



ENGINEERING

Stirling Golf Course

Stormwater Management Plan

JOB NUMBER: S53897 - 275203; 282604
CLIENT: Venture Capital Developments Pty Ltd
SITE: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
DATE: 1/12/2022
REVISION: C

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Introduction

FMG Engineering has been engaged by Venture Capital Developments Pty Ltd to undertake a preliminary stormwater assessment and develop a preliminary Stormwater Management Plan for a proposed development of the Stirling Golf Club. The Stirling Golf Course is located in the Adelaide Hills approximately 18km south east of the Adelaide CBD between Stirling and Bridgewater and is situated on the north side of the South Eastern Freeway. T

This preliminary Stormwater Management Plan describes the assessment undertaken and addresses the requirements provided by Adelaide Hills Council's engineering and planning departments.

Site Description

The site is located at 35 Golflinks Rd, Stirling SA 5152 as shown in Figure 1. The site is bounded by Old Carey Gully Rd to the North West, Golflinks Rd to the South West and Mount George Conservation Park to the East and South East. The Golf Course is surrounded by several land use zones including Country Living, Watershed (Primary Production) and Public Purpose zones.

The Cox Creek runs through the site in a south easterly direction. The site is undulating with a general downwards slope towards the south east. The catchment area of the Cox Creek upstream of the Golf Course has been estimated using local contour data available in NatureMaps.

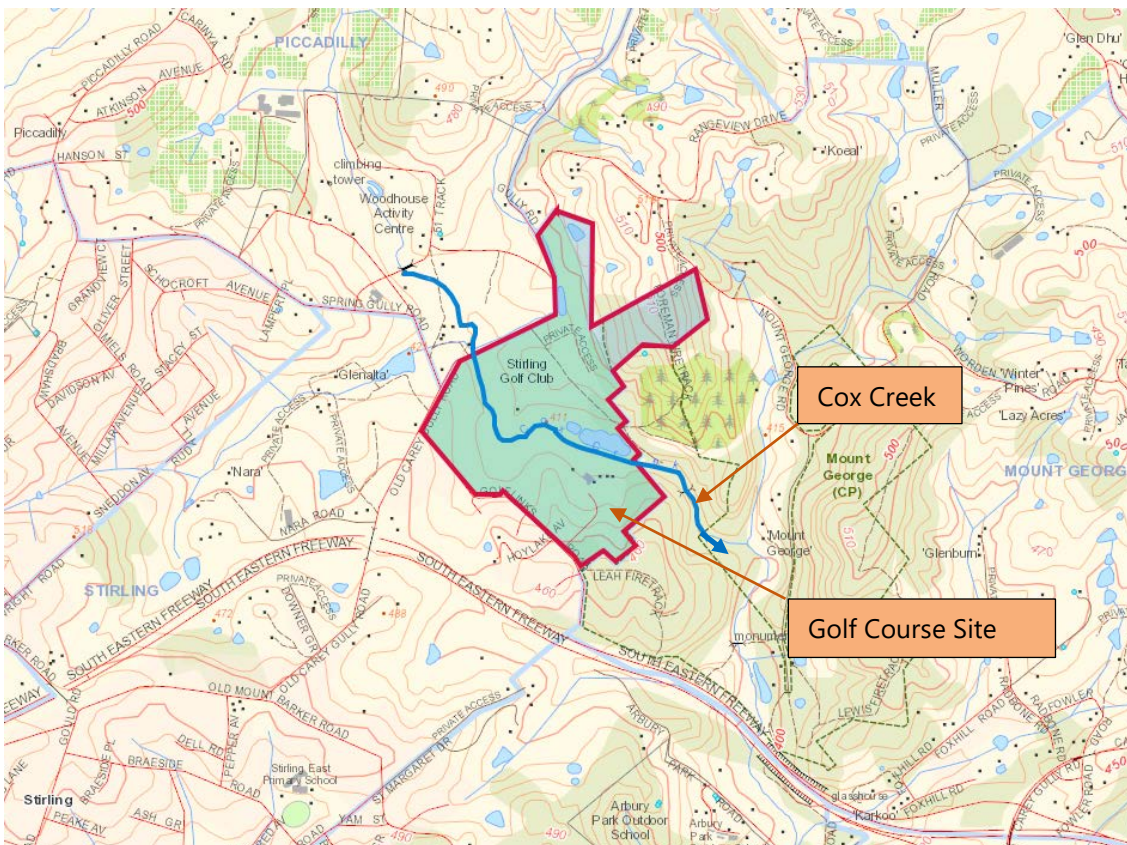


Figure 1 - Site locality plan (Nature Maps)

