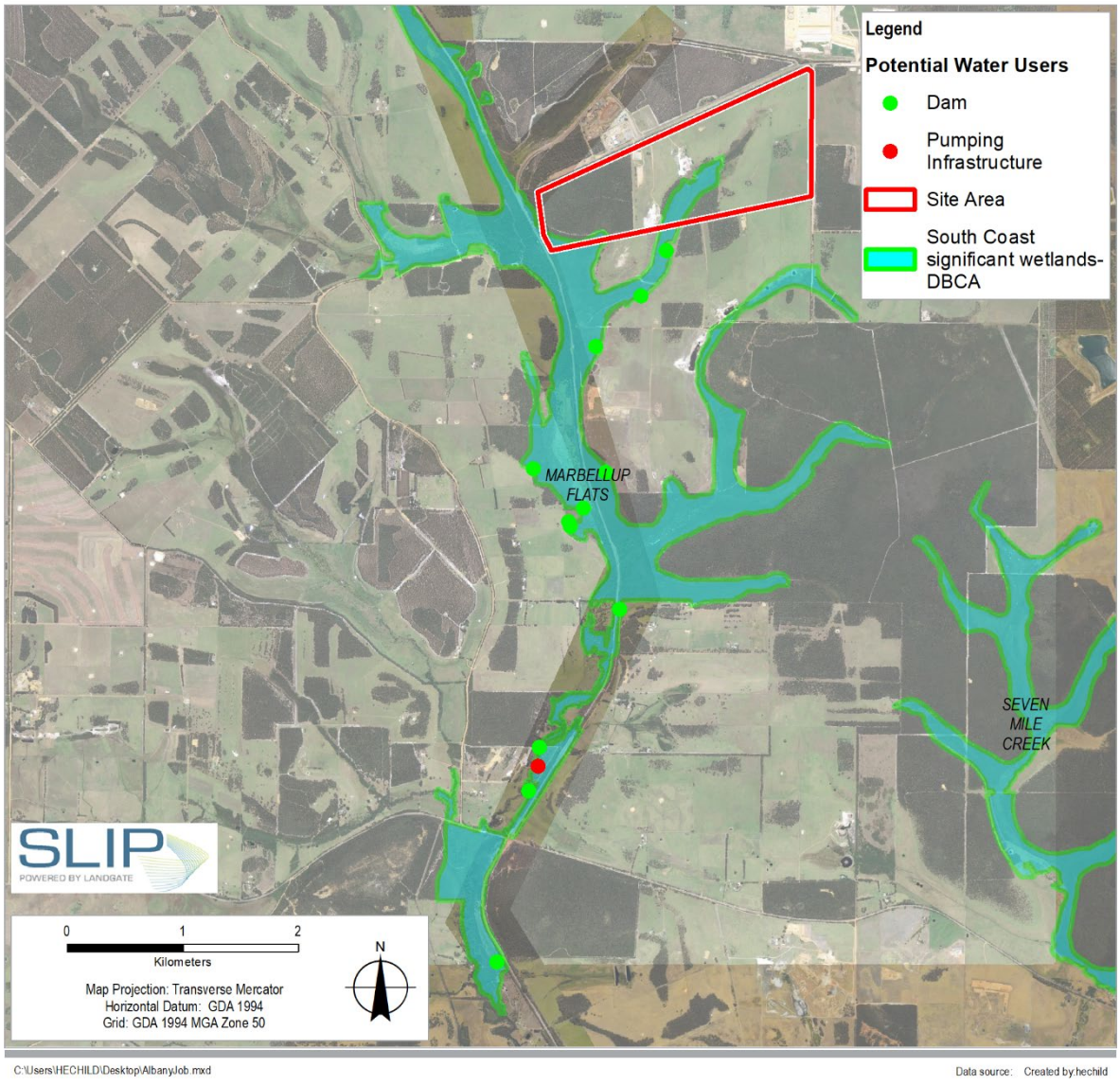
Lifeform	%cover	Species
Trees	Nil-E	*Melaleuca preissiana, Eucalyptus megacarpa*
Shrubs >2m	S-D	*Homalospermum firmum, Callistemon glaucus, Hakea linearis, Taxandria linearifolia, Taxandria parviceps +/- Callistachys lanceolata, Rhadinothamnus anceps*
Shrubs 1-2m	S-M	*Acacia hastulata, Hypocalymma cordatum, Boronia crassipes, Sphaerolobium rosulatum, Boronia stricta, Sphaerolobium fornicatum*
Shrubs <0.5m		*Dampiera leptoclada, Sphenotoma gracilis, Astartea corniculata*
Sedges/rushes	D	*Empodisma gracillimum, Gymnoschoenus anceps, Schoenus multiglumis, Leptocarpus tenax, Gahnia decomposita, Lepidosperma striatum, Baumea rubiginosa, Schoenus sublaxus, Baumea acuta*
Herbs	V	*Xyris lanata, Xyris lacera, Cephalotus follicularis, Lycopodium serpentinum, Diaspasis filifolia, Stylidium assimile*

