STORMWATER MANAGEMENT PLAN

Hopetoun Park North – Western Catchments

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V01	12/05/2023	Initial Version

Climate Change Statement

A wide range of sources, including but not limited to the IPCC, CSIRO and BoM, unanimously agree that the global climate is changing. Unless otherwise stated, the information provided in this report does not take into consideration the varying nature of climate change and its consequences on our current engineering practices. The results presented may be significantly underestimated; flood characteristics shown (e.g. flood depths, extents and hazards) may be different once climate change is taken into account.

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1. Introduction

Afflux Consulting were engaged by Urban Land Developments to investigate the surface water implications for the proposed development of a collection of properties to be rezoned into Hopetoun Park North (Stormwater Management Strategy (SWS)) in mid 2020. This report set the high level drainage details for all of the properties associated with this area as described in this report.

Relevant authorities that were consulted at the time included:

- Moorabool Shire Council – Building, Planning and Maintenance Requirements
- Melbourne Water – Drainage and Waterway Interaction
- Southern Rural Water – Melton Reservoir Interaction

Background information about the site and drainage requirements in the area have been obtained from these sources where possible, however many of the outcomes for this report have been guided by the Infrastructure Design Manual (IDM, 2019).

This report is a Stormwater Management Plan (SWMP) for the **western part of the catchment only.** This area will not be a Melbourne Water Scheme – as it is under 60 hectares. This report will outline investigations that have been undertaken to determine:

- Site hydrology and localised flood extents and levels
- Flood safety in roads, channels and storages
- Outfall requirements and limitations including potential outfall upgrades
- Water quality requirements as per best practice environmental management (BPEM) guidelines
- Greater detail on outfall configuration
- Greater detail on geotechnical risks

To meet these requirements a range of hydrological, hydraulic and water quality modelling has been undertaken. The modelling in this report shows that all of the stormwater requirements can be met for this western catchment with relatively standard IDM solutions. This report has been written with significantly more detail than would generally be provided at this stage and should provide comfort that design solutions are available for the multiple approval stages that will be required for this site.

Finally, as we move towards an integrated water sensitive city, aspects associated with stormwater harvesting, potable water use reduction, and alternative water supply should be considered as part of the development. Excerpts from the Bacchus Marsh IWM will be used to inform this development.

2. Background Greater Area

The strategy area originally assessed approximately 150ha including both developable and non developable land. At this stage the status of the eastern portion is not part of this assessment, and as such this report concentrates on Property 1, Property 9 and Property 2 only. For completeness, the greater strategy area is described here, but this should not be read as an endorsement or investigation of the greater area.

The area is bounded by the Western Freeway to the north, Djerriwarrh Creek to the east, Pyrites Creek to the west and low density development forming Hopetoun Park to the south. The properties are undulating with areas of existing storage and some farm drains present across the site as will be discussed.

The area is intersected by Hopetoun Park Rd, forming the highpoint of the site with properties sloping generally south west and south east respectively. Steep embankments for the existing flow paths to the gullies and waterways make outfall arrangements important and will be discussed in detail in this report. This study only addresses the western area as shown in blue.

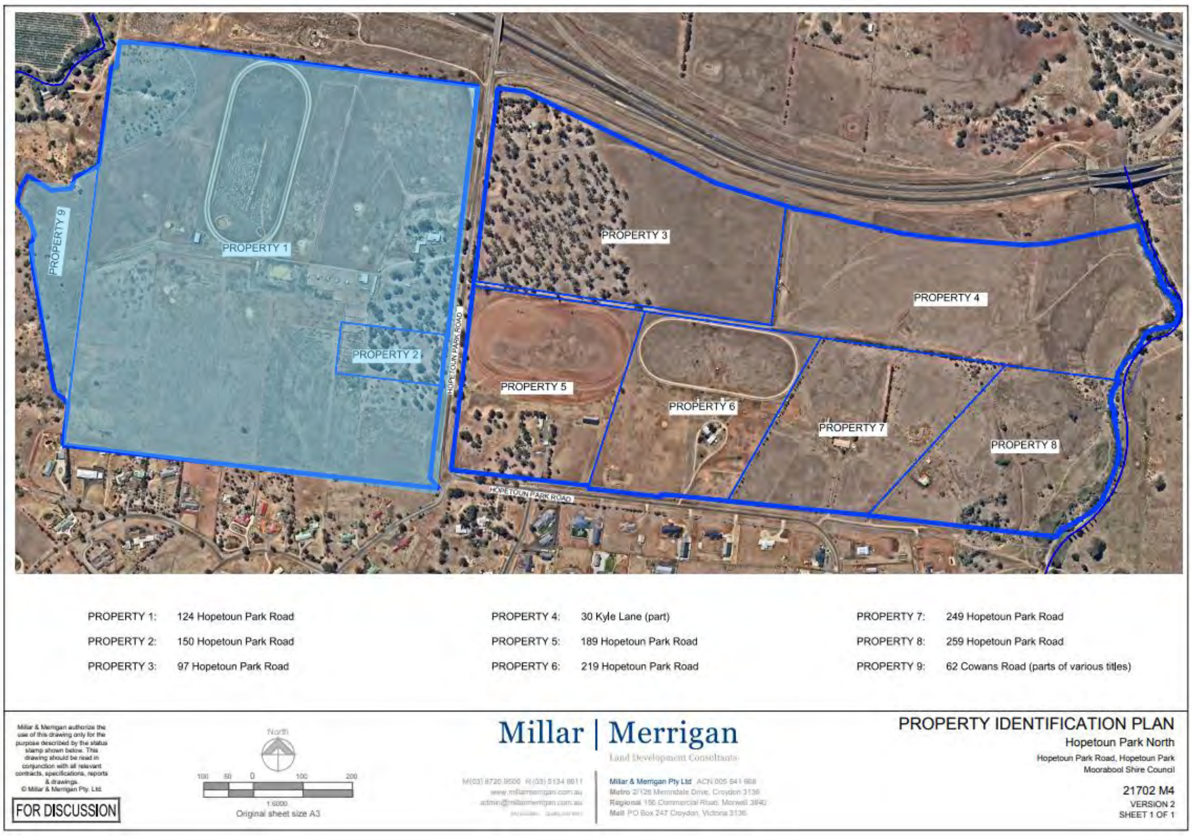


Figure 1. Aerial of Site

2.1. Information Sources

A number of information sources have been used in the formation of this report, these include:

- DEPI planning scheme and cadastral information as accessed online June 2020
- Lidar Data sourced Commercially
- Survey of Property 1 and Hopetoun Park Rd by Millar Merrigan

2.2. Site Visit

A site visit was conducted on the 27th of May 2020. Key drainage features are shown below.

South-west outlet of Property 1 – Pyrites Crk

South-west outlet of Property 1 – Basin Location

Looking west from Hopetoun Prk Rd

North West outlet of Property 1

Figure 2. Site visit

Site Controls

There are no direct site controls of flood management concern with this site. The current hydrology is directed to a number of site dams, or discharges to the gullies at the north western and south western corners of the land. These gully outlets are expected to have a limit on flow capacity (see geomorphology reports), whether piped or overland and will be considered in this report.

3. Catchment Design Objectives

All development has the potential to adversely affect downstream environments through the effects of stormwater runoff. Increased impervious areas resulting in increased volumetric and peak flows have been extensively researched and linked to downstream environmental degradation. Contaminants contained in the runoff have also been linked with adverse changes to both water quality and stream ecology. Finally, the contribution of increased runoff can be linked to downstream flooding and capacity constraints.

To combat these affects a range hydrological and water quality mitigation measures have been researched and legislated in Victorian planning schemes. The design objectives for this catchment are considered below.

General Considerations

The Victorian State Planning Policy Framework includes provisions incorporating the provisions for stormwater management in its integrated water management clauses.

Water Quality Requirements

Current water quality requirements as listed by the Victorian EPA Best Practice Environmental Management (BPEM) Guidelines are:

- 80% Total Suspended Solids (TSS) reduction
- 45% Total Nitrogen reduction
- 45% Total Phosphorus reduction
- 70% Gross Pollutant capture

Flood Storage Requirements

New developments are typically required to be designed to ensure that flows are not to increase above the pre-development levels. Generally, this would be applied to the 100-year Average Recurrence Interval (ARI) storm only and checked at each of the site discharge points. Given the proximity to the major water storage, Melton Reservoir, flood storage is not a major environmental concern. The capacity and peak flow stability of the out falling gullies will however be the key constraint to flood storage. Southern Rural Water have agreed to this approach.

Flood Protection Requirements

All lots within the development will be provided at least 300mm freeboard above any predicted 100-year ARI flood level. All retarding basins will be designed to be cut into the natural surface where possible to avoid any potential dam wall construction issues.

Ecological Objectives

A number of ecological studies have been completed for this area, and should be referred to for comprehensive coverage of issues. .At this stage the waterways and treatment systems have been nominated to compliment any existing major vegetation areas. More broadly the sites will discharge into the Melton Reservoir, and as such a particular focus on site derived nutrients should be given.

Specific Challenges

A number of catchment specific challenges have presented themselves in the review of the site. These include:

- The site topography results in steep outfall conditions, posing challenges in reducing stormwater velocity and flows at the outfall of site

- The climate in this location will promote significant drying of the water storages. The design of these systems to deal with these wetting and drying cycles will be critical to their future success. From the outset a preference for a wetland treatment highlighted from this point.

These challenges are noted as they are unique to this stormwater management plan and will be addressed as part of this document.

4. Hydrology

The hydrology for this site has been updated into a RORB model as per request from authorities. The model was calibrated to the previous (SWS) hydrology.

4.1. Catchment delineation and reconciliation

As the internal area of the site is relatively flat, catchments have been determined based on clear existing site outfalls and logical division of developed catchments based on property ownership as well as topography. Figure 3 outlines the major catchment areas and existing and developed fraction imperviousness.

To maintain the internal consistency with the SWS, the hydrology calibration has been adopted, as such all four catchments described in this section. The existing catchments, shown in Figure 4, show four major site outlets with a significant central section of the site discharging towards the existing development to the south. Note again that this report is for the western portion only.

The preference of the strategy was to consolidate all site flows to four well defined site outlets shown in Figure 4 (two main outlets for western portion shown only). This simplifies treatment of all site outflows and reduces flooding risk in the downstream areas. It also simplifies the geomorphological interactions, allowing for precautionary engineering solutions. The site has therefore been considered to consist of four major catchments with relevant sub-catchments based on internal expected topography and road alignment. There is significant independence between the eastern and western catchments, however high interdependence within these two macro divisions.

The current existing catchments are shown in Table 1 , along with the revised Western developed catchments.

Table 1. Existing and developed catchment summary

Outfall	Existing Catchment (ha)	Existing FI	Developed Catchment (ha)
North-West	21.6	0.05	9.9
South-West	14.5	0.05	50.8
North-East	11.9	N/A	N/A
South-East	25.4	N/A	N/A
Central	64.4	N/A	N/A

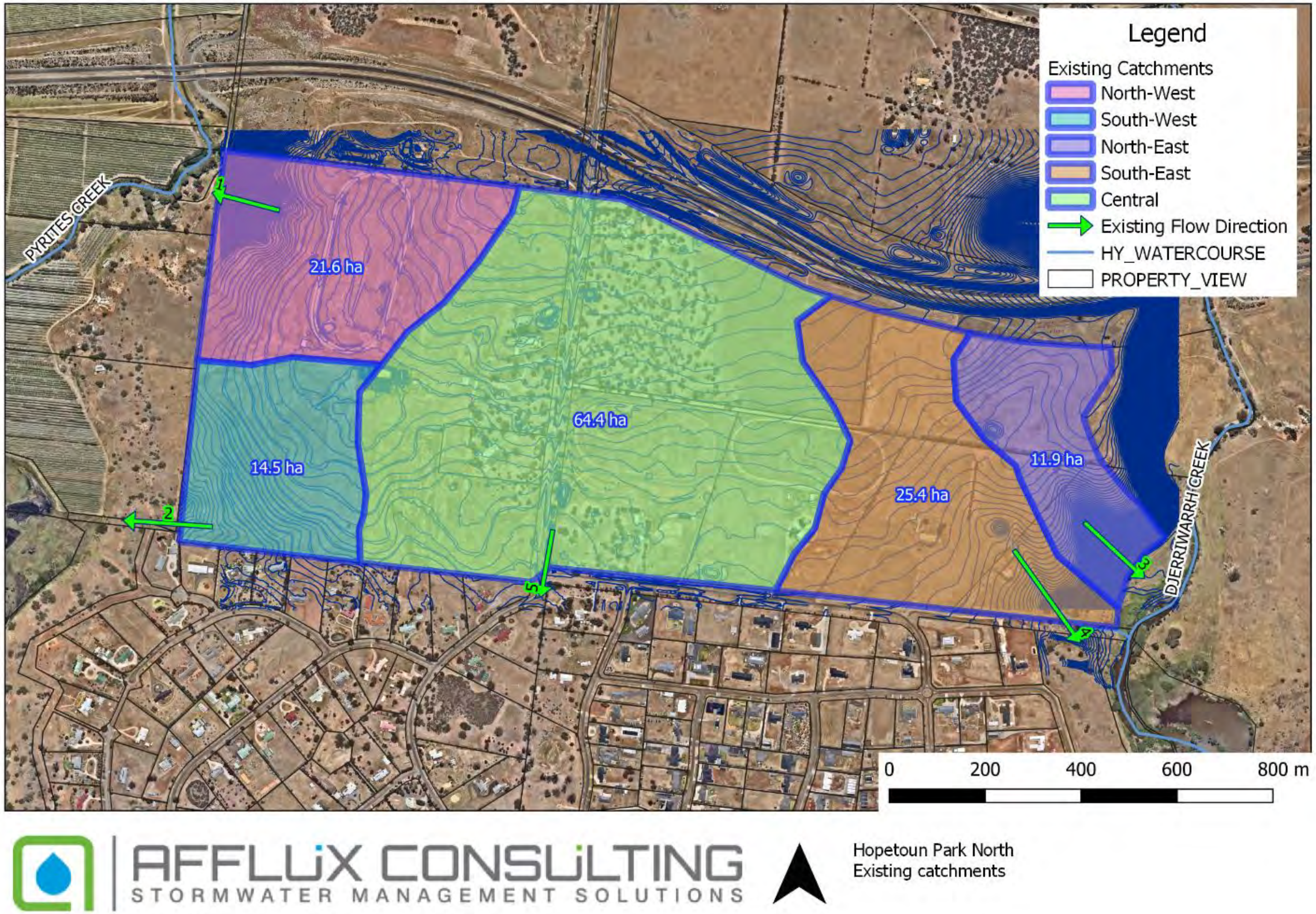


Figure 3. Existing Catchment Area contributing to site discharge points (note only western catchments to be considered here)

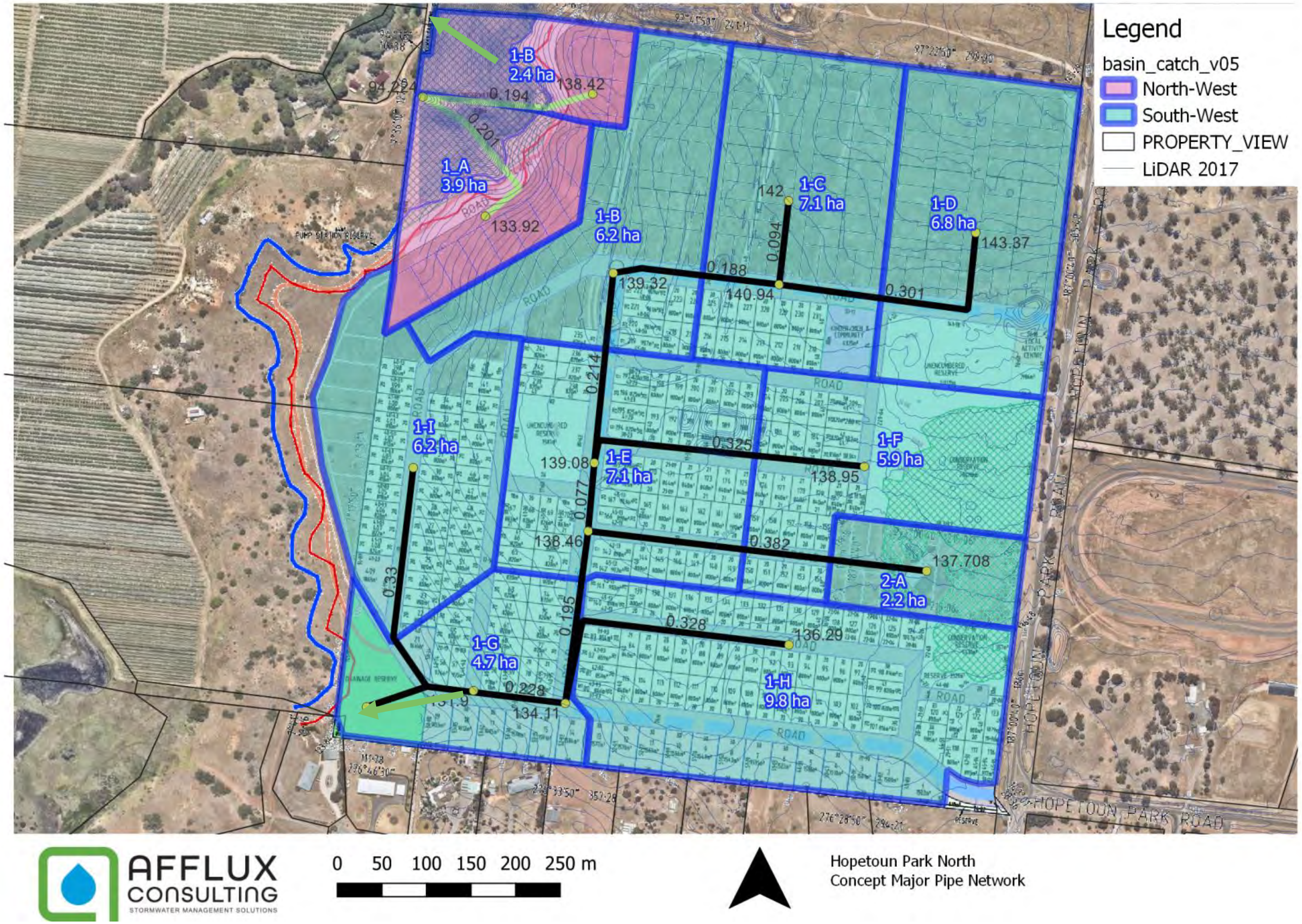


Figure 4. Proposed Development Catchment Area for West only (note subdivisional plan indicative only)

4.2. Existing Conditions flow reconciliation

Several methods were examined and compared, to provide a range of probable existing peak flows at the catchment outlets. These methods include the Rational Method, regression curves, and various calibration values advised for DRAINS and RORB.

The following section summarises the peak flows calculated using these methods. The ultimate hydrology method selected should be in accordance with current hydrological estimation methods of Australian Rainfall & Runoff 2019 (ARR19).

Rational Method

Rational Method estimates were used to estimate the peak 1% Annual Exceedance Probability (AEP) flows. The Adam's formula for rural Victorian catchments was the preferred method of calculating the time of concentration for this site. Intensity Frequency Duration curves for Hopetoun Park North were used (Figure 5).

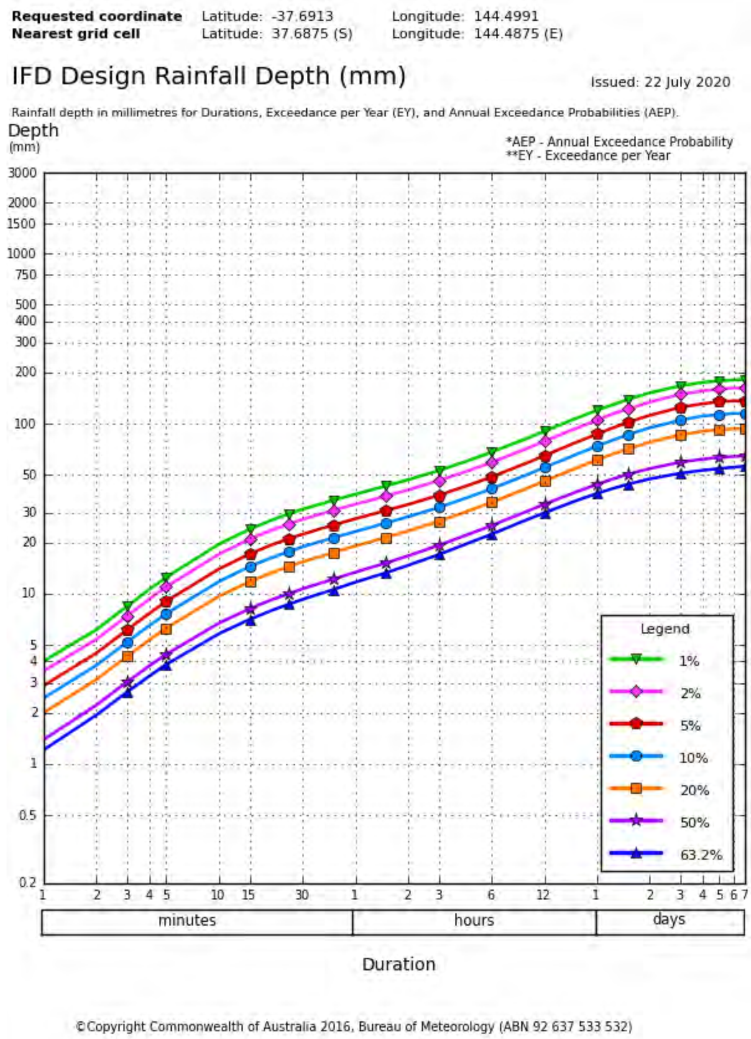


Figure 5. Intensity Frequency Duration curves for Hopetoun Park North

The rational calculation results are included in Table 2.

Regional DSE Regression Curves

Another comparison flow rate is the data set known as the DSE Regression Curves for 105 sites either side of the Great Dividing Range in Victoria. Historical data for events approaching or exceeding the 1% AEP events were collated as can be seen in Figure 6. The results for each catchment are shown in Table 2.

Rural Catchments 4.67A^0.763

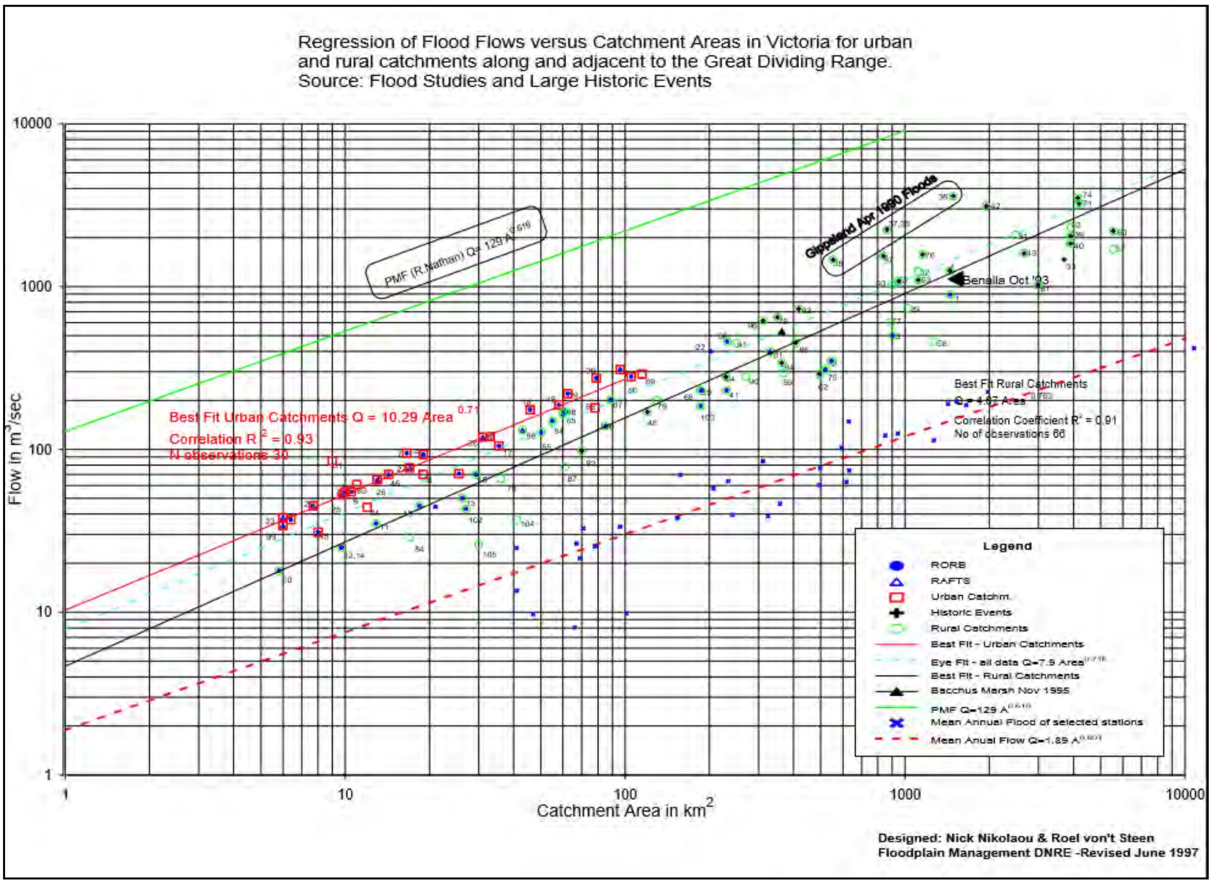


Figure 6. DSE Regression Curves

DRAINS Modelling

A DRAINS model of the site was formed to gauge the peak flows and estimated storage volumes required. A DRAINS model was selected over the traditional RORB model in this catchment due to the varying flat and steep flow paths and small catchments (Rorb averages slopes, and is calculated in km²) . Any solution requires a detail analysis of these outfalls, and in this case a combined hydraulic and hydrologic model was justified.

The model splits the two catchments into multiple sub catchments to replicate ownership and staging assumptions. The model setup is shown with existing conditions results in Figure 9 below.

The ARR Data Hub was used to provide recommendations for losses as shown below. The ARR16 tool estimates losses and reduction factors using the information from Data Hub.

ARR Data Hub Pervious Losses

Initial Loss = ***15 mm***

Continuing Loss = ***1.1 mm/h***

In this case, the supplied losses were taken as a starting point for the flow reconciliation undertaken in the following section. These losses resulted in much higher flows than expected from previous checks. In an attempt to rationalise these flows more to the calibration, the final estimated loss factors are shown in Figure 7. Although these losses still result in higher than expected flow estimations, they are closer to expected values and represent a conservative estimation with ARR19 methodology.

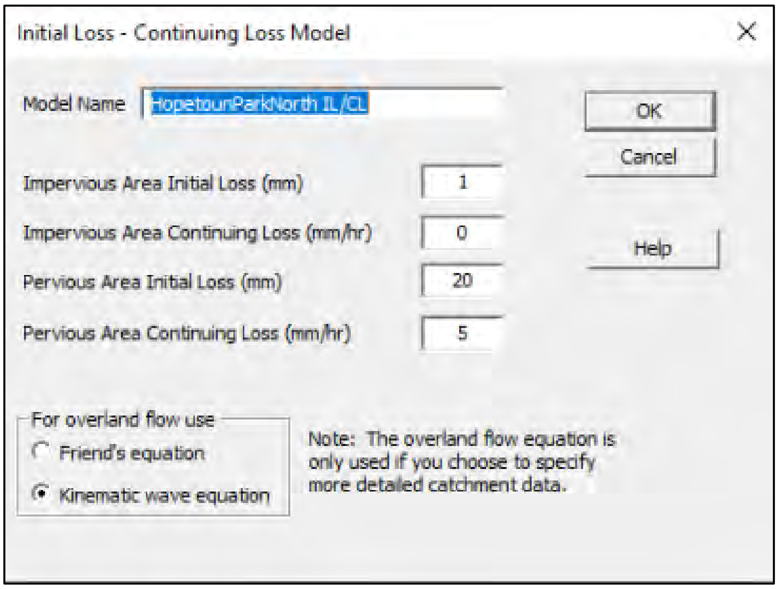


Figure 7. Revised loss model

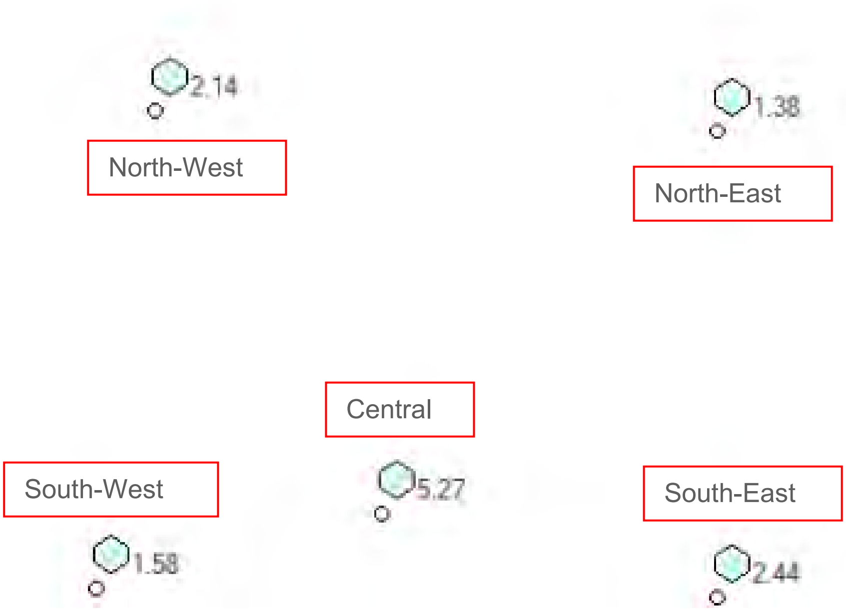


Figure 8. Drains Model Layout and Existing Conditions peak flows

Typical model catchment assumptions are shown in below. The full ensemble of storms and temporal patterns was run from 5 minutes to the 30 hours as per ARR19. The maximum of all average flows was accepted as the peak flow for the existing and developed scenarios. Results are shown in Figure 8 to Figure 11 below with the peak flow values highlighted below. As can be seen, this ARR19 methodology has resulted in a higher estimated existing flow – probably associated with the longer Tc and temporal pattern variabilities (initial TC based on Adams Estimate).

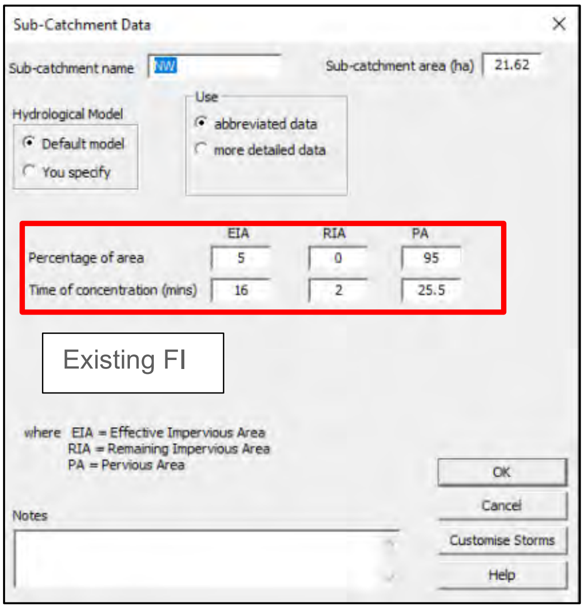


Figure 9. Assumed Catchment Conditions

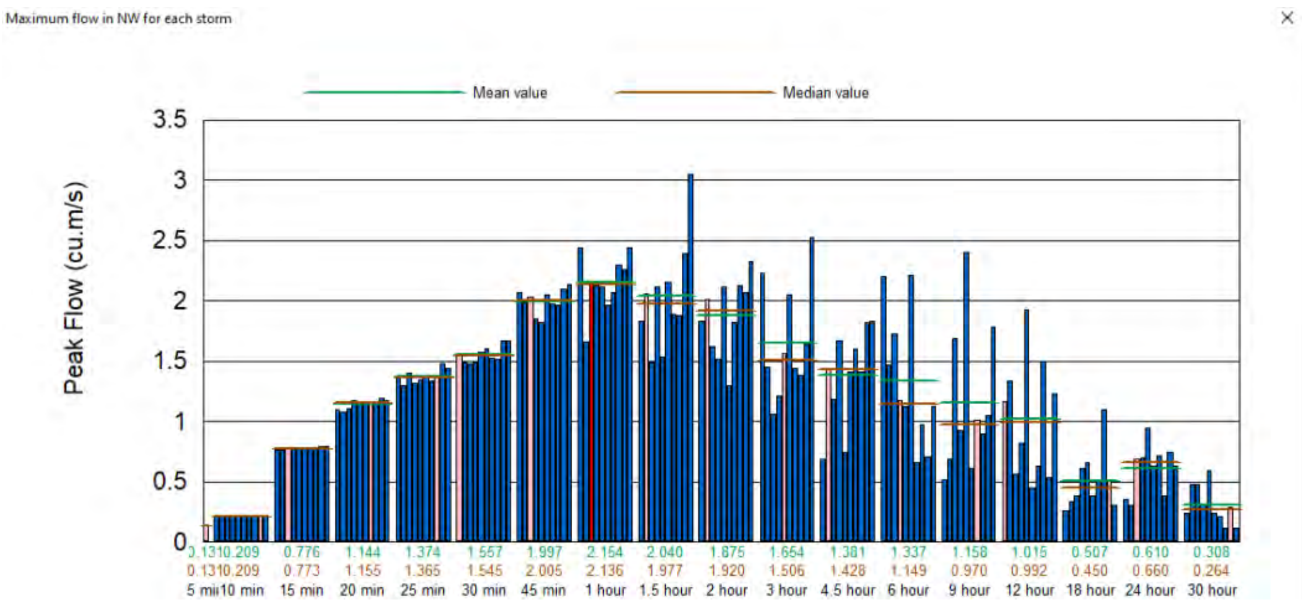


Figure 10. North-West Catchment - Existing Conditions Flows 1% AEP

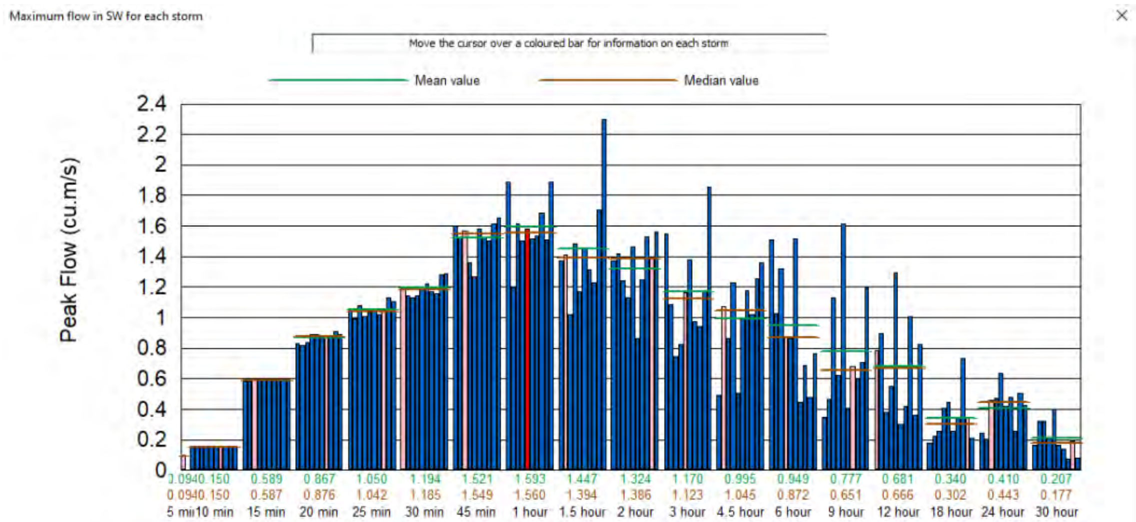


Figure 11. South-West Catchment - Existing Conditions Flows 1% AEP

RORB Model Western Catchment Development

On request by Council and Melbourne Water, the hydrology model has also been contructed in RORB. Generally, for catchments this small RORB models begin to become difficult to calibrate given the resolution of catchment size. RORB catchments are created in km² areas, and as such small catchments run out of significant figures. Regardless, an Existing conditions model has been created as detailed below in Table 2 and Figure 12. Derived flows are shown in Figure 13 and Figure 14

Table 2. Rorb Model Calibration Parameters

Rorb Model Parameter	Value	Comment
Kc	1.34	Rorb Default Kc – gives reasonable estimates
M	0.8	Default Value
Initial Loss	15	75% median loss applied/ Full loss applied
Continuing Loss	1.1	As per Data Hub