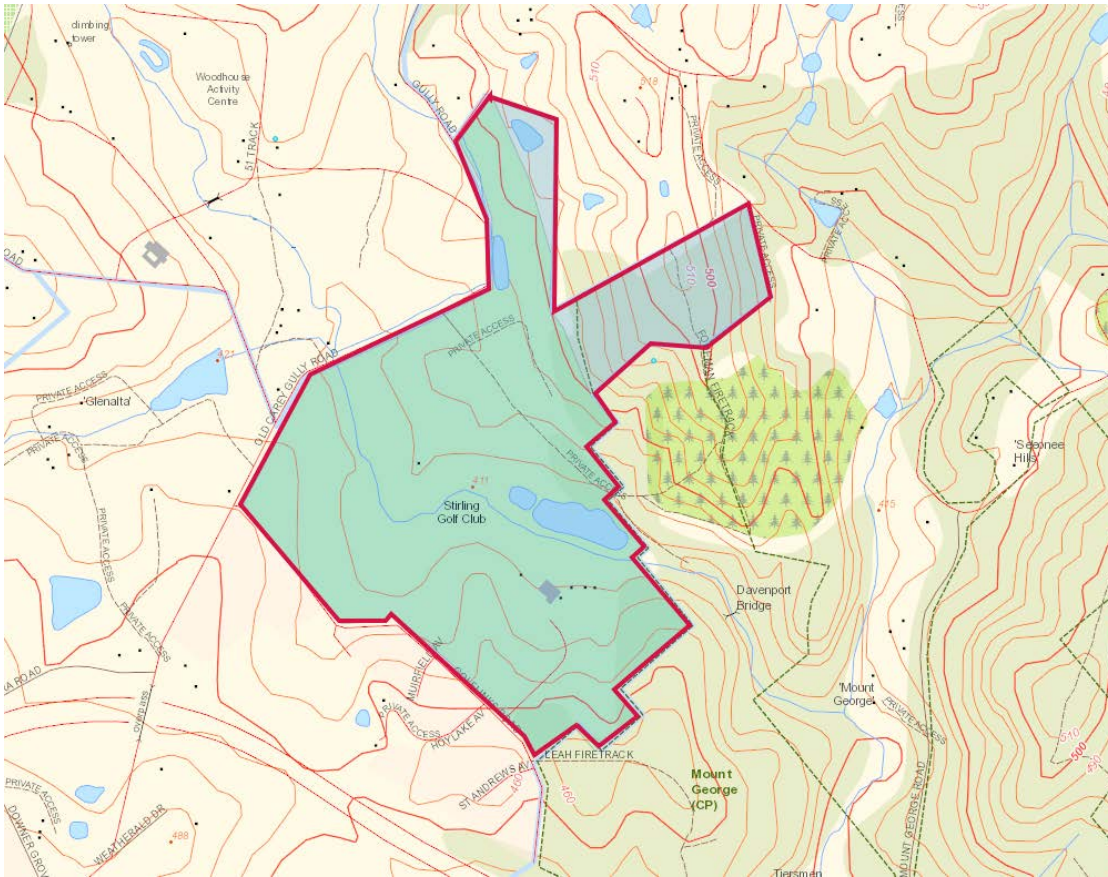


Figure 2 – Golf Course site plan (Nature Maps)

Proposed Development

The proposed development plan for this site includes ;

- Hotel - 3-5 level hotel building comprising:
 - 56 hotel suites.
 - 15 x two bedroom serviced apartments.
 - 15 x three bedroom serviced apartments.
 - 2 penthouse serviced apartments.
 - Back of house, plant storage and maintenance areas.
 - A 537m² function room.
 - A 212m² restaurant with 89 m² external terrace.
 - 186m² sports bar.
 - A 189m² gallery and cafe.
 - A 94m² wellness centre with 125m² gym and spa/massage treatment rooms.
- Private retreats – ‘Pods’
 - 17 x one bedroom units.
 - 1 x back of house Service Pod.
- Adaptive reuse of the existing perfumery:

- Refurbishment of the existing local heritage place to accommodate a multipurpose space for use as café, retail or functions.
- Extension to the Perfumery to include a covered outdoor dining area.
- Orchard and perfumery garden plantings to reimagine the former use of the building as a "Scent Factory".
- Note: the perfumery building will temporarily house the golf club whilst construction is occurring.
- Golf Course Facilities Building - 2-5 level building comprising:
 - Retention of 18-hole golf course with improvements.
 - Refurbished function facilities, cart storage and 138m² clubhouse in new building.
 - New 97m² pro-shop, administration areas, gym and change rooms.
- Car Parking, Access and Waste Management
 - A total of 200 car parking spaces in two car parking areas.
 - Emergency vehicle access via western entry from Golflinks Road.
 - Main access point via Golflinks Road.
 - Designated service bay for waste collection and service vehicles.
 - Porte cochere and valet area for guests and buses.
 - A separate entry from Old Carey Gully Road to provide maintenance vehicle access and public access to the perfumery building.
- Designated waste storage areas.
 - Subdivision – following construction of the proposed development, it is proposed to divide the site into three (3) allotments:
 - Allotment 532, with an approximate area of 9,924m² together with a right of way 'A', comprising the hotel building and pods.
 - Allotment 533, with an approximate area of 5,056m² together with a right of way 'B', comprising the golf club and facilities building.
 - Allotment 531, with an approximate area of 38.4 hectares, comprising the balance of the golf course, subject to easements 'A' and 'B'.

The current building and carpark facilities situated up the hill and to the south west of the lake have a total hard surface area of approximately 5,000m². Preliminary measurements indicate that the proposed development buildings and carparks have a total hard surface area of approximately 8,300m². This increased hard surface area of 3,300m² represents <1% of the golf course area.

Stormwater Management

Current Site Drainage

Cox Creek enters the golf course site from the north as it passes under Old Carey Gully Road and runs through the site in a south easterly direction. The creek exits the site to the east, continues in a south easterly direction and passes under the South Eastern Freeway approximately 1,250m downstream of the site.

Preliminary investigations indicate the catchment area of Cox Creek upstream of the site exit point is approximately 2,000Ha. This catchment area includes sections of Summertown, Carey Gully, Crafrers and Piccadilly and includes residential, primary production and public purpose land use areas. The approximate catchment area of Cox Creek upstream of the golf course site is shown in Figure 3.