Unit 49

Floristic Summary

Lifeform	%cover	Species
Trees	E-S	*Melaleuca preissiana +/- Banksia littoralis*
Shrubs >2m	M	*Aotus intermedia, Homalospermum firmum, Callistemon glaucus, Hakea ceratophylla, Taxandria linearifolia, Taxandria parviceps*
Shrubs 0.5-1m	V	*Sphenotoma gracilis, Sphaerolobium hygrophilum, Astartea corniculata.*
Sedges/rushes	M	*Leptocarpus tenax, Schoenus efoliatus, Evandra aristata, Anarthria prolifera, Cyathochaeta avenacea, Lepidosperma striatum, Baumea juncea, Lepidosperma* sp Down Rd Fan
Herbs		*Xyris lanata*

Appendix E – Potential water users



Appendix F – AMP risk assessment

Albany Motorsport Park Drinking Water Quality Risk Register
Risk Assessment Matrix

Item No.	Source / Cause	Scenario / Event Description	Hazard	Existing controls	Likelihood	Consequence	Significance of Risk	Proposed controls	Likelihood	Consequence	Significance of Risk	Action	Responsibility	Critical Control Points	Comments
1.01	Compliance	Changes in water quality due to development; both groundwater and surface water not measured over time	Various	1. Preliminary groundwater investigation and shallow bore installation	2	3	6 Med	1. Finish preliminary investigation by installing deep bores 2. Regular groundwater monitoring program and reporting to Department of Water and/or City of Albany	1	3	3 Low				
1.02	Groundwater contamination	Lack of understanding of existing hydrology/hydrogeology (baseline data)	Chemical / Unexpected Water Quality	N/A - site undeveloped				1. Further geotechnical investigations, with deeper bores drilled to improve hydrogeological site understanding 2. Continual monitoring and inspection as per approved plan	1	3	3 Low				
1.03	Groundwater contamination	Contamination during construction activities with chemicals or drilling mud	Chemical	N/A - site undeveloped				1. Only use approved contractors.	2	2	4 Med				
1.04	Water Quality	Sediment loading and erosion occurs during construction	Dirty water / Biological/Chemical	N/A - site undeveloped				1. Erosion and sediment control plan in place by contractor. 2. Use controls such as sediment fences, stockpile management, dust control etc. 3. Majority of construction to take place in summer if possible	1	3	3 Low				
1.05	Land use - agriculture	Groundwater source is contaminated with pesticides and agricultural chemicals from land use in the area, particularly catchments upstream of site	Chemical	1. Sites regulated by development approvals 2. Zoning/planning restrictions for Mirambeena Strategic Industrial Area	1	3	3 Low	1. Increased fencing to keep cattle off property at Lot 5780 2. Revegetation of degraded areas of the site, particularly the creek/wetland and fringe	1	3	3 Low				
1.06	Land use - gardening and landscaping	Landscaping and gardening uses pesticides or fertilisers in close proximity to the wetland/creek	Chemical	N/A - site undeveloped				1. Buffer zones in place 2. Retain existing vegetation where possible 3. Targeted revegetation of degraded land areas 4. Use native vegetation for landscaping 5. Avoid the use of pesticides 6. Training of gardeners/maintenance personnel	1	3	3 Low				
1.07	Land use - waste facilities	Wastewater leaches into groundwater	Biological / Chemical	N/A - site undeveloped				1. Approved wastewater systems installed 2. Water Management Plan developed for the site 3. Temporary waste facilities used for larger events with waste taken off site for treatment, post-event 4. Install wastewater treatment systems on higher ground where there is atleast clearance to groundwater	1	3	3 Low				
1.08	Maintenance	Drainage system fails due to poor maintenance (e.g. Basin fills up with sediment over time)	Biological/Chemical	N/A - site undeveloped				1. Stormwater system designed to attentuate flows to pre-development levels 2. Stormwater management plan in place which specifies regular activites such as de-silting of sedimentation basins 2. Site walkover after large storm events in winter to check system function (optional)	1	3	3 Low				
1.09	Materials of construction	Materials of construction not suitable for contact with wetland/creek resulting in the introduction of contamination	Chemical	N/A - site undeveloped				1. Design and construction by competent contractors 2. Water quality monitoring throughout system 3. Avoid construction during winter months where rainfall is likely to wash materials downstream into wetland/creek	1	3	3 Low				