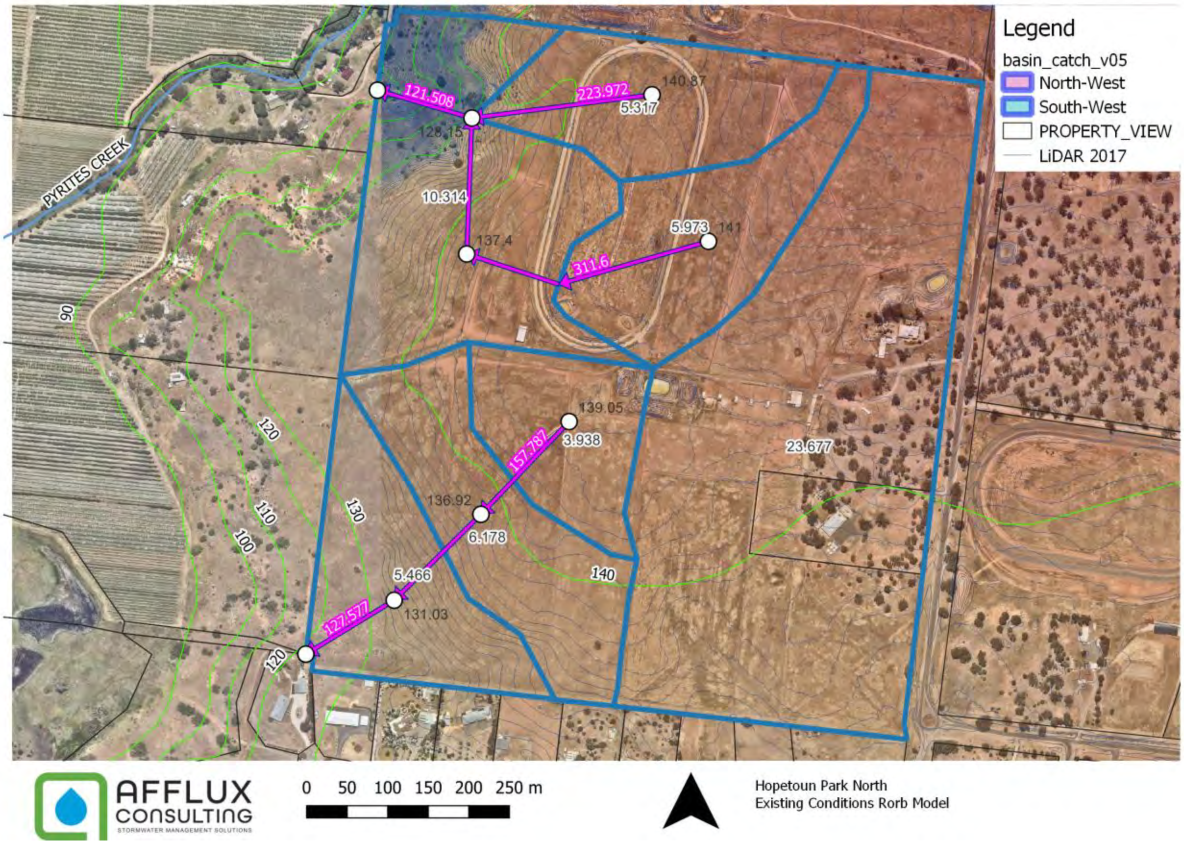


Figure 12. Existing Conditions Rorb Catchment Model

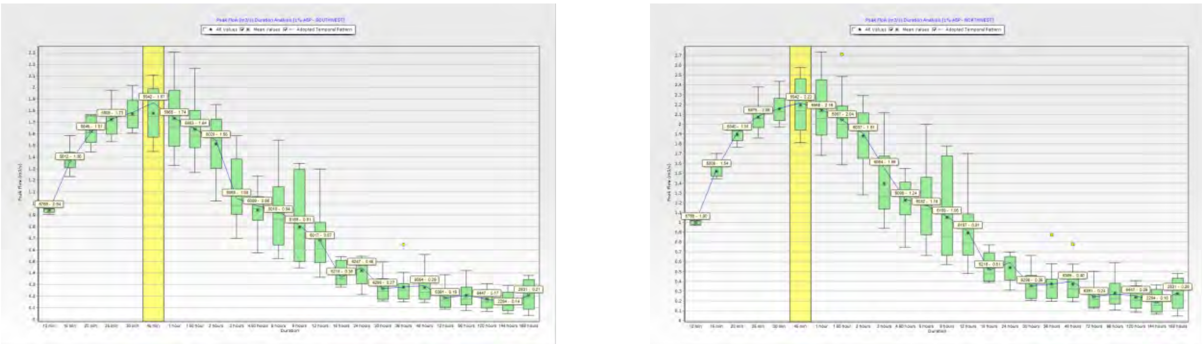


Figure 13. Existing Conditions Rorb ARR19 Box Plots 75% IL

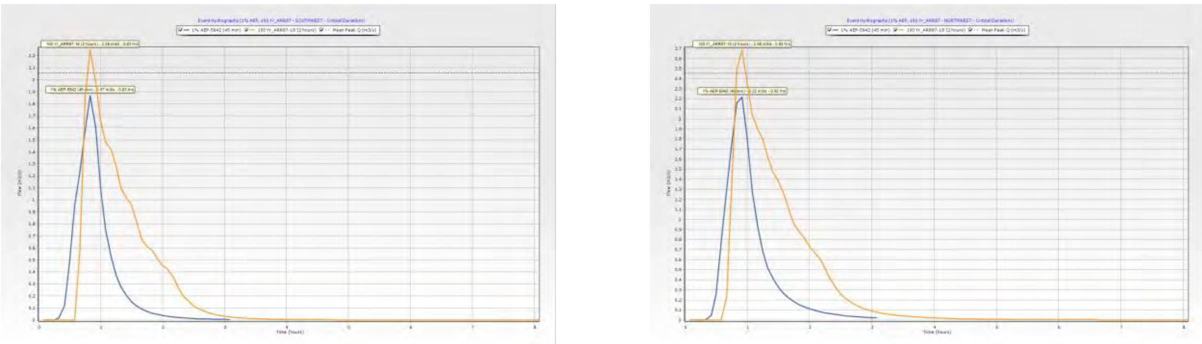


Figure 14. Existing Conditions ARR19 and ARR87 Comparison Flows 75% IL

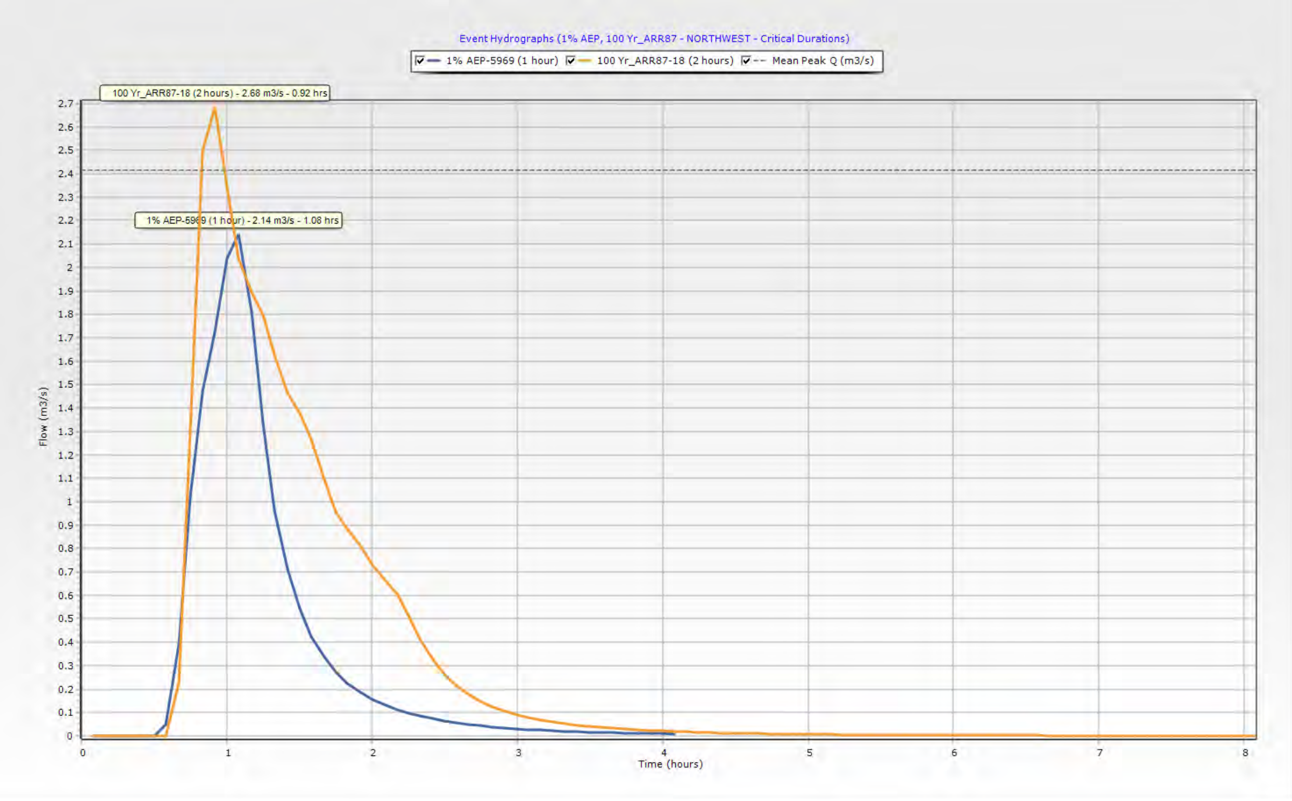


Figure 15. Existing Conditions NW Catchment Full IL

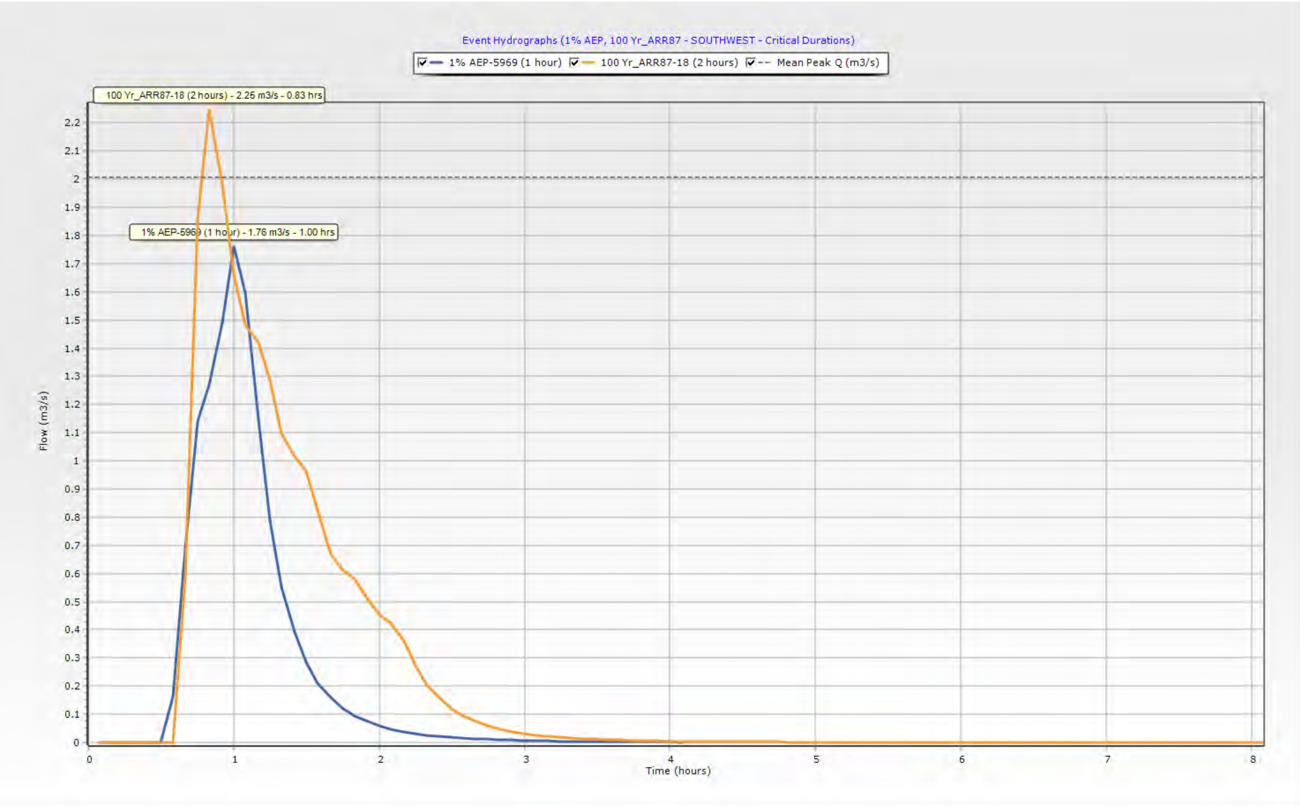


Figure 16. Existing Conditions SW Catchment Full IL

4.2.1. Hydrology Discussion

As discussed in the SWS, this area provides some difficulty in assessing the best hydrological fit for flows generated from the existing catchments. As pointed out in the SWS, *"It is suspected and it is born out in the modelling, that this region is on the edge of both hydrological isopleth and significant soil losses. This is conclusion is supported in both the vegetation seen on site, and general lack of surface water. Given this, the larger than normal loss models are probably still conservative*."

The RORB models for the site were reconciled with this in mind, and using full losses and the ARR19 temporal patterns a reasonable fit has been found using the default RORB Kc. A number of other Kc approaches were considered including Pearce and MAR<800mm, but were found to produce much higher flows than this approach. Given the results in Table 3, and the information in the SWS, the below highlighted flows (and subsequent calibration parameters) were adopted.

Table 3. Reconciliation of RORB model to existing peak 1% AEP flow estimations

Catchment	Size (ha)	Rational Calc	DSE Regression	DRAINS DataHub Losses	DRAINS Revised Losses*	RORB ARR19 75%IL	RORB ARR87 75%IL	RORB ARR19 100%IL
North-West	21.6	0.9	1.5	2.8	2.1	2.2	2.7	2.1
South-West	14.5	0.7	1.1	2.1	1.6	1.9	2.2	1.7
North-East	11.9	0.6	0.9	1.7	1.4	N/A	N/A	N/A
South-East	25.4	1.0	1.6	3.1	2.4	N/A	N/A	N/A
Central	64.4	2.0	3.3	6.4	5.3	N/A	N/A	N/A

*SWS, 2020 Adopted DRAINS Calibration

4.3. Developed Conditions Flows

The developed flow conditions were modelled for the reconciled Rorb model. The developed catchment model can be seen in Figure 17, with reaches and Fraction Impervious levels adjusted in line with the development. The model Kc was adjusted through the Kc/Dav ratio and the model re-run for all storms 15m through 96 hours. The model flows and results are shown in Figure 18 through Figure 20. Note the extremely steep NW catchments significantly influence the peak flow.

Table 4. Development Rorb Model

Rorb Model Parameter	Value	Comment
Kc	2.07	Adjusted Kc/Dav ratio
M	0.8	Default Value
Initial Loss	15	Full loss applied
Continuing Loss	1.1	As per Data Hub
Reaches (black)	Type 3	All roads and development reaches.
Reaches (green)	Type 2	Excavated but unlined.

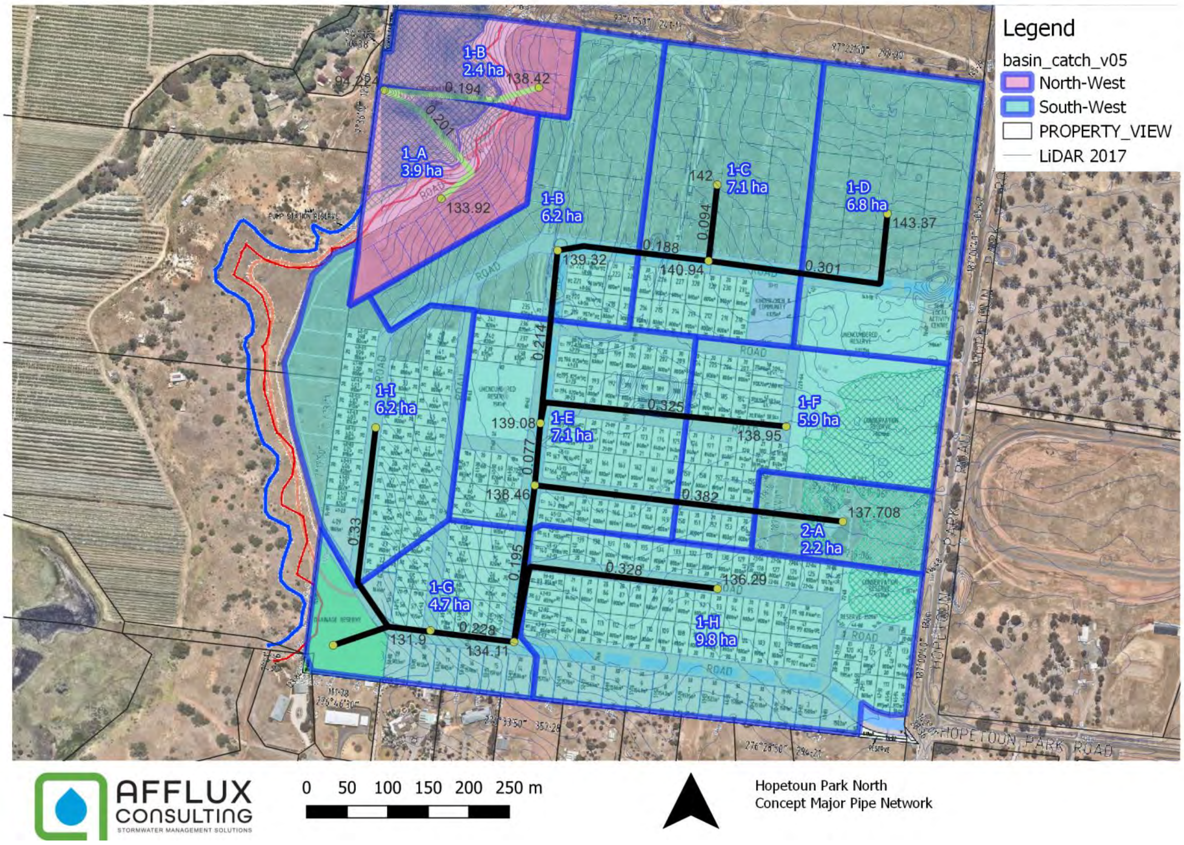


Figure 17. Developed Conditions Catchments (note underlying subdivision indicative only)

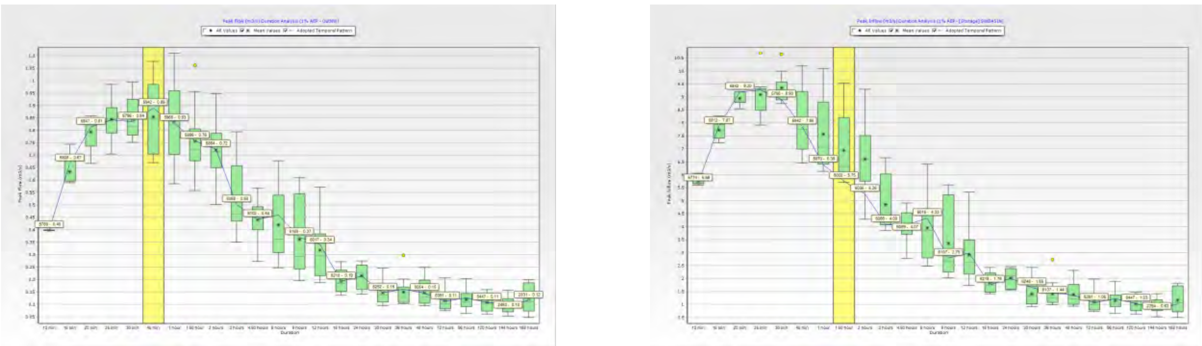


Figure 18. Developed Conditions ARR19 Flows Box Plots

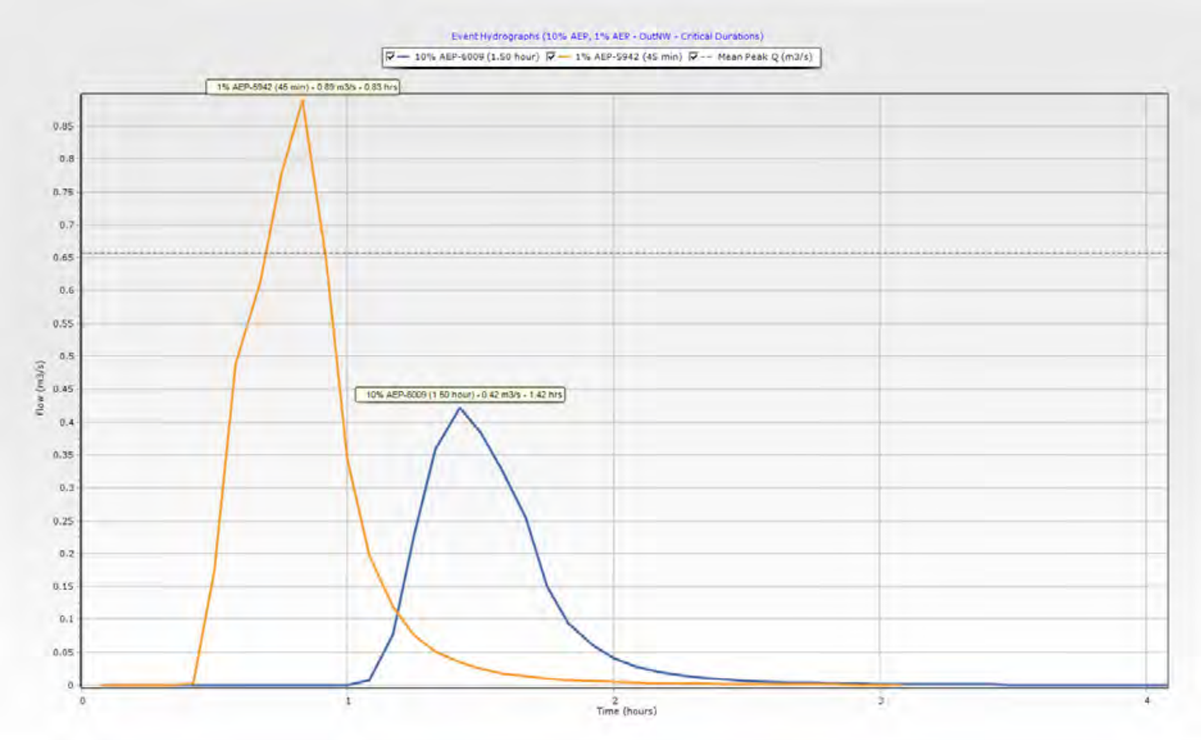


Figure 19. Developed Conditions Northwest Catchment Flows 10% and 1%

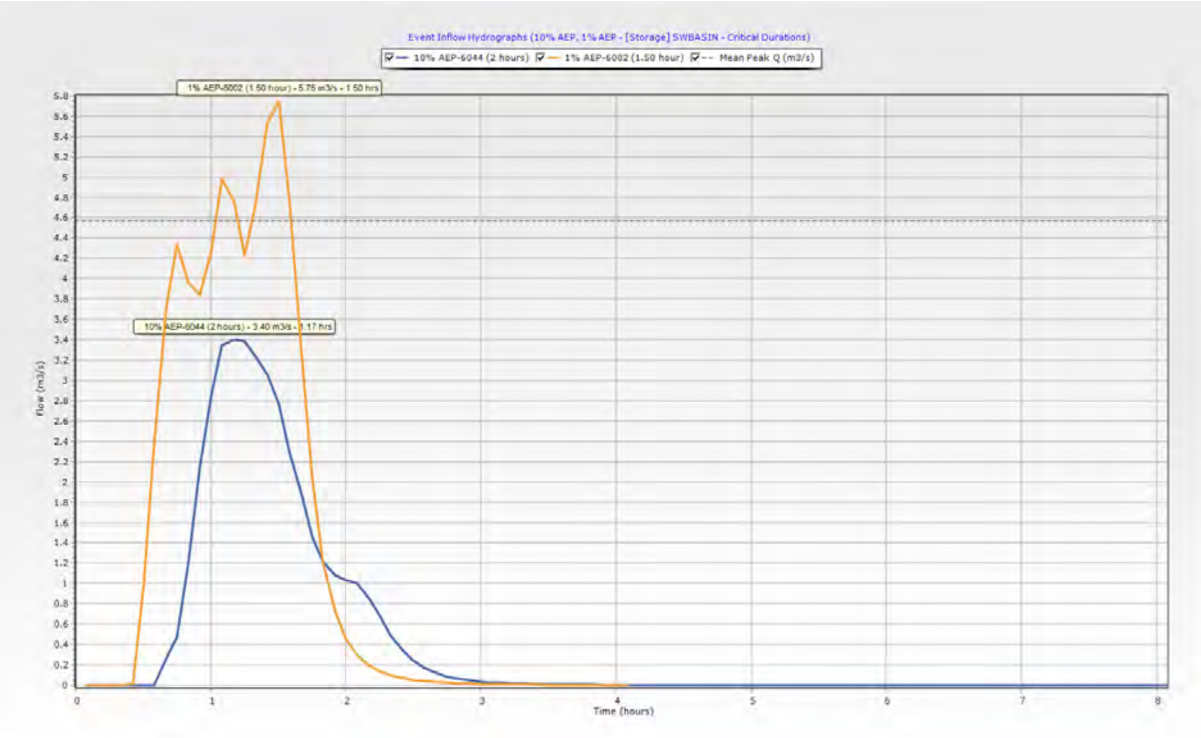


Figure 20. Developed Conditions (Critical) Southwest Catchment Flows 10% and 1%

4.4. Comparison of Flow Events Northwest Catchments

No attenuation feature is proposed for the Northwest catchment as the proposed development catchment area is significantly reduced. To check the development flows in comparison to the existing conditions flows in this catchment, the flows for all durations and all common design events can be seen below. As can be seen the proposed development catchment maintains lower flows throughout the full suite of design events.

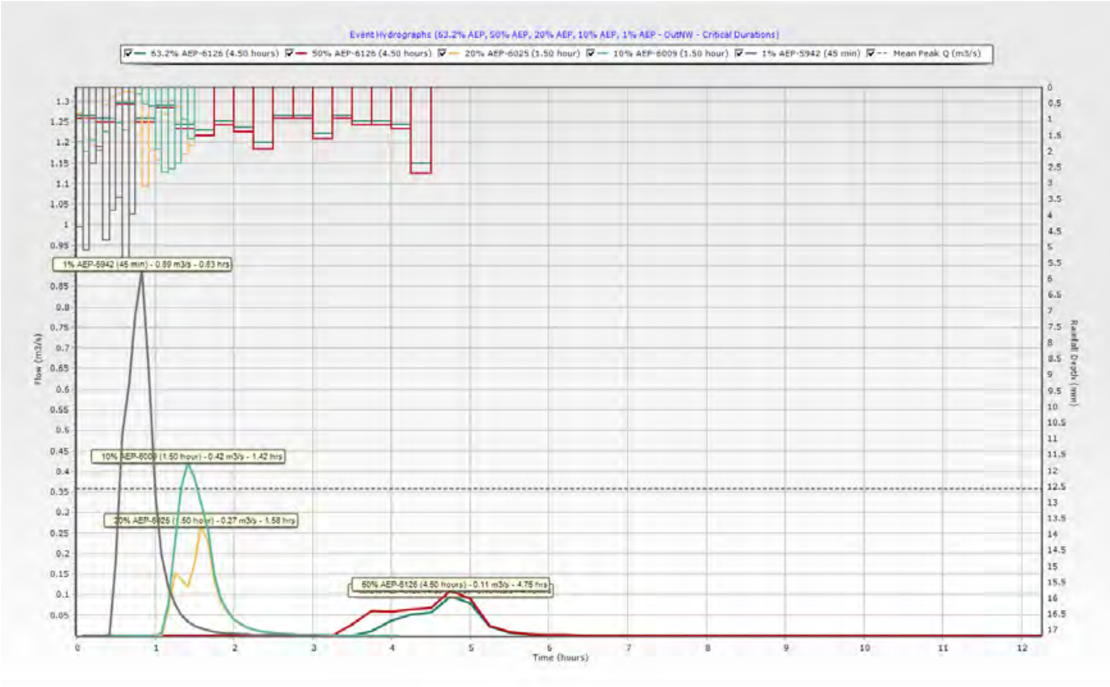


Figure 21. Developed All Critical Durations Northwest Catchment

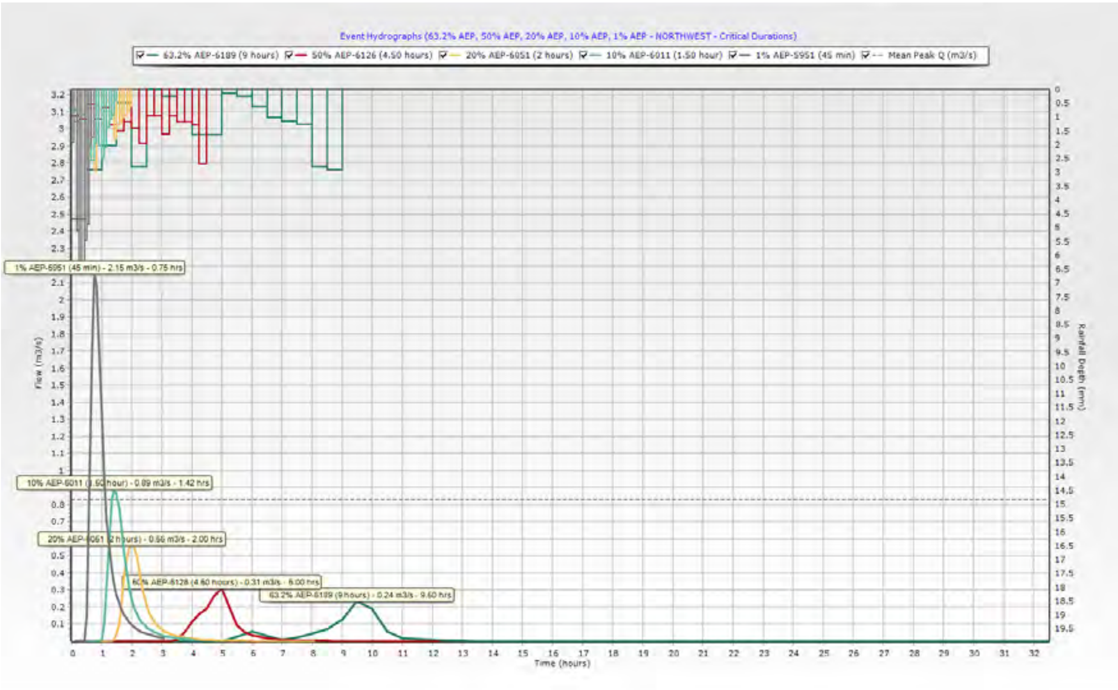


Figure 22. Existing Conditions All Critical Durations Northwest Catchment

5. Geomorphological Study

A geomorphological study was undertaken for the site and is included as an appendix to this report. The key geomorphological outcomes include:

- The steep escarpments indicate a significant risk of erosion if flows in the natural gullies were to be increased, or open channels constructed
- Piped drainage outfalls are required for all outfalls to minimise construction risk, or flows maintained at existing flow rates
- Water tanks and or other reuse options should be considered to reduce the total volume and frequency of flows in the catchment
- Water retention should be minimised on the site, and in particular towards the escarpment areas. Period of retention should be minimised as much as possible. No lakes or long term storages, preference for ephemeral wetlands.
- Constructed pool and riffle sequences are unlikely to be able to be constructed or supported by the soils (as is typically used to convey flows down escarpments)
- Soil treatment (addition of gypsum) should be considered as part of the water treatment areas to chemically enrich the soils
- A further specific soil study should be conducted as part of the detailed design of these features

Figure 6 Anthony's Cutting showing intercalation of Newer Volcanics basalt with overlying and underlying sedimentary formations (Source: Google Maps)

Figure 23. Major underlying formations (Brizga & Seymour)

These recommendations have been included as part of the development assessment and incorporated into the development solutions.

6. Geotechnical Investigations

Black Geotechnical were engaged to undertake a geotechnical investigation of the site. This report is included as an appendix to this report, however the major recommendations are:

- There are no landslide risk concerns impacting the subject site, and the proposed building setbacks are appropriate. The landslide risk assessment determined a risk to loss of life of less than 10^{-6} per annum, which is at least 10 times better than the limit of 10^{-5} commonly adopted for new developments.
- The observed surface erosion and springs on the western escarpment are due to overland and subterranean flow. These are a large distance from the proposed setbacks, are progressing slowly and do not impact the proposed development.
- The rate of these erosion process will be reduced by the development due to the substantial improvement in drainage conditions proposed.
- •The failure of the fill in the DOTP road reserve is outside of the property boundary and does not affect the development, however, the DOTP should be advised of this issue.
- The proposed pipeline routes are appropriate and either the Frankische or traditional concrete pipelines proposed would be suitable.

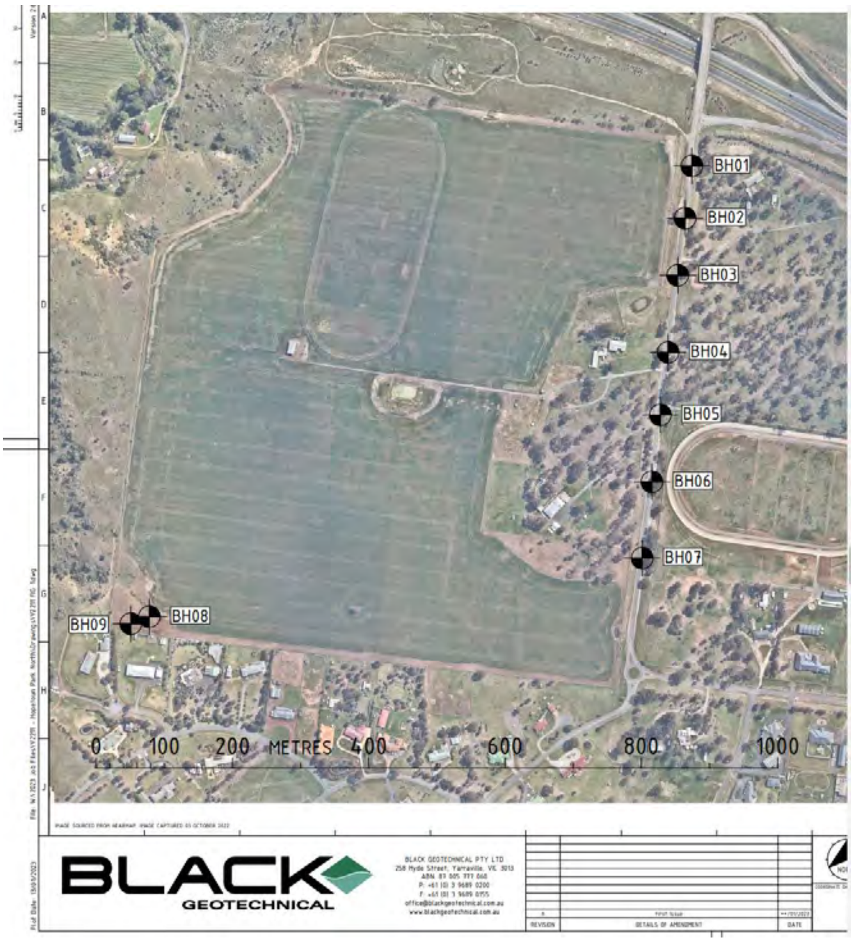


Figure 24. Borehole locations Western Properties (Black,2023)

7. Vegetation Assessment

A vegetation assessment of the property including the proposed drainage outfalls has been completed. The vegetation assessment summary can be seen in Figure 25. The executive summary points from this report, and there *impact on drainage* include:

- The majority of the study area is currently used for wheat cropping and does not support any significant ecological values
- Retain all existing Grey Box trees and Grey Box woodland areas in the east of the study area in a reserve. Site nearby development a minimum of 15m from the trunks of any treed native vegetation to avoid consequential impacts. (*Maintain hydrology in these areas)*
- Site entrances to the proposed subdivision to avoid impacts to native vegetation recorded in the road reserve of Hopetoun Park Road. (Minor catchment delineation Implications)
- Retain a minimum 20m buffer adjoining the edge of the escarpment in the west of the study area as a reserve and a 5m buffer around retained grasslands to prevent impacts to remnant vegetation, namely the area of EPBC-Act listed NTGVVP in HZ 1E and FFG-Act listed Melbourne Yellow Gum and Buloke. (Escarpment Recommendations)
- In addition, while the majority of the escarpment and bank of Pyrites Creek west of the study area were not included in this investigation, they were noted to support native vegetation. Any development near to the western edge of the study area will be designed to minimise erosion and potential damage to vegetation through water runoff as specified in a stormwater management plan.

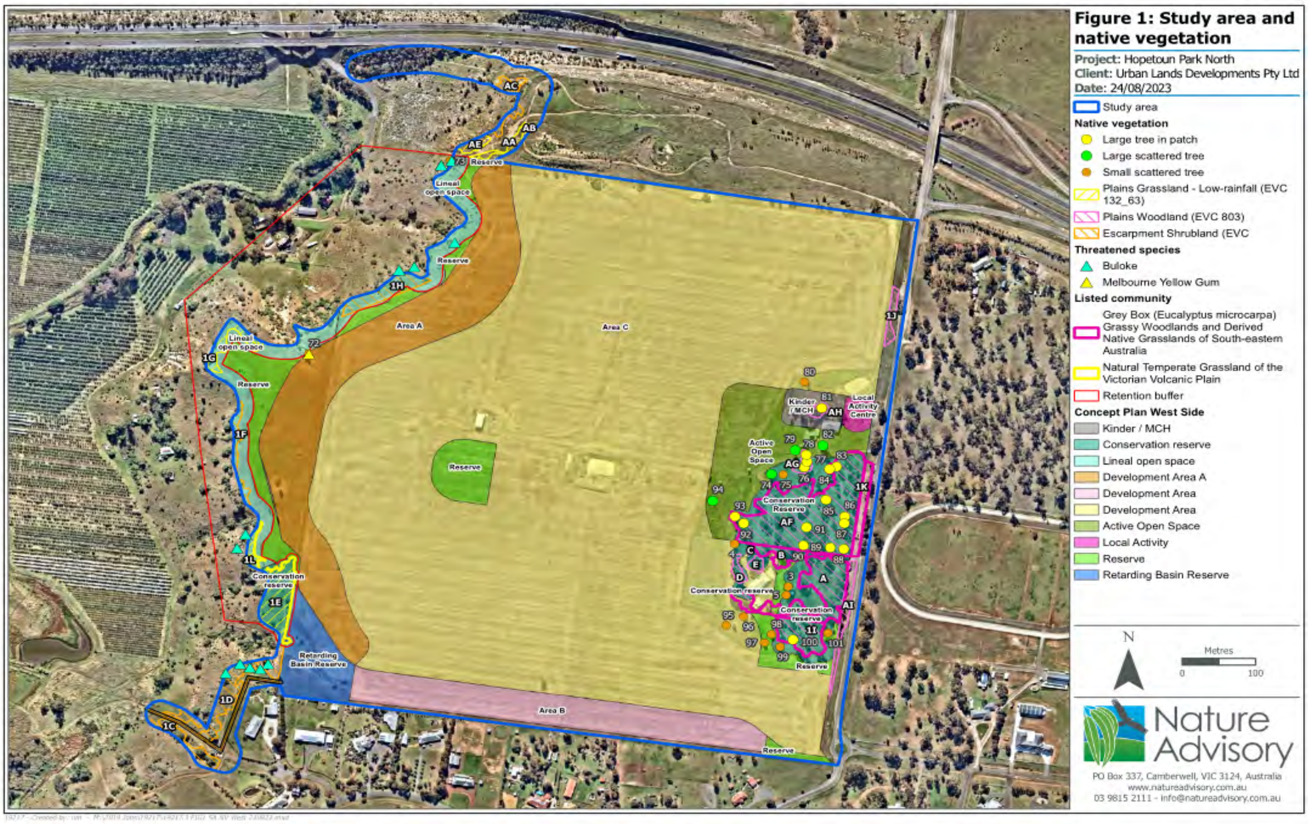


Figure 25. Vegetation Assessment including Drainage Outfalls

For more information see *Hopetoun Park North Western Section Flora and Fauna Assessment (2023)*

8. Escarpment Treatment

An assessment of the escarpment and appropriate setbacks has been conducted based on the geotechnical and vegetation assessments. The proposed setbacks can be seen in Figure 26 below. As can be seen this has the following drainage implications:

- The road network should be used to control and direct water away from the escarpment areas.
- Road network to be directed towards controlled discharge systems
- Revegetation strip to protect upper toe of escarpment from local runoff events.
- 20m wide reserve proposed

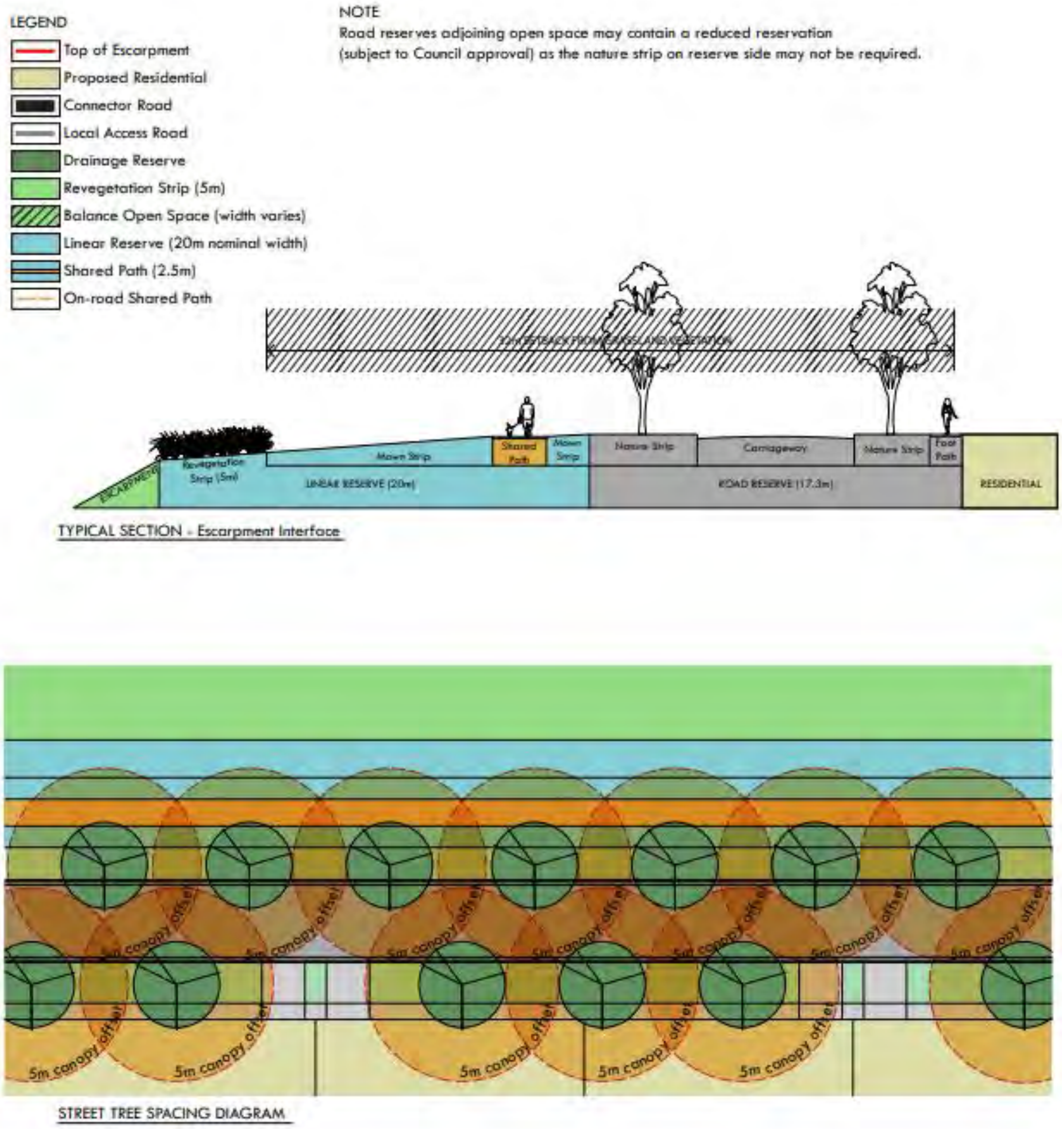


Figure 26. Proposed Escarpment Setbacks

9. Development Assessment

This development assessment has focussed on the design of estimated major drainage alignments and waterbodies proposed throughout the site (Figure 27). As the site is to be redeveloped changing both terrain levels and land imperviousness, a new RORB model has been constructed, building on pervious loss assumptions from the existing model to assess the impact of the ARR19 ensemble of storms.