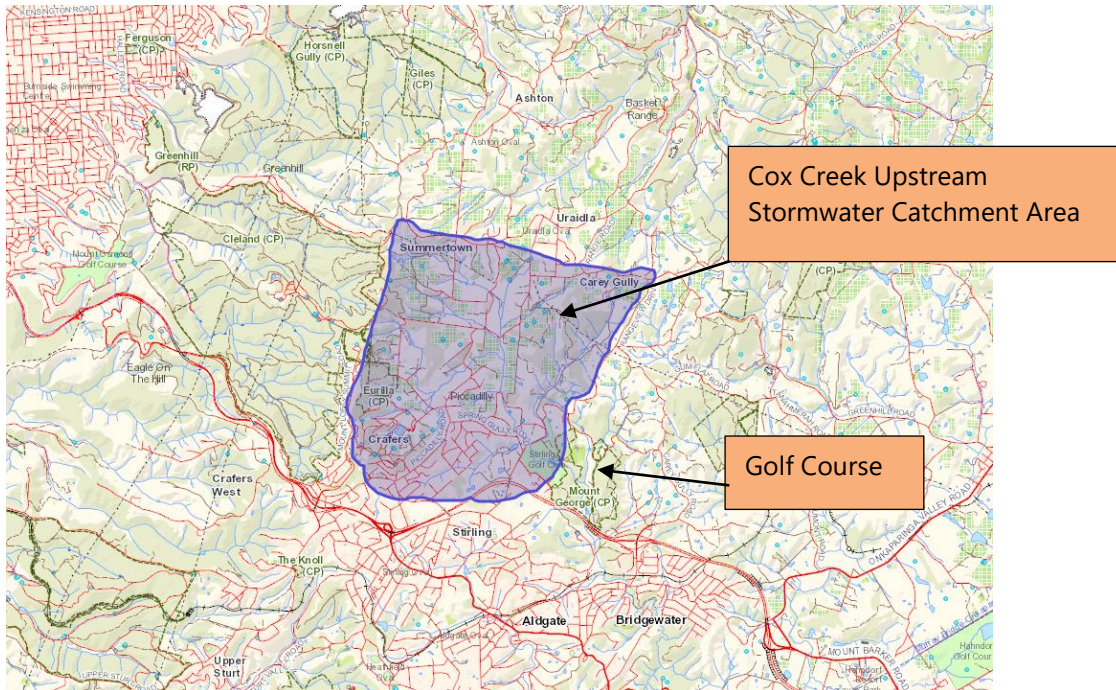


Figure 3 – Approximate Upstream Catchment Area of Cox Creek (Nature Maps)

BOM Rainfall data for Piccadilly Station 23891 indicates an average annual rainfall of 1068mm with the highest rainfalls occurring in the winter months as expected. A summary of the previous 20 years of data is provided in Table 1.

Table 1 – Piccadilly Rainfall Data Summary

Month	Mean (mm)	5 th percentile (mm)	95 th percentile (mm)
Jan	37.5	11.2	81
Feb	34.6	1.3	83.9
Mar	38.6	11.7	80.3
Apr	68.9	6.6	167.2
May	133.3	68.3	191.1
June	149	19.2	226.1
July	160.6	66.6	276.6
Aug	147.9	43.6	243
Sep	119.4	48.5	222.8
Oct	68.1	2.8	179.4
Nov	51.5	13.8	120.7
Dec	53.3	20.1	141.5
Annual	1068.6	933.1	1227.4

Source: BOM Rainfall Data 2001 – 2020 Piccadilly Station 23891

Stormwater Management Requirements

This stormwater management plan will address the following State Planning Commission requirements (with other items within the specialist reporting provided by others);

- Integrated Water Management Plan (IWMP);
 - Infrastructure for the storage and treatment of stormwater
 - Predicted stormwater generation volumes and details of stormwater quality improvements, including the location and sizing of the bio-retention swales and basins, anticipated quality improvements and details of any other proposed stormwater quality treatment features.
 - Whole site, upstream catchment and downstream stormwater discharge point
 - (balance of IWMP provided by others reporting)
- Demonstration of no stormwater nuisance or flooding to occur on downstream properties due to the development
- Compliance with Council and Natural Resource Management Board requirements

It is noted that a surface water management plan has been included within the Construction Environmental Management Plan (CEMP) prepared by FMG as a separate report.

Adelaide Hills Council Stormwater Drainage Design Guidelines for Submission of Engineering Plans for New Developments require the following to be considered;

- The designer ensure that the proposed development within the drainage reserves such as fences of facilities shall not obstruct the path of flows from major storm events
- The major drainage network shall have the capacity to control stormwater flows under normal and minor system blockage (50% blockage) conditions for an ARI 1 in 100 years
- The drainage system shall be designed to ensure that the landform of watercourses is stabilised and that erosion is minimised
- All dwellings must be protected from inundation during a flood of 1 in 100 years ARI
- The drainage system shall be designed to ensure that flows downstream of the site are restricted to pre-development levels, unless council approves increased flows
- Underground stormwater systems designed to convey the minor 1 in 10 year ARI storm event
- Minimum 300mm freeboard to the 100 year ARI flood / ponding level

Further to the above, FMG recognises the sensitive urban environment the proposed development is located within, and following feedback from the EPA during pre-lodgment meetings, understand there to be a need for a tertiary level stormwater quality system to be implemented on site which fully complies with the South Australian EPA water quality reduction targets for runoff generated by the development;

- 80% retention of the typical urban annual load for Total Suspended Solids (TSS)
- 60% retention of the typical urban annual load for Total Phosphorus (TP)
- 45% retention of the typical urban annual load for Total Nitrogen (TN)
- 100% retention of the typical urban annual load for Gross Pollutants (litter)

Stormwater Assessment

Proposed Development Drainage

Stormwater drainage of the golf course facilities situated to the south west and uphill of both Cox Creek and the existing dam / lake observed on site. Lake levels are managed through pumping of stormwater local storage ponds throughout the golf course, and is utilised for irrigation. Peak levels within the lake are managed via a weir which spills into Cox Creek when full.

Surface run off from the subject development area, and further upstream catchments drains into open drains associated with the carpark retaining wall and runs into entry pits and underground stormwater pipes. This runoff is currently diverted towards Cox Creek.

It is envisaged that where possible, existing drainage pits and pipes will be retained to minimise the construction impact of the development. Generally, the new stormwater pit and pipework will be laid within the building footprint and collect all rainwater runoff for storm events up to the minor storm event (10 year ARI) into a below ground drainage pipe. Major storm events which exceed the drainage pipe capacity will travel overland towards the north. Roof runoff will be collected into downpipes and conveyed into a rainwater retention tank (designed and documented by others with water balance calculations to support) with 100 year ARI overflows connected into the below ground outlet drain.

Discharge from the underground drain, and major storm overland flow will be conveyed into a new detention and water quality improvement stormwater basin located adjacent Cox's creek. The stormwater basin will be sized during detailed design to achieve the following performance requirements;

- Approximately 150m³ detention storage with a staged flow control (i.e. dual orifice control or similar) over the outfall to Cox's creek to limit post-development flow rates to pre-development flow rates. Detention volume will be calculated and adjusted as necessary to ensure peak outflows do not exceed pre-development flow rates for the minor and major storm events respectively.
- Minimum 300mm freeboard from peak 1% AEP storm event basin water level, to emergency overflow weir to Cox creek
- Provision of 300mm of extended duration detention depth, sized to capture and treat the 3mo ARI (4EY AEP) storm event for all runoff from the ground surface areas of the basin.
- Provision of 200micron stormwater filter baskets within all stormwater inlet pits within the development to remove
- Basin floor to be planted with effective nutrient removal native vegetation, deep filter media, transition layers and drainage layers in accordance with EPA / Water Sensitive SA best practice guidelines.
- Provision of a emergency overflow to Cox creek via a rock lined weir or similar approved to mitigate erosion and protect the existing watercourse in the event of a blockage.