Albany Motorsport Park Drinking Water Quality Risk Register
Risk Assessment Matrix

Item No.	Source / Cause	Scenario / Event Description	Hazard	Existing controls	Likelihood	Consequence	Significance of Risk	Proposed controls	Likelihood	Consequence	Significance of Risk	Action	Responsibility	Critical Control Points	Comments
1.1	Facility operations	Vehicle accidents, fuel and chemical spills, fires etc.	Biological/Chemical/Dirty Water	N/A - site undeveloped				1. Buffer zones in place 2. Incident management plan (e.g. portable bund kits available on site) 3. Emergency response plan also required	2	2	4 Med				
1.11	Facility operations	Vehicle washdown or refuelling does not take place in designated area	Biological/Chemical/Dirty Water	N/A - site undeveloped				1. Buffer zones in place 2. These activities to take place in designated areas that are double bunded and have water quality treatment controls in place (i.e. oil/water separators) 3. Incident management plan (e.g. portable bund kits available on site)	2	3	6 Med				
1.12	Facility operations	Trash enters wetland/creek	Gross-pollutants	N/A - site undeveloped				1. Temporary waste facilities for larger events 2. Facility waste management plan to be implemented 3. Adequate numbers of permanent bins placed around site	2	1	2 Low				
1.13	Stormwater	Flood event leading to ingress of dirty stormwater (i.e. high sediment loads and/or hydrocarbons) into wetland/creek	Dirty water / Biological/Chemical	N/A - site undeveloped				1. Stormwater drainage system designed to safely manage the critical 1% AEP event 2. Water quality monitoring program in place	1	2	2 Low				
1.14	Unauthorised access	Unauthorised person/s access site with vehicles for the purposes of hooning or vandalism	Various	1. Private property with padlocked gate	2	1	2 Low	1. Signage to deter persons from entering when the facility is not in use 2. Fenced/gated entrances once site is fully developed 3. Security for larger events if needed	1	1	1 Low				

GHD
166 Stirling Terrace
T: 61 8 9840 5100 F: 61 8 9463 6012 E: albmail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

6137331-25114/
https://projects.ghd.com/oc/WesternAustralia1/albanymotorsportspar/Delivery/Documents/6137331-REP-A_Albany Motorsport LWMS.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	P. Yoganthan C. Finneran	K. Hunt		J. Foley		22.01.20

www.ghd.com