9.1. Proposed Drainage Scenario

The assets included in the drainage concept include:

- A "South-West" retarding basin and wetland located at the south-west of the drainage strategy area in Property 2. This asset has the dual purpose of limiting discharge flow to a new piped outlet down the existing embankment and providing water quality treatment. The basin has been designed to minimise holding periods, with minimal storage volume required.
- An outfall drain to the Melton Reservoir/Werribee River floodplain. A number of outfall drain construction methods have been investigated to prove the engineering outcomes
- Recommendations for Integrated Water Management outcomes
- Discharge recommendations for the North West Catchments

The Mitigation Rorb model simulates the proposed drainage concept for the hydraulics of the region. Retarding basins have been included in this modelling, with wetlands being considered in later water quality modelling.

The macro drainage concept can be seen in Figure 27.

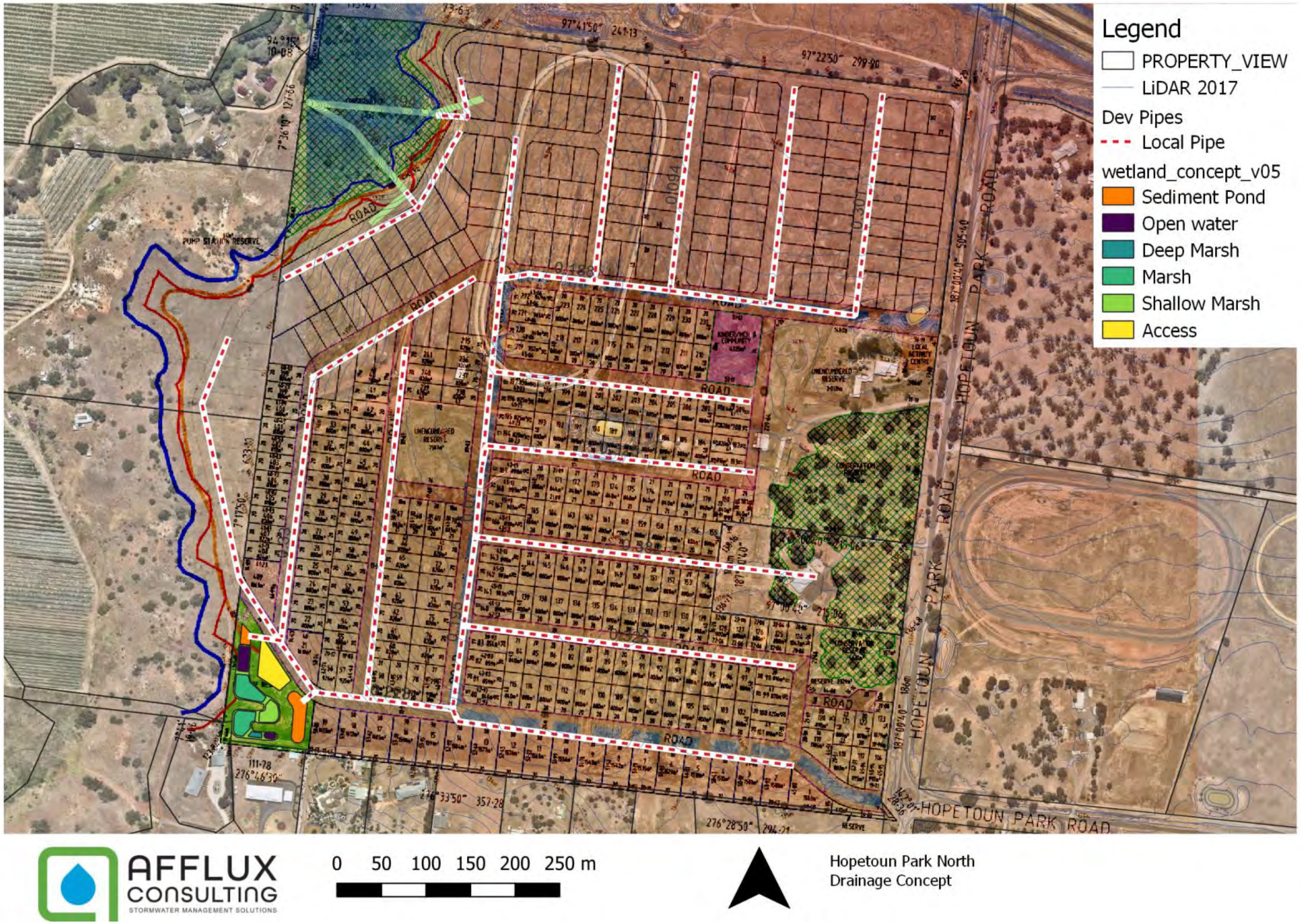


Figure 27. Drainage Development Concept (Note indicative layout only for Stormwater calculations)

9.2. RORB Model

A new Mitigated RORB model was constructed for the site to simulate the catchment conveyance and storage volumes underdeveloped conditions. The features of the RORB model are outlined below. The model setup is shown in Figure 28.

- All storms from the 1EY to the 1% AEP
- Selection of durations from 10min to 96hr
- Rainfall data sourced from ARR Datahub and BOM
- IL/CL model applied as per estimated values
  - o IL: 15mm
  - o CL: 1.1mm/hr
- Limned flow links were used to estimate the timing of the catchment
- Initial concept retarding basin sizing to determine storage volume estimates as discussed
- Calibration as listed in Table 4

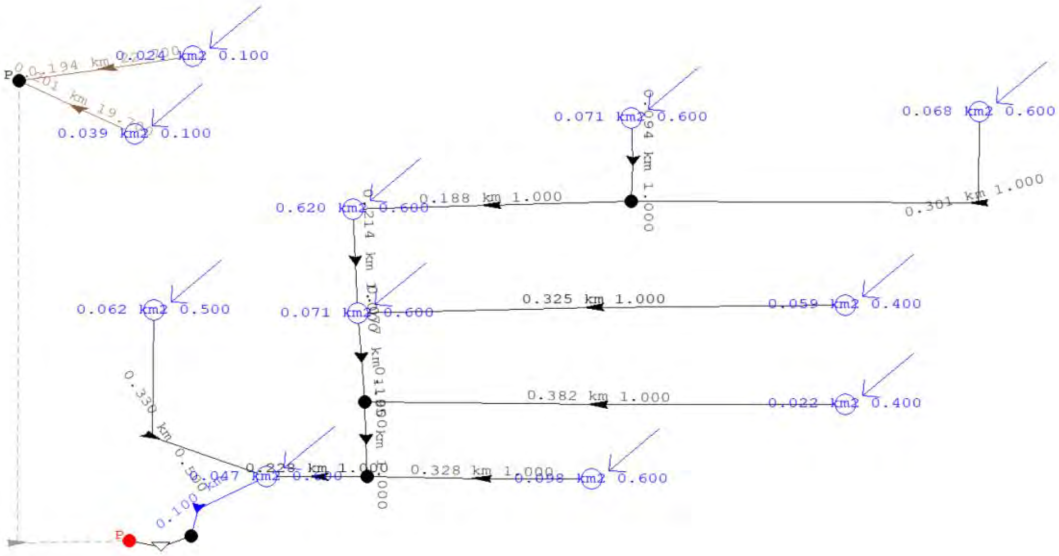


Figure 28. RORB Model Layout

9.3. Mitigated Model Results

The peak flow and critical storage flow graphs are presented below. The critical storage volume storm is shown in Figure 29, with the peak inflow shown in Figure 30. A summary of the peak flows and volumes can be seen in Table 5.

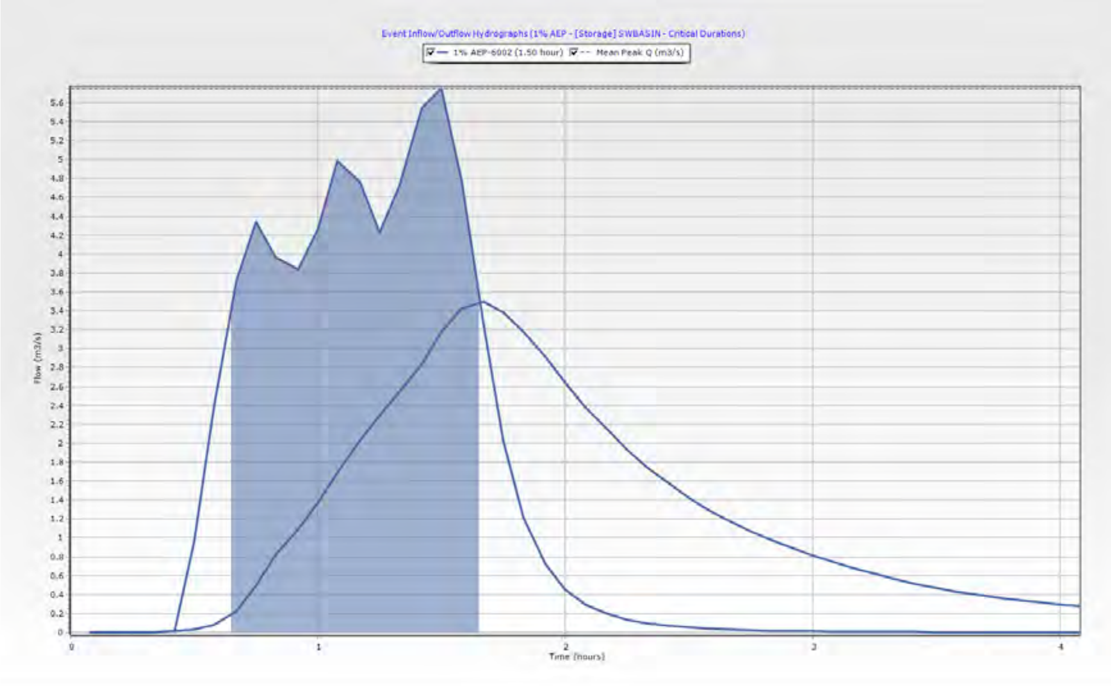


Figure 29. South West Catchment Critical Volume Storm (1.5h) Basin Inflow and Outflow

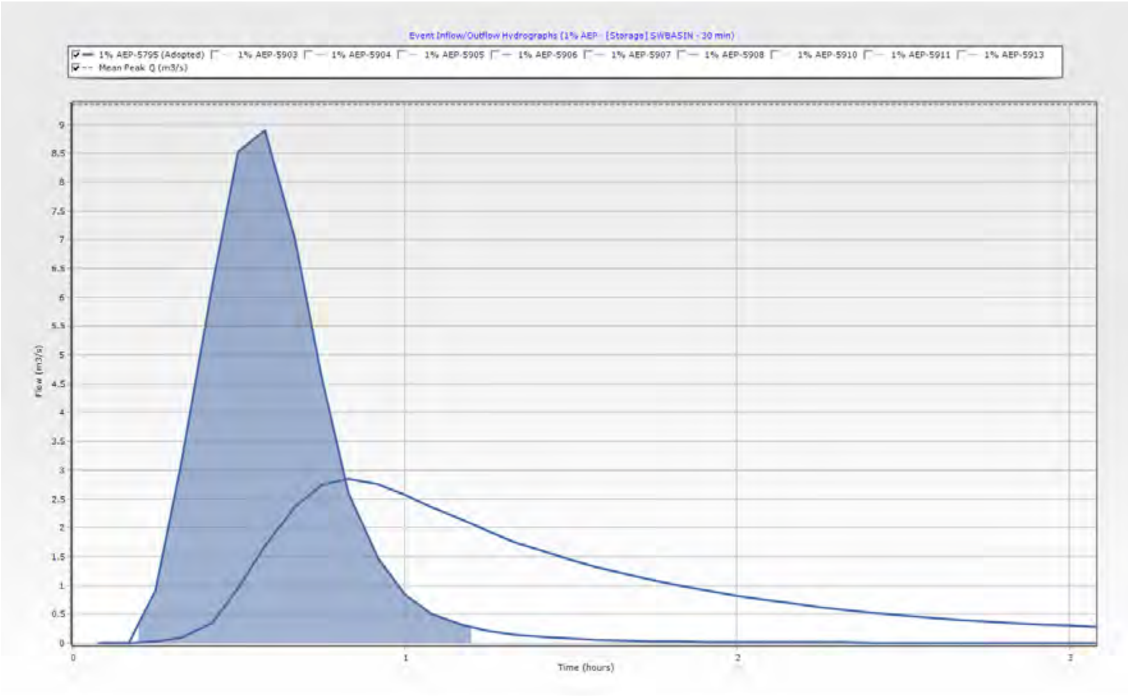


Figure 30. South-West Catchment Peak Flow Storm Basin Inflow and Outflow

Table 5. Developed model summary 1% AEP flows

Catchment	Size (ha)	Peak 1%AEP Outflow	Critical Storm	Volume (m^3)	Peak Level (m AHD)
North-West	6.3	0.83 m^3/s	45m	N/A	
South-West	56	3.5m^3/s (5.7m^3/s)	1.5h	11,300	125.35
		2.7m^3/s (8.85m^3/s)	20m	8,530	125.08

9.4. Modelled Basin Assumptions

To convey the design flows (Table 5) down the monocline, it is recommended that the entire 1% AEP flow be piped. This is born out in the associated geomorphological and geotechnical studies. To meet this requirement a compromise between land use at the top of the escarpment for retardation, and pipe size and quantity to convey the flow. All flows have been assumed to be piped in an 900mm pipe, with a number of options explored below.

North – West Outfall

No basin is required in the north west area. No piped system. The existing drainage catchment of ~22ha has been reduced to ~6ha, of which 2ha is low impervious development (the remainder being ecological reserve). This maintains the peak flows below existing conditions.

South-West Basin

The retarding basin assumptions at this location are outlined in Table 6. As can be seen in Figure 31, an 900mm outlet down the steep grade has resulted in a peak 1% AEP storage of ~12,000m³.

Table 6. South-West retarding basin concept stage-storage

Surface Area (m^2)	Volume (m^3)	Comments
5268	525	New 900mm Black Poly Pipe Outlet at invert
5329	1585	
5391	2657	
5452	3741	
5513	4838	
5574	5947	
5636	7068	
5697	8201	
5758	9346	
5820	10504	
5881	11674	Weir Level (TWL)
5942	12856	
6004	14051	

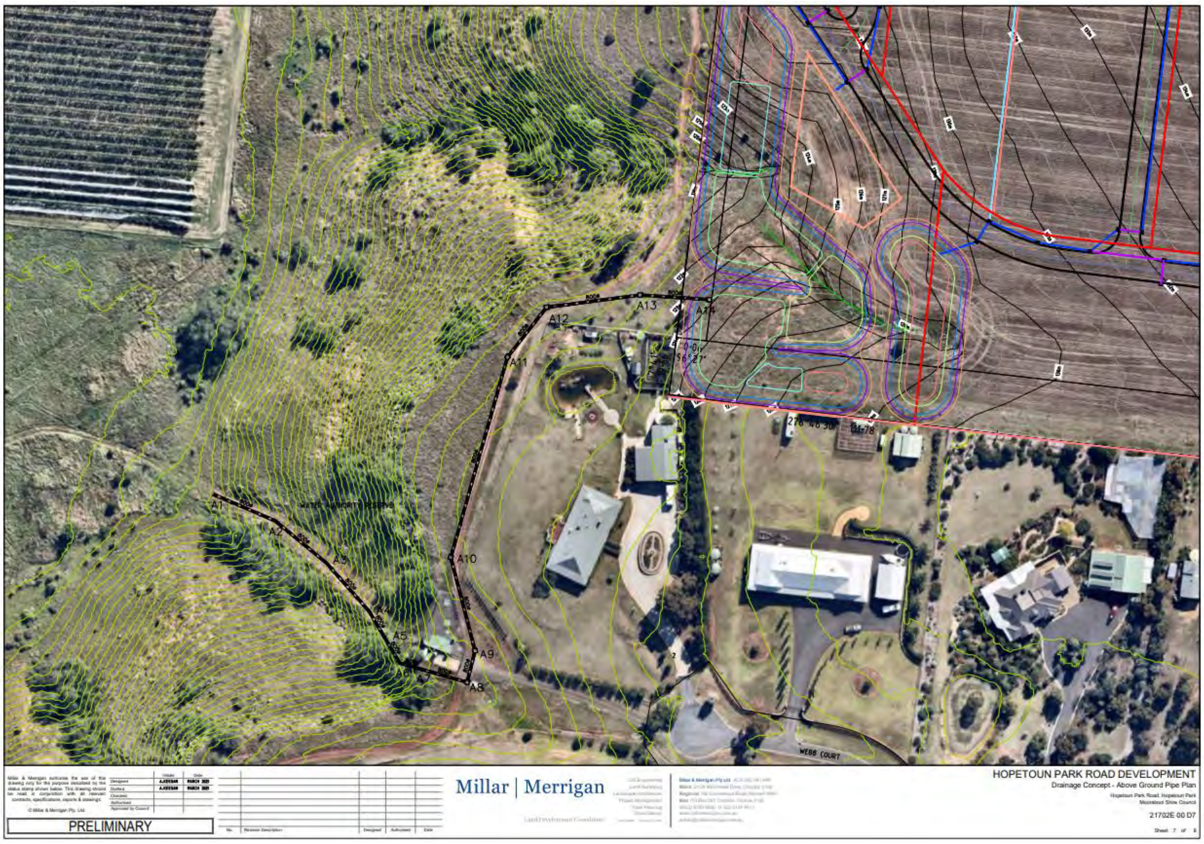


Figure 31. South-West retarding basin modelled storage concept

9.5. Climate Change impact on Flows

The impacts of climate change on urban development will be many and varied, with much of the health and lifestyle impacts outside of the scope of this report. However, the ARR19 guidelines provide advice on potential rainfall impacts due to the increased macro temperatures. This advice is purely based on the holding capacity of air as temperatures increase and results in a factoring of current rainfall. The impacts on loss models (including long term antecedent moisture changes), weather patterns and generation of rainfall for any particular region is less well known. Regardless, as requested by Council this management plan has explored the impact of flow increases only.

9.5.1. Flow Impacts

The ARR19 guidelines recommends a range of rainfall factoring for rainfall to measure the impact of potential climate change. The Interim Climate Change Factors can be seen in Figure 32. For this study the impact on 2090 flows using the Representative Concentration Pathways (RCP 6.0) impacts has been used.

The flow impacts for the basin inflows can be seen in Figure 33, with the impact on the proposed basin levels and outflows shown in Table 7. As can be seen the flow increase is around 10% for the critical duration, which results in an increase in flood level of approximately 200mm (170mm).

Interim Climate Change Factors			
Year	RCP 4.5	RCP 6	RCP 8.5
2030	0.648 (3.2%)	0.687 (3.4%)	0.811 (4.0%)
2040	0.878 (4.4%)	0.827 (4.1%)	1.084 (5.4%)
2050	1.081 (5.4%)	1.013 (5.1%)	1.446 (7.3%)
2060	1.251 (6.3%)	1.229 (6.2%)	1.862 (9.5%)
2070	1.381 (7.0%)	1.460 (7.4%)	2.298 (11.9%)
2080	1.465 (7.4%)	1.691 (8.6%)	2.719 (14.2%)
2090	1.496 (7.6%)	1.906 (9.7%)	3.090 (16.3%)

Figure 32. Climate Change Rainfall Factors

Table 7. Flow impacts with Climate Chage Factors on Basin

Catchment	Size (ha)	Peak 1%AEP Outflow	Critical Storm	Volume (m³)	Peak Level (m AHD)
North-West	6.3	0.83 m³/s	45m	N/A	
South-West	56	4.24m³/s (6.29m³/s)	1.5h	12,400	125.52

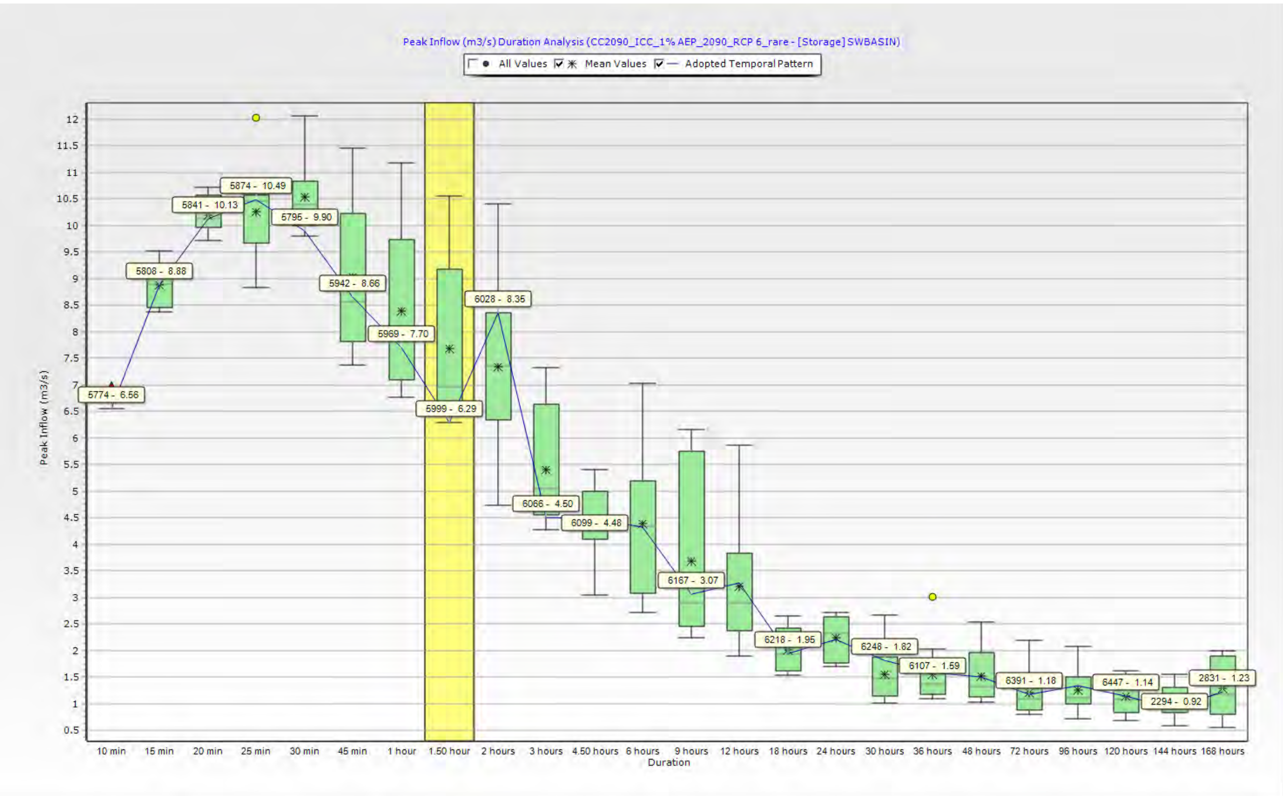


Figure 33. Peak Basin Inflows 2090 Climate Change Impacts

9.5.2. Implications of Increased flows

The increase in flows and volumes associated with the Climate change factors are relatively easy to mitigate during the design phase of this development (though would be much harder to implement after the development phase). To mitigate the effects the following mitigation measures are recommended for the detailed design phases (assuming Council requirements to be outside of IDM):

- Increase trunk drainage design to 10% AEP. This would apply to Road E, or the main collector road. This change has been incorporated into the design calculations later in this report
- Consider increasing pipe outfall into Melton reservoir by one pipe size to allow for future capacity constraints. A peak outflow design of around 4.2m³/s is recommended over the current 3.5m³/s

9.6. Modelled Outfall Options

The construction of the outfall pipe has been the subject of a number of technical enquiries by drainage authorities stemming from the Stormwater Strategy. To provide a comprehensive response, a number of options have been investigated to pipe the outflows from the proposed basin. The investigation has included:

- Investigation of traditional construction methods and RCP pipes on other steep sites within Melbourne's development corridors
- Use of alternative pipe types on steep sites
- Pipe supplier recommendations and product details

Based on this four concept designs have been developed with drawings attached in the appendix to this report. Where possible, design pipe technical information has also been provided. To compare the four different options a quantitative assessment has been provided in Table 8 below.

It should be noted that all options are constructable, and have been designed to meet as closely as possible the design standards available. The final detailed design would be subject to future engineering review and approval, however this options analysis should give confidence that there are a number of design solutions that are available for the site.

Table 8. Pipe Outfall Construction Options Quantitative Assessment

Design Option	Construction Method	Qualitative Risk	Cost	Comment
RCP Option	⬤	•	⬤	Standard option compliant with IDM. Velocities limited to >7m/s. Costly due to number of pits
Hel-Core Option	●	●	●	Higher allowable velocity. Generally used in Aus for single culvert crossings
Rail Pipe Option	●	•	●	Used extensively in the Austrian Alps. Used in Geelong attached example. Provides limitless velocity profile so can reduce pits.
Welded PP Option	•	●	•	Will comply with sewer standards. Fully sealed option. Minimal pits and low construction difficulty
Above Ground Option	•	●	•	Easiest construction option. Could use either Hel-Core or Welded PP options.

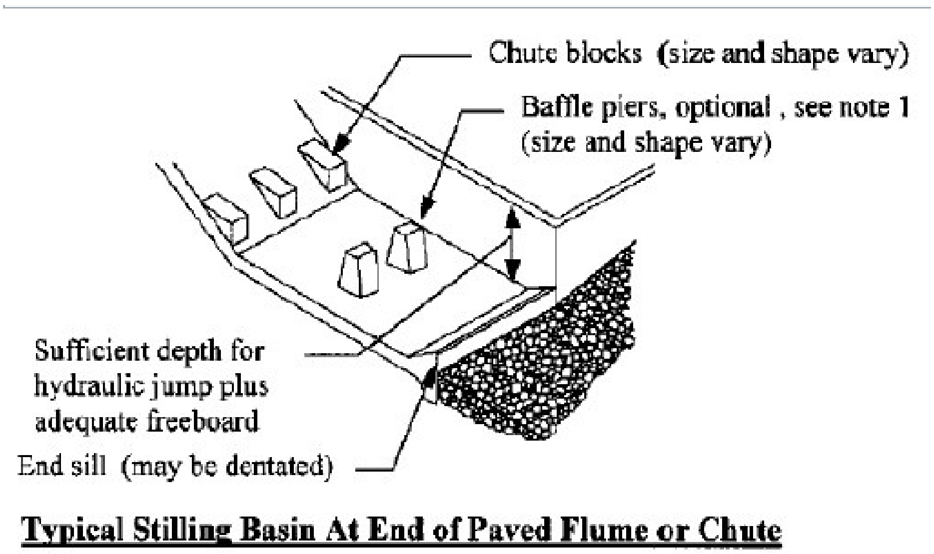
Low/Easy • Medium ● High/Difficult ⬤

The final pipe alignment has been based on the following principles:

- Alignment to follow existing access tracks/disturbed areas
- Alignment to follow existing road reserves and easements.
- Alignment to place all pits in accessible locations and avoid sewer interactions
- Discharge to SRW floodplain
- Vegetation assessment on alignment as per Nature Advisory Report
- Outfall drainage assessed by the Black Geotechnical report and deemed appropriate

9.7. Outfall Structure

The outfall of the escarpment pipe system will require an energy dissipation structure to reduce velocity before discharging to the floodplain. Southern Rural Water have recommended that this velocity be limited to 2 m/s at this location. A number of 'off the shelf' dissipation structures are available (with many installed on the adjacent Hopetoun Park subdivision. The exact detailed design is outside of the scope of this report however a number of example structures can be seen below. Reference to the *Federal Highway Administration, Hydraulic Design of Energy Dissipators for Culverts and Channels (2006)* report or any of the Austroads investigations into these structures is recommended.



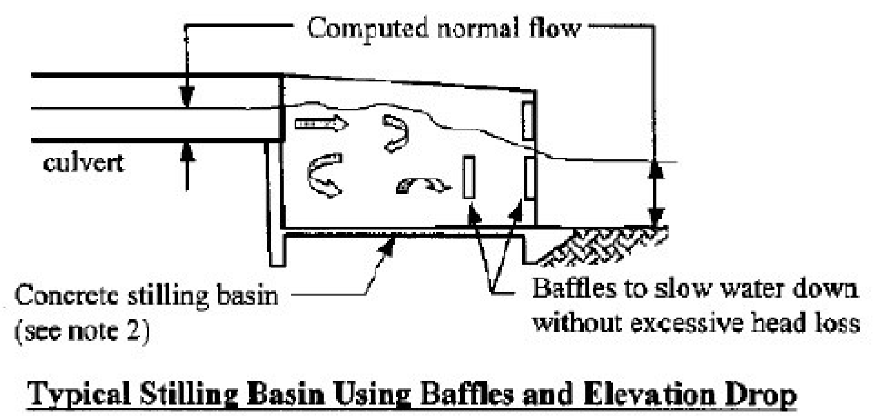


Figure 34. Potential Outfall Structures

10. Water Quality

In order to achieve water quality objectives, a number of treatment elements will be required.

The MUSIC software program has been used to develop and evaluate an ultimate treatment train for the catchment comprising of:

- A Rocla CDS 0708 gross pollutant trap at the North-West outfall of property 1
- A 1200m² sediment basin and a 4300m² wetland within the South-West retarding basin

10.1. MUSIC Modelling

MUSIC modelling is an industry standard approach to determine water quality treatment and sequencing.

Guidance for model inputs was sourced from the IDM as well as Melbourne Water's MUSIC guidelines. 10y rainfall data was taken from the Little River rainfall station as shown in Figure 35.

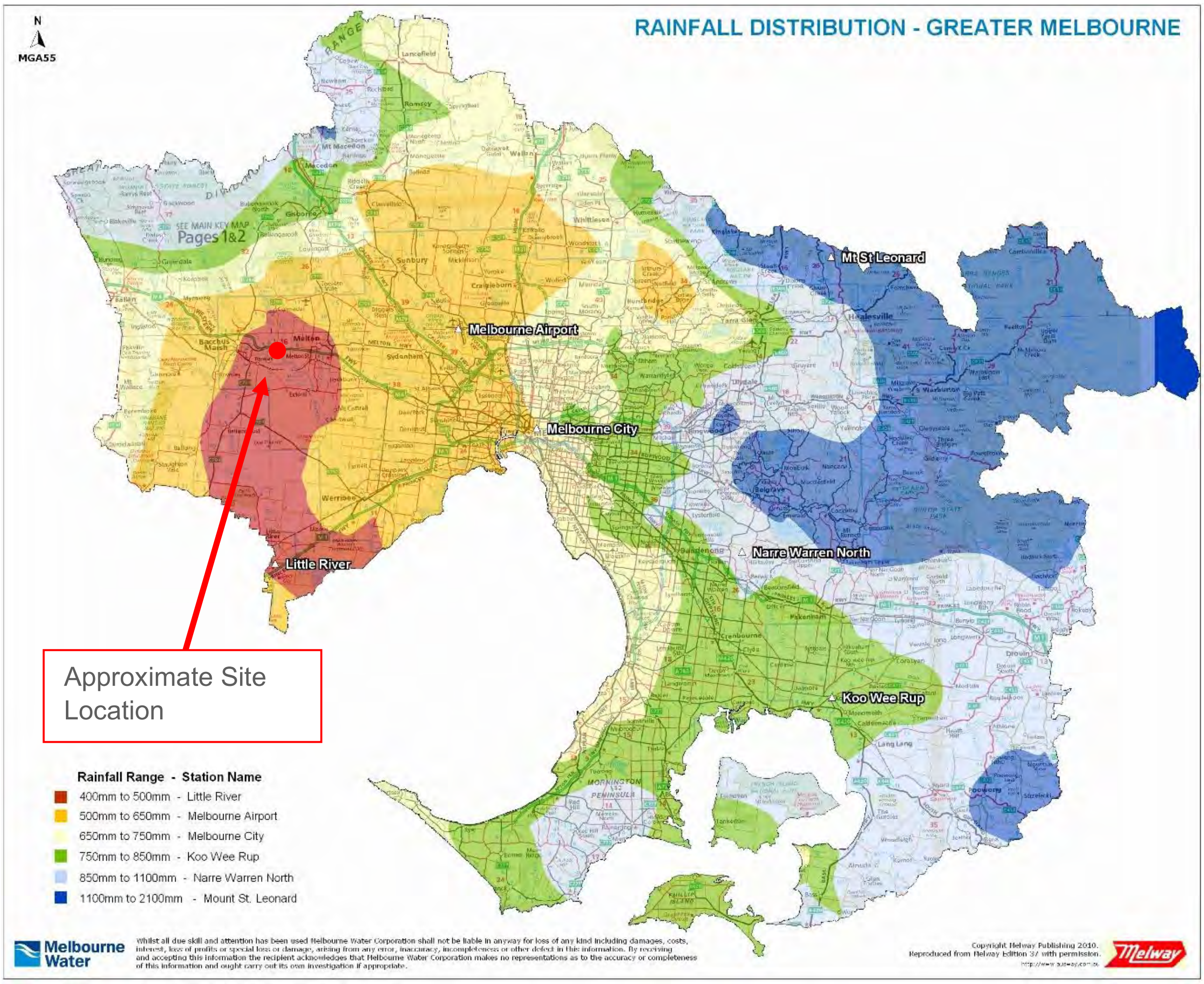


Figure 35. Greater Melbourne rainfall distribution - Melbourne Water MUSIC Guidelines

Treatment elements used in the model are discussed below.

10.1.1. *Sediment Control*

Control of sediment from a developed area is an important consideration for both the hydraulic function of drainage and water quality assets.

Build-up of sediment can lead to the failure of pipe networks (through blockage) and biological systems (through blockage and bypass).

Given the scale of the residential development, sediment ponds are recommended as a suitable intervention. Maintenance requirements are an important consideration when allowing for reserve areas, with access and sediment dry out areas adding up to 20% to the required footprint area. It is recommended that all local pipe network outlets where possible end in a sediment pond before discharge to the waterway or wetland. Fair and Geyer calculation for the minimum pond size for the south west catchment is shown in Figure 36.

Southwest Catchment Sediment Pond

Calculations
South
Target = very fine sand

Vs =	0.011	m/s	
d_e =	0.4	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.68	m^3/s	use rational method to obtain 1 Year ARI flow for sub catchment
A =	800	m^2	Area of basin
V_s = / Q/A	12.94		
λ =	0.26	pond shape assumption	
n =	1.35		

Fraction of Initial Solids Removed
R = 96%

Requirement: Melbourne Water Requires R = 95% for a 125 micrometer particle

Cleanout Frequency
South

Catchment Area =	56	ha	Just urban catchment concidered		
Sediment load =	1.60	m^3/ha/yr	(Willing and Partners 1992)		
Gross Pollutant Load =	0.40	m^3/ha/yr (	Alison et al 1998)		
Actual basin depth =	1.4	m			
Actual Basin area =	3200	m^2			
Sediment Dryout area =	2240	m^2	10	yr Cleanout Vol	1120 m^3

Therefore, cleanout frequency required =	$(1.6+0.4)A_{catchment}$ = / $0.5d_{basin}*A_{basin}$	0.05 per year	Clean out every 19.3 years

Figure 36. Fair and Geyer – South West sediment basin

Northwest Catchment

Council have indicated a strong preference for no GPT structure to be applied to the north west catchment. Therefore to ensure that sedimentation is minimised from this catchment a ZAM (Zero Additional Maintenance) sediment treatment is recommended. The following points are noted:

- Houses will be connected to rainwater tanks, reducing the possibility of sediment from dust sources.
- The small section of road associated with this catchment (~0.8Ha) can be treated with the ZAM sediment groves and grass capture system. An example of this system can be seen in Figure 38. This type of design is intended for small road catchments only, and in combination with the planned linear reserve would work well in this situation. A standard drawing has been included in the Appendix to this report.