Internal drainage pipe capacity requirements will be determined during detailed design of the proposed development, however as a minimum requirement all below ground pipes will be designed to ensure conveyance of the 10% AEP (10 year ARI) storm event, and a minimum pipe diameter of 225mm to mitigate the likelihood of blockages in this environment.

A plan showing the stormwater concept, with bulk elevation estimates and earthworks renders is included as an appendices to this report.

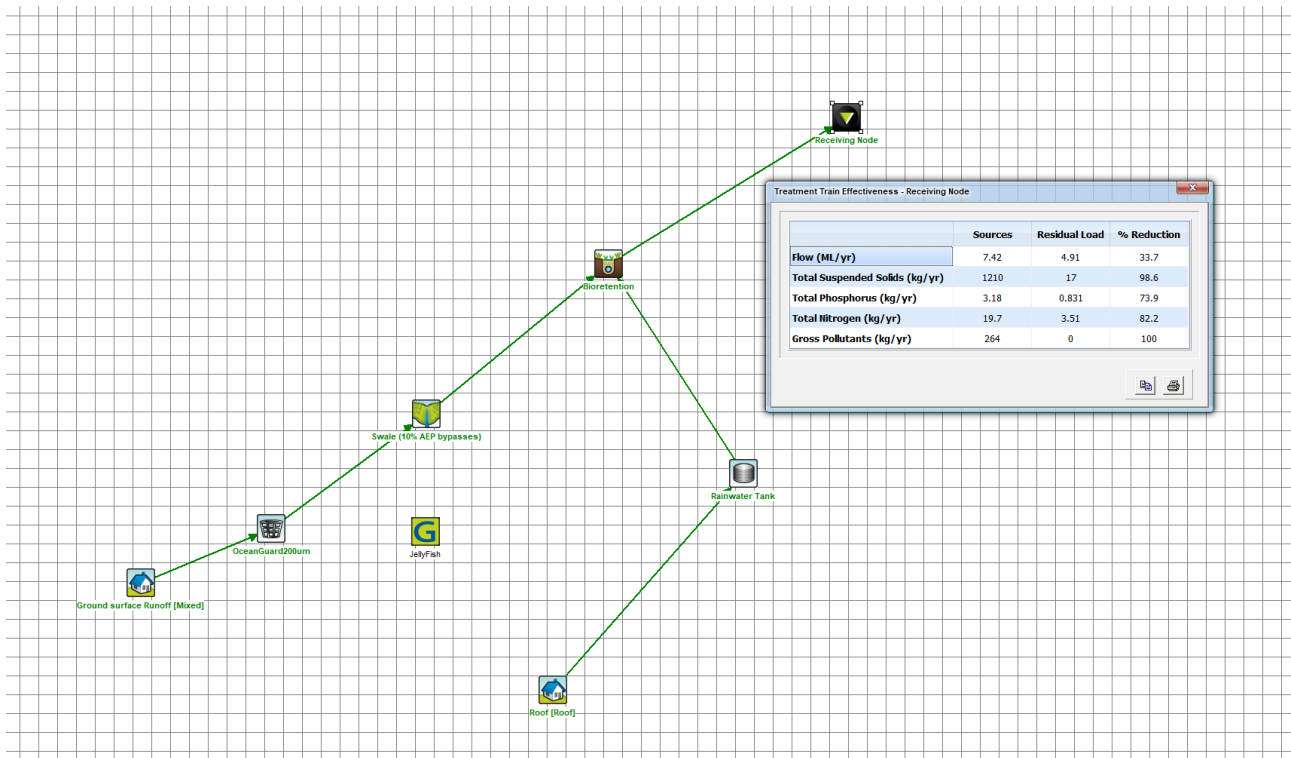
Pod accommodation

Individual pod accommodation will adopt a similar stormwater drainage scheme, with retention / detention tanks provided to each individual pod as a self sufficient unit. Discharge from these tanks will be managed via either a main collector pipe, or individual discrete outlets to the bushland which will be suitably controlled via orifice and erosion protection elements.

Roof areas approximate 70m² resulting in the need for 1-1.5m³ of stormwater detention volume per pod to restrict post-development runoff to pre-development runoff.

Music modelling results

A Music model was developed to assess the reduction in pollutants based on the proposed treatment train consisting of bioretention raingardens and grassed roadside swales. This assessment was undertaken in accordance with the Water Sensitive SA MUSIC modelling guidelines. The results of the model can be seen in Figure 9 with a summary of reductions shown in Table 1. A filter cartridge based device (Jellyfish) however was not necessary to achieve adequate water quality improvements.



Pollutant	Water Sensitive SA Target	Reduction achieved
Total Suspended Solids	80%	98.6%
Total Phosphorous	60%	73.9%
Total Nitrogen	45%	82.2%
Gross Pollutants	90%	94.1%