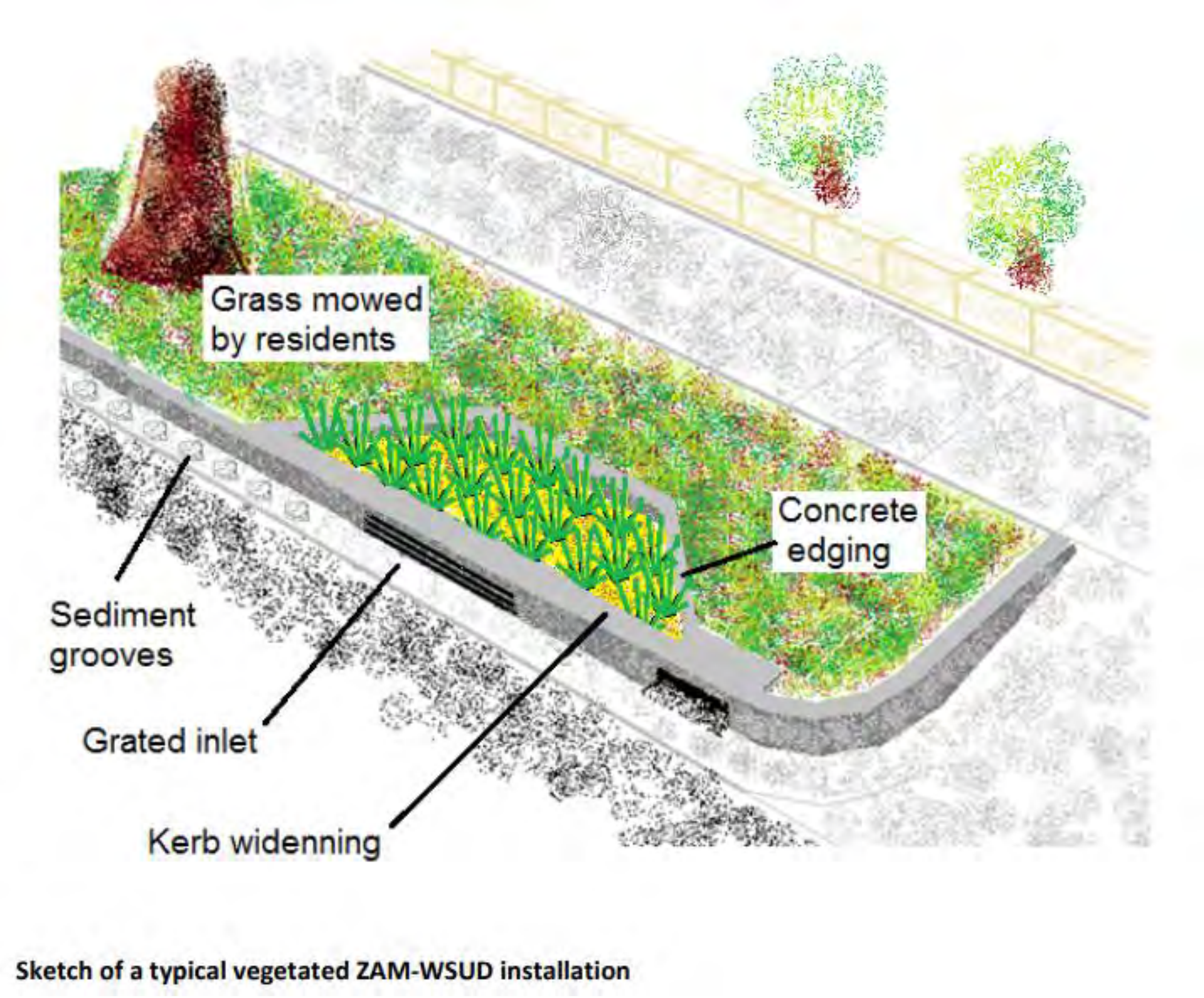


Figure 37. Proposed ZAM grassed concept

Grassed

Prototype at the Manningham Depot, Blackburn Road, Doncaster East

Park Avenue, Doncaster, single barrier kerb installation

Figure 38. ZAM sediment treatment system

10.1.2. *Wetland Treatment*

Biological treatment of stormwater reduces the loads of nutrients entering receiving waters, an important aspect of best practice guidelines. Wetland surface area dictates the potential effectiveness of these treatments, with plant selection and density being limited by available treatment area. Sediment ponds were modelled as ‘Inlet Ponds’ when in the same drainage reserve as the wetland nodes as per MUSIC guidelines. The proposed basin treatment can be seen in Figure 39

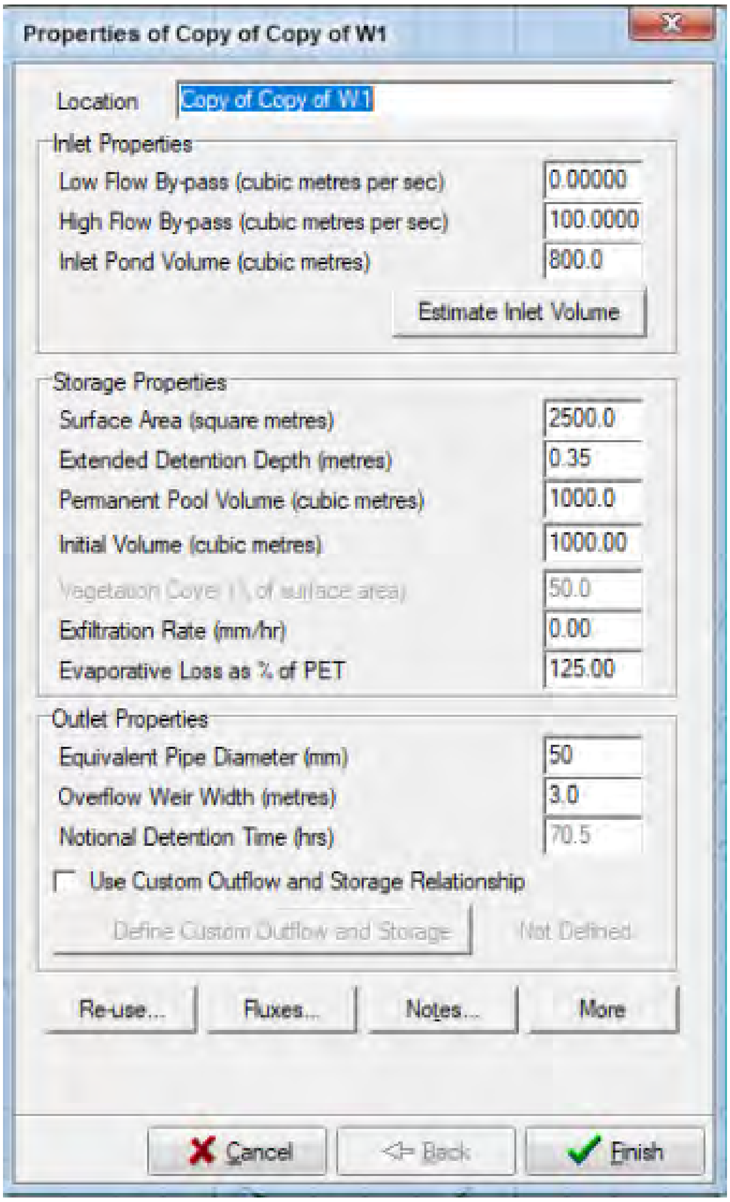


Figure 39. MUSIC Wetland Design Inputs – South-West wetland

10.2. MUSIC Model Setup

The modelled MUSIC setup (shows the general layout of the nodes in the model for the ultimate developed treatment. Sub catchments have been modelled on the basis of area with an impervious fraction as suggested from MUSIC guidelines. The basin contains the following nodes:

- Residential Catchments (Mixed Node) based on FI (60% for 800m², 30% for larger blocks)
- A Buffer strip to represent the ZAM treatments
- Wetland Treatment inclusive of sediment ponds (2x)

- Rainwater Tanks of 3KL with some freeboard (2.5KL effective) for all lots

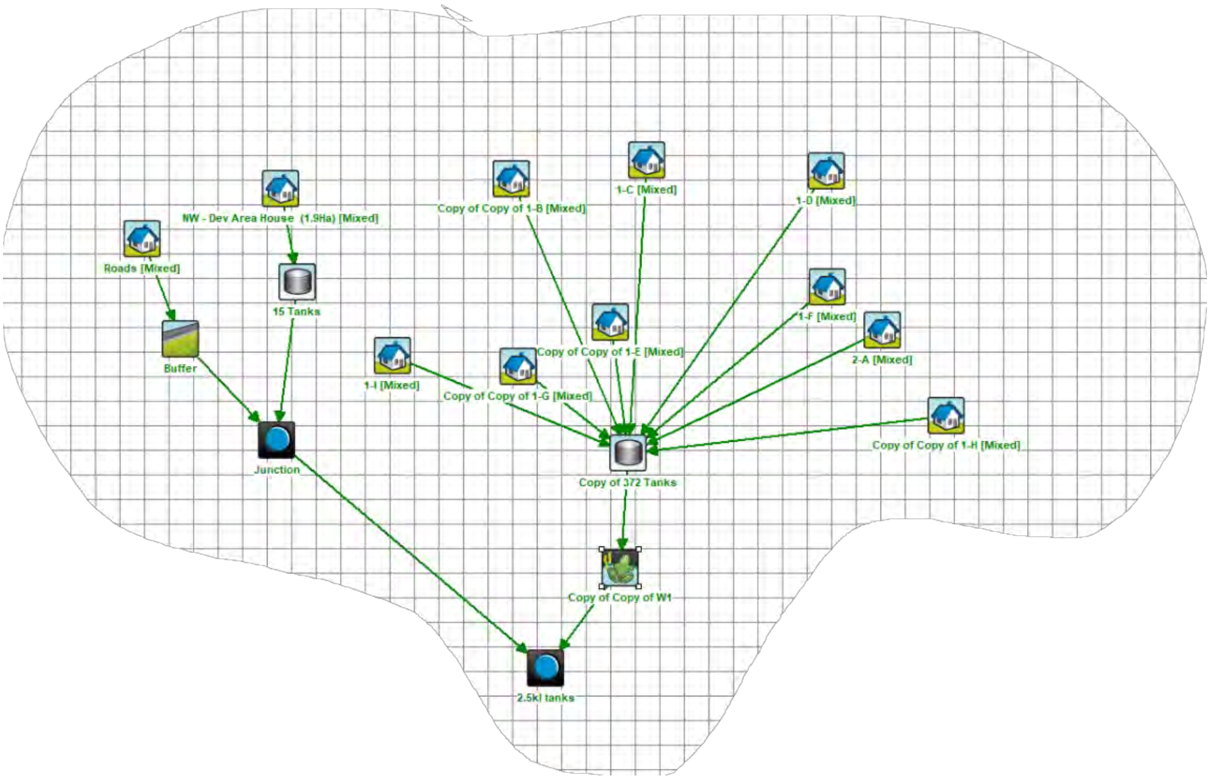


Figure 40. MUSIC model layout

The results of the MUSIC modelling taken at the receiving node are shown in. These results indicate that best practice objectives can be met or exceeded in all categories.

Treatment Train Effectiveness - 2.5kl tanks

	Sources	Residual Load	% Reduction
Flow (ML/yr)	98.8	75	24.1
Total Suspended Solids (kg/yr)	19800	4640	76.6
Total Phosphorus (kg/yr)	40.2	13.9	65.5
Total Nitrogen (kg/yr)	282	148	47.8
Gross Pollutants (kg/yr)	4600	55.5	98.8

Figure 41. Model results for total proposed treatment train

10.2.1. Treatment Summary

The treatment asset sizing achieving the above water quality outcomes is outlined in Table 9 below.

Table 9. Concept water quality treatment asset sizing

	Catchment Area (ha)	1 Year Flow (m^3/s)	Approx SB Size (m^2)	Macrophyte Treatment Area (m^2)
South-West Wetland	56	0.68	1050	2500
Rainwater Tanks	387	2.5KL (Usable)		

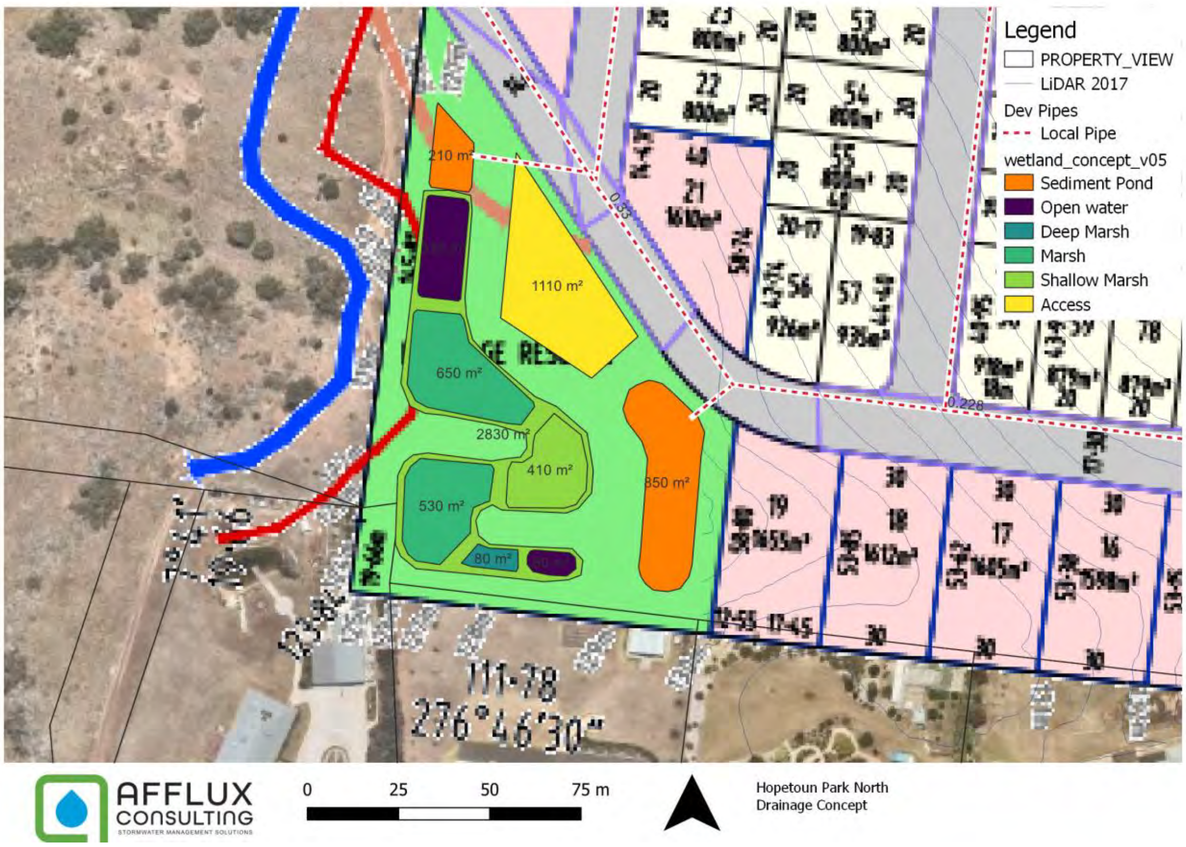


Figure 42. Wetland Concept Plan with Areas

10.3. Stormwater Re-Use and IWM Approaches

The Bacchus March IWM strategy (BMIWM) was completed in consultation with Moorabool Shire Council, Greater Western Water, and Melbourne Water in late 2021. The report analysis a number of possible water use and reduction methods to provide a number of recommendations for development in this region. Whilst this area is adjacent to the BMIWM, and has many of the same drivers, there are distinct differences that may differentiate the final outcome, these include:

- This catchment is on the edge of the lower rainfall region to the east of BMIWM. The rainfall is less certain than further west (and BOM loss models much harder to calibrate too)
- This area is on top of the escarpment and discharges fully (and directly) to the Werribee Reservoir. In effect all water from this development is discharged directly to a very large stormwater harvesting system

- The soils in this area as described are different to the BMIWM and are not recommended to hold significant water volumes for long periods of time i.e. storages are not recommended

Based on this it is recommended that the major items from the recommended BMIWM Portfolio 1 be adopted. These are shown in Figure 43, with modifications listed further below.

Table 8: Recommended preferred portfolios

Portfolio 1: Local focus	Portfolio 2: Regional Catalyst
In major development areas: Rainwater tanks to homes Passively irrigated street trees Local stormwater harvesting for open space irrigation End-of-line infiltration in alluvial plains **In the region:** Recycled water to BMID and local industry	**In major development areas:** Passively irrigated street trees Recycled water to future homes and open space irrigation **In the region:** Recycled water to BMID and local industry Stormwater transferred (via separate piped transfer) to Melton Reservoir Transfer link created between Pykes Creek or Melton Reservoir and Merrimu Reservoir to transfer new resources (stormwater and purchased BMID/industry allocations) for potable use
Headline outcomes: • New homes, BMID and local industry supported by alternative sources • 1,022ML/year of potable water substitution • 2,750ML/year of river water allocation transferred to the environmental water reserve • Sensitive downstream waterway protected from urban runoff • Local trees and open spaces supported by alternative sources	**Headline outcomes:** • New homes, BMID and local industry supported by alternative sources • 1,100ML/year of potable water substitution • 2,750ML/year of river water allocation transferred to potable water resources • 2,100ML/year of stormwater transferred to potable water resources • Sensitive downstream waterway protected from urban runoff • Local trees and open spaces supported by alternative sources
Total outcome score: 78 **Benefit-cost ratio:** 1.59 **Deliverability**: Proposals for new development are readily deliverable. Coordinated and tailored design of stormwater treatment train needed to ensure downstream waterway is protected. Recycled water supply to BMID and industry will require further investigation and consultation.	**Total outcome score:** 84 **Benefit-cost ratio:** 2.26 **Deliverability**: Recycled water supply to homes, BMID and industry will require further investigation and consultation. Expansion of water grid to incorporate transfer of water from Pykes Creek or Melton to Merrimu requires investigations and approvals.

Figure 43. Bacchus Marsh IWM Recommended Portfolios

- Rainwater Tanks to all homes – Recommended, see below analysis
- Passively irrigated street trees – Recommended, in particular for northwest catchment and incorporated into ZAM treatment. All escarpment vegetation treatments to be passively irrigated.
- Local harvesting – not recommended due to storage issues and lack of demand. Recommend discharge direct to Werribee reservoir (through alluvial plain) for larger harvesting
- End of line infiltration – recommended and included in part of outfall design to the alluvial plain
- Recycled water – recommended if available – unlikely and in conflict with rainwater tanks

10.3.1. Rainwater Tank Sizing and Recommendations

Household scale stormwater reuse presents an opportunity to both reduce the impact of increased runoff from the catchment whilst also reducing the communities reliance on potable water. Rainwater reuse at a household level can contribute to a decrease in total stormwater to receiving waters, reducing nutrient loads. Rainwater tanks may be considered for individual sites depending on viability of entrenching the requirement on title. As seen in the geomorphic report, rainwater tanks are also highly recommended to reduce the volumetric impacts on the soils in the area.

NOTE – Rainwater tanks have not been assumed in any of the flood calculations. There is no flood or drainage risk associated with this approach.

The impact of rainwater tanks on overall wetland requirements has been assessed for the South-West wetland. The modelling assumptions used are outlined below:

- 387* household rainwater tanks installed with minimum 2,500L capacity for reuse
- All toilets and garden taps plumbed to rainwater tanks
- Conservative garden watering of a 300m² area of lawn, yearly demand of 37.5kL as shown in Figure 44
- An average occupancy of 2.6 people per dwelling as per the 2016 ABS census and a daily toilet flushing demand of 20L/person/day as outlined in Figure 45

*note final lots approximate

SmartGardenWatering.org.au

Garden Name

Hopetoun Park North

Suburb	Gardener	Weather Data Set	Created	Printed
Hopetoun Park	Afflux	Average year	23/09/2020	23/09/2020

Watering Plan for	Watering System	Mulch	Area Size	Area Water Use
Lawn	Sprays	Default Mulch	300.0 m2	37,586 L

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
This plant area demands (L)	13,784	9,943	3,488	0	0	0	0	0	0	0	2,732	7,639
Recommended scheduled amount (L)	10,500	5,250	0	0	0	0	0	0	0	0	0	5,250
So, water for 35 minutes...	**every 2 weeks**	**only once**	**don't water**	**don't water**	**don't water**	**don't water**	**don't water**	**don't water**	**don't water**	**don't water**	**don't water**	**only once**

Plants in this area: *Buffalo Grass*

Figure 44. SmartGardenWatering.org.au estimated garden watering demand

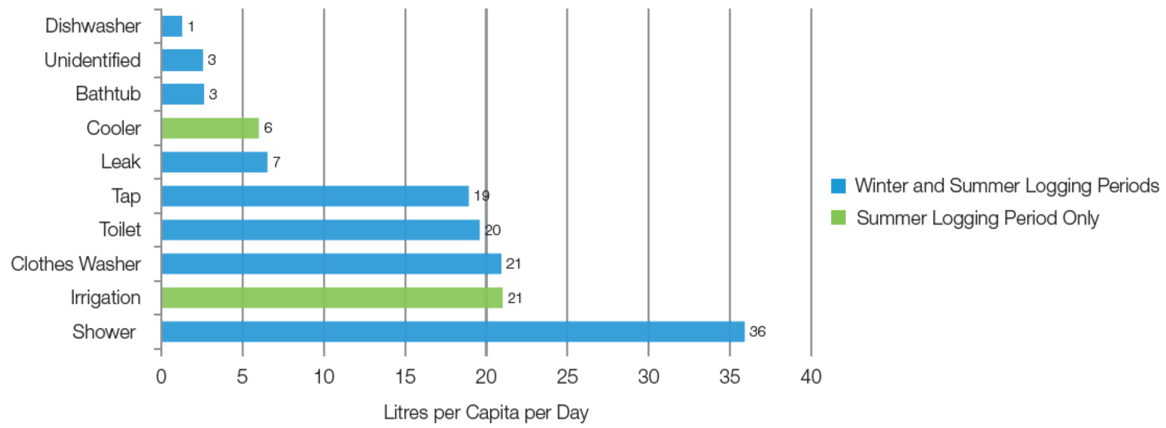


Figure 45. Litres used per household item per day (Melbourne Residential Water Use Final Report 2011)

The rainwater tank MUSIC node inputs are shown in Figure 46 below. With this tank capacity and household reuse assumption, around 20% of development runoff is expected to be reused, with an 85% of demand met. Given the demand achievement, there is no advantage in increasing the tank size above 3KL from a harvesting perspective.

Overall developed catchment setup and water use results are shown in Figure 47.

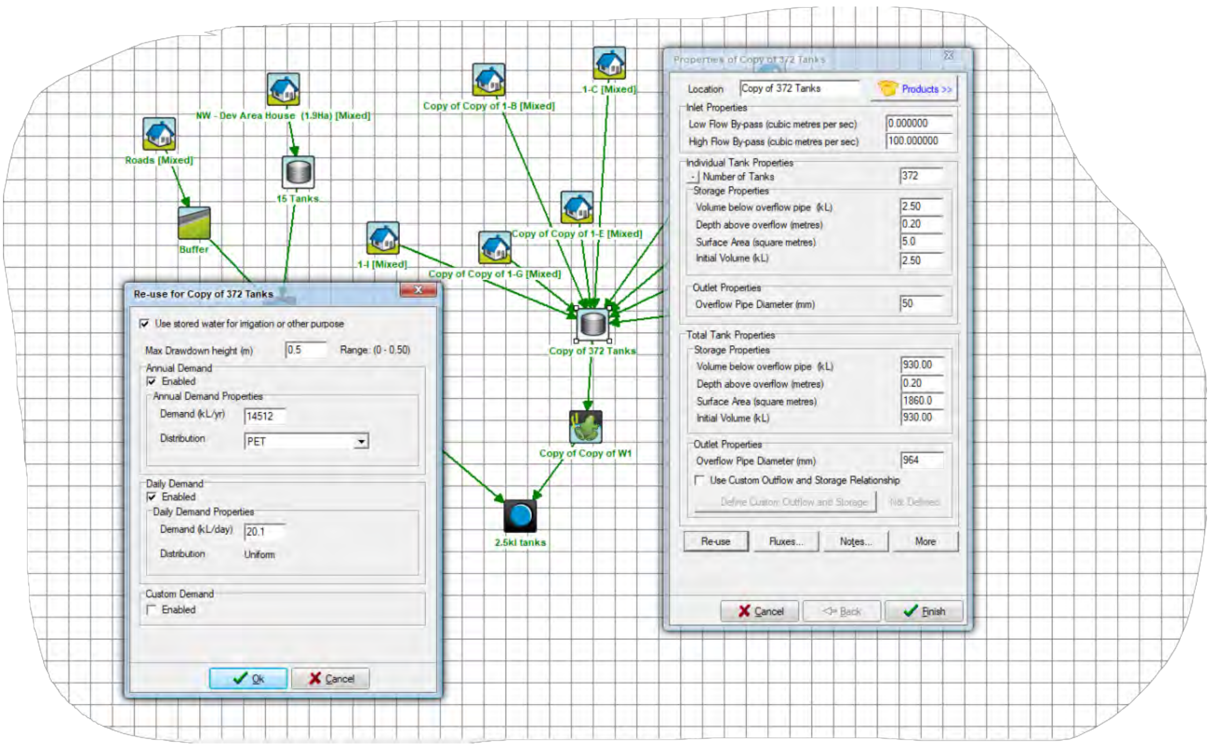


Figure 46. Rainwater tank assumptions for western catchment

Node Water Balance - Copy of 372 Tanks

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	93.81	18846.20	38.17	268.35	4383.30
ET Loss	0.00	0.00	0.00	0.00	0.00
Infiltration Loss	0.00	0.00	0.00	0.00	0.00
Low Flow Bypass Out	0.00	0.00	0.00	0.00	0.00
High Flow Bypass Out	0.00	0.00	0.00	0.00	0.00
Pipe Out	72.26	9296.67	22.29	188.06	0.00
Weir Out	2.97	564.70	1.12	8.00	0.00
Transfer Function Out	0.00	0.00	0.00	0.00	0.00
Reuse Supplied	18.72	414.33	2.79	35.47	0.00
Reuse Requested	21.92	0.00	0.00	0.00	0.00
% Reuse Demand Met	85.43	0.00	0.00	0.00	0.00
% Load Reduction	19.80	47.67	38.67	26.94	100.00

Decimal Places 2

Figure 47. Reuse demand met Southwest Catchment

There is strong commitment to implementing appropriate title protections to the western catchments (173 agreements) as per the geomorphic, IWM, geotechnical, and stormwater management recommendations.

11. Treatment Concept

The major site treatment assets have been approximately sized within each estimated available reserve. Where possible all batters are to be kept to 1 in 6 grades with subsurface wetland grades as per Melbourne Water safety guidelines. These concept designs are indicative only and further investigation into practicality and constructability is recommended. Concept layouts are shown below

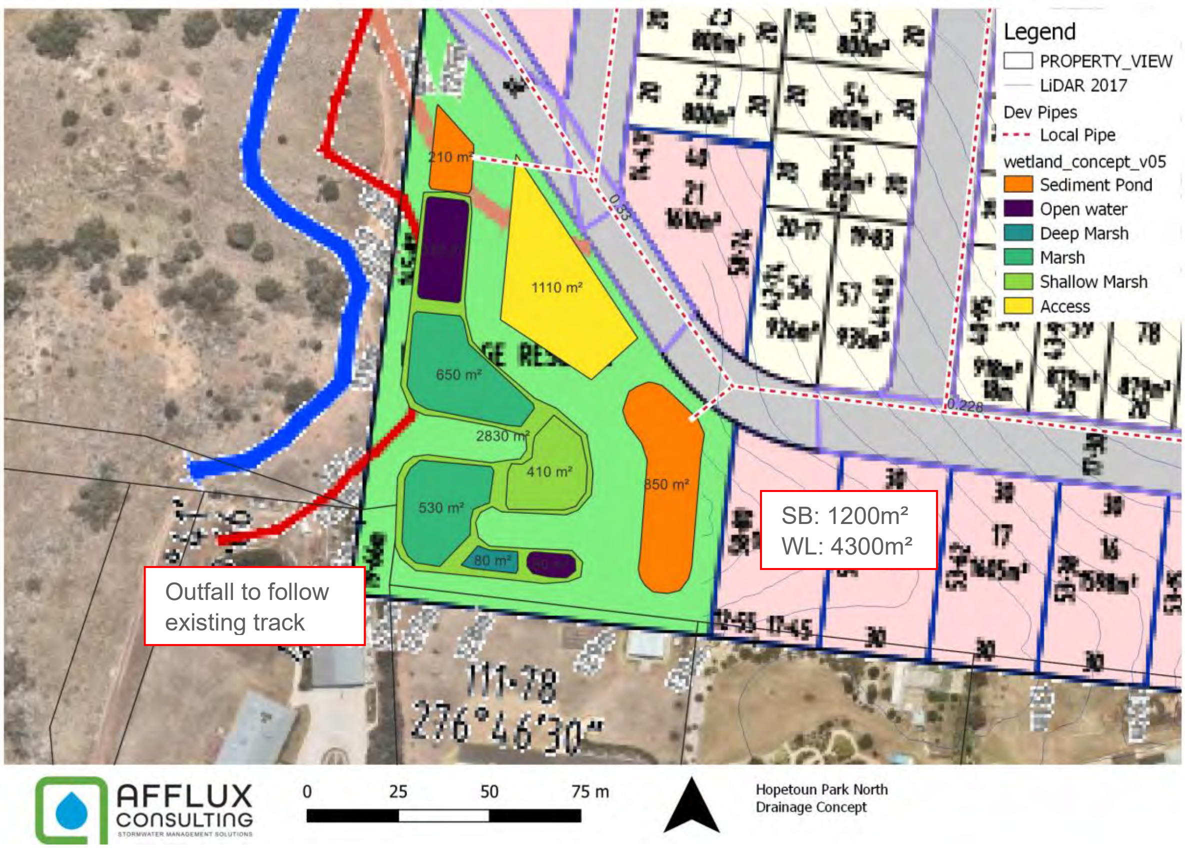


Figure 48. South-West wetland concept

12. Design Considerations

This section highlights unique drainage considerations specific to the stormwater management and design of this site.

12.1. Steep Outfall Considerations

The steep outfalls have been thoroughly investigated in this SWMP (Section 9.6). No recommendation has been made in this report, as all options are viable, but have different maintenance, risk and cost implications. The purpose of a SWMP is to provide a plan for the management of stormwater, and the possible design solutions and land takes. In this case it is felt that enough information has been provided to prove the outfall construction, and the finer details can be worked through at the design and approvals stages.

Figure 49. Polyethylene (black) pipe installed on a steep slope (Source: Google Images, 2020)

12.2. Street Capacity

It is noted that whilst we are not assessing a subdivision application at this stage (only a rezoning application), that the work on the final street layouts and drainage connections is preliminary only. However, Council do require some comfort that the overall SWMP can meet its macro requirements and as such an indicative major flow paths assessment through the subdivision has been undertaken for hazard parameters. The flow path check locations can be seen in Figure 50. The flows have been derived from the RORB model, and cross section checks can be seen in Figure 51. It is recommended that a 10% AEP be used for the collector streets to maintain safe flows.

A typical 24m street cross section has been used for the collector roads as per the IDM guidelines.

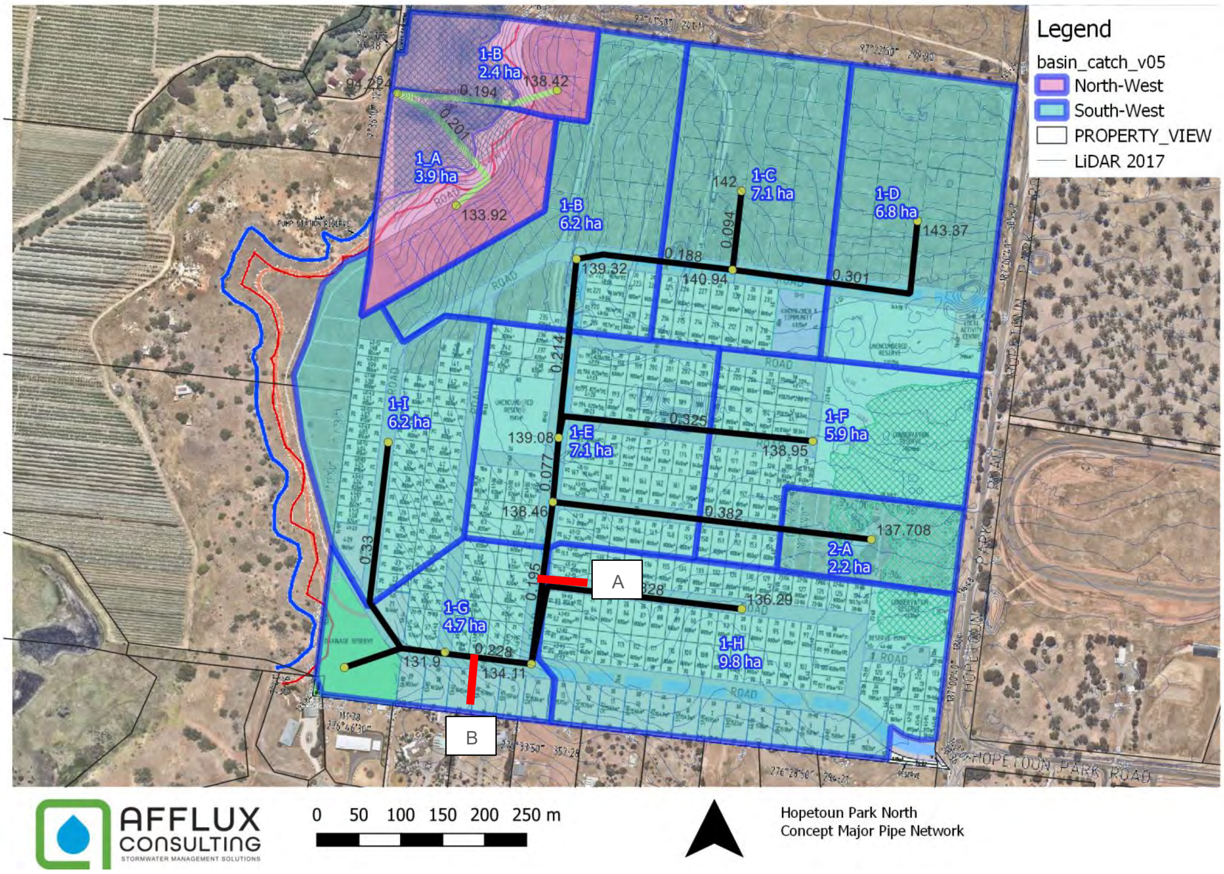


Figure 50. Flow Cross Section Checks

PROJECT: 24m
Dummy Comment for template file
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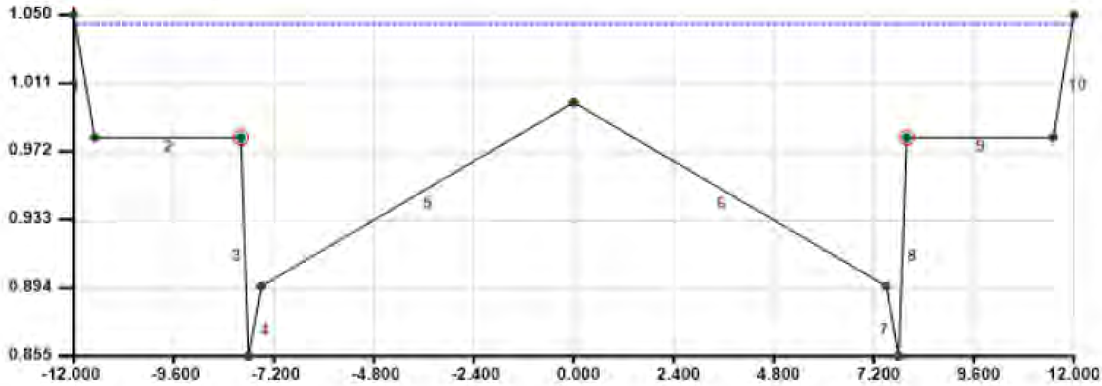
Data File: 24mXsec.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 8.19 cumecs

1 no.1350 mm diameter Class 2 (X) pipe; grade of HGL = 1 in 100

Pipe discharge = 5.41 cumecs
Pipe flow velocity = 3.6624 m/s

Overland / Channel / Watercourse discharge = 2.78 cumecs

Figure 51. Gap Flow analysis with 10% AEP pipe Section B

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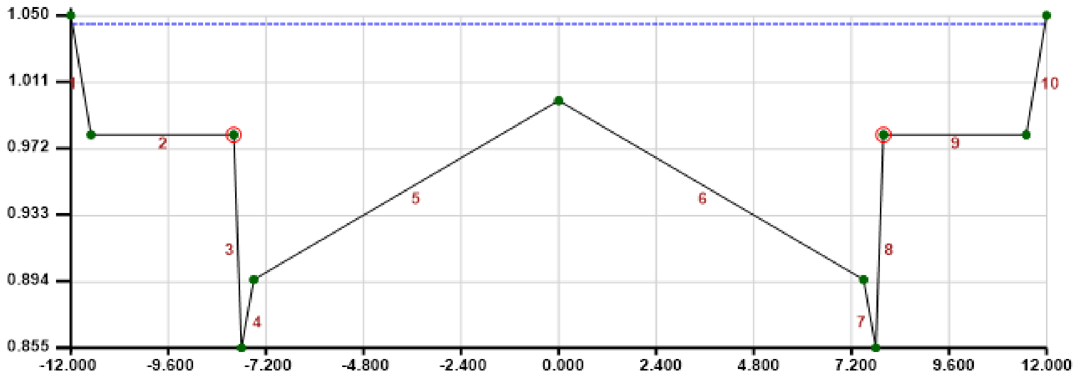
Print-out date: 11/05/2023 - Time: 11:16
Data File: 24mXsec.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 6.60 cumecs

1 no.1200 mm diameter Class 2 (X) pipe; grade of HGL = 1 in 100

Pipe discharge = 3.97 cumecs
Pipe flow velocity = 3.4019 m/s

Overland / Channel / Watercourse discharge = 2.63 cumecs

Figure 52. Gap Flow analysis with 10% AEP pipe Section A

12.3. Temporary Requirements

Given the well documented discharge arrangements required down the escarpments, the pipe outfall and associated basin structures should be considered as early as possible in the development phasing. If temporary works are considered they should meet the following criteria:

- The existing flow rates down the escarpment cannot be varied. Figure 22 and Figure 53 in this report can be used to determine these limits
- Any temporary structure should take into account the recommendations of the Geotechnical investigations and may require significant basin liners
- Any structure should be located some distance from the escarpment areas. Typically a value of at least 50m is often specified, but specific geotechnical advice should be sought

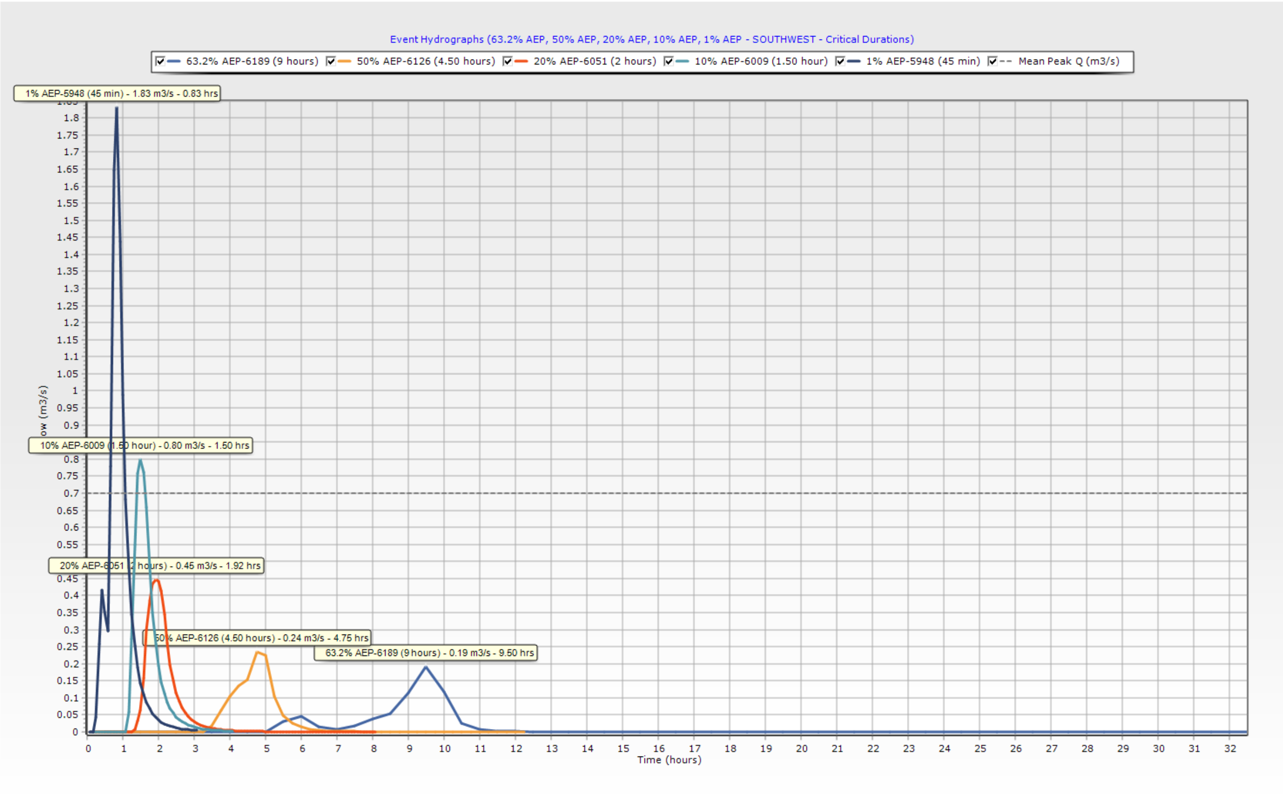


Figure 53. Southwest Catchments All critical Durations

12.4. Stormwater Asset Maintenance

The treatments for the Northwest Catchments and Southwest Catchments are significantly different with recommended maintenance requirements listed below.

12.4.1. Northwest Catchments

The treatments in the northwest catchment are specifically designed to be Zero Additional Maintenance requirements. Regular street sweeping will remove the majority of the sediment from the sediment grooves. Any additional sediment will become incorporated into the grassed embayment. No pipes required.

12.4.2. Southwest Catchments

The southern catchments are discharging to a retarding basin and incorporated wetland system. Typically on final design of the system the following maintenance items would be submitted with the designs:

- A wetland maintenance plan would be submitted with the designs. An Example plan is shown in the appendix to this report
- A retarding basin maintenance plan would be submitted with final designs. Similar to the wetland maintenance plan a schedule of inspections would be included in this plan. Actions may include:
  - Inspections of the outfall for blockages or other possible failures
  - Maintenance of embankment for inspection. Includes grass mowing and inspection schedule
  - Inspections of outfall pipes
- The stormwater infrastructure should not have any major maintenance requirements to much of Councils other stormwater infrastructure.

12.5. Sodic Soils Implications on Stormwater Development

Council have agreed that a full Sodic Soil assessment will be completed as part of the subdivisional assessment stage. However, based on drainage management experience on similar sites with identified sodic soil interactions, the following design requirements are commonly applied. These items, and recommendations for stormwater assets include:

- All stormwater pipes to be Rubber Ring Jointed to avoid future leakage and potential interaction with sub soils
- A wetland system was recommended based on the soils discussion over other potential treatment types. It is recommended that this system be largely ephemeral, with a lower average depth (0.3m) than MW guidelines suggest and appropriate planting to manage the longer periods of dry. This vegetation and depth consideration needs to be made in consultation with the best geotechnical recommendations.
- Use of geosynthetic liners for the wetland and retarding basin system as per the geotechnical recommendations
- Use of Rainwater tanks as recommended in the geomorphology reports to minimise volume changes

Figure 54. Rubber Ring Jointed pipes on other sodic soil sites

12.6. South East Catchments

A number of inquires have been made from authorities regarding the influence of the proposal on existing ephemeral assets within Hopetoun Park. There is a small section of the existing land that drains south and east based on the existing contour information. These catchments are discussed here:

- Around 4ha drains directly south towards Hammond Cct, and whilst there are a number of lifestyle dams in this flow path no direct ephemeral system connection can be seen. As such this area has not been further investigated
- Around 2Ha drains east towards an existing dam on Hopetoun Park Rd as shown in Figure 55 below. This dam could then in large events overflow and drain south along Riverview Dr towards the ephemeral system. There is however significant hydraulic barriers to this occurring (median strip on Riverview) and it is unlikely that other than in the most extreme events any water would reach the system at 5 Riverview Dr. As such this property development is unlikely to change the exiting low flow hydrology of this system.

Based on this high level investigation no further detailed hydrological analysis has been performed. An allowance for a small section of catchment and treatment has been accounted for in the conceptual development plans, but this area is not advanced enough at a rezoning stage for detailed analysis. When the staging of this area is contemplated a further investigation can be completed.