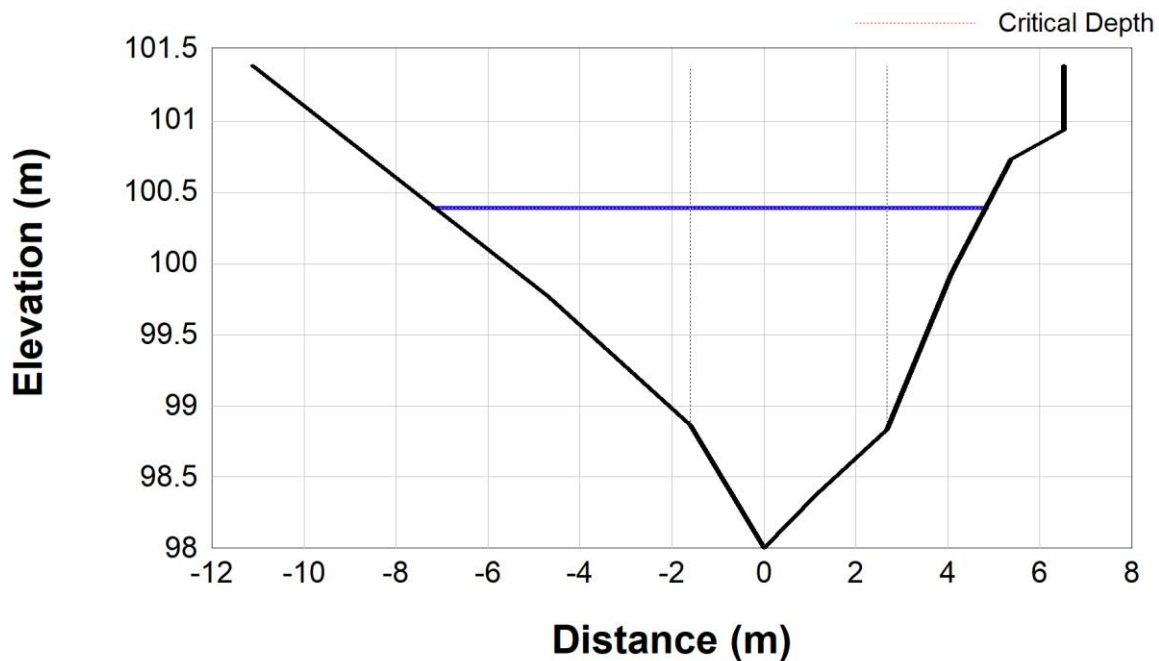
Table 1 – Summary of MUSIC model results

Cox Creek Preliminary Drain Model

A preliminary stormwater assessment was undertaken to assess required floor levels for the proposed development. The following parameters were used to develop a preliminary Drain Model using an extended rational model.

- Upstream catchment area of 2,115Ha
- Impervious area 10%, pervious area 90%
- Flow in 1% AEP major storm event of approximately 47.5m³/s
- Irregular channel cross section based on contour data

Calculations indicate the water depth in Cox Creek and the associated lake may approach 2.5m increase in height with a maximum velocity of 5m/s during a 1% AEP major storm event. According to contour plans, Cox Creek is at an elevation of approximately 412m AHD at the location directly downhill from the proposed development. The proposed development area is at an elevation between 418m – 420m AHD which is 6m-8m above the creek. An increase in creek level of 2.5m would not impact the floor level of the proposed development. The preliminary creek cross section showing an increased water level of 2.5m is provided in Figure 4.



Note that the creek invert on the model is an arbitrary datum. Elevation 98 equates approximately to the Cox Creek invert level of 412m AHD (from contour plans)

Figure 4 – Cox Creek Cross Section Preliminary Stormwater Assessment

Conclusion

This Preliminary Stormwater Management Plan has been prepared prior to detailed design and outlines the general intent for managing stormwater runoff from the site. The requirements set out in this document should be adhered to within final detailed design to ensure compliance with the requirements of the Adelaide Hills Council and EPA.

Specifically, site stormwater should be retained and detained on site to ensure post development peak flows do not exceed pre-development peak flows for an equivalent storm event. Furthermore, management and reduction of pollutants within stormwater runoff is of high importance within this sensitive environment, and EPA water quality targets must be adhered to.

Minimum finished floor levels shall be 300mm above the maximum flood level within Cox Creek, which is estimated at 414.5m AHD. Concept site plans suggest this will be easily incorporated with all structures sited around the existing development at 419-420m AHD.

Detailed stormwater design including MUSIC and DRAINS modelling will be completed to verify the performance of the drainage network in meeting the retention/detention and water quality parameters in line with Adelaide Hills Council and EPA requirements.

Appended;

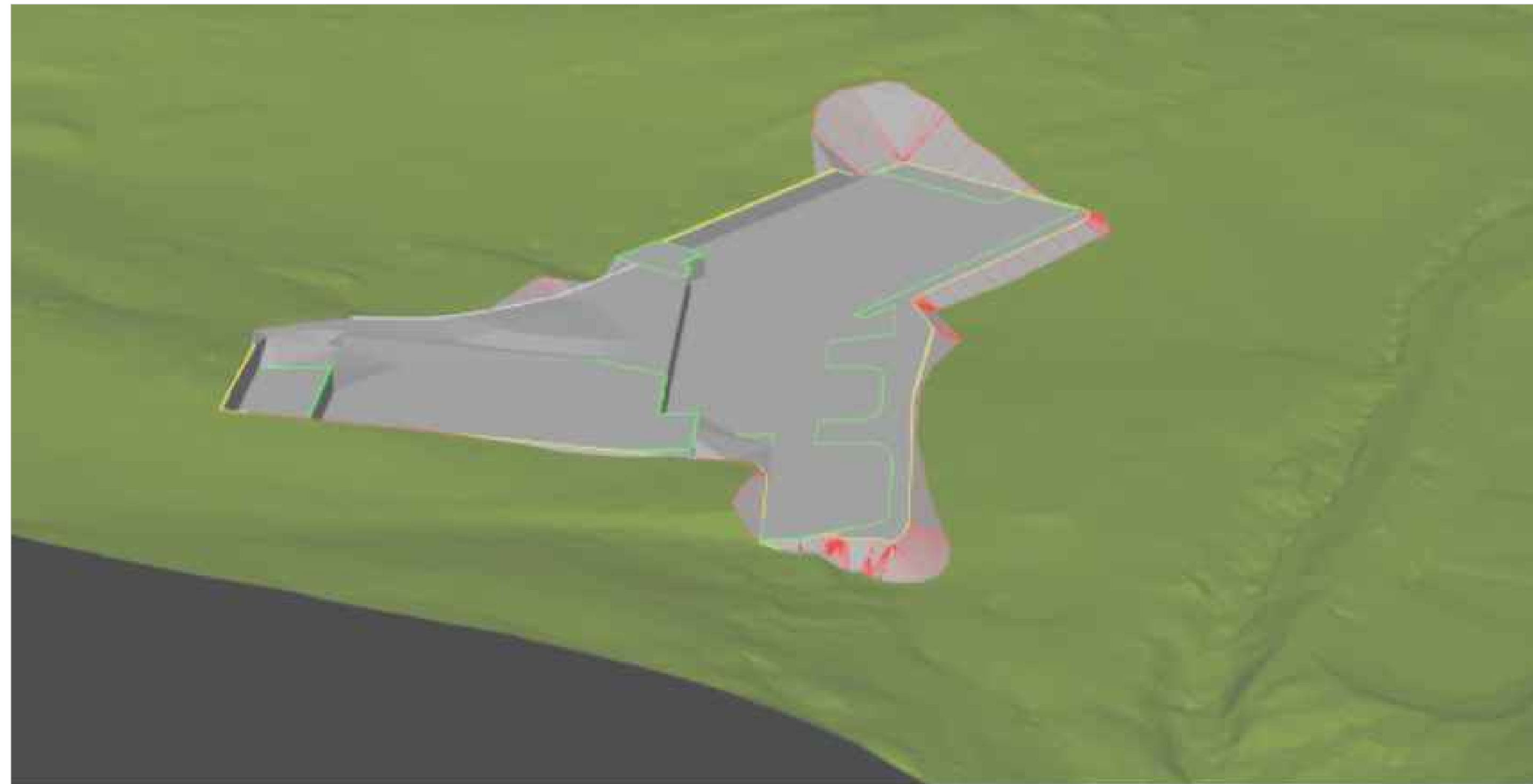
- C110 Perspective Images
- C120 Earthworks Plan
- C130 Stormwater Management Plan



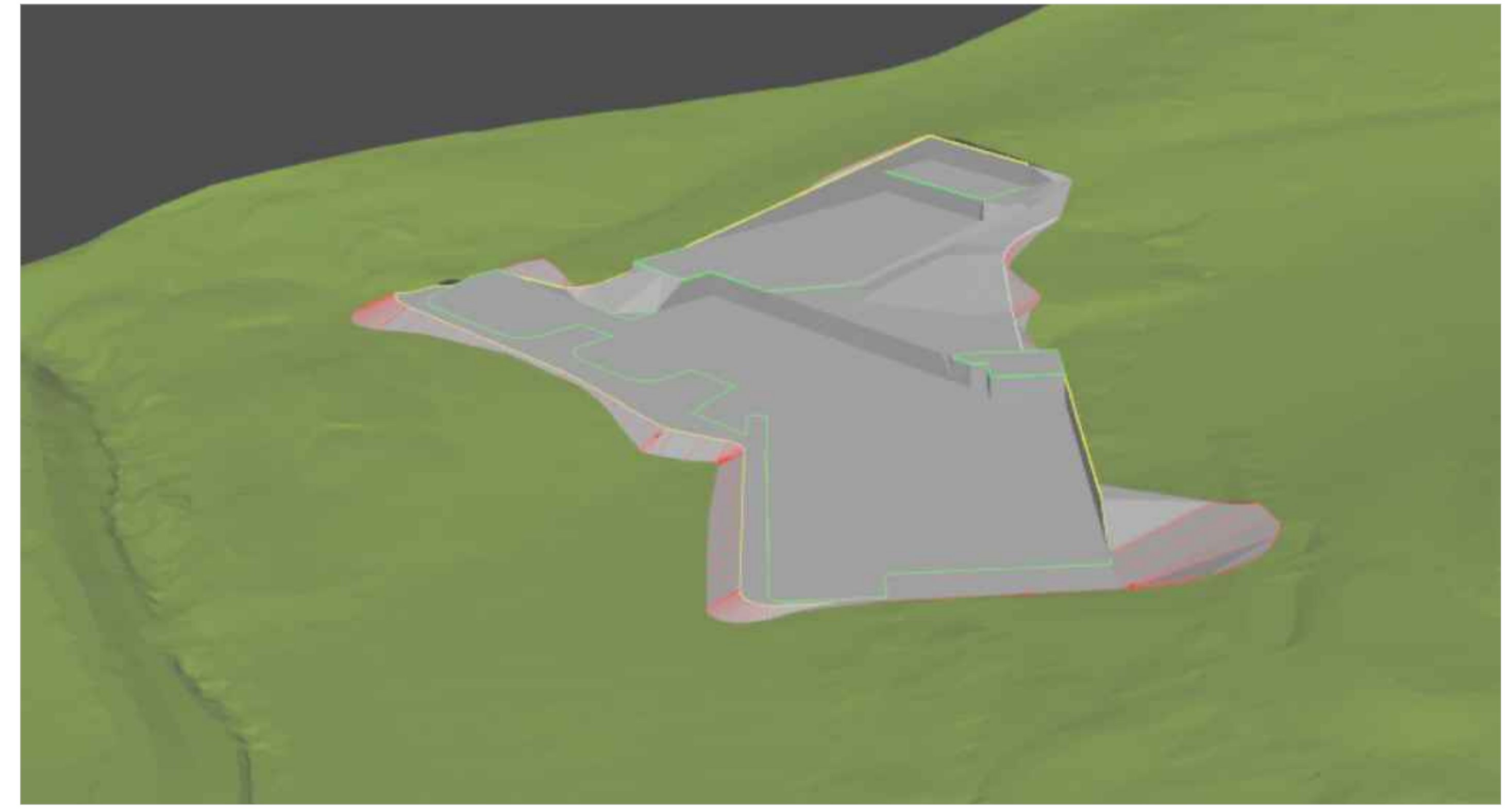
NORTH ELEVATION
SCALE NTS



SOUTH ELEVATION
SCALE NTS



EAST ELEVATION
SCALE NTS



WEST ELEVATION
SCALE NTS

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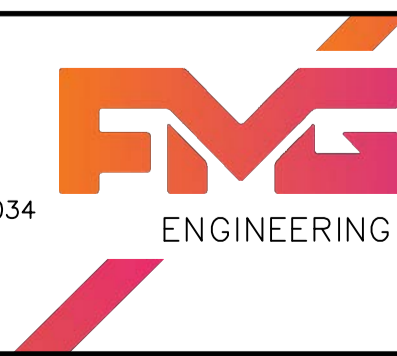
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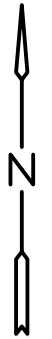
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PROJECT TITLE: MOUNT LOFTY GOLF ESTATE
SITE ADDRESS: 35 GOLFLINKS RD, STIRLING SA