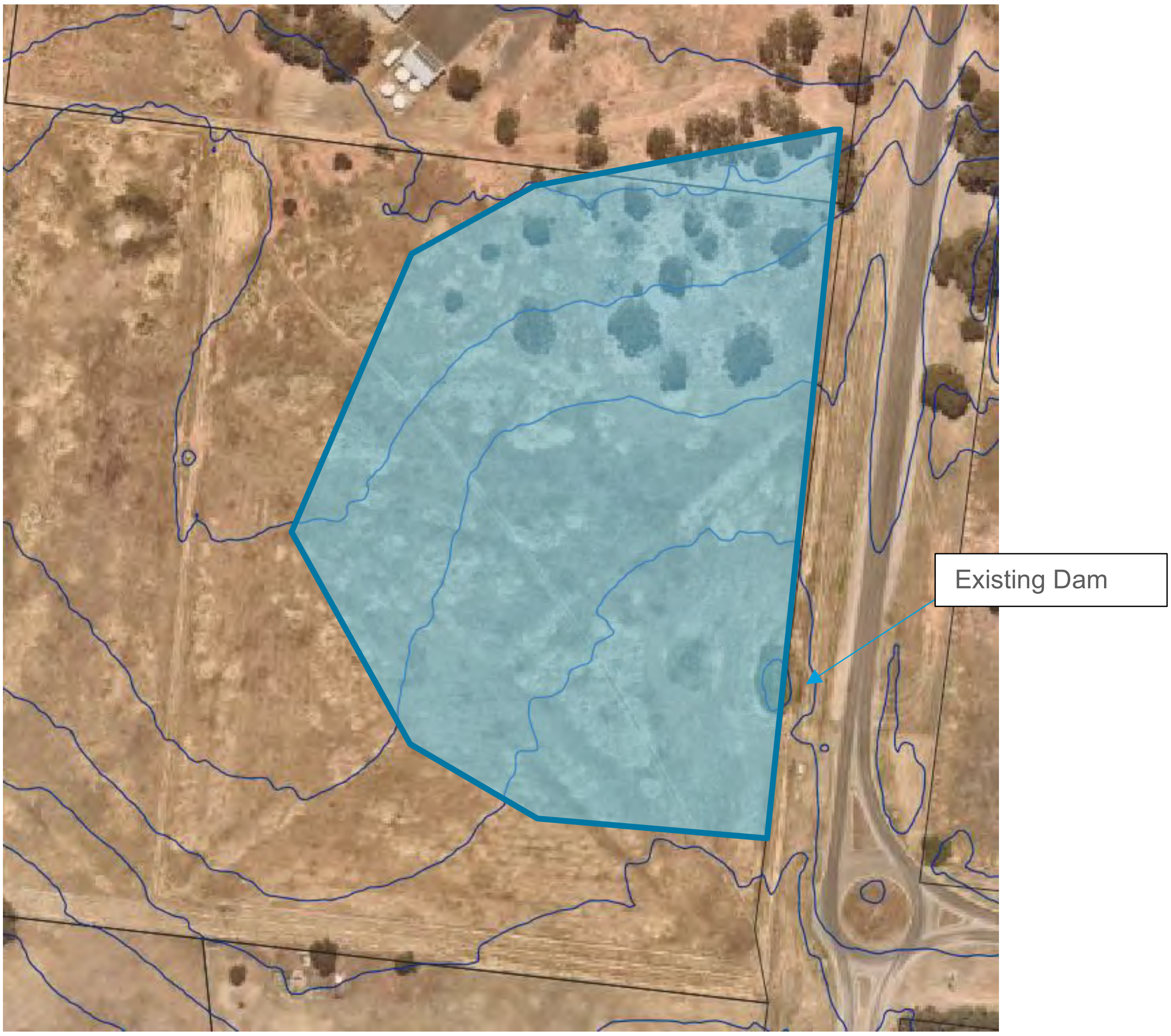


Figure 55. Existing South East Catchment

13. Conclusion

This stormwater management plans sets out the major requirements for the development of the western catchments of land in Hopetoun Park North and provides important background information for the rezoning of this land. These catchments are under the Melbourne Water 60Ha limit, and as such all stormwater management will be undertaken by Council. Through the calculations shown in this report, it has been shown that:

- Safe management of flows and flow paths can be achieved through the proposed management interventions
- All stormwater management items are relatively standard and can be constructed in line with the IDM (although there are alternative solutions that may want to be explored further at future stages)
- The BPEM requirements can be met
- The Bacchus Marsh IWM requirements can be met with no adverse change in risk to the development
- The Climate Change potential rainfall increase changes can be accounted for in the design
- The unique soil and hydrology of this catchment can be accounted for

The macro drainage features including flow conveyance and storages, have been considered for the site, and reasonable design constraints given. The micro (pipe network) systems have also been considered in concept, along with water quality treatment. In summary the following elements are required for this site to meet contemporary drainage outcomes:

- Around 12,000m³ of retention storage required at the South-West outfall
- Outfall to be considered in detail for individual asset design including outfall structures. A number of options for this have been provided including IDM compliant options
- ZAM treatments for minor sediment and nutrient controls on the NW catchment

14. Abbreviations and glossary

For clarification, provided are terms referred to within this report and their definitions as applicable to stormwater and water engineering.

TERM (Abbreviation)	DEFINITION
Afflux	A measure of the increase in water elevation (or flood level difference) at a given location, relative to the water elevation that would have occurred.
Alluvium\alluvial material	Extensive deposits of sand, silt and/or clay formed by a river or flood, typically forming a floodplain. Alluvium is generally unconsolidated.
Annual Exceedance Probability (AEP)	The likelihood of a storm event or flood occurring or being exceeded within any year. Where, $$AEP = 1 - e^{\left(\frac{-1}{ARI}\right)}$$
Attenuation	Reduction in the magnitude of a flood peak
Australian Rainfall and Runoff (ARR)	Australian Rainfall and Runoff guidelines document.
Average Recurrence Interval (ARI)	A statistical estimate of the average length of time (in years) between equivalent (or larger) flood events. Note. Events do not occur at regular intervals. This is an average and not the expected elapsed time until the next exceedance. e.g. a "100 year ARI flood event" has a 1% exceedance probability each year.
Australian Height Datum (AHD)	Vertical height in meters above the mean sea level.
Baseflow	The slow component of catchment runoff, not immediately in response to a storm event. Encompasses interactions with seepage and groundwater discharge into a waterway.
BPEM	Best practice environmental management guidelines used for planning, designing or managing stormwater systems or urban land uses
Catchment	The upstream land and water surface area that drains to a specified location under consideration.
Consequence	Outcome or impact of an event.
Critical Sorm Duration	The length of time of a rainfall event that results in the peak flow or level at a particular location of interest for a given AEP.
Cumec	An abbreviation of cubic meters per second, a unit of discharge (m^3/s)
Drainage Network **or System**	A system of natural or constructed flow paths within a catchment used to convey runoff to its outlet. This may include surface or subsurface systems such as pipes, channels, gutters, overland flow paths, culverts, water storages, etc.

Design Event	A probabilistic or statistical flood or rainfall event used for flood/flow estimation processes for a given AEP.
DELWP	Department of Environment, Land, Water and Planning
EPA	Environmental protection agency
Extended Detention	Distance above normal water level in where stormwater is temporarily stored
Evaporation	The transfer of water, as vapour, from a water surface to the air
Evapotranspiration	The transfer of water, as vapour, from near the earth's surface to the air. Includes open water surfaces, ice, frost, soil and transpiration from plants.
Freeboard	The difference in height between the calculated water surface elevation and the top, obvert, crest of a structure or the floor level of a building, provided for the purpose of ensuring a safety margin above the calculated design water elevation.
Flood	Inundation of normally dry land by water that has exceeded the capacity of the normal confines of waterbodies, water storages or watercourses.
Flood Frequency	Descriptor for the annual exceedance probability or average recurrence interval of a flood
Floodplain	The land area which experiences flooding during high discharge events.
Hazard	Potential for damage or harm. Considered alongside consequence and likelihood of occurrence.
Hydrological Analysis	Developing and understanding a set of relationships to determine how rainfall is converted into runoff or streamflow (includes consideration of climate, losses, soil types, etc).
Hydraulic Design	The process of numerically analysing actual or expected flow conditions (such as water surface elevation and velocity) associated with a given hydraulic structure or overland flow.
Infiltration	The downward movement of water into a catchment surface or infiltration system. Largely governed by soil conditions, vegetation and antecedent moisture content.
Loss rate	Removal (loss) of water from the rate of rainfall that occurs during the process of forming stormwater runoff. Usually measured in units of mm/hr. The assumed loss rate usually varies across the drainage catchment in accordance with known or assumed surface conditions.
Local Authority	Any local or regional external authorities (including local and State Governments or non-government authorities) that have a legal interest in the regulation or management of a given activity, or the land on which the activity is occurring, or is proposed to occur.
Manning's 'n' Roughness Coefficient	The numerical representation of the hydraulic roughness of a conduit, flow path or channel as used in the Manning's formula.
Rainfall Excess	The portion of rainfall that contributes to streamflow
Rainfall Intensity	The rate at which rain falls, typically measured in mm/hour.

Runoff	The part of rainfall (or snow/hail) not lost to infiltration, evaporation, transpiration or depression storage that flows from the catchment area past a specified point.
Sedimentation Basin	A basin or tank in which sediment collects primarily through the actions of gravitational settlement. The basin facilitates low-velocity, low-turbulent flows to facilitate the settling of coarse sediment particles from stormwater runoff.
Soil Erosion	The detachment and transportation of soil and its deposition at another site by wind, water or gravitational effects. Although a component of natural erosion, it becomes the dominant component of accelerated erosion as a result of human activities, and includes the removal of chemical materials.
Stage	Elevation of the water surface in a stream measure to some convenient datum
Storm	In hydrology this includes any rainfall event. Unlike common usage implying a period of extreme weather with intense rain and strong wind.
Stormwater Flooding	Inundation by local runoff caused by heavier than usual rainfall. Stormwater inundation is caused by local runoff before it has entered a watercourse or joined watercourse flow. In a rural setting and within large rural allotments, we define stormwater flooding as sheet flow caused by local runoff before it has concentrated into a watercourse, including a drainage channel, stream, gully, creek, river, estuary, lake or dam, or any associated water holding structure.
Surface Water or Inundation	Any water collecting on the ground or in an open drainage system or receiving water body. In this report we use these terms to discuss water before it is categorised into flood, stormwater or other.
Temporal pattern	The time sequence of rainfall intensity. A representation of the variability of rainfall throughout a storm event.
Water Balance	An account of all the water in a specified system. Includes measurement of all inflows, outflows and changes in stored water volumes.
Wetland	A natural or constructed area of land inundated temporarily or permanently with shallow water that is usually slow moving or stationary

15. References

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16. Appendix

Appendices:

- Geomorphological Study
- Black Geotechnical Study
- Draft Wetland Maintenance Plan
- Outfall Investigation

Hopetoun Park: Geomorphic Settings for Development

Sandra Brizga and Scott Seymour DRAFT Version 1.0, 24 August

Contents

1 Introduction

A development scheme is being prepared for Hopetoun Park, Victoria. The study area is situated between Pyrites and Djerriwarrh Creeks in the Werribee River catchment (Figure 1). The study area is mainly situated on a broad plateau but also includes escarpments and gullies that fall steeply to the adjacent valleys on the western and eastern sides. The delivery of flows from developed areas on the elevated plateau to the streams at the base of the escarpment is a key challenge for the development scheme. This report provides an assessment of the geomorphology of the study area and implications for drainage, with particular emphasis on potential drainage arrangements for the escarpments.

This report is based on the following sources of information:

- site inspections on 11 and 26 May
- desktop review, including aerial imagery, geological and topographic mapping, and previous relevant reports including Sites of Geological and Geomorphological Significance[1]
- review of preliminary proposals for drainage arrangements including hydrologic and hydraulic information provided by Afflux Consulting

The report is presented in two sections. The first section provides a review and analysis of the existing geomorphology of the study area. The second section examines the implications of the geomorphology for future drainage arrangements associated with development.

[1] http://vro.agriculture.vic.gov.au/dpi/vro/portregn.nsf/pages/port_lf_ppsites_sig

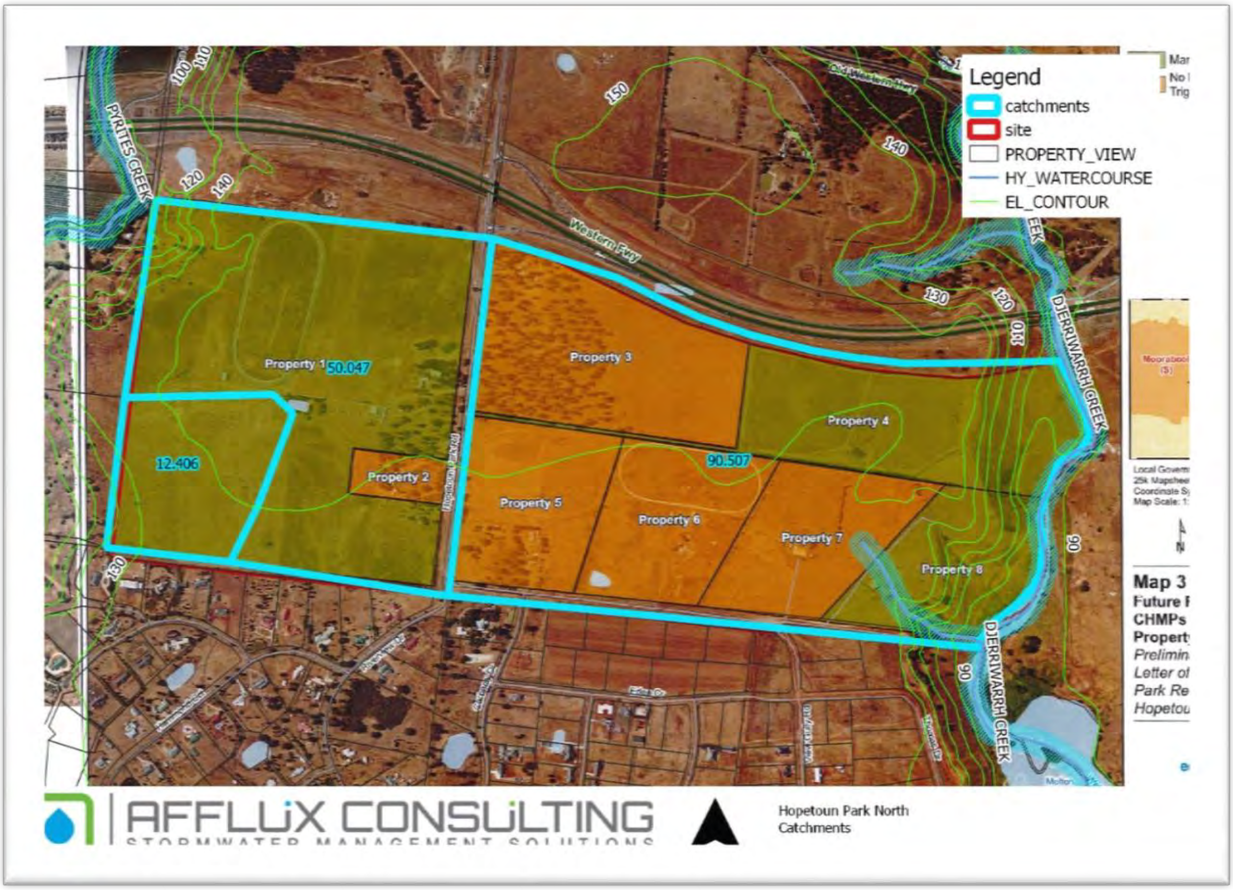

Figure 1 Study area

2 Geomorphological Context

2.1 Topography

The study area includes a central elevated plateau located between Pyrites Creek and Djerriwarrh Creek as well as the escarpments and gullies on the eastern and western sides of the central plateau that fall towards these streams (Figure 2, Figure 3). To the west of the study area, Pyrites Creek flows across a wide alluvial plain sometimes referred to as the 'Bacchus Marsh Basin', which it shares with the Lerderderg and Werribee Rivers (Roberts 1984). To the east of the study area, Djerriwarrh Creek flows through a deeply incised gorge-like valley and is subject to tailwater inundation as part of the Melton Reservoir. The elevation of the central plateau is 140 m AHD, 50 m higher than the adjacent Bacchus Marsh Basin and Djerriwarrh Creek valley. Natural drainage from the central elevated plateau flows towards the streams below via small steep gullies on the western and eastern escarpments.

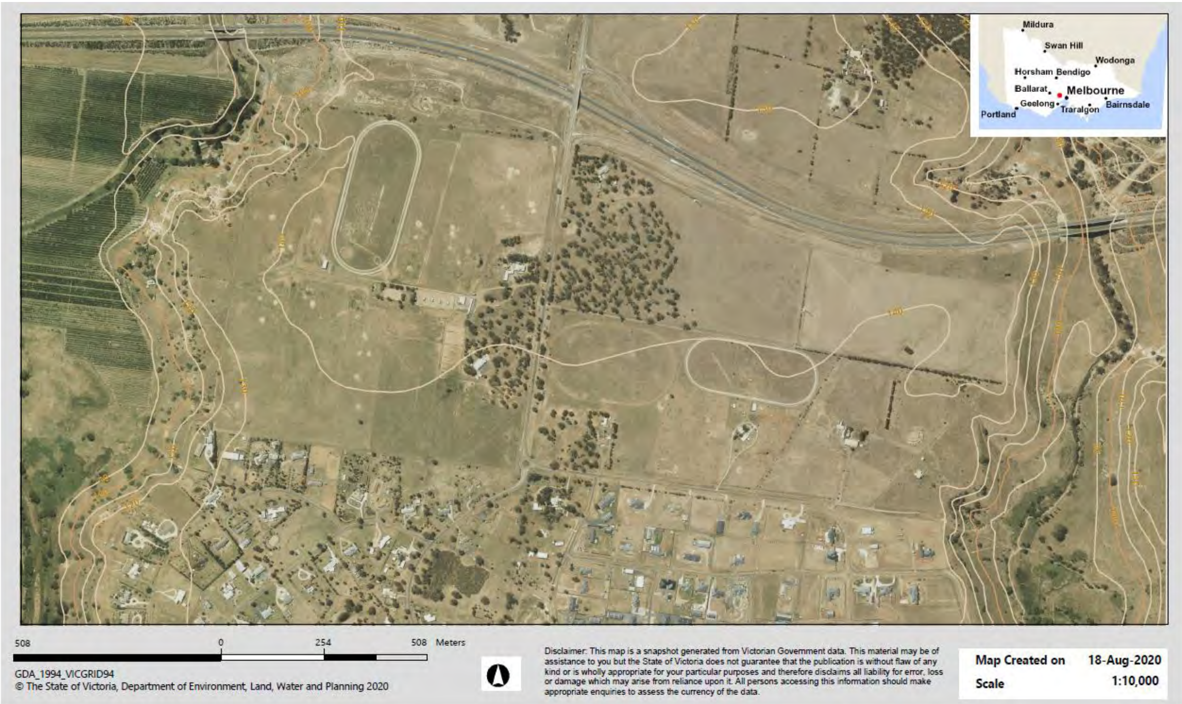

Figure 2 Aerial image and contour plan of the Hopetoun Park study area

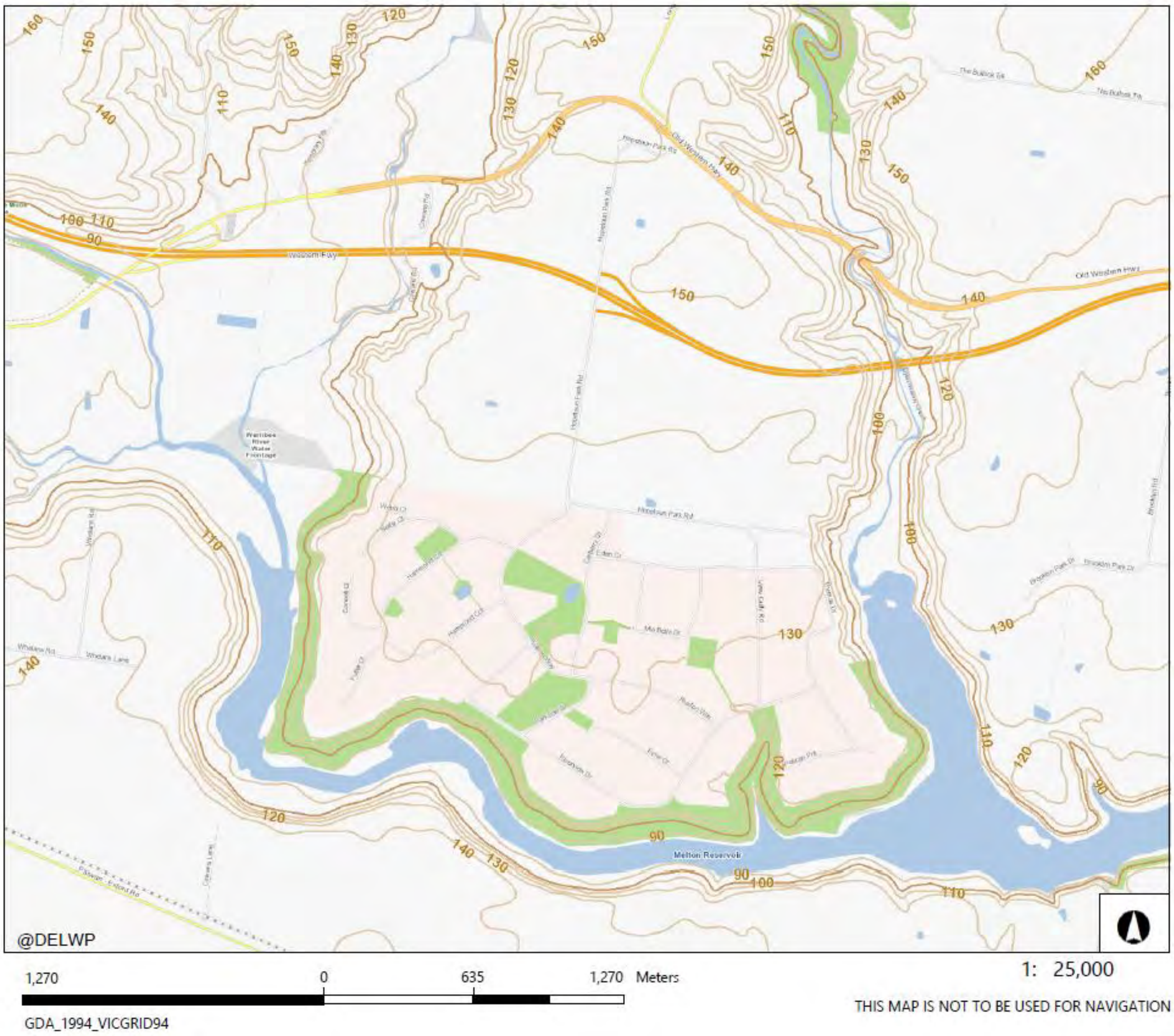

Figure 3 Topographic map showing the Hopetoun Park study area, including the central plateau, the broad alluvial plain of the Bacchus Marsh Basin to the west and narrow, gorge-like valley of Djerriwarrh Creek to the east

2.2 Geology

The geology of the study area consists Ordovician basement rock (shale and greywacke) overlain by Cainozoic sedimentary and volcanic formations (Figure 4). The surficial formations and outcrops in the study area are all Cainozoic. The western escarpment is aligned with the Djerriwarrh Fault.

Extracts from geology maps:

⇦ Melbourne 1:250,000

Bacchus Marsh 1:50,000

⇩ Melton 1:63.360

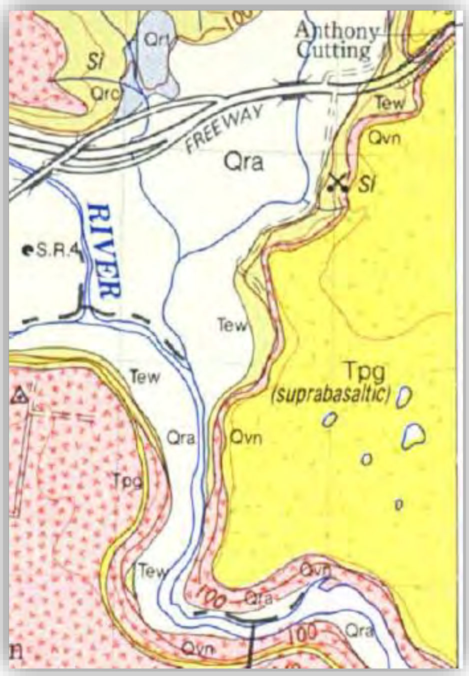

Figure 4 Extracts from geology maps showing the Hopetoun Park study area

The Ordovician basement rock is overlain by Tertiary sediments. The Tertiary sediments along the western escarpment have been mapped as the Werribee Formation ('Tew' on Figure 4). The Werribee Formation consists mainly of clay, sand, brown coal and gravel (Roberts 1984). Roberts (1984) drew attention to a silica sand deposit within the Werribee Formation in the western escarpment, near the northern end of the study area, which has been quarried (as shown on the extract from the Bacchus Marsh 1:50,000 geology map). Outcrops of the Werribee Formation were observed during the site inspections along the western escarpment (Figure 5).

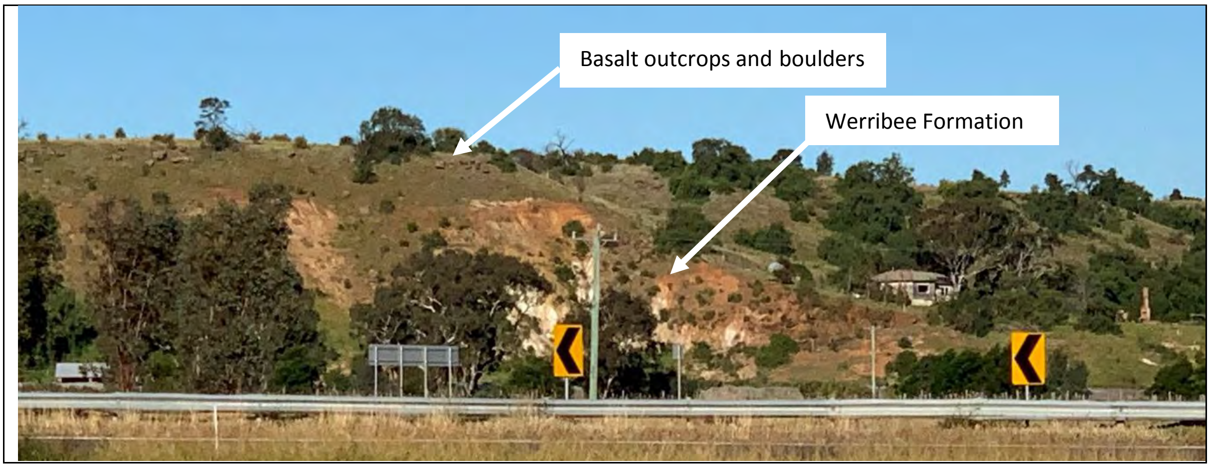

Figure 5 View of the northern end of the western escarpment showing basalt outcrops at the top of the escarpment and Werribee Formation exposures in the escarpment

The Tertiary sediments overlying the Ordovician basement rock In the eastern part of the study area, have been mapped as 'Brighton Group' on the Melbourne 1:250,000 geology map or 'Bullengarook Gravel' on the Sunbury 1:63,360 geology map (Figure 4). The formation consists gravel, sand and silt. No outcrops of this formation were observed during the site inspection.

The Werribee Formation and Brighton Group/Bullengarook Gravel sediments are overlain by the Newer Volcanics – a formation consisting of basalt with minor occurrences of other volcanic rocks including scoria, tuff and agglomerate. Basalt outcrops were observed at the tops of both escarpments.

The Newer Volcanics basalt is overlain by sedimentary deposits that have been mapped as either late Tertiary or Pleistocene age. The Bacchus Marsh 1:50,000 geology map shows these deposits as 'Tpg', a generalised unit of late Tertiary non-marine deposits of mainly gravel and sand, with a sandy, silty or clayey matrix (Roberts 1984). An important characteristic of 'Tpg' is that it underlies, overlies or interfingers with the Newer Volcanics (Roberts 1984). The Melbourne 1:250,000 geology map shows the same deposits as 'Qrc' – Quaternary gully alluvium or colluvium (gravel, sand, silt). The Sunbury 1:63,360 Geology map (1973) mapped these deposits as Darley Gravel ('Qpe') – gravel, sand and gritty silt of Pleistocene age, with no formative process specified. No exposures were observed in the study area during the site inspection; however, sedimentary deposits overlying the Newer Volcanics basalt are evident at Anthony's cutting (Figure 6).

Figure 6 Anthony's Cutting showing intercalation of Newer Volcanics basalt with overlying and underlying sedimentary formations (Source: Google Maps)

2.3 Sites of Geological and Geomorphological Significance

Two sites of geological and geomorphological significance relevant to the present study have been identified from Rosengren (1986) (Table 1).

Site L12 (Bacchus Marsh Basin) includes part of the western escarpment south of the study area. The geomorphological values identified by Rosengren (1986) for site L12 are also relevant to the section of the western escarpment that is included in the study area (Figure 5, Figure 7).

Site L11 is a road cutting on the Old Western Highway (north of the study area). It provides a clear exposure of three of the geological formations that occur in the study area and their stratigraphic relationships.

Table 1 Sites of geological and geomorphological significance (from Rosengren 1986)

Site	Significance	Comments	Relevance
L12 - Bacchus Marsh Basin	Regional	Site L12 includes part of the western escarpment south of the study area. It was selected as an example to illustrate the major characteristics of the valley floor and lava flow slopes that surround much of the basin. Rosengren (1986) recommended that 'The valley side slopes could be retained in agricultural land use to maintain site significance'	The western escarpment to the north of site L12 has similar values
L11 - Anthony's Cutting	State	Site L11 is a road cutting displaying the stratigraphic relationship of the Newer Volcanics basalt to overlying and underlying sedimentary formations.	The road cutting displays exposures of geological formations that occur in the study area

Figure 7 Western escarpment and Bacchus Marsh Basin alluvial plain

2.4 Rainfall and Hydrology

The study area has relatively low rainfall (average rainfall ~500mm/year and 95th percentile rainfall ~ 700 mm/year) (Figure 8). Regional-scale climate change projections published by the Bureau of Meteorology (2020)[2] indicate likely reductions in mean annual rainfall (particularly resulting from reductions in winter and spring rainfall as well as possible changes to summer and autumn rainfall) and increased intensity of the more intense rainfall events. At a local scale, the study area is likely

[2] https://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=SSVWC&tooltip=true&popup=true

to have enhanced reduction in rainfall due to the rain shadow effect of the Brisbane Ranges with a tendency to become more arid.

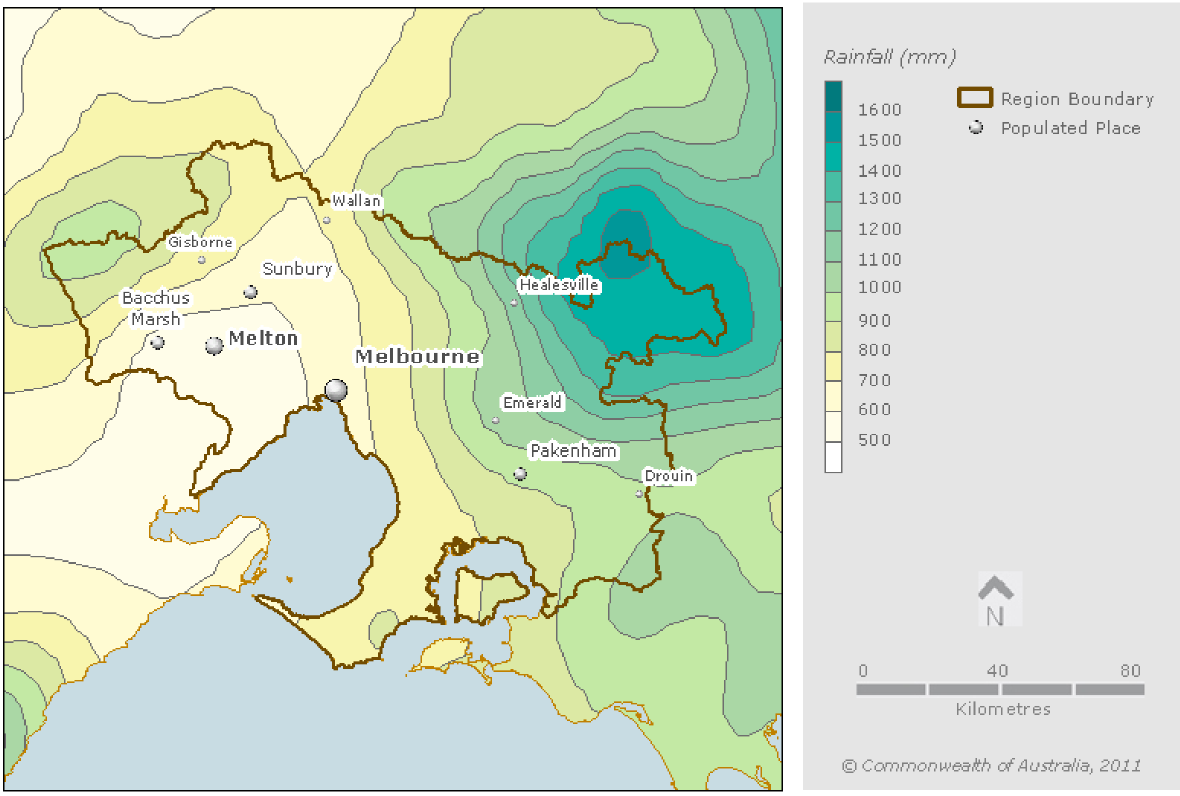

Figure 8 Average annual rainfall 1961-1990 (Source: Bureau of Meteorology[3])

2.5 Soil Characteristics

The study area spans volcanic plains (on an elevated plateau) and the sides of dissected eroded valleys to the west (Pyrites Creek / Lerderderg River / Werribee River) and east (Djerriwarrh Creek). The weathering of the plateau has been slower than many areas around Melbourne due to the relatively dry climate and low rainfall (Section 2.4). The soil profile on the Newer Volcanics basalt shows weathered clays graduating to weathered rock at about 2-3m and then fractured rock for a depth of about 5 m through to the Tertiary material below. The Tertiary formations underlying the basalt are highly erodible once exposed and include dispersive clays such as Kaolinite.

The basaltic clays include lumps of Calcium Carbonate about 300-500mm below the surface indicating that long term leaching of Calcium has been very slow. This makes the soils high in pH and well as being sodic and saline. The basaltic clay also exhibits a mild cracking characteristic associated with a moderate shrink swell. Examination of nearby cuttings indicates moisture passing through the fractured rock as well, so the rock cannot be considered as impermeable. Due to the sodic and high pH nature of the soils, the area is not highly fertile and trees take a long time to establish.

[3] http://www.bom.gov.au/water/nwa/2010/melbourne/climateoverview.html

3 Geomorphological Zones

The study area has been divided into three geomorphological zones based on distinctive topographic, geological and geomorphological attributes: Western Escarpment, Central Plateau and Eastern Escarpment. The key geomorphological features of each zone are outlined and their implications for drainage arrangements are discussed.

3.1 Western Escarpment

The western escarpment has basalt outcrops at the top of the slopes (Figure 9) with eroded more weathered material overlying the rock. Bluffs in the Werribee Formation sediments in the middle and lower parts of the slopes occur near the northern end of the study area (Figure 5). Two steep gullies define the main natural drainage lines down the western escarpment in the study area (Figure 1). On a geological timescale, this is an area of active ongoing erosion, although erosion rates under the present regime (climate, base level and land use) are moderate compared to areas of more rapid erosion, such as the Parwan Valley. On management timeframes, , erosion under the present rural land use appears to be slow but insidious. Erosion processes include mass movement, subaerial erosion and fluvial erosion in the gullies. The western escarpment is at high risk of accelerated erosion if disturbed due to the steep slopes and underlying geology.

Figure 9 Basalt outcrops at the top of the western escarpment

The geology of the western escarpment (Werribee Formation capped with Newer Volcanics Basalt) is similar to the geology of the nearby 'Tabletop – Landslips' site of geological and geomorphological significance (Site L18 in Rosengren 1986), which is situated 4 km west of Bacchus March, on the southern slope of Tabletop Hill. 'Tabletop – Landslips' is a site where extensive mass movement has occurred, including rotational slumps and earthflows (Rosengren 1986). Spring discharges at the base of the basalt in such situations has been identified as a contributing factor for landslips and salinity in the Rowsley Valley (Dalhaus et al. 2004).

Saline seepage was observed at the base of the western escarpment and hummocky ground raises suspicion of past mass movement or landslips (Figure 10). The Werribee Formation has been associated with major historical soil erosion and numerous landslips in the Parwan Valley (Forbes 1948, Lubczenko et al. 1994). The Werribee Formation exposure in Anthony's Cutting displays extensive rilling due to the exposure of the Kaolinite Clays (Figure 6).

Figure 10 Werribee Formation exposure near base of western escarpment showing saline seepage and basalt boulders that appear to have fallen from the outcrop at the top of the escarpment

The steep slopes and presence of the Werribee Formation indicate a significant risk of erosion and landslip if flows in the natural gullies were to be increased as a result of development, or open channels were to be constructed to provide additional drainage. The steep escarpment slopes and Werribee Formation are not conducive to the establishment of a stable natural or quasi natural stream channel morphology down the western escarpment due to a significant risk of severe erosion.

The natural template for a stable watercourse on such a steep gradient would be a series of cascades or waterfalls in hard bedrock. The Newer Volcanics basalt is likely to have sufficient strength to support such a channel, but it only occurs in a thin layer at the top of the western escarpment and therefore would not provide support down the escarpment batters. The much more erodible Werribee Formation is predominant and highly unlikely to support a stable natural channel at a steep gradient.

Constructed rock riffles or armouring are unlikely to be safe and effective at such a steep gradient. Pool and drop/riffle sequences do not naturally occur at such steep gradients unless supported by extensive bedrock controls. Constructed rock riffles are likely to cause a landslip or debris flow hazard if they fail for any reason, including infiltration at the interfaces.

It is strongly recommended that drainage from the developed areas on the central plateau be piped down the western escarpment to minimise stability risks and prevent uncontrollable erosion. Care needs to be taken with the construction of the pipeline, to ensure that the trench does become a preferential flow path for overland flows or groundwater surcharge and thereby exacerbating erosion and landslip risk. Saline seepage is likely to require salt-tolerant species to be used for ground cover and soil stabilisation.

Water should not be retained at the top or near the face of the escarpment for any significant length of time, due to the risk of surcharging the local groundwater and exacerbating the landslip hazard. Any proposed waterbodies such as wetlands must be lined with a low permeability clay.

The western escarpment is a prominent large-scale geomorphological feature that is visible across the Bacchus Marsh Basin, including from the Western Highway, and this relationship is of geomorphological and geological significance (Rosengren 1986). Any works on the escarpment should be designed so as to minimise the visual impact on the escarpment and its relationship to the elevated plateau at the top of the escarpment and alluvial plain at the base.

3.2 Central Plateau

The central plateau extends across areas of the Newer Volcanics and Cainozoic sediments. Soil and substrate conditions will vary depending on geology and location, and will need to be further investigated in detail as part of the design of any constructed channels or drains.

The plateau grades generally from the North to South, but with lateral east and west gradients over the edge of the plateau. Long term low gradient erosion has provided a number of discharge lines over the edge of the plateau both east and west and south.

Although the land surface is relatively flat, the Cainzoic sediments appear to be readily erodible (as observed in Anthony's Cutting – Figure 6), and a channel cut into this formation may be affected by bank erosion even if the bed is stable.

Water quality management will be complicated by the presence of sodic material and unsettleable turbidity and suspended solids. The construction and building phases will be particularly problematic. Once developed the establishment of good grass cover is unlikely to be achieved due to the soil characteristics and low summer autumn rainfall. It is probable that the addition and incorporation of Gypsum into the soils will be required across all the disturbed areas prior to topsoiling.

3.3 Eastern Escarpment

The eastern escarpment forms one side of the gorge-like valley of Djerriwarrh Creek (Figure 11). Steep gullies provide natural drainage down the eastern escarpment. Newer Volcanics basalt outcrops occur along the top of the escarpment as in the western escarpment. No outcrops of the underlying Tertiary sediments (Brighton Group / Bullengarook Gravel) were observed but it would be prudent to assume that erosion risks are similar to the western escarpment.

Figure 11 View of eastern scarp near Hopetoun Park Road, looking north, showing very steep slopes with basalt outcrops in the upper part of slope. The floodplain at the base is periodically inundated as part of Melton Reservoir pondage.

The steep slopes of the eastern escarpment indicate a significant risk of erosion if flows in the natural gullies were to be increased, or open channels were to be constructed to provide additional drainage. The erodibility of Brighton Group/Bullengarook Gravel formation at this site is unknown but the steep batter slopes indicate a high risk. Melton Reservoir has been significantly affected by high rates of sedimentation (Chanson 1988) although this has been attributed primarily to catchment erosion (Forbes 1948).

The geomorphological issues associated with drainage on the eastern escarpment are similar to those for the western escarpment. The Brighton Group / Bullengarook Gravel formation is potentially susceptible to erosion and landslip than the Werribee Formation, although further investigations would be required to confirm this.

The very steep slopes of the eastern escarpment mean that piped drainage over the escarpment and down the steep batter would present lower risks than constructed open channels, which would be highly likely to be unstable and dangerous.

Again, as on the western side, water should not be retained at the top or face of the escarpment for any significant length of time, due to the risk of surcharging the local groundwater and exacerbating the landslip hazard.

4 Implications for Drainage Management

Management of drainage for Precinct Structure Plan (PSP) requires flows from five catchments to be drained off the plateau to adequately service the development. In addition, consideration needs to be given to mechanisms to reduce flow – through reuse of roof runoff via minimum 10,000 litre storages and also use of reuse mechanisms on each lot created.

A soils investigation needs to be undertaken to confirm soil properties within the development area to ensure appropriate management, including confirmation of the soil types associated with basaltic and sedimentary geologies as well as relevant details of soil chemistry. For example, the application of Gypsum may assist to aid soil erosion management on basaltic soils but this needs to be informed by a soil scientists' investigation for Gypsum requirement. The soils investigation will inform soil erosion management of both the subdivision construction and also the building phases.

4.1 Middle - Southern Catchment

This catchment straddles the North South portion of Hopetoun Park Road and land into the existing lots 1, 2, 3 and 5. There are two drainage lines from this area that head south, one via Riverview Drive and a drainage line through a property west of Carderry Drive, both finding their way through a succession of natural and enhance seasonal wetland depressions colonised by Tangled Lignum *Muehlenbeckia florulenta*. These ultimately discharge overland to a south facing valley draining to the Melton Reservoir.

Given that the connections between each of these assets is via small capacity shallow channels, it is not seen as an option for conveying increased flows from the development unless flows are restricted to current rural rates. Accordingly, it is recommended that the majority of flows derived for this catchment from properties 1, 2, 3 and 5 and are discharged to the west via a small RB in the SW corner of Property 1. Base flows would continue to follow the existing route to sustain the existing wetlands, but higher flows be directed by a flow control balance pipe to the west to a new RB created for the SW corner of property 1.

The RB in the SW corner of property 1 would be near the escarpment and needs to be designed to avoid surcharging groundwater percolation into the escarpment formations (e.g. sealing and minimising storage times, as discussed in Section 4.2).

Flows from the balance of Properties 5, 6 and a small portion of Property 7 should be controlled back to rural rates and allowed to pass down the existing flow path. Water quality treatment should also be applied. An alternative to this latter portion, is for a pipe to be run eastwards through the natural catchment break to discharge to Djerriwarrh Creek via a pipe down the escarpment at the eastern end of Hopetoun Park Road

4.2 South West Catchment

This catchment is currently indicated as only being about 13 Ha. However, due to the constraints with attaining a discharge point for the north west and also south east of Property 1 and flows from portions of property 5, it is suggested that expansion of this catchment to be able to take the majority of the flows from Property 1. It will be important that flows from the North west portions of the catchment be diverted to the SW corner as the ability to establish a large outfall in the NW corner of Property 1 appears problematic.

Under this scenario, all flows will be subject to retardation back to existing rural flows in an RB located adjacent to the SW corner of the property with discharge being down the escarpment along the old road reserve to discharge at Lerderderg River, via a sealed high wall thickness continuously seamed HDPE Pipe and energy dissipation structure. Multiple cut offs and anchor blocks will be required on this pipeline along with erosion control. The trenching through the escarpment will be difficult and liable to involve deep step benching and even blasting. The trench should be fully back filled and stabilised for erosion control and planted, before the rock escarpment is re-established. Care may be needed with access near the existing sewer pump station. Water quality treatment will have to be applied in the upstream end of the RB in a lined portion of the RB.

Establishing an RB in this locality will be guided by a thorough engineering and geotechnical design process that considers the need to have a seal and probably concrete cut off/anchor into the bed rock for the RB wall and a full low permeability liner in the base. The Retarding Basin should not have any permanent water against the RB wall. Further, the RB should consider ANCOLD design guidelines with greater than 100-year ARI overflows being allowed to traverse the existing valley line.

4.3 North West Catchment

The terrain in this part of the site is very steep and discharge to Pyrites Creek down the existing gully is expected to be problematic due to the steep slope and high risk of erosion in the Werribee Formation once disturbed.

The catchment area to this site should be diverted as much as possible to the south west corner to reduce the size of any RB and also size of outfall pipe. If possible, the creation of larger lots with reduced runoff would also be an approach that should be considered to further reduce flows.

With suitable diversion of flows to the southwest, only a small RB and wetland may need to be installed in the head of the valley – again with appropriate consideration of structural needs of the wall, no permanent water against the RB wall and consideration of sealing of the storage. Saline groundwater seepage is already evident near the base of the escarpment in this general area.

Discharge from this site would best be in a hermetically sealed HDPE pipe that traverses the slope at a low gradient below the rock outcrops heading northwards towards the Western Freeway Drain. This is likely to need the approval of VicRoads. This pipe should be a small diameter continuously seamed, high wall strength HDPE pipe with appropriate energy dissipation at the end.

Again, the RB should consider ANCOLD design guidelines with greater than 100-year ARI overflows being allowed to traverse the existing valley line.

4.4 South Eastern Catchment

The flows to this site should be reduced as much as possible by maximising on site detention and reuse for vegetation retention. Without considering a pipe along the south side of Hopetoun Park Road, the outfall should serve the natural catchments of lots 6, 7 and 8. As Council require a piped outfall, this must be via a Retarding Basin and water quality treatment. The pipe size down the escarpment should be kept as small as possible and again be a hermetically sealed high wall strength HDPE pipe.

Due to the very steep nature of the grades from the top of the escarpment to the valley floor of Djerriwarrh Creek, the provision of an outfall is liable to require a deep pipe through the escarpment. As with the south west site this is technically difficult and liable to involve steep bench cutting and cut-offs along the pipe before full reestablishment of the terrain. Use of the existing valley line for the pipeline is not recommended due to the high erosion potential and post construction erosion control needs.

4.5 North East Catchment.

This area drains the majority of Property 4. It is possible to develop the plateau lands and then have an RB near the SW corner of Lot 7 with the outfall pipe traversing the existing track down the slope to Djerriwarrh Creek with suitable use of a hermetically sealed high wall strength HDPE pipe and energy dissipation structure. Discharge over the escarpment in the south east corner of Property 4 is not recommended due to the existing steep terrain and Tertiary sedimentary formation. The water quality control should be established up on the plateau before discharge.

The re-establishment of the trench will require cut offs and erosion control treatment.

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HOPETOUN PARK NORTH
RESIDENTAL DEVELOPMENT

INTERPRETIVE GEOTECHNICAL INVESTIGATION

REPORT NO V2211-1R1, MARCH 2023

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CONTENTS

1.0 GENERAL

1.1 Purpose of investigation

This report presents the results of a geotechnical investigation performed at the proposed Hopetoun Park Road residential subdivision.

An open space network plan provided by Weir and Co is shown in Image 1 with the proposed building lots area shown in pale yellow (800 m^2 lots) and orange (1,500 m^2 lots).

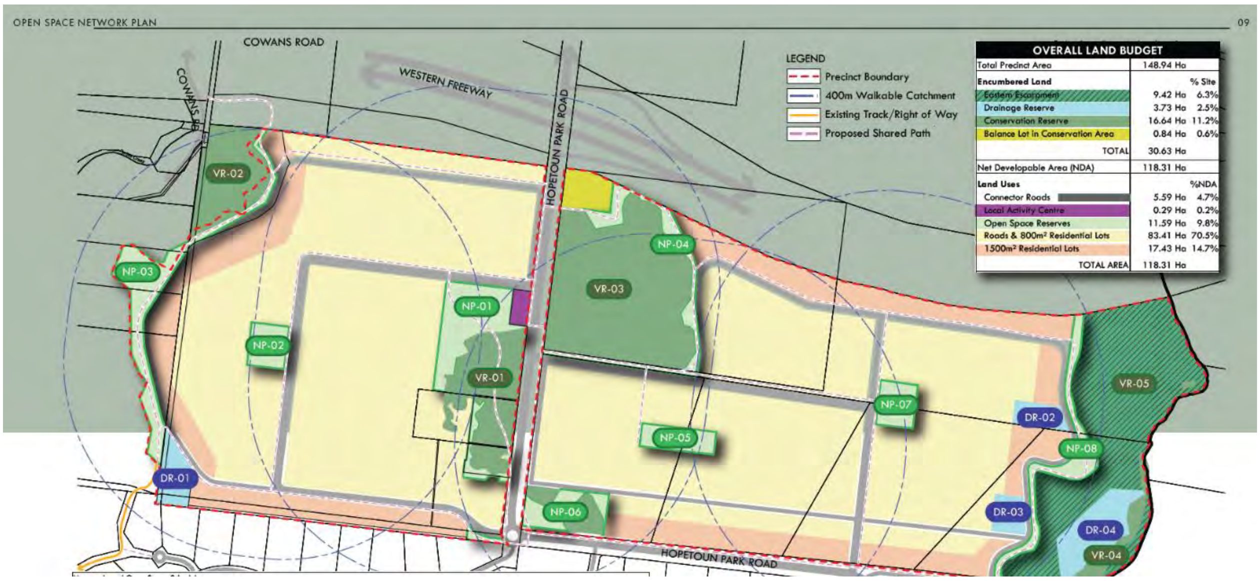

Image 1 – Open space network plan Hopetoun Park North by Weir and Co.

The purpose of the investigation is best described in the brief provided by Urban Land Developments in October 2022, reproduced below.

1. ***That the proposed setbacks from the top of the escarpment are appropriate**. As mentioned above, we have agreed to increase the width of the lineal reserve from the top of the escarpment from 10m to 20m as recommended by DELWP. This lineal reserve will contain a shared path for pedestrian and cyclists. (Please see attached Millar Merrigan definition of the top of the escarpment). Note that in various sections the lineal reserve will be greater than 20m where there are various 'jut outs'. Adjoining the lineal reserve will be an active road frontage. (Whilst local roads are proposed in a 17.3m road reservation it is hoped that this might be reduced slightly as the reserve can act as the verge on the reserve side.) The lots fronting the road along the escarpment are all required to be 1,500m2 minimum in size with a minimum 10m front setback. This means that dwelling will be setback a minimum of 47.3m from top of escarpment (or slightly less if 17.3m road reservation reduced but still likely to be 45m). We will require a geotechnical assessment to confirm the appropriateness of these setbacks.*

2. ***The appropriateness of the proposed outfall locations and any design requirements.** There are proposed to be 1 drainage pipe down the west escarpment and one down the east. Piping the outfalls was a recommendation from the Geomorphology assessment. Careful consideration has been given to the proposed location of each outfall to be cognisant of: ensuring the stormwater engineering requirements work, choosing an alignment which is less steep and able to be practically constructed and likely to minimize erosion, avoiding vegetation loss where possible. Please see attached the proposed alignments for west and east. We require an assessment of the appropriateness of these locations from a geotechnical perspective and any specific design considerations.*

1.2 Proposed development

The proposed subdivision occupies about 150 hectares and with potentially about 850 lots. There is an existing residential subdivision (Hopetoun Park) immediately to the south of proposed subdivision. The existing subdivision occupies about 350 hectares and contains about 280 lots, all of which appear to have been developed. It is understood that the subdivision was developed in the early 2000s.

The site is on an elevated plain with escarpments to the west towards Pyrites Creek and the Werribee River, and east towards Djerriwarrh Creek.

Two piped stormwater outfalls are proposed, one in the south east corner of the site and one in the south west, connected to retarding basins. It is understood the Frankische piped product is being considered as one option as it is suitable for construction on steep slopes (refer Afflux Consulting response to Melbourne Water comments). Conventional concrete pipe design is also being considered.

The location of the retarding basins and proposed pipeline routes down the escarpments is included in an image from Afflux Consulting, shown below in Image 2.

It is important to note that the drainage report and proposed layout provided by Urban Land Development shows that overland flows will be substantially reduced. The roads are designed to act as overland flow paths which will limit surface flow, and combined with AG drains, and crushed rock backfilled service trenches flow through the soil will also be limited. Further flow reductions are made by the connection of houses to the underground drainage system.

It is understood water tanks for the properties are being considered. It is recommended these are adopted as they will further improve the drainage conditions.

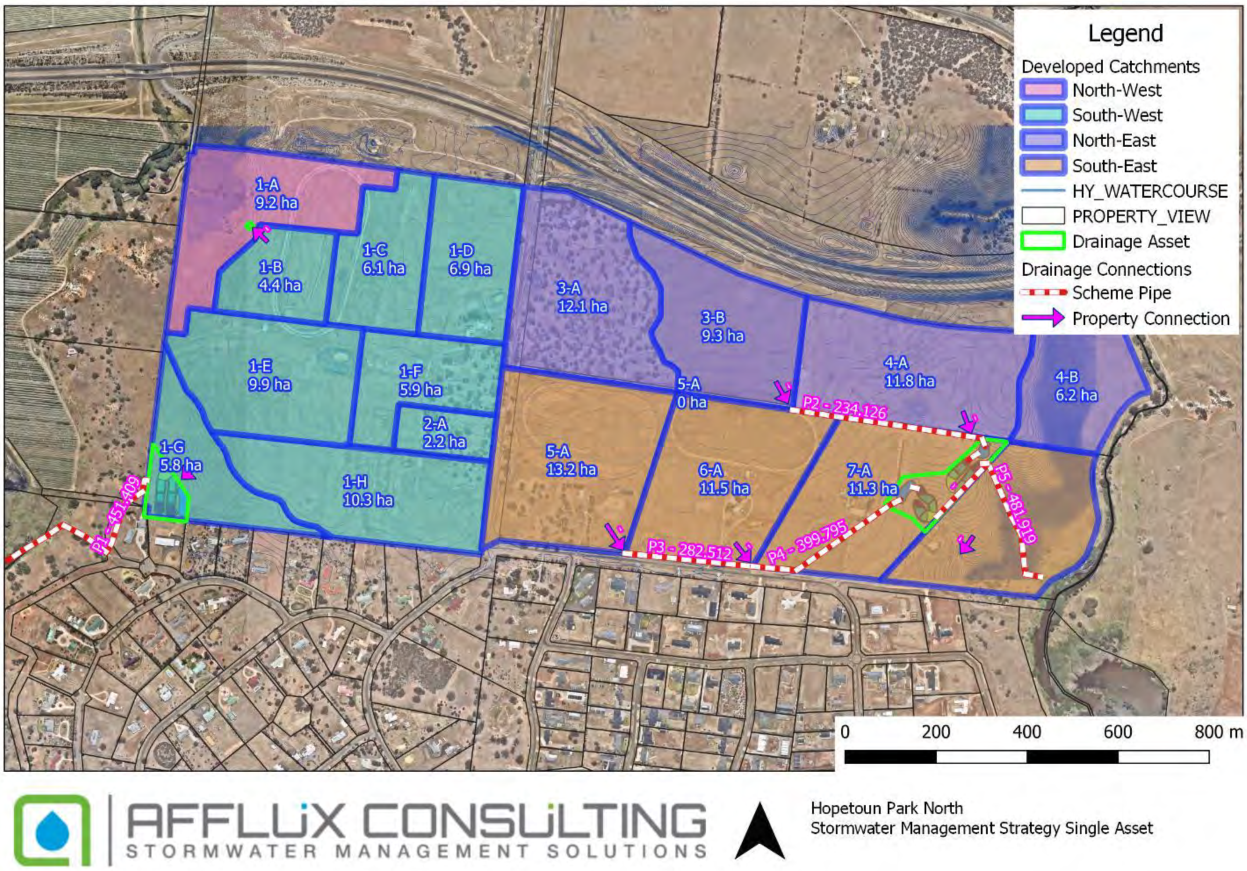

Image 2 – Proposed retarding basins and pipeline routes.

2.0 ENGINEERING GEOLOGY

2.1 Engineering geology review

The GeoVic3 online, 1: 50,000 Series, state wide geological database, indicates the site surface geology is relatively complex across the site. The surface geology at the western and eastern escarpments is described below:

Eastern escarpment

The database shows Neogene - Quaternary Period Newer Volcanics (Neo - basalt) on the approach to the slope. Going down the slope, Neogene – Quaternary Period conglomerate and sandstone (Czg – conglomerate, quartz sandstone and siltstone, conglomerate commonly ferruginised) is shown within the upper third, or so, of the slope, with much older Ordovician period Riddell Sandstone (Osrg – sandstone, black shale, black and grey siltstone) shown below.

Western escarpment

The database shows the Neogene – Quaternary Period Darley Gravel (Nxr – gravel, sand and silt) on the approach to the slope. Going down the slope, the Newer Volcanics are shown within the top third, or so, of the slope, with Neogene Period Werribee Formation (-Pxe – sand, silt, clay, gravel) shown below this to the toe of the slope. Beyond the toe of the slope, Quaternary period alluvium associated with Pyrites Creek and the Werribee River is shown.

Central plain

The database shows the Neogene – Quaternary Period Darley Gravel across much of the site, and Neogene – Quaternary period Newer Volcanics in the north and east of the site.

An extract from the GeoVic3 database in shown below in Image 3.

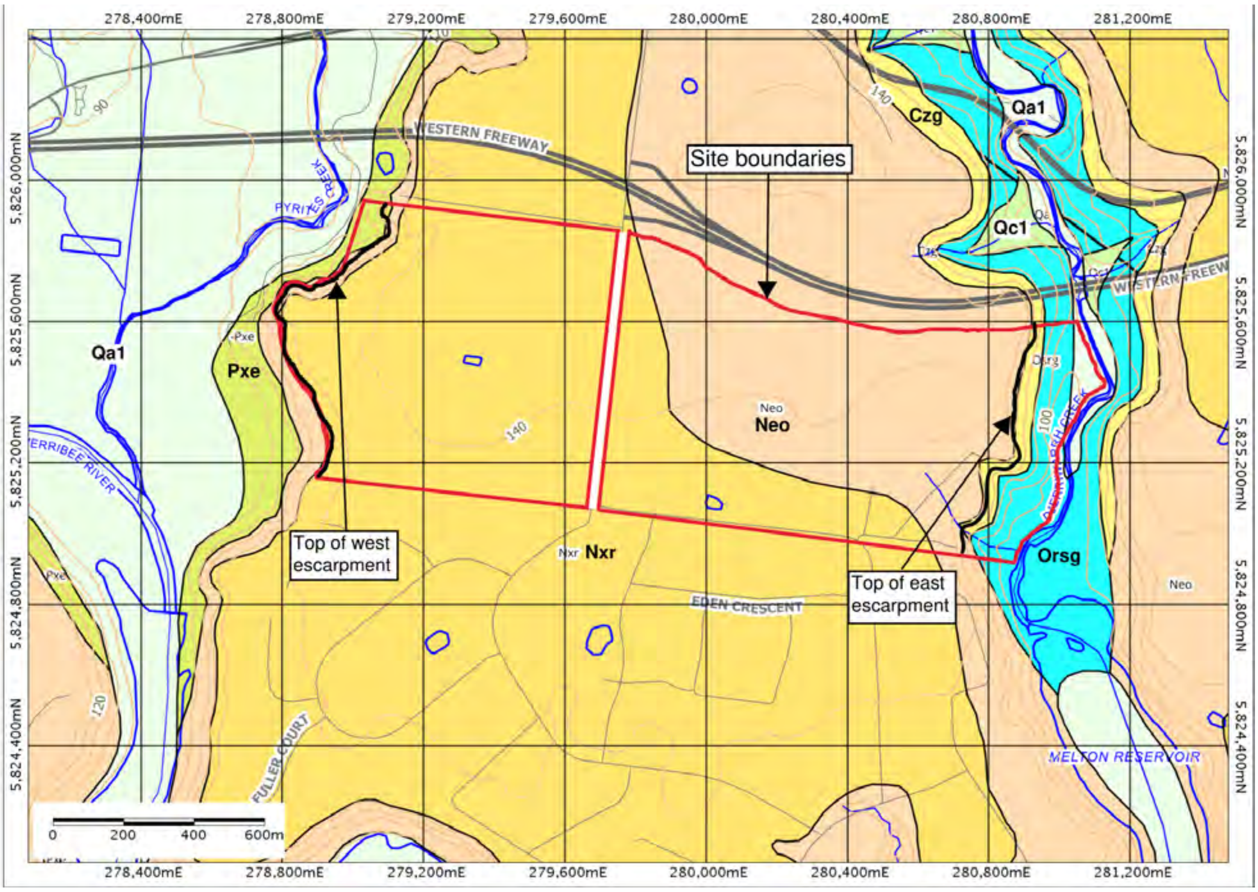

Image 3 – GeoVic3 database extract.

Historical information available on Geovic3 show boreholes were drilled in 1983 between the north west corner of the site and the old Western Highway. Within the borehole information is a reference to a Soilmech Pty Ltd report titled "*Report on Investigation for Proposed Sand Pits at Bacchus Marsh"*, January 27, 1984. The report shows an existing sand pit located between the north west corner of the site and Cowans Road to the west of the site. The historical sand pit extents are well away from the site boundaries and will not affect the development.

These boreholes are also shown in the GeoVic3 database.

Extracts from GeoVic3 database showing the borehole locations, and from the report showing the location of the sand pit are shown below in Images 4 and 5

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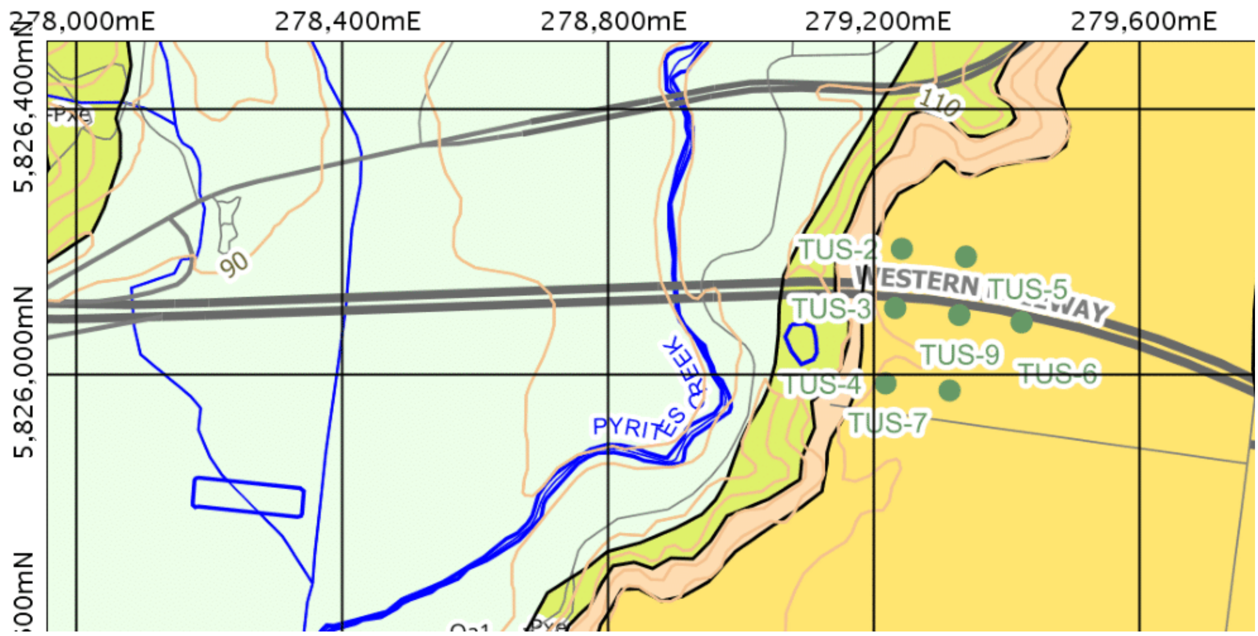


Image 4 – GeoVic3 extract showing historical boreholes.

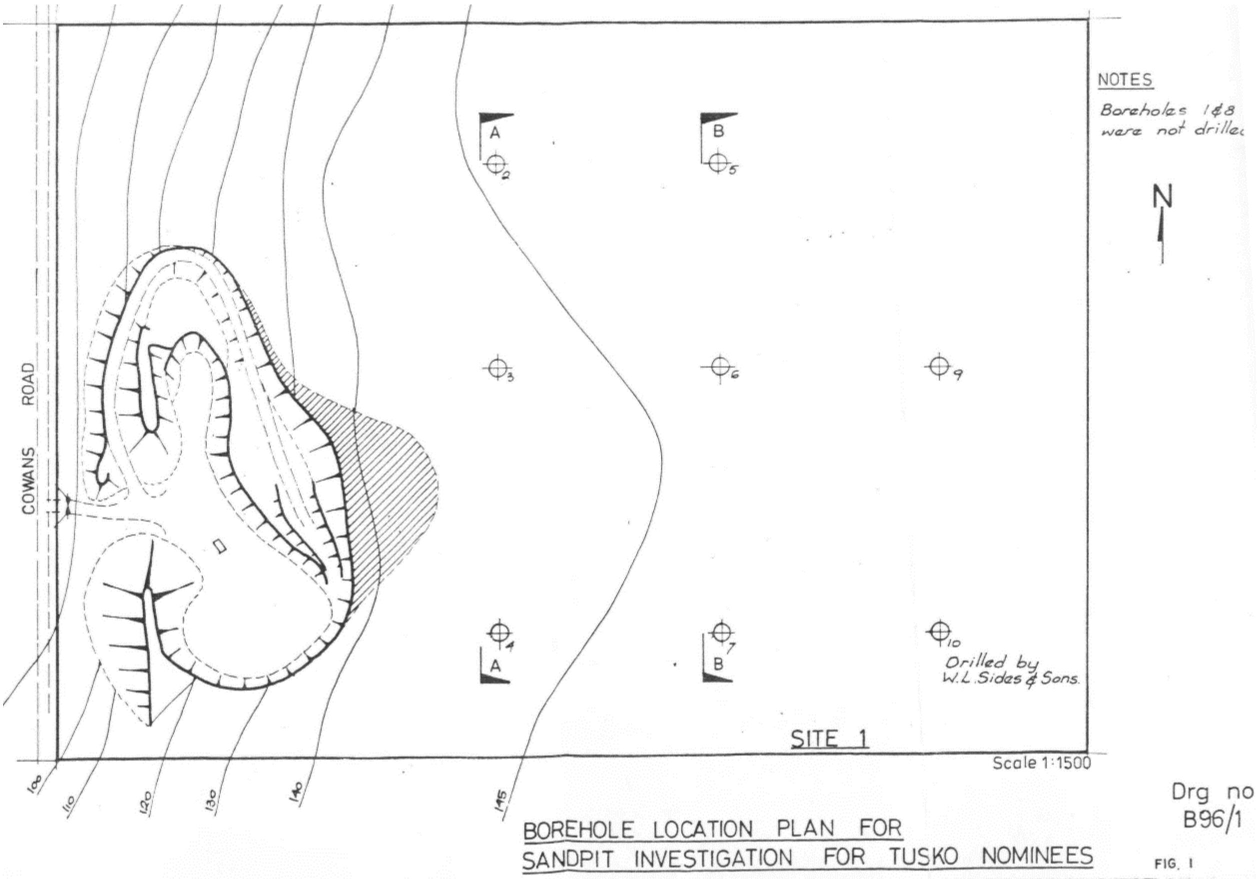


Image 5 – Extract from 1984 Soilmech report showing same historical boreholes and the existing sand pit.

2.2 Sites of geological and geomorphological significance

2.2.1 Anthony's Cutting – L11

Sites of geological and geomorphological significance are described on the Victorian Resources Online website (now archived).

Site L11 is Anthony's Cutting which is just to the north of the site on the old Western Highway, and is described by Neville Rosengren as follows:

The cutting on the southern side of the Western Freeway reveals an important section into lava flows from Mount Bullengarook and Tertiary and Quaternary sediments. Flows of strongly jointed basalt outcrop at road level at the Melbourne end of the cutting and these are overlain by a 15 m thick deposit of cross-bedded non-marine Pleistocene sands and gravels. One hundred meters along the cutting (towards Bacchus Marsh), sandy clays, sands and gravels of the middle Tertiary Werribee Formation that underlies the Bullengarook lava flow are exposed at road level and the lavas are 10 to 15 m above road level. At the top of the Werribee Formation (beneath the lava flow) is a reddish zone in the sediments that is the weathering horizon and soil of the pre-basaltic land surface. It is therefore an example of paleosol. Several types of jointing and weathering occur in the volcanics.

This description matches the observed conditions on the western escarpment, except that the Darley Gravel (described as the non-marine Pleistocene sand and gravels by Rosengren) are much thinner on this site. It is considered likely that historical extraction of the Darley Gravel has reduced the thickness on site to negligible amounts. An image of Anthony's Cutting is shown below in Image 6.

Image 6 – Anthony's Cutting, photo dated 2015. Image source: www.expressway.online

2.2.2 Tabletop Hill – site L18

Rosengren describes the conditions at Tabletop Hill (which lies just west of Bacchus Marsh) as follows:

Tabletop hill is capped by a remnant of Newer Volcanics basalt which overlies sediments of the Werribee Formation. The southern hillslope includes an extensive area of mass movement including rotational slumps and earthflows. Other extensive mass movements occur on the opposite valley slope above the alluvial floodplain of the Werribee River.

The location of the Tabletop Hill landslides is shown below in Image 7.

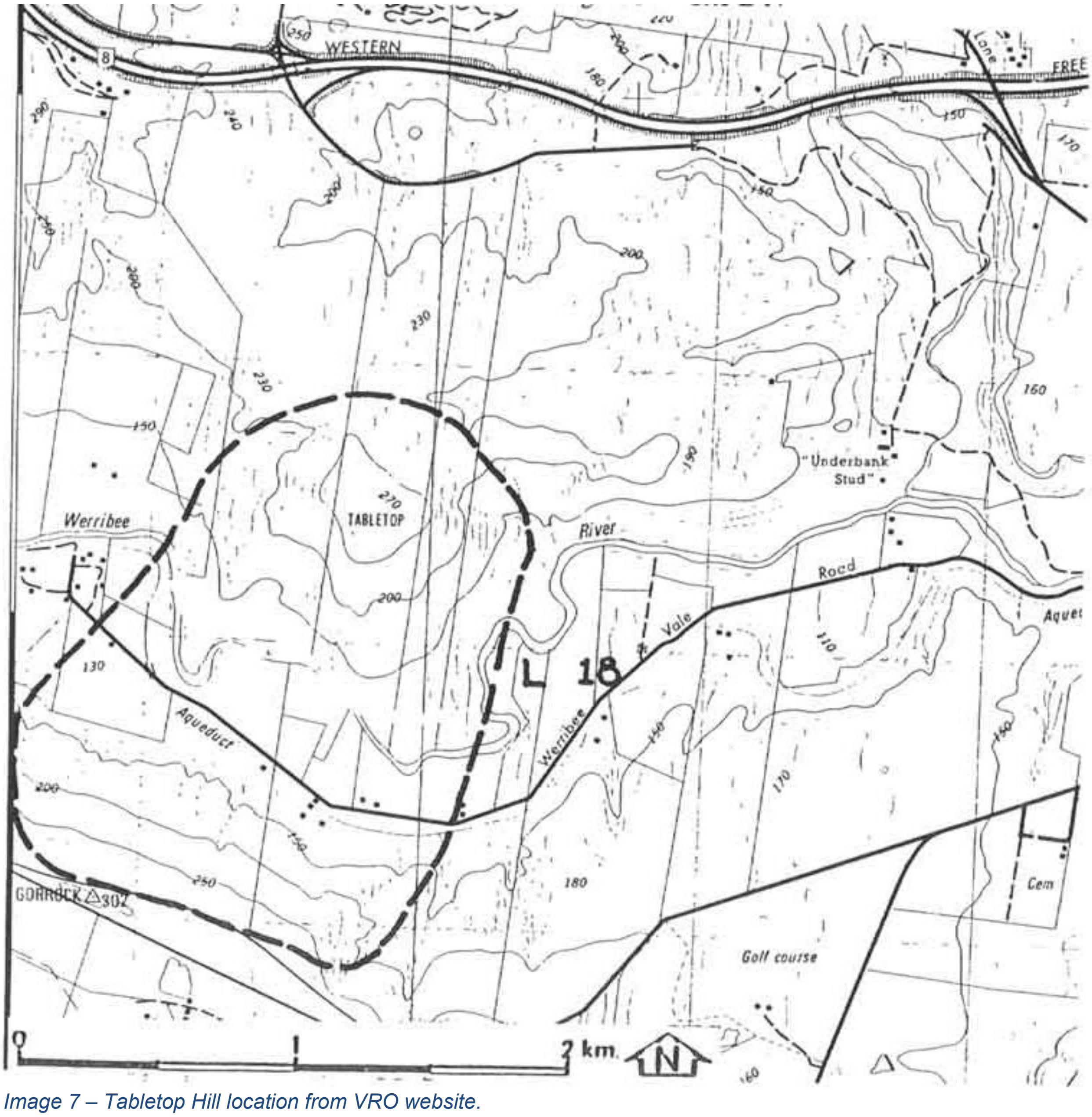


Image 7 – Tabletop Hill location from VRO website.

2.2.3 Cut Hill Landslide – site i6

The geological setting of the Parwan Valley, to the south west of the site, is similar to the western escarpment. A well-known study site, the Cut Hill Landslide (which is some 20 km to the west of the site), describes instability in the Werribee Formation in a report *An Investigation of the Cut Hill Landslide, Rowsley (Parwan) Valley* by R A Wilson in 1983/91. This describes the slope failure types as follows:

The slope failure types include:

1. *Slumping, gully and tunnel erosion, and/or creep of colluvium and other surface materials. These are common and are spread throughout the valley. Although minor in themselves, if not controlled by normal erosion prevention methods, they can lead to any of the following more massive types.*
2. *Gully and tunnel erosion, and chemical weathering combining to reduce the resisting forces of the Werribee Formation. This can lead to non-circular failure along bedding planes at times of excess water head. The Cut Hill slip is an excellent example of this type of failure.*
3. *Weathering and removal of the toe by failures of the above types can lead to circular-type failures through the 'weathered' basalt toe in the Werribee Formation. Once again excess water pressures will be the triggering mechanism. The slip approximately one kilometre to the north-west of the Slip is an example of this type of failure.*
4. *Toppling type failure of the 'fresh' basalt of the Newer Volcanics. Examples of this type of failure are widespread along the escarpment.*
5. *Large scale complex slump failures through the 'fresh' basalt cap which may toe out either in 'weathered' basalt or in the Werribee Formation. This type of failure is potentially the largest type occurring in the valley. A possible recent example of this type is the failure about 2km north west of Cut Hill, and the basaltic block is an obvious ancient example.*

As a simplification the cycle of erosion in the Parwan Valley proceeds from slope failure type (1) to (5), but due to geological and hydrological non-homogeneity, any sequence of events is possible.

2.3 Engineering geology walkover

2.3.1 Engineering geology walkover summary

An engineering geology walkover was conducted over four days, from 17 January to 20 January 2023. The walkover concentrated on the eastern and western escarpments.

Conditions encountered in the walkover broadly aligned with the reported geology discussed in Section 2.1 of this report.

2.3.2 Eastern escarpment

Generally, the eastern escarpment was observed to be steep, with a few gullies incised in the slopes. The overall slope varies from around 2H : 1V in the south, flattening to 3H : 1V in the north. The upper slopes include sub-vertical exposures of basalt.

Two potential geological contacts were noted on site. On the very steep path leading down from the eastern end of Hopetoun Park Road a contact between the Newer Volcanics basalt (Neo) and Ordovician Riddell Sandstone (Osrg) was observed at an elevation of 108 m AHD. On the much less steep access track to the north of this, a contact between the basalt and likely Neogene – Quaternary Period ferruginised conglomerate (Czg) was observed at an elevation of 121 m AHD.

Exposures of the Ordovician Riddell Sandstone were also noted at elevations of 103 m and 93 m AHD in the northern part of the site.

Apart from the two contacts and two exposures noted, the site surface was comprised of basalt rock and residual soil at the top of the slope, and basalt colluvium downslope. Some large boulders were visible well below the expected thickness of basalt indicating toppling occurs periodically.

A small landslide was noted in the bank on the opposite side of the valley. This is likely due to undermining by the Djerriwarrh Creek.

There were no signs of recent large-scale landslides on the eastern escarpment. Some terracettes (indicative of soil creep) were noted near the northern end of the site. Some potential ancient landslides could be present above the gentler track as evidenced by change in grade of the slopes and can be seen in the LiDAR survey data provided by Urban Land Developments, however, this may be partially or entirely due to track construction.

The thickness of basalt rock identified in the eastern escarpment was between 15 m thick in the south to about 6 m thick in the north, although this is difficult to determine accurately due to the presence of colluvium and soil creep.

In general, no stability issues apart from slow, albeit ongoing, rock toppling and soil creep were identified. The lack of geological contact exposures in the gullies and partial substantial vegetation indicates that the gullies are replenished with basalt clay colluvium continually and exposure of the underlying units would not occur for a long period of time.

The steepness of the escarpment means that piping stormwater to the base of the escarpment is sensible. Open drainage that concentrates flow could lead to rapid erosion and degradation of the slope.

The conditions indicate that the eastern escarpment is handling the current levels of overland and subterranean flow. No seepage from the slope was observed during the walkover.

The proposed stormwater outfall location along the less steep access track is a good choice. The steeper access track would present significant construction challenges (it is difficult for a human to stand up, for example). The proposed track is still relatively steep and piping the stormwater to the toe of the slope is also a good choice as significant erosion would occur with an open drain.

Images of the eastern escarpment are shown below in Images 8 to 16.

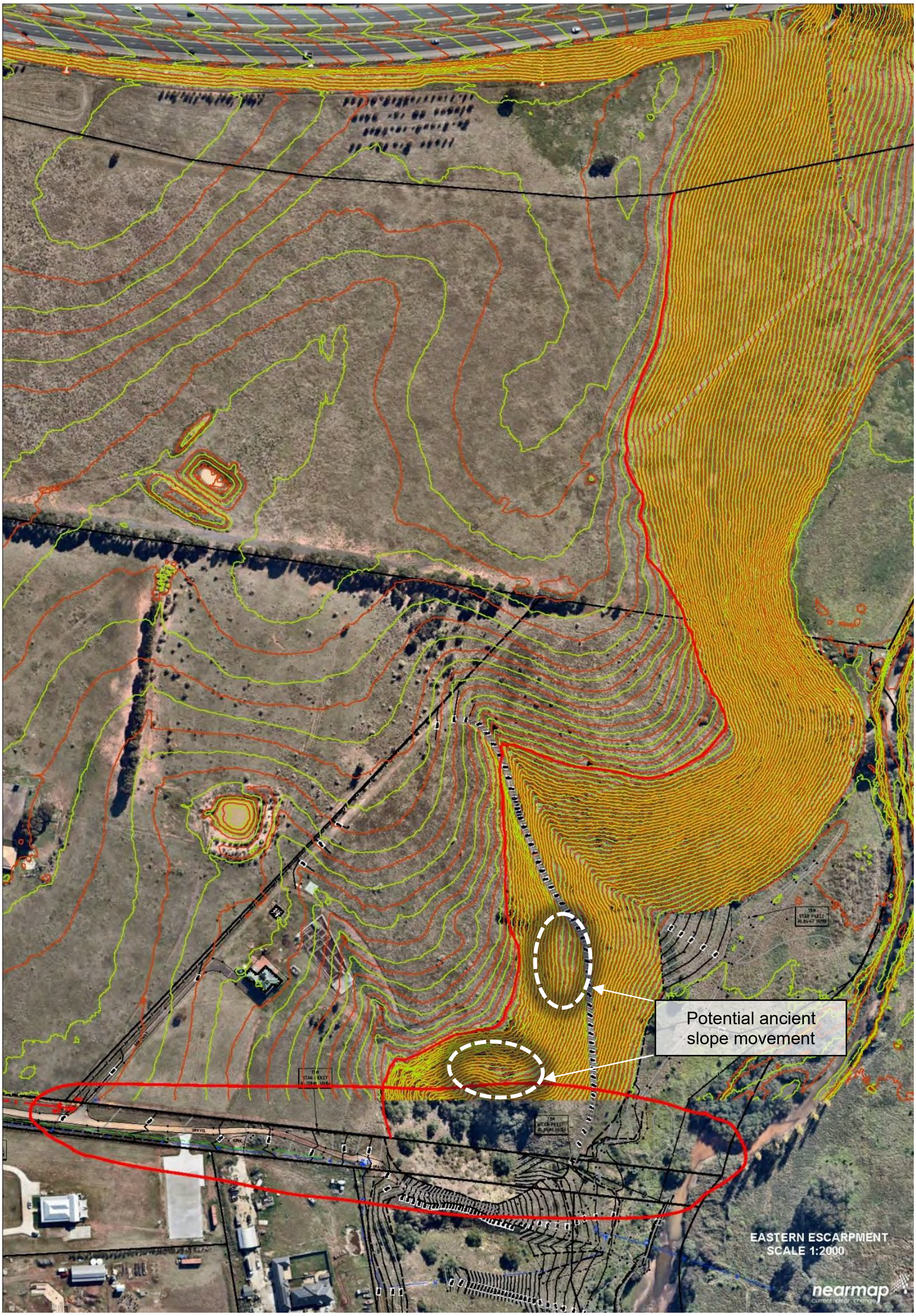


Image 8 – LiDAR contours on Nearmap image, supplied by Urban Land Developments.