DRAWING TITLE: PERSPECTIVE IMAGES

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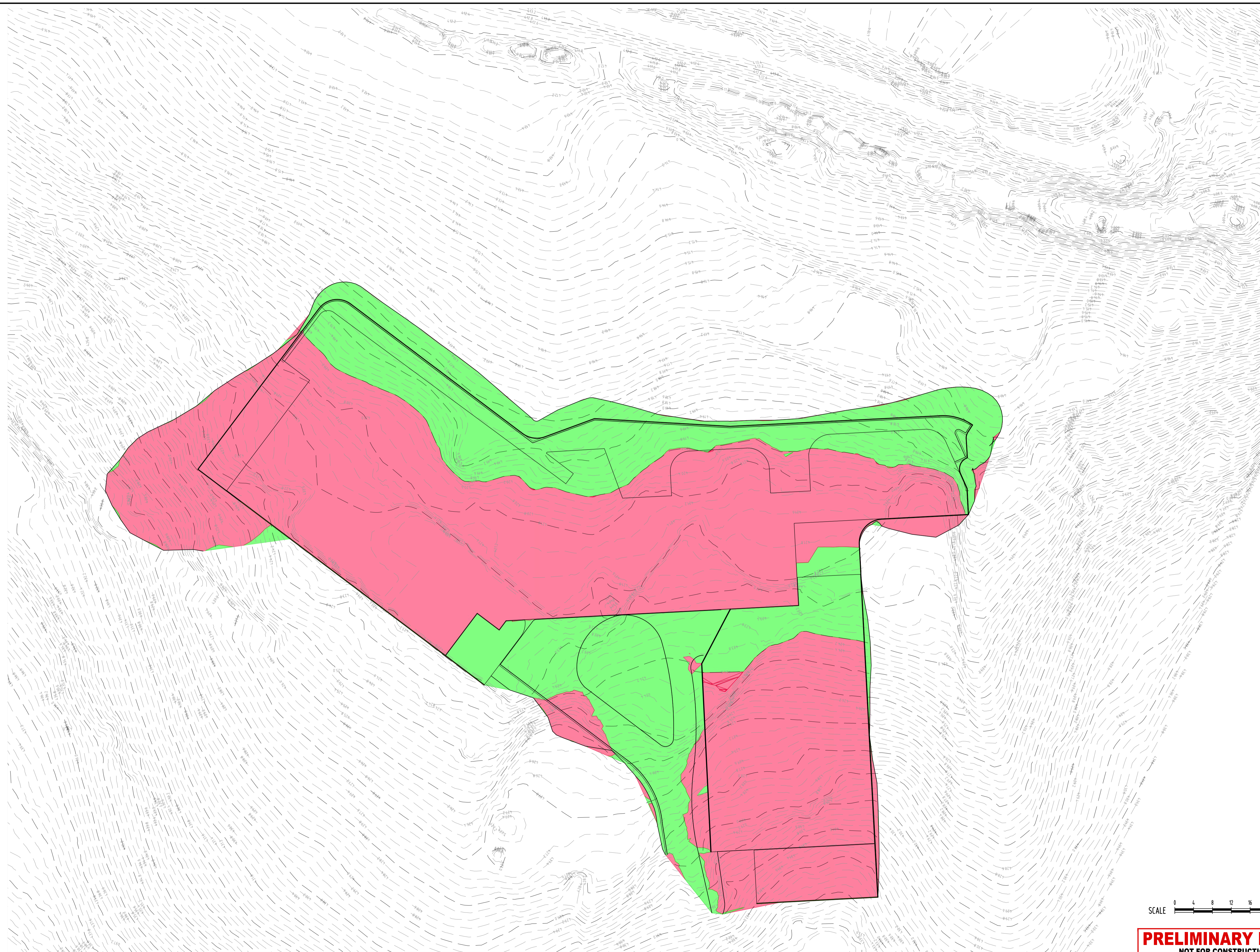
INDICATIVE EARTHWORKS VOLUMES:
 CUT = -15871m³
 FILL = 2978m³
 NET = 12892m³ EXCESS OF CUT OVER FILL

ASSUMPTIONS:
 - 100mm TOPSOIL STRIP
 - COMPACTION/EXPANSION FACTORS IGNORED
 - VOLUMES TO FINISHED LEVELS, NO ALLOWANCE FOR
 SLAB, FOOTINGS OR BENCHING AT THIS TIME.

NOTE:
 CUT/FILL VOLUMES ARE UNRELIABLE & CONTRACTOR SHALL
 UNDERTAKE THEIR OWN DUE DILIGENCE TO DETERMINE
 SUITABLE EARTHWORKS ALLOWANCES.

EARTHWORKS LEGEND

- EXTENT OF EARTHWORKS CUT
- EXTENT OF EARTHWORKS FILL



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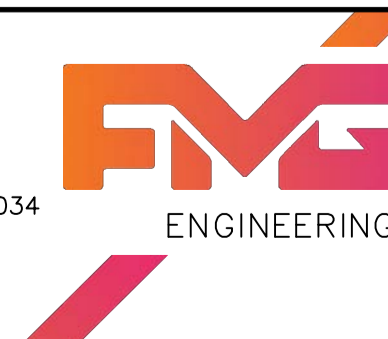
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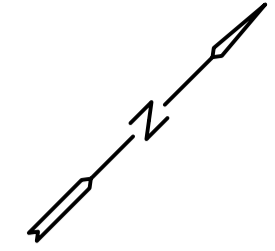


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 PROJECT TITLE: MOUNT LOFTY GOLF ESTATE
 SITE ADDRESS: 35 GOLFLINKS RD, STIRLING SA