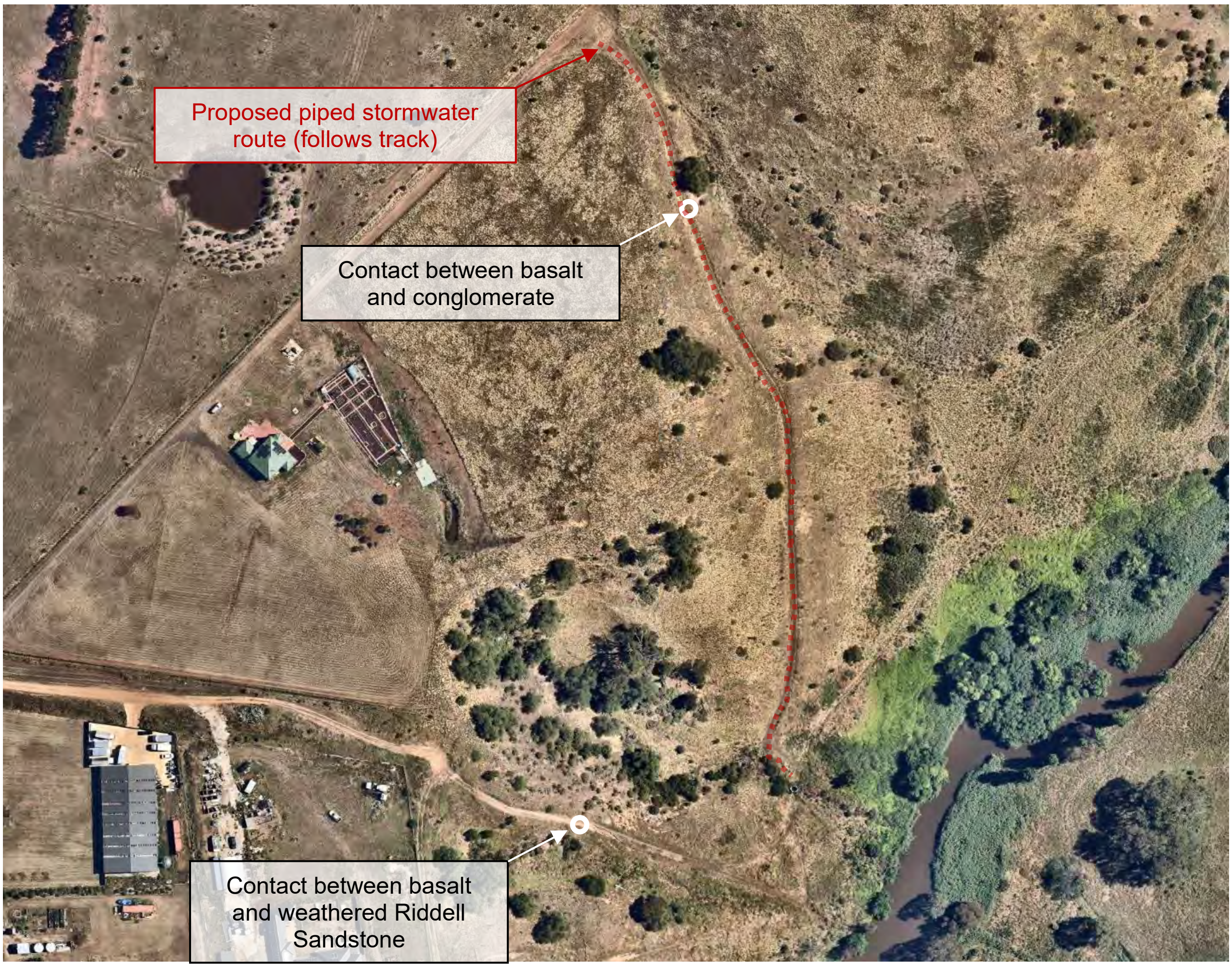


Image 9 – Marked up Nearmap image with geological contacts and proposed pipeline route.

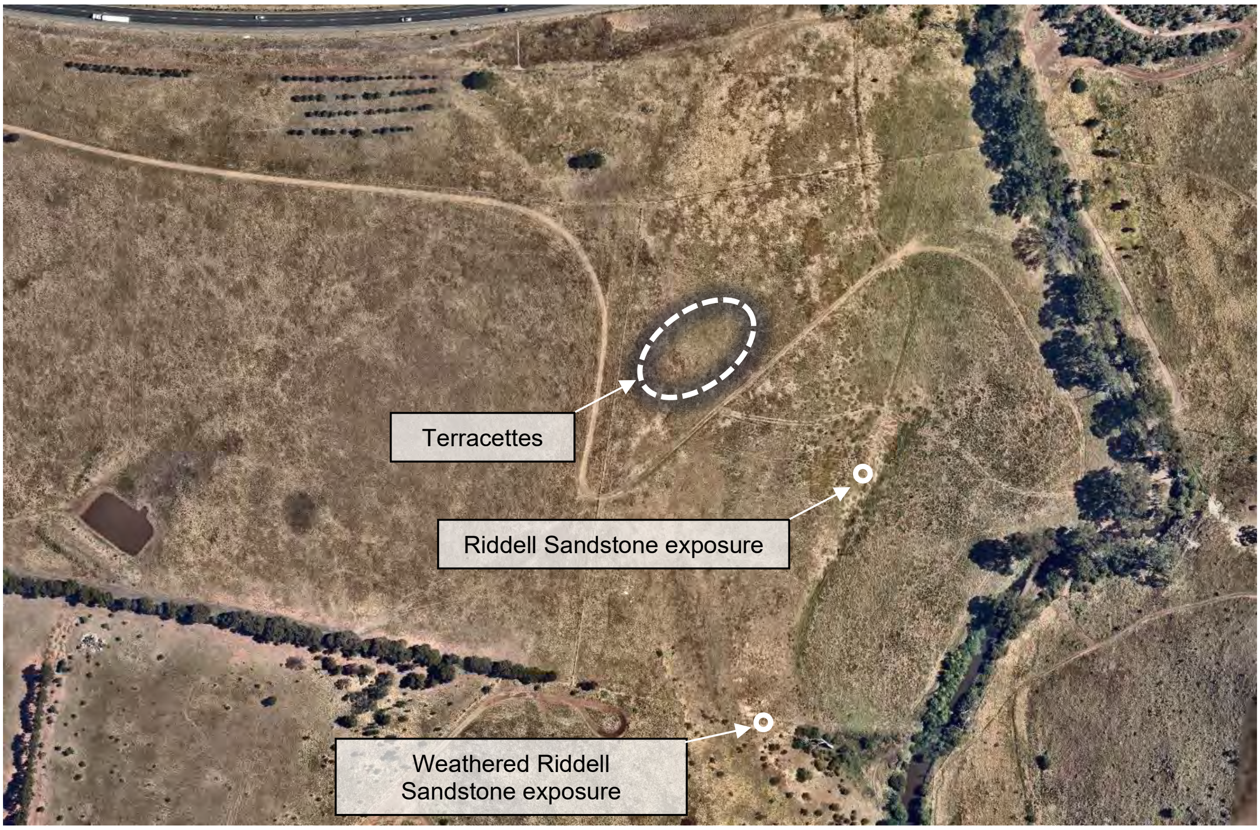


Image 10 – Marked up Nearmap image with geological exposures.

Image 11 – Geological contact between basalt and underlying Riddell Sandstone. Steepness of track is evident.

Image 12 – The much less steep track / proposed pipeline route.

Image 13 – Base of basalt / potential contact with colluvium above less steep track.

Image 14 – View of gullies and ridgelines, towards the north

Image 15 – Aerial view of gullies and ridgelines, towards the south.

Image 16 – Aerial view towards the north.

2.3.3 Western escarpment

The western escarpment was also generally steep, however, more variable than the eastern escarpment. Slopes varied from 1.8 H : 1 V to flatter than 3.5 H : 1 V. The upper slopes include sub-vertical exposures of basalt.

The top of the basalt was measured between 127 m AHD in the south, to 136.5 m AHD in the north, reflecting the overall general slope of the plateau to the south. The contact with the Werribee Formation was noted in many locations, which was at around 119 m AHD in the south and 127 m in the north, indicating a basalt thickness of around 8 to 10 m. The top of the plateau in the north west of the site is around 140 m AHD reducing to 130 m AHD in the south. Darley Gravel was clearly present in the north half of the site, however, it reduced to negligible thickness towards the south.

Many gullies are incised in the slopes. On the ridgelines, many contacts between the basalt and the underlying Werribee Formation are visible. Springs have previously formed at the contacts on these ridgelines, with four locations showing evidence of recent water flow and soil movement, with locations shown on Image 17 below. No seepage was noted at the spring locations during the investigation. It is not known how regularly the springs flow, although lack of vegetation at the spring outfall locations indicate it is not a rare event.

The gullies generally appear similar to the eastern escarpment, where they are well vegetated and appear to be replenished with basaltic clay colluvium.

A major erosion zone is present just to the north of the abandoned houses situated mid-slope. The erosion is considerable and has formed large, deep, solution features and vertical to sub-vertical slopes. The runoff from the erosion crosses the track at the base of the escarpment and enters the apple orchards to the west of the site.

The abandoned houses appear to be situated on an ancient landslide, evidenced by the change in grade and also the presence of basalt blocks at a much lower elevation than expected. It is difficult to estimate the age of the landslide, however, the presence of established vegetation, the muted surface features, and difficulty in identifying the landslide in the first place indicates a minimum age in the thousands of years.

To the north of the site, between the north west corner and the Western Highway, significant erosion is also noted. This is in a different form to the erosion in the Werribee Formation, expressed mostly as near vertical piping erosion forming multiple holes spread throughout the slope, although concentrated near the top, below the base of the basalt, and near the toe, just above Cowans Road. This area was previously occupied by the sand pit, discussed in Section 2.1, and is understood to have been filled by VicRoads (now the DOTP) as part of the Western Highway upgrade. The fill is similar in appearance to the Werribee Formation (pale grey and white clay) and is dispersive. It is likely that the Werribee Formation soils excavated as part of the cutting for the Western Highway was used as fill, and this has subsequently failed. Although this is of little relevance to the geotechnical stability of the proposed Hopetoun Park development, it should be highlighted now to provide clarity that the development has not caused this failure.

The existing pumping station pipeline route, which contains sewer and stormwater lines, is along the side of an existing gully, and as with other gullies has basaltic clay colluvium within the gully, which appears to be protective, and is stable. This is a good choice for the proposed stormwater outfall due to the favourable conditions and previous successful construction.

Images of the western escarpment are shown below in Images 17 to 30.

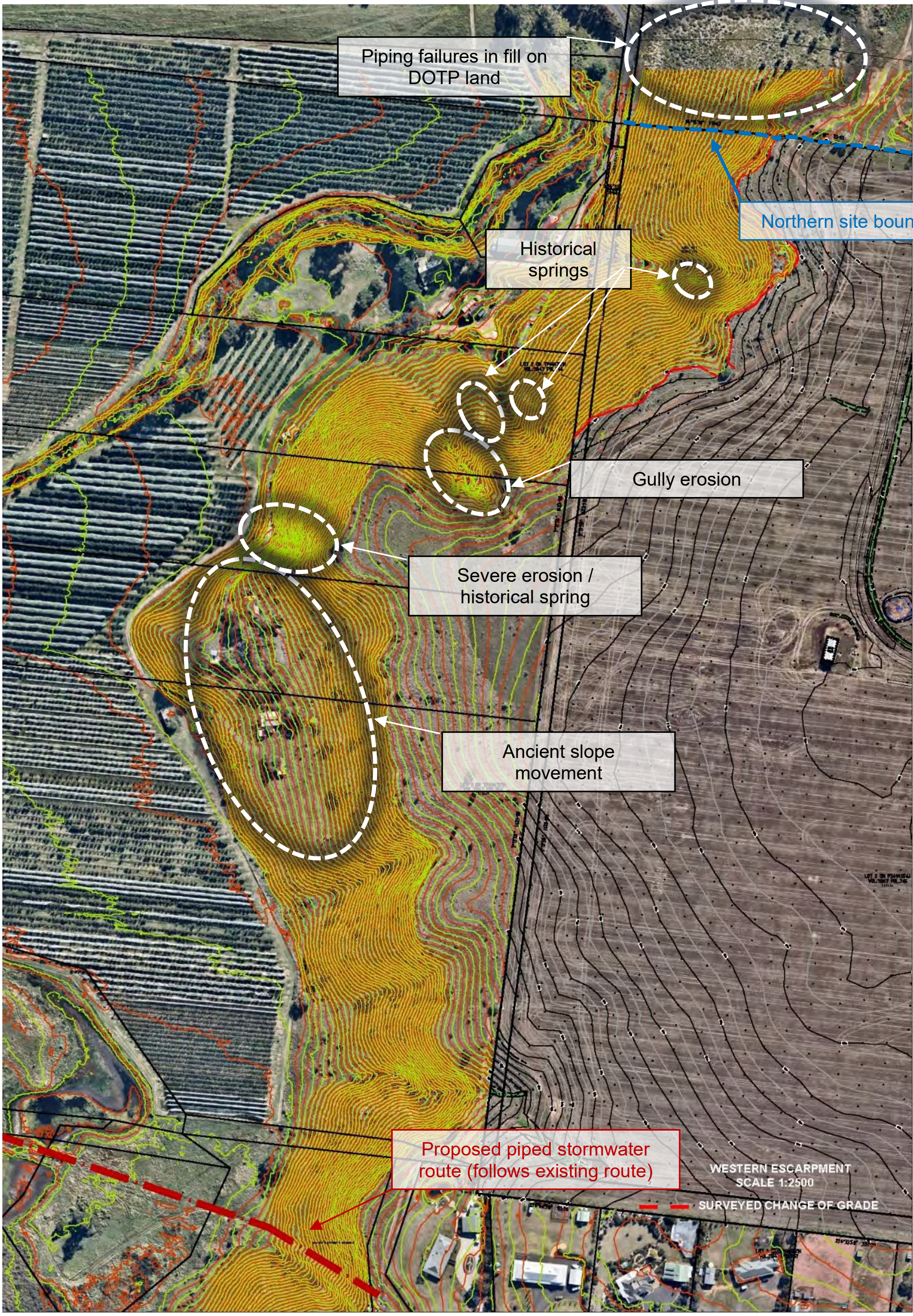


Image 17 – LiDAR contours of western escarpment, provided by Urban Land Developments.

Image 18 – Proposed pipeline route.

Image 19 – Severe erosion below spring.

Image 20 – Broad view of severe erosion area.

Image 21 – Detail of severe erosion.

Image 22 – Gully erosion.

Image 23 – Clear geological contact between basalt and Werribee Formation.

 continued...

Image 24 – Large solution feature above filled quarry/sand pit, located north of subject site in DOTP road reserve.

Image 25 – 1.9 m deep solution hole towards base of filled quarry/sand pit in DOTP road reserve.

Image 26 – Aerial view of failing fill (grey and white material), located north west of subject site in DOTP road reserve.

Image 27 – Aerial view towards western escarpment. Springs seen as white patches. Large erosion feature to the right.

Image 28 – Aerial view of large erosion feature. Abandoned house to the right on ancient landslide feature.

Image 29 – Aerial view to south from north.

Image 30 – Aerial view to south from midway along western escarpment showing good vegetation cover in gullies.

2.4 Historical aerial imagery

Historical aerial photos were obtained for the site. Of note, the significant erosion noted on the western escarpment is evident as far back as the photos go (1946 is the earliest obtained) and does not appear to have changed much in nature in the intervening years. This is a good indication that the erosion has been a slow process.

38 aerial images in total were retrieved. A select few are included below in Images 31 to 33.

Image 31 – 1946 aerial photograph showing similar erosion features near the (now) abandoned houses.

Image 32 – 1968 aerial photograph showing similar spring and erosion features as today.

Image 33 – 1985 aerial image showing similar spring and erosion features as today.

continued...

2.5 Slope stability

2.5.1 Landslide risk assessment

A landslide risk assessment following the Australian Geomechanics Society 2007 guidelines requires the estimation of the risk of a landslide occurring, the risk of the landslide impacting a building, the risk of the building behind inhabited at the time of the landslide, and the vulnerability of the inhabitants. The most difficult parameter to estimate is the risk of a landslide occurring. On this site, there is one ancient (possibly two) evident, but the exact age of this is not easy to determine. However, as discussed in Section 2.3.3, the minimum age of the landslides is in the thousands of years, and in any case, the size of a future landslide would need to be unreasonably large to affect the proposed buildings due to the geometry of the site and the proposed setbacks.

The continual erosion of the Werribee formation has the potential to initiate a landslide, however, the most severely eroded area is over 200 m away from the proposed setback on the western escarpment. There is a smaller spring within the property boundary towards the north of the western escarpment, however this is still 40 m away from the edge of the escarpment, so at least 85 m away from the proposed buildings. If another landslide similar to the ancient landslide identified on the western escarpment were to occur it would be far too small to affect the development.

The risk to loss of life (R_{LOL}) due to a landslide occurring is estimated to less than 10^{-6} per annum, which is well within the "broadly acceptable" limit for risk as defined by the landslide risk assessment guidelines. It is worth noting that new developments usually proceed on the basis of achieving less than 10^{-5} per annum, which is defined as "tolerable" in the guidelines, i.e. the risk assessed for this site is at least 10 times lower than this limit.

There are no landslide risk concerns impacting the subject site, and the proposed building setbacks are appropriate.

2.5.2 Slope erosion

As discussed, slope erosion will be well controlled, and the risk of continued slope erosion will be reduced as the development will improve overland and subterranean flow to the escarpments.

If overland and subterranean flows were instead increased, erosion could accelerate and potentially impact the development. This is not to say that flows are expected to increase but serves as a comparison to other sites with similar geological settings where landslides have occurred. The Cut Hill Landslide is an example of where poor slope practises contributed to the ongoing landslide which is still being managed today. It is also a good example of the various environmental factors which can affect the stability of the Hopetoun Park Slope.

As discussed in the Cut Hill Landslide report, that landslide required multiple factors to initiate instability, described by R A Wilson as follows:

As discussed in this report the factors which have contributed to the Cut Hill Slip include:

1. *Lithologies susceptible to erosion and mass movement.*
2. *Uplift of the Parwan Valley.*
3. *Unfavourable dip.*
4. *Montmorillonite on or near the assumed failure plane.*
5. *Poor surface drainage.*
6. *Aquifers leading water into the failure plane.*
7. *Heavy rainfall, which ultimately triggered the failures.*
8. *Uneven topography promoting ponding of water.*
9. *Poor vegetation cover.*
10. *Seepage erosion.*

Items 1, 3, 5, 6, 7, 8, 9, and 10 are relevant to this site and are addressed below.

The lithology is similar at both sites. The dip of the Werribee Formation was difficult to measure as bedding was mostly not apparent, and the formation is likely to be more massive and homogeneous at this site compared to Parwan Valley. The dip direction was measured in two places on the western escarpment which indicated relatively steep dips to the north west and south west, which is unfavourable. Montmorillonite (high plasticity clay) was not noted, however, it was also not specifically targeted during the investigation. Items 5 – 10 are all in the same category in that they involve drainage and are the most relevant for the subject site.

The basalt rock is highly permeable and acts as an aquifer. The presence of springs at the subject site may be associated with thicker deposits of basalt. The pre-basaltic surface would have included gullies, which were subsequently buried by the basalt flow (paleochannels) forming deeper aquifers and higher seepage flow in these areas. It is suspected that the spring areas on the western escarpment align with deeper basalt deposits (which have formed ridgelines on the escarpment).

In comparison to the subject site including the proposed drainage systems, the Cut Hill landslide drainage was very poor, with a roadway and culverts directing significant water flow to the Werribee formation upslope, and resulted in removal of material from the toe, destabilising the slope.

Item 8 above is relevant as ponding of water on uneven ground may lead to increased subterranean flow due to increased ground water levels. No ponding will be introduced by the development. The proposed retarding basins will have impermeable bases and will not increase any flow to the escarpments.

Due to the overall better drainage conditions at the subject site, and the proposed further improvement of these conditions, there is no conceivable risk that the conditions that lead to the Cut Hill landslide can occur at the subject site.

3.0 CONCLUSION

- There are no landslide risk concerns impacting the subject site, and the proposed building setbacks are appropriate. The landslide risk assessment determined a risk to loss of life of less than 10^{-6} per annum, which is at least 10 times better than the limit of 10^{-5} commonly adopted for new developments.

- The observed surface erosion and springs on the western escarpment are due to overland and subterranean flow. These are a large distance from the proposed setbacks, are progressing slowly, and do not impact the proposed development.

- The rate of these erosion process will be reduced by the development due to the substantial improvement in drainage conditions proposed.

- The failure of the fill in the DOTP road reserve is outside of the property boundary and does not affect the development, however, the DOTP should be advised of this issue.

- The proposed pipeline routes are appropriate and either the Frankische or traditional concrete pipelines proposed would be suitable.

BLACK GEOTECHNICAL PTY LTD

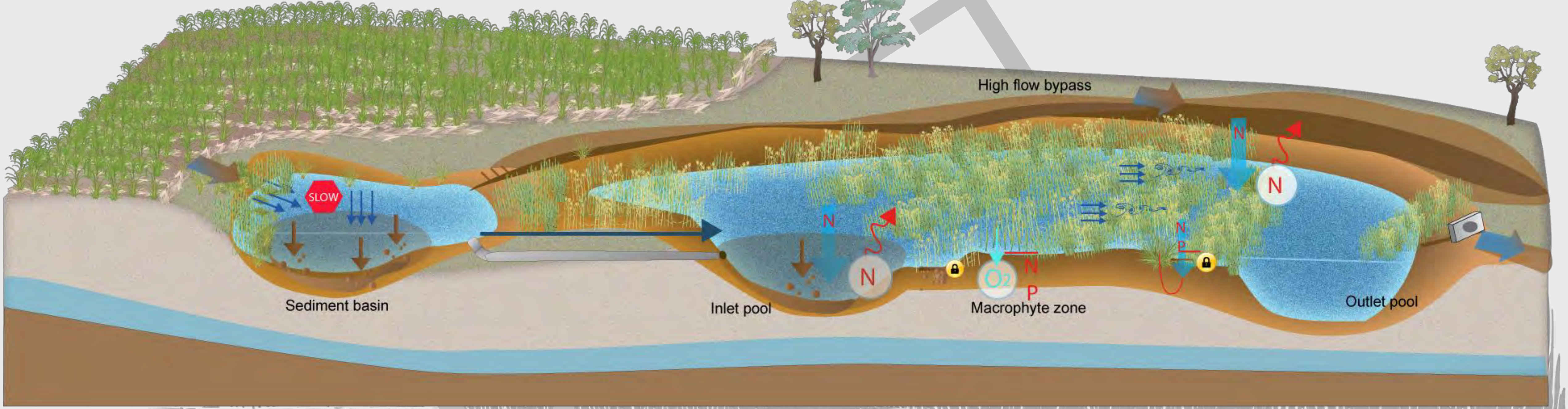
WETLAND MAINTENANCE PLAN

Hopetoun North Wetland

25/04/23

MAINTENANCE PLAN OBJECTIVES

Objective: The objective of this wetland maintenance plan is to ensure the health, functionality, and sustainability of the wetland ecosystem through regular monitoring, management, and restoration activities. A generic wetland, labelling the wetland zones and functions is shown below.



- Water run-off, carrying sediment particles (coarse and fine) and dissolved pollutants (nutrients and pesticides)
- Vegetation slows water and promotes even flow
- Wetting and drying of sediments leads to fixation of pollutants in sediments
- Processing of nutrients into wetland vegetation and biofilms
- Water leaving treatment system with reduced sediment, nutrient and pesticide loads
- Slowing of run-off increases sediment deposition rate.
- Deposition of coarse (and medium sized) sediment particles
- Wetland vegetation inhibits the release of deposited nutrients by pumping oxygen into the soil.
- Vegetation provides a surface for biofilms plus contributes carbon and oxygen to the soils, providing conditions that promote nitrification-denitrification, leading to nitrogen removal

WETLAND MONITORING

1. Regular Monitoring: Conduct regular monitoring of the wetland area to assess its ecological health, including water quality, vegetation composition, and wildlife populations. Monitoring should be conducted at least once per year, or more frequently if necessary, to detect any changes or issues early on.
2. Data Collection: Collect and record relevant data during monitoring efforts, including water quality parameters (such as pH, temperature, dissolved oxygen, and nutrient levels), vegetation species composition, and wildlife observations.
3. Analysis and Reporting: Analyse the collected data to identify any trends or changes in the wetland ecosystem, and prepare regular reports to document the findings. Use the data to inform decision-making and adapt the management strategies as needed.

VEGETATION MANAGEMENT

1. Invasive Species Control: Regularly monitor and control invasive plant species that may threaten the native wetland vegetation. This may involve manual removal, chemical treatment, or other appropriate methods based on the severity and extent of the invasive species.
2. Planting and Restoration: Implement a wetland vegetation planting and restoration program using native species appropriate for the specific wetland type. This may involve re-vegetation of disturbed areas, re-establishment of native plant populations, and removal of non-native vegetation to promote the growth of native species.
3. Wetland Buffer Management: Maintain a buffer zone around the wetland area to protect it from adjacent land uses. This may include controlling encroaching vegetation, limiting access to the wetland, and implementing best management practices to minimize pollution and sediment runoff from surrounding areas.

WATER QUALITY MANAGEMENT

1. Pollution Prevention: Implement measures to prevent pollution from entering the wetland, including runoff from nearby agricultural fields, parking lots, and other human activities. This may involve installing sediment basins, vegetative buffers, or other erosion control measures.
2. Nutrient Management: Monitor nutrient levels in the wetland and adjacent water sources, and implement measures to manage excessive nutrient inputs that may cause water quality degradation. This may involve reducing fertilizer application, implementing vegetative buffer strips, or implementing nutrient management plans for nearby agricultural lands.
3. Water Level Management: Monitor and manage water levels in the wetland to maintain appropriate hydrological conditions for wetland vegetation and wildlife. This may involve installing water control structures, managing water inputs and outputs, and adapting water management practices based on seasonal and climatic changes.

WETLAND MAINTENANCE INSPECTION SCHEDULE

Seasonal Inspections:

- Conduct seasonal inspections to assess changes in wetland conditions and vegetation dynamics.
- Conduct vegetation surveys to track changes in species composition and density.
- Monitor water levels and hydrological conditions to ensure they are within the appropriate range for wetland health.
- Check for any signs of habitat degradation or disturbance, and take appropriate actions as needed.

Annual Comprehensive Inspections:

- Conduct annual comprehensive inspections to assess the overall health and functionality of the wetland ecosystem.
- Review and analyse monitoring data and reports from the previous year to identify any trends or changes.
- Assess the success of wetland management activities, such as invasive species control, vegetation restoration, and water quality management.
- Review and update the wetland management plan based on the findings and recommendations.

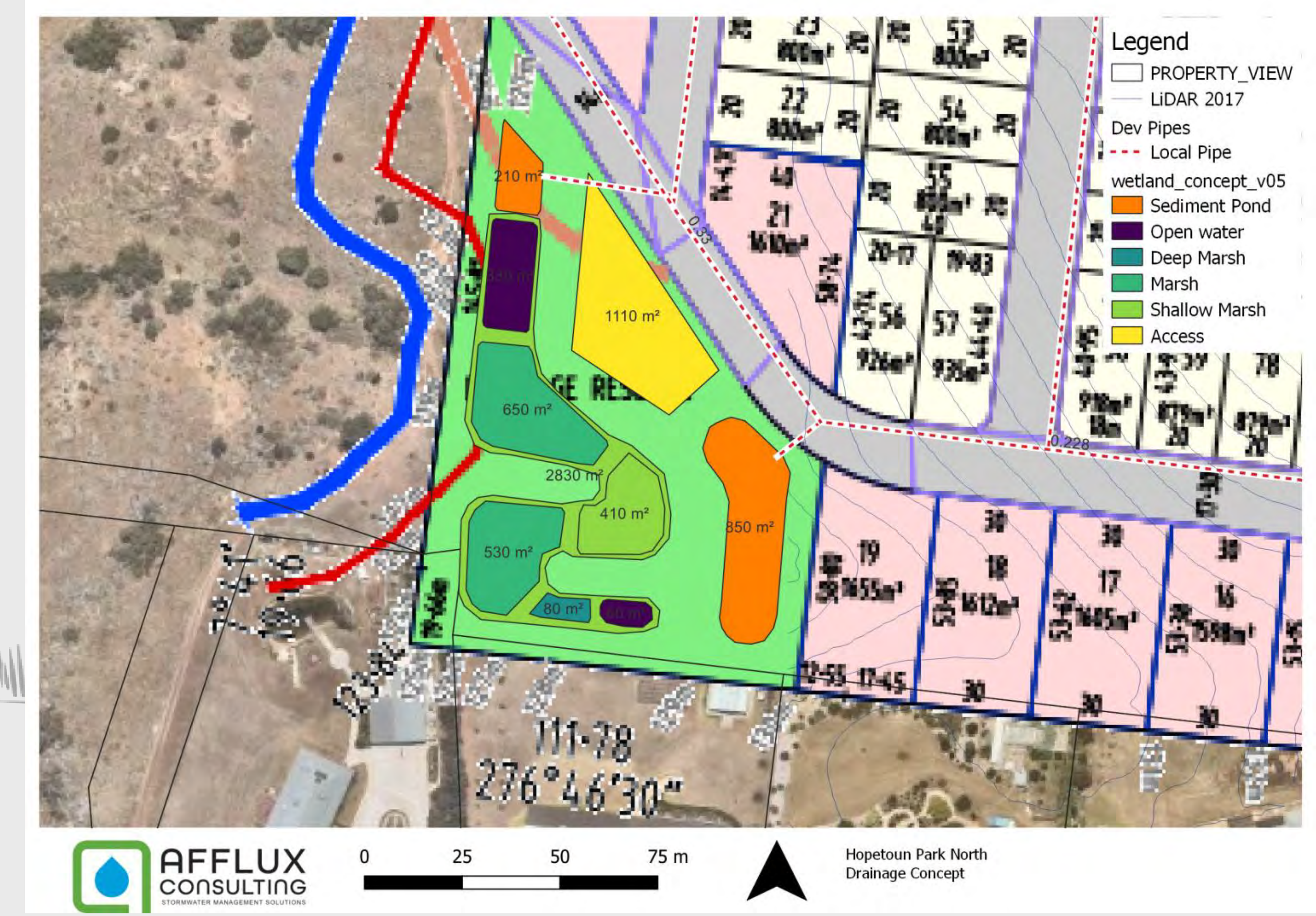
Event-driven Inspections:

- Conduct event-driven inspections in response to any significant weather events, such as storms, floods, or droughts, that may have an impact on the wetland ecosystem.
- Assess any potential damage or changes in wetland conditions resulting from the event.
- Take appropriate actions to mitigate any adverse impacts, such as repairing erosion, restoring vegetation, or addressing water quality issues.

Ad-hoc Inspections:

- Conduct ad-hoc inspections as needed in response to specific issues or concerns related to wetland health or management.
- Investigate any reported incidents, such as pollution, encroachment, or wildlife disturbances, and take appropriate actions to address the issues.
- Keep records of ad-hoc inspections and actions taken for documentation and reporting purposes.

WETLAND LAYOUT AND FEATURES



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SEDIMENT BASIN CLEANOUT

Basin Parameter	Value
Basin Sediment Storage Volume	250m³
Estimated Sediment Load	13m³/year
Sediment Volume @ 5 years	65m³
Area required to dry @0.5m	130m²
Estimated time till full	~20 years (requires major reset and dryout if left this long

Cleanout Frequency

Catchment Area =	6.77	ha	Just urban catchment concidered
Sediment load =	1.60	m^3/ha/yr	(Willing and Partners 1992)
Gross Pollutant Load =	0.40	m^3/ha/yr	(Alison et al 1998)
Actual basin depth =	1.0	m	
Actual Basin area =	300	m^2	

Therefore, cleanout frequency required = $\frac{(1.6+0.4)A_{catchment}}{0.5d_{basin}*A_{basin}}$ = 0.09 per year   Clean out every 11.1 years

Assumes cleanout when basin 50% full

Try to minimise cleanouts - ideally, once every 5 years OK

Figure 7: Excavator and swamp dozer on the pond floor removing sediment.

Resources

https://www.melbournewater.com.au/sites/default/files/Resetting-sediment-ponds-best-practice-guide.pdf

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STORMWATER MANAGEMENT SOLUTIONS

SPECIFIC REQUIREMENTS

Inspection/Maintenance Requirement	Frequency	Action Required/Notes
Check outlet sidewinder weir	All inspections (seasonal, annual, ad-hoc)	Check weir is clear of debris and free flowing. A blocked weir will result in NWL changes, and vegetation changes/dieback
Check for erosion exposures	All – particular focus of post event/ad-hoc	Ensure no erosional heads, particularly at inlet and outlet locations
Check Sediment pond sediment depth	Annual inspection	Check depth of sediment to calculate when next de-silting is required
Vegetation Health	Annual/Seasonal	Check for invasive species Typha/other aquatic species
Algae inspection	Annual/Seasonal	Check for algae infestations. May need algae removal treatments
Safety Inspections	Annual	Check safety batters exist around wetland. Check for general safety issues.
Water Quality Monitoring	Ad- Hoc	Check water quality base parameters for indications of wetland degradation (DO, TSS, Nutrient levels)

AFFLUX CONSULTING
STORMWATER MANAGEMENT SOLUTIONS

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AFFLUX CONSULTING

	Initials	Date
Designed	A.KEEGAN	MARCH 2023
Drafted	A.KEEGAN	MARCH 2023
Checked		
Authorised		
Approved by Council		

PRELIMINARY

No.	Revision Description	Designed	Authorised	Date

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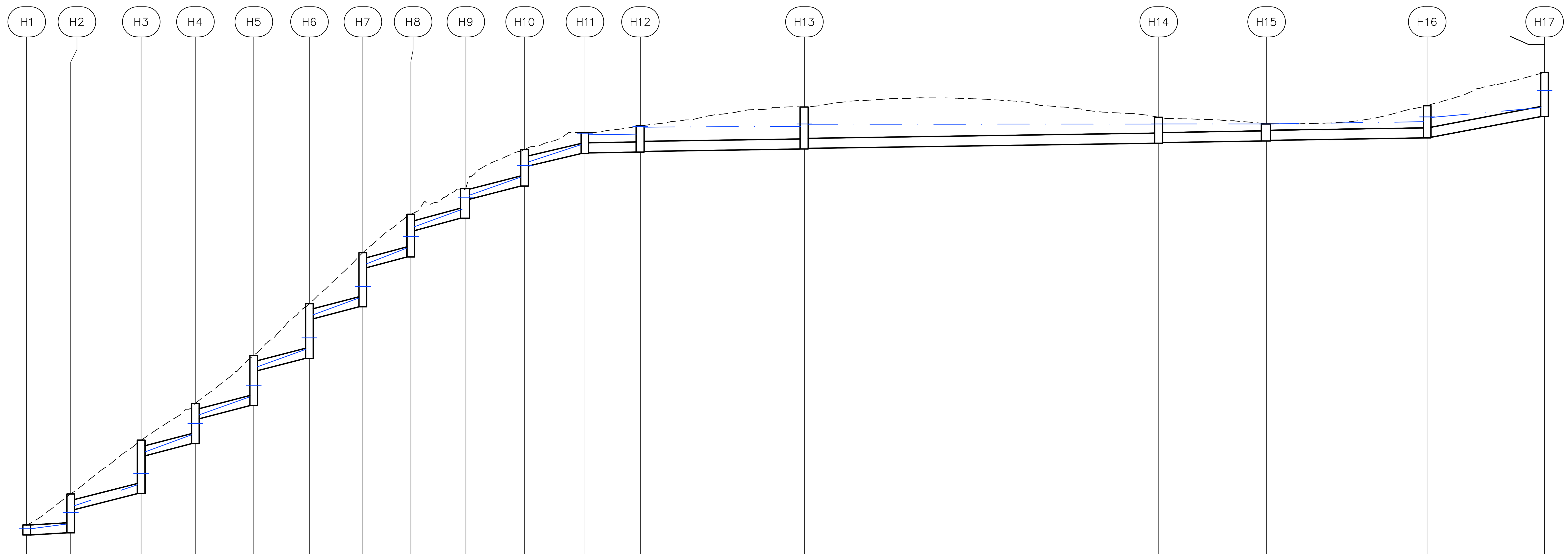
HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - HELCOR Pipe Plan

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D1

Sheet 1 of 8



Pipe	DESIGN DISCHARGE (l/s)	PIPE CAPACITY (l/s)	FULL VELOCITY (m/s)	PIPE TYPE	PIPE ROUGHNESS	PIPE DIAMETER (mm)	PIPE GRADE	Length
H1–H2	1400	2004	3.99	HEL-COR	0.012	800	1 in 51.5	8.759
H2–H3	1400	4311	8.58	HEL-COR	0.012	800	1 in 11.1	14.034
H3–H4	1400	4300	8.55	HEL-COR	0.012	800	1 in 11.1	10.776
H4–H5	1400	4309	8.57	HEL-COR	0.012	800	1 in 11.1	11.616
H5–H6	1400	4286	8.53	HEL-COR	0.012	800	1 in 11.2	11.069
H6–H7	1400	4286	8.53	HEL-COR	0.012	800	1 in 11.2	10.624
H7–H8	1400	4303	8.56	HEL-COR	0.012	800	1 in 11.1	9.539
H8–H9	1400	4310	8.57	HEL-COR	0.012	800	1 in 11.1	10.948
H9–H10	1400	4293	8.54	HEL-COR	0.012	800	1 in 11.1	11.7
H10–H11	1400	4118	8.19	HEL-COR	0.012	800	1 in 12.1	12.002
H11–H12	1400	1522	3.03	PP	0.009	800	1 in 158	11.032
H12–H13	1400	1458	2.90	PP	0.009	800	1 in 172	32.635
H13–H14	1400	1457	2.90	PP	0.009	800	1 in 172	70.483
H14–H15	1400	1487	2.96	PP	0.009	800	1 in 165	21.457
H15–H16	1400	1474	2.93	PP	0.009	800	1 in 168	31.948
H16–H17	1400	5079	10.11	PP	0.009	800	1 in 14.2	23.352

DATUM R.L. 73.00

Pit	DEPTH TO INVERT	HYDRAULIC GRADE LINE	DESIGN INVERT LEVEL	FINISHED SURFACE LEVEL	NATURAL SURFACE LEVEL	CHAINAGE
H1	0.757 / 0.757	87.49	87.000 / 87.000	87.800	87.757	0
H2	3.090 / 1.243	87.88 / 88.79 89.33	87.170 / 89.018	90.260	90.260	8.759
H3	4.258 / 1.253	90.99 / 91.91 93.61	90.288 / 93.293	94.546	94.546	22.793
H4	3.186 / 1.210	94.97 / 95.88 96.55	94.263 / 96.239	97.450	97.450	33.569
H5	3.994 / 1.223	97.99 / 98.91 100.38	97.289 / 100.061	101.284	101.284	45.185
H6	4.339 / 1.199	101.76 / 102.67 104.51	101.051 / 104.192	105.391	105.391	56.254
H7	4.308 / 1.201	105.85 / 106.76 108.56	105.142 / 108.249	109.450	109.450	66.878
H8	3.391 / 1.305	109.81 / 110.73 111.51	109.109 / 111.195	112.500	112.500	76.417
H9	2.363 / 0.849	112.89 / 113.81 114.01	112.185 / 113.700	114.549	114.549	87.365
H10	2.894 / 1.305	115.46 / 116.37 116.66	114.750 / 116.339	117.644	117.644	99.065
H11	1.670 / 1.620	118.04 / 118.95 118.82	117.330 / 117.380	119.000	119.000	111.066
H12	2.087 / 2.037	118.88 / 119.50 119.43	117.450 / 117.500	119.537	119.537	122.098
H13	3.340 / 3.290	119.49 / 119.69 119.67	117.690 / 117.740	121.030	121.030	154.733
H14	2.065 / 2.015	119.67 / 119.69	118.150 / 118.200	120.215	120.215	225.216
H15	1.356 / 1.306	119.68	118.330 / 118.380	119.686	119.686	246.673
H16	2.559 / 2.509	119.86 / 120.24 120.20	118.570 / 118.620	121.129	121.129	278.621
H17	3.512	120.98 / 122.35	120.270	123.782	123.782	301.973

HEL–CORE PIPE OPTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:200

	Initials	Date
Designed	A.KEEGAN	MARCH 2023
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HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - HELCOR Pipe Longitudinal Sections

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D2

Millar & Merrigan authorise the use of this drawing only for the purpose described by the status stamp shown below. This drawing should be read in conjunction with all relevant contracts, specifications, reports & drawings.