DRAWING TITLE: EARTHWORKS PLAN

REV	DESCRIPTION	DATE	INT	APP
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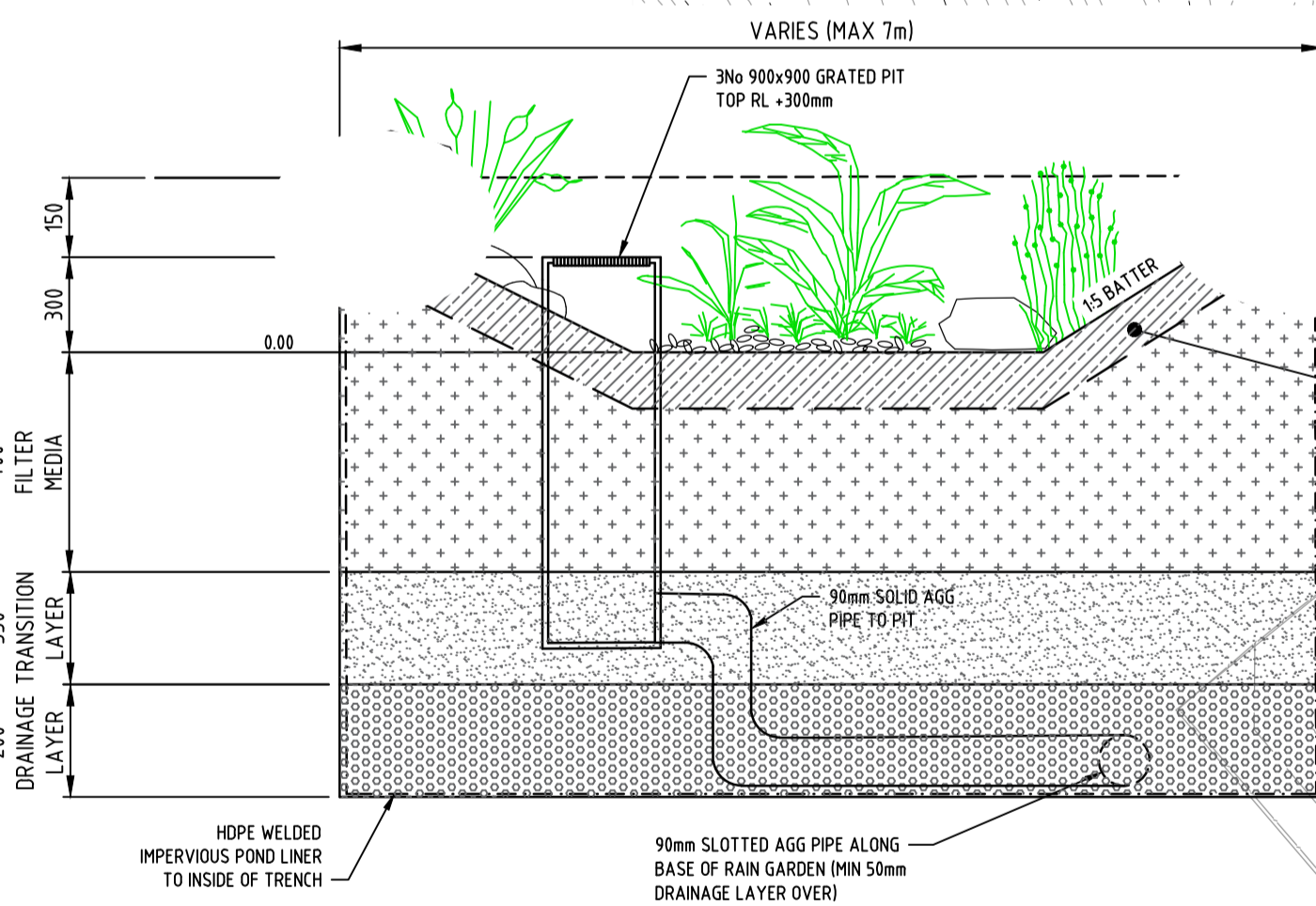
Outlet to Cox creek via concrete drainage pipe and associated headwall.
 1% AEP overflows protected via rock rip rap suitable sized to manage both site generated flows, and bypassing Cox creek
 1% AEP flood waters.

Stormwater basin
 Nominally 150m³ detention storage volume with 300 freeboard
 900x900 GIP outlet drain set 300mm above invert of basin.
 Outlet from 900x900 GIP limited via orifice plate weir within pit to restrict peak discharge post-development, back to estimated pre-development peak flow rates.
 300mm extended detention depth to retain and treat all flows up to the 4EY (3 month ARI) storm event.
 Biofiltration treatment to base of basin, planted with effective nutrient removal vegetation.

Internal drainage network designed to cater for the 10% AEP storm event

Roof drainage and overflow from rainwater retention tank piped directly to outflow control

Overland flow path shaped to ensure excess major storm runoff is diverted towards basin



RAIN GARDEN - TYPICAL SECTION
 SCALE: NTS
 REFER TO GENERAL NOTES FOR RAINGARDEN SPECIFICATIONS

SCALE 0 2 4 6 8 10 METRES

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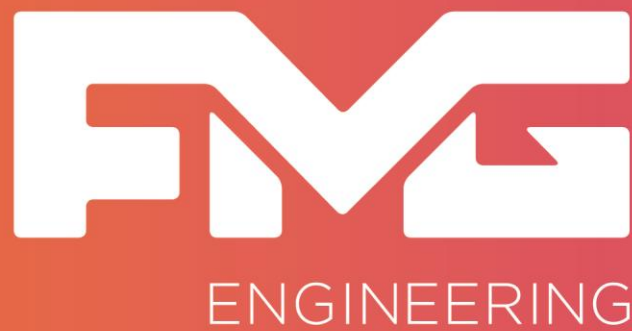
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SITE ADDRESS 35 GOLFLINKS RD, STIRLING SA	SCALE 1:400 AT A1	DATE STARTED 23.09.2022
DRAWING TITLE STORMWATER MANAGEMENT PLAN	SITE ID & JOB NO. S53897 282604	REV. --
	DRAWING NO. C130	A

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