	Initials	Date
Designed	A.KEEGAN	MARCH 2023
Drafted	A.KEEGAN	MARCH 2023
Checked		
Authorised		
Approved by Council		

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No.	Revision Description	Designed	Authorised	Date

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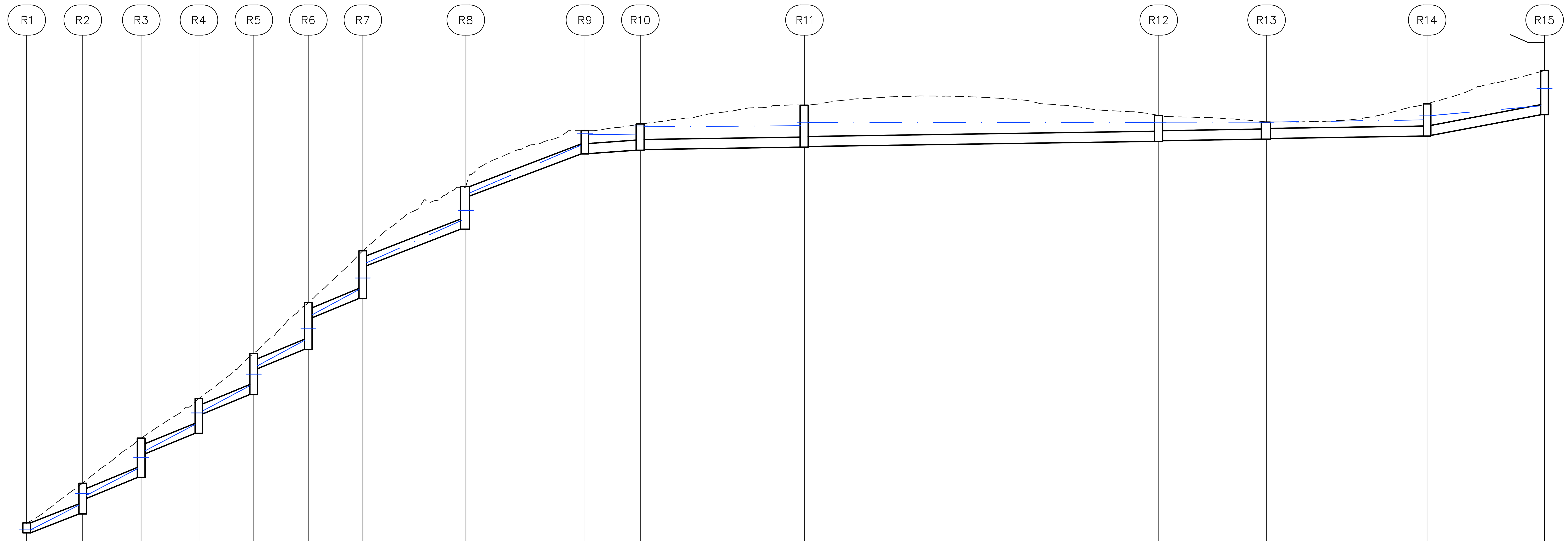
HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - Rail Pipe Plan

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D3



	R1–R2	R2–R3	R3–R4	R4–R5	R5–R6	R6–R7	R7–R8	R8–R9	R9–R10	R10–R11	R11–R12	R12–R13	R13–R14	R14–R15
DESIGN DISCHARGE (l/s)	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
PIPE CAPACITY (l/s)	7057	7217	7203	7200	7220	7209	7214	7724	2989	1458	1457	1487	1474	5079
FULL VELOCITY (m/s)	14.04	14.36	14.33	14.32	14.36	14.34	14.35	15.79	5.95	2.90	2.90	2.96	2.93	10.11
PIPE TYPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	RAIL PIPE	PP	PP	PP	PP	PP	PP
PIPE ROUGHNESS	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
PIPE DIAMETER (mm)	800	800	800	800	800	800	800	800	800	800	800	800	800	800
PIPE GRADE	1 in 7.4	1 in 7	1 in 7	1 in 7	1 in 7	1 in 7	1 in 7	1 in 7.1	1 in 40.9	1 in 172	1 in 172	1 in 165	1 in 168	1 in 14.2
CHAINAGE (length)	11.156	11.638	11.472	10.919	10.847	10.847	20.486	23.702	11.032	32.635	70.483	21.457	31.948	23.352

DATUM R.L. 73.00

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
DEPTH TO INVERT	0.757 0.757	2.447 1.212	3.141 1.253	2.764 1.222	3.269 1.223	3.703 1.201	3.795 1.201	3.380 0.749	1.850 1.820	2.087 2.037	3.340 3.290	2.065 2.015	1.356 1.306	2.559 2.509	3.512
HYDRAULIC GRADE LINE	87.24	89.22 90.13 90.00	92.11 93.03 93.53	95.63 96.54 96.70	98.72 99.64 100.30	102.32 103.23 104.35	106.36 107.28 108.49	111.87 112.67 114.04	117.86 118.80 118.67	118.73 119.38 119.31	119.39 119.69 119.66	119.67 119.69	119.68	119.86 120.24 120.20	120.98 122.35
DESIGN INVERT LEVEL	87.000 87.000	88.510 89.745	91.405 93.293	94.923 96.465	98.015 100.061	101.610 104.111	105.655 108.249	111.169 113.800	117.150 117.180	117.450 117.500	117.690 117.740	118.150 118.200	118.330 118.380	118.570 118.620	120.270
FINISHED SURFACE LEVEL	87.800	90.957	94.546	97.687	101.284	105.312	109.450	114.549	119.000	119.537	121.030	120.215	119.686	121.129	123.782
NATURAL SURFACE LEVEL	87.757	90.957	94.546	97.687	101.284	105.312	109.450	114.549	119.000	119.537	121.030	120.215	119.686	121.129	123.782
CHAINAGE	0	11.156	22.793	34.266	45.185	56.032	66.878	87.365	111.066	122.098	154.733	225.216	246.673	278.621	301.973

RAIL PIPE OPTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:200

	Initials	Date
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HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - Rail Pipe Longitudinal Sections

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D4

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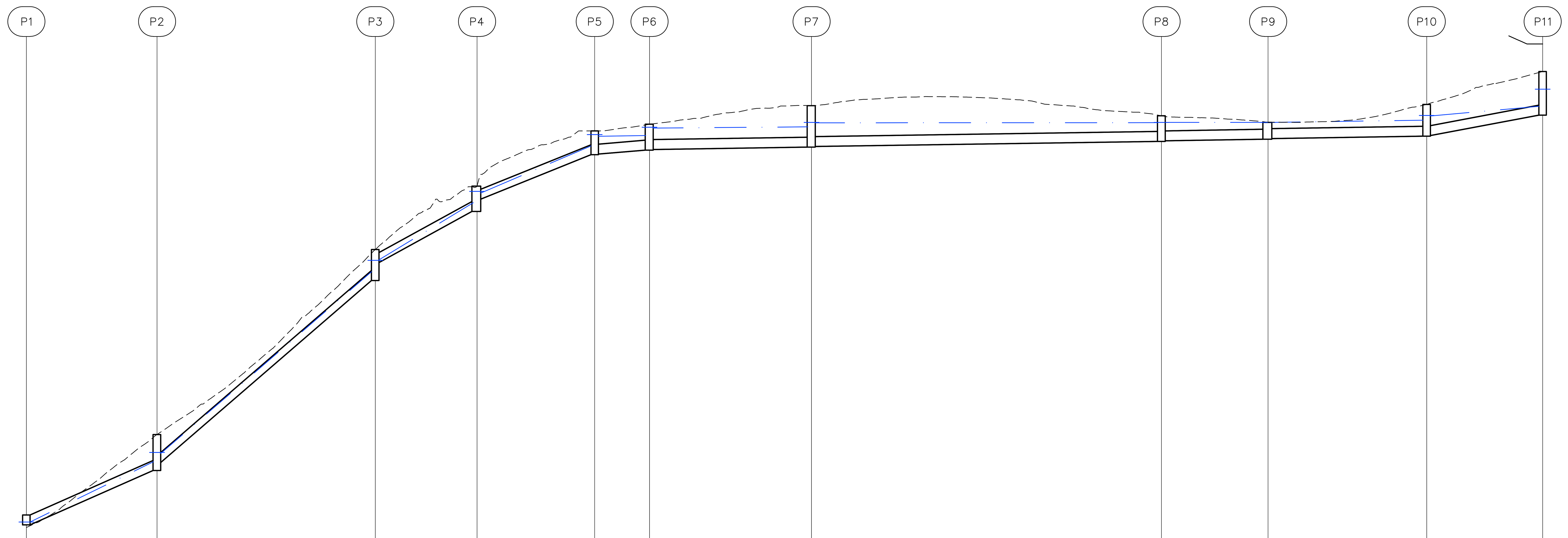
HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - Welded PE Pipe Plan

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D5



	P1–P2	P2–P3	P3–P4	P4–P5	P5–P6	P6–P7	P7–P8	P8–P9	P9–P10	P10–P11
DESIGN DISCHARGE (l/s)	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
PIPE CAPACITY (l/s)	7826	11033	8559	7426	3255	1458	1457	1487	1474	5079
FULL VELOCITY (m/s)	15.57	21.95	17.03	14.77	6.47	2.90	2.90	2.96	2.93	10.11
PIPE TYPE	WELDED PE	WELDED PE	WELDED PE	WELDED PE	PP	PP	PP	PP	PP	PP
PIPE ROUGHNESS	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
PIPE DIAMETER (mm)	800	800	800	800	800	800	800	800	800	800
PIPE GRADE	1 in 6	1 in 3	1 in 5	1 in 6.6	1 in 34.5	1 in 172	1 in 172	1 in 165	1 in 168	1 in 14.2
CHAINAGE (length)	26.311	43.954	20.486	23.702	11.032	32.635	70.483	21.457	31.948	23.352

DATUM R.L. 73.00

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
DEPTH TO INVERT	-0.208 / -0.208	2.896 / 2.250	2.500 / 1.050	2.039 / 1.049	1.920 / 1.870	2.087 / 2.037	3.340 / 3.290	2.065 / 2.015	1.356 / 1.306	2.559 / 2.509	3.512
HYDRAULIC GRADE LINE	87.50	92.36 / 93.10 / 93.02	107.66 / 108.57 / 108.62	113.22 / 114.13 / 114.00	117.79 / 118.70 / 118.57	118.63 / 119.29 / 119.22	119.32 / 119.69 / 119.65	119.66 / 119.69	119.68	119.86 / 120.24 / 120.20	120.98 / 122.35
DESIGN INVERT LEVEL	87.270 / 87.270	91.650 / 92.296	106.950 / 108.400	112.510 / 113.500	117.080 / 117.130	117.450 / 117.500	117.690 / 117.740	118.150 / 118.200	118.330 / 118.380	118.570 / 118.620	120.270
FINISHED SURFACE LEVEL	88.070	94.546	109.450	114.549	119.000	119.537	121.030	120.215	119.686	121.129	123.782
NATURAL SURFACE LEVEL	87.062	94.546	109.450	114.549	119.000	119.537	121.030	120.215	119.686	121.129	123.782
CHAINAGE	0	26.311	70.265	90.752	114.453	125.485	158.12	228.603	250.06	282.008	305.36

WELDED PE OPTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:200

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HOPETOUN PARK ROAD DEVELOPMENT
Drainage Concept - Welded PE Pipe Longitudinal Sections
Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D6

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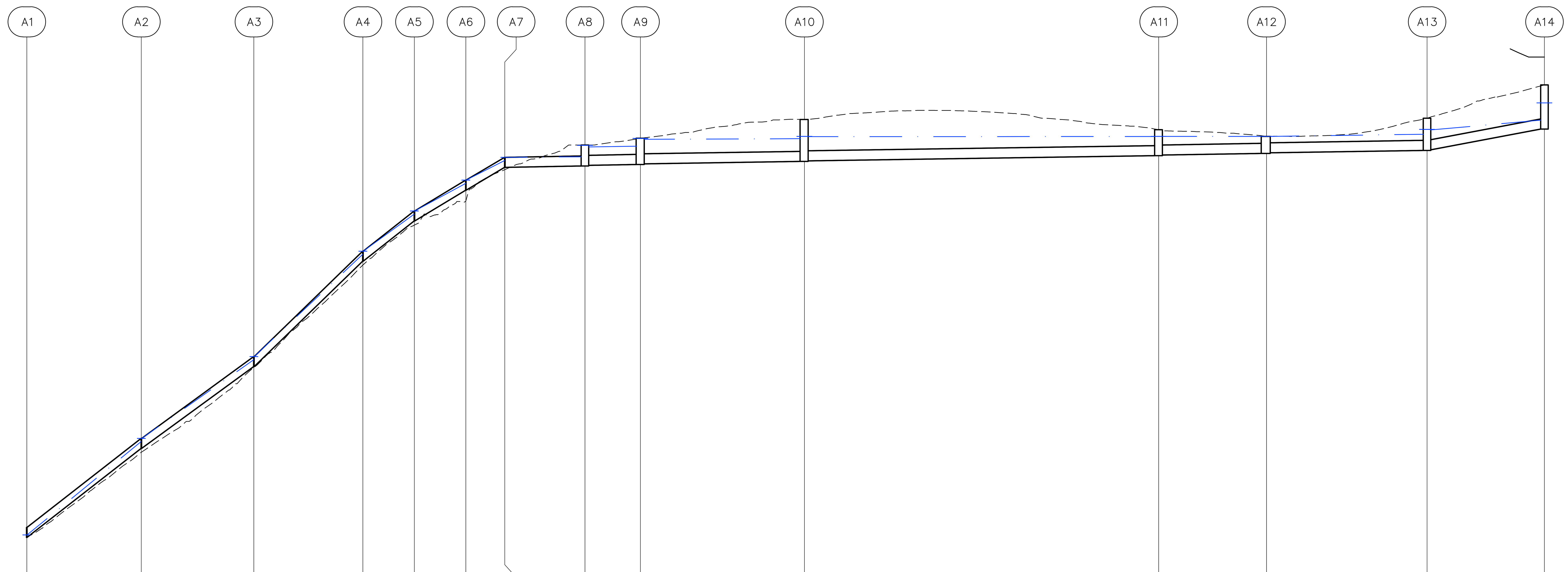
HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - Above Ground Pipe Plan

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D7



Pipe	A1–A2	A2–A3	A3–A4	A4–A5	A5–A6	A6–A7	A7–A8	A8–A9	A9–A10	A10–A11	A11–A12	A12–A13	A13–A14
DESIGN DISCHARGE (l/s)	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
PIPE CAPACITY (l/s)	10691	10343	11929	10721	9381	9294	1593	1522	1458	1457	1487	1474	5079
FULL VELOCITY (m/s)	21.27	20.58	23.73	21.33	18.66	18.49	3.17	3.03	2.90	2.90	2.96	2.93	10.11
PIPE TYPE	WELDED PE	WELDED PE	WELDED PE	WELDED PE	WELDED PE	WELDED PE	RCP – RRJ	PP	PP	PP	PP	PP	PP
PIPE ROUGHNESS	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
PIPE DIAMETER (mm)	800	800	800	800	800	800	800	800	800	800	800	800	800
PIPE GRADE	1 in 3.2	1 in 3.4	1 in 2.6	1 in 3.2	1 in 4.2	1 in 4.3	1 in 145	1 in 158	1 in 172	1 in 172	1 in 165	1 in 168	1 in 14.2
Chainage length	22.793	22.392	21.693	10.243	10.243	7.752	15.949	11.032	32.635	70.483	21.457	31.948	23.352

DATUM R.L. 74.00

Pit	DEPTH TO INVERT	HYDRAULIC GRADE LINE	DESIGN INVERT LEVEL	FINISHED SURFACE LEVEL	NATURAL SURFACE LEVEL	CHAINAGE
A1		87.97	87.770 87.770	87.757	87.757	0
A2		95.39 95.65	94.850 94.850	94.546	94.546	22.793
A3		101.90 102.16	101.360 101.360	101.284	101.284	45.185
A4		110.29 110.55	109.750 109.750	109.450	109.450	66.878
A5		113.49 113.75	112.950 112.950	112.629	112.629	77.121
A6		115.94 116.20	115.400 115.400	114.549	114.549	87.365
A7		117.76 118.02	117.220 117.220	117.038	117.038	95.117
A8	1.920 1.870	118.06 118.98 118.84	117.330 117.380	119.000	119.000	111.066
A9	2.087 2.037	118.90 119.52 119.45	117.450 117.500	119.537	119.537	122.098
A10	3.340 3.290	119.50 119.69 119.67	117.690 117.740	121.030	121.030	154.733
A11	2.065 2.015	119.67 119.69	118.150 118.200	120.215	120.215	225.216
A12	1.356 1.306	119.68	118.330 118.380	119.686	119.686	246.673
A13	2.559 2.509	119.86 120.24 120.20	118.570 118.620	121.129	121.129	278.621
A14	3.512	120.98 122.35	120.270	123.782	123.782	301.973

ABOVE GROUND PIPE OPTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:200

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Drafted	A.KEEGAN	MARCH 2023
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Authorised		
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HOPETOUN PARK ROAD DEVELOPMENT

Drainage Concept - Above Ground Pipe Longitudinal Sections

Hopetoun Park Road, Hopetoun Park
Moorabool Shire Council

21702E 00 D8

WEBB COURT
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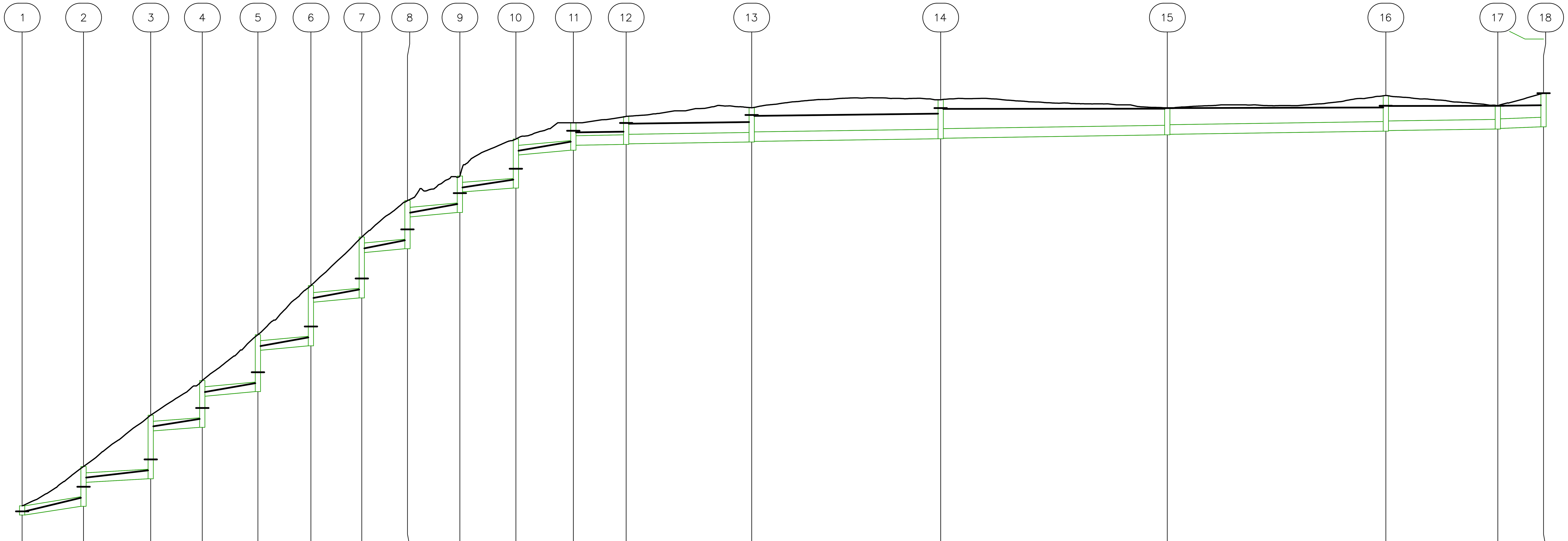

DATUM R.L. 73.00

Pipe (from–to)	Design discharge (l/s)	Pipe capacity (l/s)	Full velocity (m/s)	Pipe type	Pipe diameter (mm)	Pipe grade	Depth to invert (start / end)	Hydraulic grade line (start / end)	Design invert level (start / end)	Finished surface level (end)	Natural surface level (end)	Chainage (start)	Length
At 1							0.770	86.51	86.202	86.971	86.971		
1–2	1400	4879	9.83	PP	800	1 in 17.6	0.770 / 3.328	– / 87.64	86.202 / 86.932	90.260	90.260	0	12.827
2–3	1400	2785	5.54	RCP – RRJ	800	1 in 47.1	1.328 / 5.316	88.57, 89.33 / 89.94	88.932 / 89.230	94.546	94.546	12.827	14.034
3–4	1400	3146	6.26	PP	800	1 in 36.9	1.306 / 3.917	90.85, 93.61 / 94.24	93.240 / 93.532	97.450	97.450	26.861	10.776
4–5	1400	3489	6.94	RCP – RRJ	800	1 in 30	1.317 / 4.765	95.15, 96.48 / 97.22	96.132 / 96.519	101.284	101.284	37.637	11.616
5–6	1400	3489	6.94	PP	800	1 in 30	1.304 / 5.042	98.14, 100.33 / 101.05	99.980 / 100.349	105.391	105.391	49.253	11.069
6–7	1400	3489	6.94	RCP – RRJ	800	1 in 30	1.389 / 5.095	101.97, 104.35 / 105.06	104.001 / 104.356	109.450	109.450	60.322	10.624
7–8	1400	3489	6.94	PP	800	1 in 30	1.300 / 4.032	105.98, 108.50 / 109.17	108.150 / 108.468	112.500	112.500	70.946	9.539
8–9	1400	3489	6.94	RCP – RRJ	800	1 in 30	1.368 / 3.052	110.09, 111.48 / 112.20	111.132 / 111.496	114.549	114.549	80.484	10.948
9–10	1400	3166	6.30	PP	800	1 in 36.4	1.329 / 4.103	113.12, 113.59 / 114.25	113.220 / 113.541	117.644	117.644	91.432	11.7
10–11	1400	3489	6.94	RCP – RRJ	800	1 in 30	1.334 / 2.290	115.16, 116.66 / 117.42	116.310 / 116.710	119.000	119.000	103.132	12.002
11–12	1400	1522	3.03	PP	800	1 in 158	1.880 / 2.347	118.33, 118.20 / 118.26	117.120 / 117.190	119.537	119.537	115.134	11.032
12–13	1400	1445	2.88	PP	800	1 in 175	2.297 / 2.869	118.98, 118.92 / 119.06	117.240 / 117.390	120.259	120.259	126.165	26.218
13–14	1400	1427	2.84	PP	800	1 in 179	2.819 / 3.264	119.65, 119.58 / 119.76	117.440 / 117.660	120.924	120.924	152.383	39.475
14–15	1400	1470	2.92	PP	800	1 in 169	3.214 / 2.239	120.23, 120.16 / 120.18	117.710 / 117.990	120.229	120.229	191.859	47.345
15–16	1400	1442	2.87	PP	800	1 in 176	2.189 / 2.987	120.23 / 120.28	118.040 / 118.300	121.287	121.287	239.204	45.64
16–17	1400	1425	2.83	PP	800	1 in 180	2.937 / 1.942	120.42, 120.41 / 120.41	118.350 / 118.480	120.422	120.422	284.844	23.386
17–18	1400	2229	4.43	PP	800	1 in 73.5	1.892 / 7.340	120.42 / 120.47	118.530 / 118.660	121.474	121.474	308.23	9.558
At 18								121.47				317.788	

HOIRZONTAL SACLE 1:500
VERTICAL SCALE 1:200

TABLE 205-A: TRENCHSTOP & BULKHEAD PLACEMENT AND PIPELINE SELECTION CRITERIA

	MAXIMUM TRENCHSTOP / BULKHEAD SPACING			
SLOPE	Flatter than 1 in 20	Steeper than 1 in 20	Steeper than 1 in 15	Steeper than 1 in 10
SOC MAIN (PP / GRP)	NOT REQUIRED	100m	75m	50m
WELDED MAIN (PE / SCJ PVC)	NOT REQUIRED	200m	150m	100m

NOTES Regarding Trenchstops:

A. Mains flatter than 1 in 20 slope do not typically require trenchstops or bulkheads.
B. Where welded PE mains or solvent welded PVC DWV mains are used for steep slopes, these shall be constructed in accordance with Figure 205-A.
C. PVC mains at grades steeper than 1 in 20 shall be solvent welded and this joint type shall be specified in the design where PVC DWV pipes have been selected.
D. Mains laid steeper than 1 in 20 grade require cement stabilized Type B embedment as per MRWA-S-202.
E. For details of trenchstop design, refer to MRWA-S-206.
F. Where the slope length is less than the spacing nominated, a trenchstop or bulkhead is only required at the bottom of the slope.
G. Where the slope length is < ½ the spacing nominated, no trenchstop is required.
H. Trenchstops are required on both sides of any road crossing where there is a slope steeper than 1 in 20 across the road.
I. Spacings based on the equation in Table 5.7 from AS/NZS 2566.2. L (spacing) = [80 x Pipe Length (nominally 6m)] / Grade (%)

TABLE 205-B: MAXIMUM ALLOWABLE GRADES

PIPE DN	100 & 150	225	300	375	450	525	600	750	900	> 900
MAXIMUM SAFE GRADE	1 in 20	1 in 30	1 in 45	1 in 60	1 in 75	1 in 90	1 in 110	1 in 130	1 in 160	1 in Ø /6

NOTES Regarding Table 205-B:

a. Water Agency approval is required where proposed grades exceed those nominated in Table 205-B, . Calculations for velocity and Froude number shall be provided for the steep sewer and sewer downstream.
b. Velocities shall be kept below 3 m/s.
c. Exceeding Table 205-B grades will likely result in super-critical flow and deterioration of the sewerage system through the formation of hydraulic jumps downstream.
d. Where the downstream sewer is a sub-critical grade, controls to limit the damage from hydraulic jumps at this location shall be implemented. Controls may consist of:
   - d.1. Reducing grade of the upstream sewer(s)
   - d.2. Increasing grade &/or diameter of the downstream sewer (to reduce relative height of the hydraulic jump).
   - d.3. Directing high velocity inflows towards the outflow of the Maintenance Structure (if base connection).
   - d.4. Discharging high velocity flows to a MH drop as per Table 307-D and Figures 311-C to E.
e. Steeply graded gravity sewers present similar challenges to pressure main discharges. The controls and requirements presented in MRWA-S-317 and 319 are therefore often suitable for steep gravity sewers.

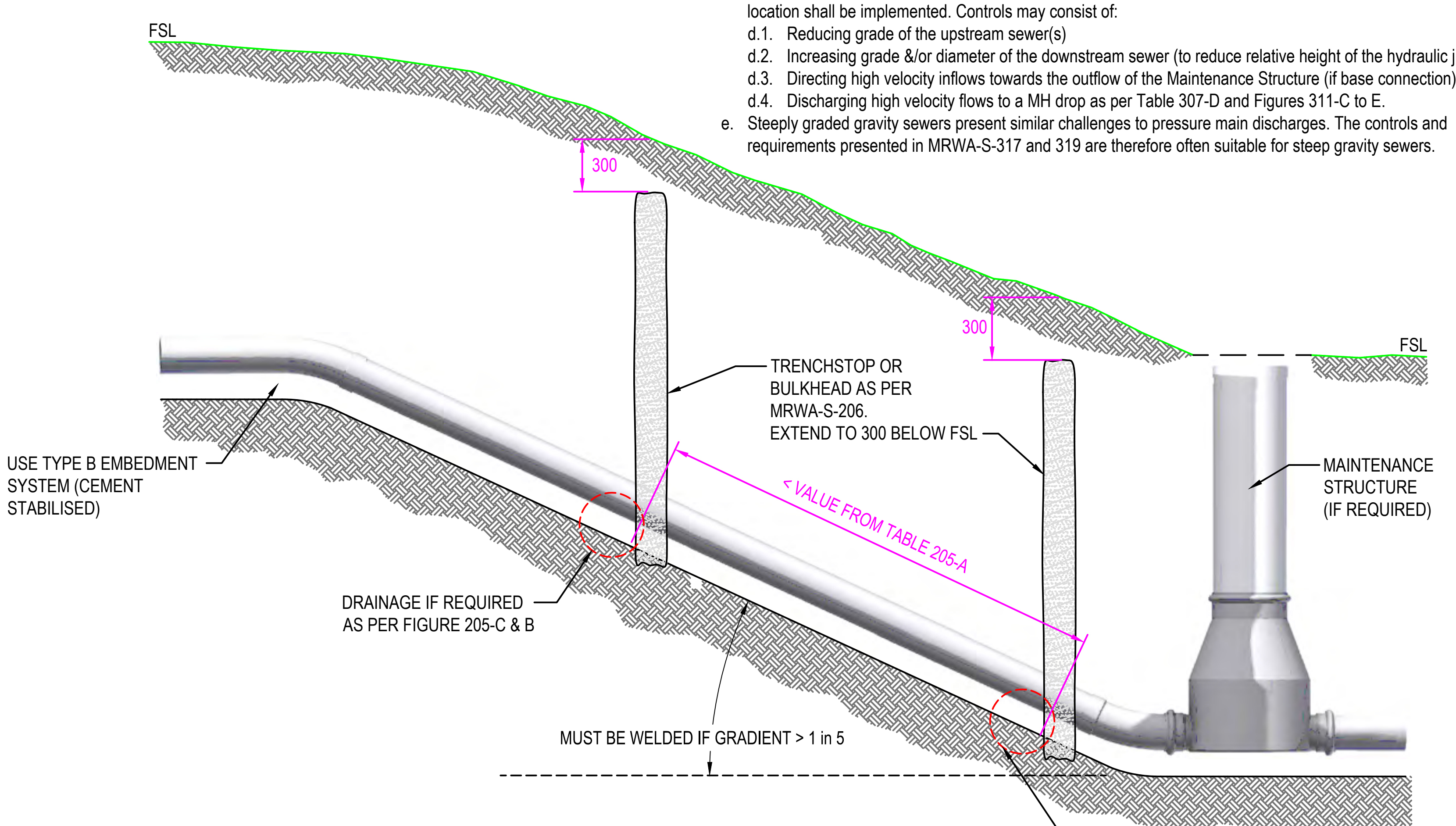

FIGURE 205-A: SEWER MAINS IN STEEP TERRAIN

NOTES on Figure 205-A:

If the main is welded PE, thrust restraints or maintenance hole connections to counteract shrinkage will be required at both ends of the PE main.
Refer to drawing MRWA-W-205-A or Figure 310-F for details.

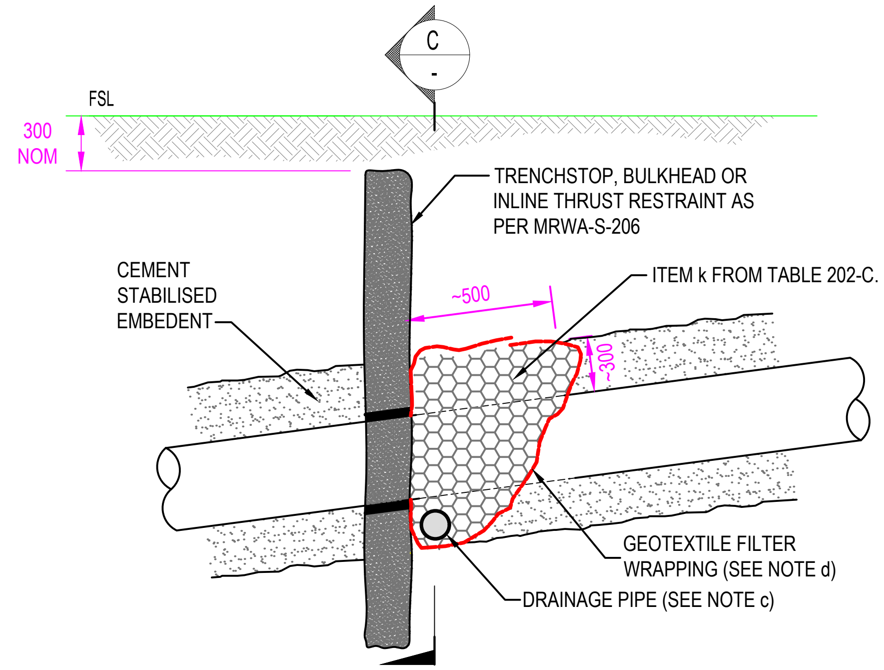

FIGURE 205-B: TRENCHSTOP WITH DRAIN (SECTION)

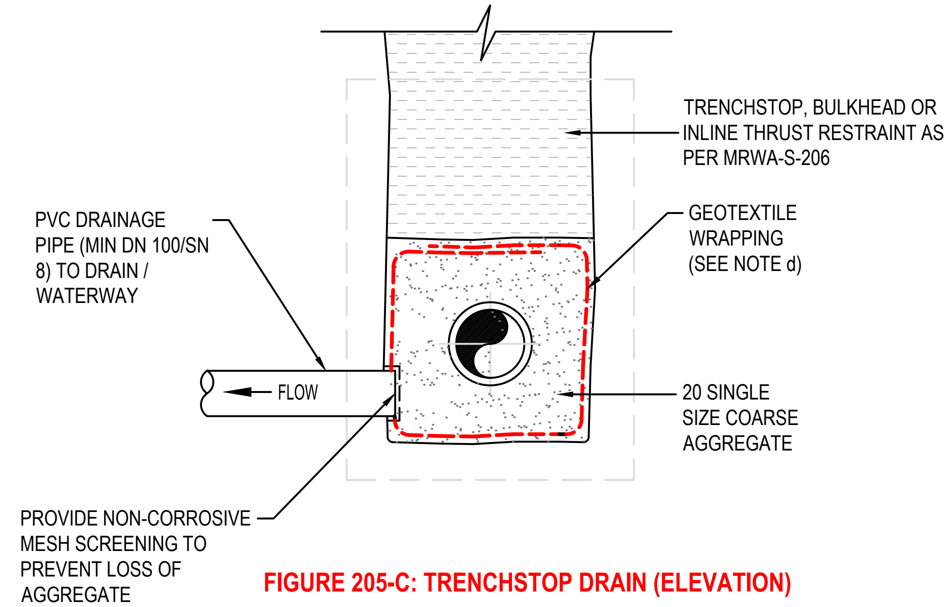

FIGURE 205-C: TRENCHSTOP DRAIN (ELEVATION)

Notes on Figures 205-B & C:

a. Trenchstops and bulkheads shall be drained as shown where the location is likely (or is known) to have high ground water or the surface water is not directed away from the sewer alignment.
   The designer shall nominate all required drainage points and drainage arrangements.
b. Provide a restricted (to slow the flow of ground water) continuous drainage path between drainage points.
   - through bulkheads and trenchstops.
   - around maintenance structures.
   - along embedment.
c. Drainage pipes to discharge ground water into authorised water discharge areas (as agreed by the drainage authority) shall be shown in the design drawings.
d. Lay geotextile filter fabric in trench such that it fully encapsulates the drainage material (coarse aggregate). Provide minimum of 250 overlap at all filter fabric joints.

ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE

REV	DESCRIPTION	DATE	APPROVED
3	CHANGES TO MAXIMUM GRADE LIMITS & REQ'S	01/04/19	CP / GA / ST
2	PUBLISHED FIRST ISSUE	01/10/15	CP / JT / KD / RJ
1	PRE-PUBLISHED DRAFT	01/03/15	CP / JT / KD / RJ

DESIGNED: R. JAGGER — DATE: 1 JULY 2015
DRAWN: R. JAGGER — DATE: 1 JULY 2015

CHECKED:	NAME	DATE	APPROVED:	NAME	DATE
☒ GWW	D. MOORE	01/09/15	☒ GWW	R. CARRUTHERS	01/09/15
☒ SEW	C. PAXMAN	01/09/15	☒ SEW	D. O'DONOVAN	01/09/15
☒ YVW	K. DAWSON	01/09/15	☒ YVW	J. TOMASI	01/09/15

ISSUED 2015 — VERSION 1

MELBOURNE RETAIL WATER AGENCIES

Greater Western Water — South East Water — Yarra Valley Water

MRWA SEWERAGE STANDARDS

SLOPING MAINS
AND TRENCH DRAINAGE

NOT TO SCALE

MRWA-S-205

Planning	Design	Construction
	✓ ✓	✓ ✓

SCARBOROUGH ROAD OUTFALL DRAIN CITY OF GREATER GEELONG

GENERAL NOTES

1. ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM AND ALL CO-ORDINATES ARE TO MAP GRID OF AUSTRALIA (MGA) ZONE 55.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH GENERAL CONDITIONS OF CONTRACT, COUNCIL STANDARDS, APPROPRIATE STANDARD DRAWINGS AND TO THE SATISFACTION OF THE SUPERINTENDENT.
3. TBM'S TO BE RE-ESTABLISHED BY THE LICENSED SURVEYOR IF FOUND TO BE MISSING AT THE COMMENCEMENT OF CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR CARE AND MAINTENANCE OF TBM'S THEREAFTER.
4. BEFORE COMMENCING WORK ON THE TRENCHES IN EXCESS OF 1.5m DEEP, NOTICE OF SUCH PROPOSAL IS TO BE SENT TO THE WORKCOVER AUTHORITY IN ACCORDANCE WITH CLAUSE 5.1.27 OF THE VICTORIAN OH&S REGULATIONS 2007.
5. ALL EXCAVATIONS FOR DRAINAGE WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE VICTORIAN WORK COVER AUTHORITY.
6. ALL EXISTING SURFACE LEVELS SHOWN ON THE ENGINEERING DRAWINGS HAVE BEEN INTERPOLATED FROM A DIGITAL TERRAIN MODEL. THESE LEVELS HAVE BEEN USED AS THE BASIS FOR ALL ENGINEERING DESIGN AND DETERMINATION OF QUANTITIES AND ARE ACCURATE TO WITHIN ±0.05m.
7. ALL VARIATIONS MUST BE APPROVED BY SUPERINTENDENT PRIOR TO UNDERTAKING ANY WORKS.
8. ALL BATTERS SHALL BE 1 IN 6, UNLESS OTHERWISE SHOWN.
9. THE LOCATION OF EXISTING SERVICES SHOULD BE DETERMINED BY THE CONTRACTOR PRIOR TO COMMENCING ANY EXCAVATION BY CONTACTING ALL LOCAL SERVICE AUTHORITIES. ANY EXISTING SERVICES SHOWN ON THESE DRAWINGS ARE OFFERED AS A GUIDE ONLY AND ARE NOT GUARANTEED AS CORRECT. ANY DISTURBANCE OR DAMAGE TO EXISTING SERVICES SHALL BE AT THE CONTRACTOR'S EXPENSE.
10. DISTURBED AREAS MUST BE TOP SOILED AND HYDROSEEDED WITH APPROVED GRASSES. TEMPORARY FENCING MUST BE ERECTED TO PREVENT ACCESS TO TREATED AREAS.
11. CONTRACTOR TO PREPARE AN ENVIRONMENTAL MANAGEMENT PLAN (SEMP) AND FORWARD TO THE SUPERINTENDENT PRIOR TO COMMENCEMENT OF ANY WORKS. CONSIDERATION SHOULD BE MADE TO MWC DRAINAGE DESIGN MANUAL AND CONTROL OF EROSION ON CONSTRUCTION SITES BY DEPT. CONSERVATION FORESTS & LANDS, 1987. DE-WATERING MUST BE IN ACCORDANCE WITH THE EPA'S GUIDELINE "CONSTRUCTION GUIDELINES FOR MAJOR CONSTRUCTION SITES" DECEMBER 1995. THE CONTRACTOR MUST CONSTRUCT THE WORKS IN ACCORDANCE WITH THE APPROVED SEMP. WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THIS PLAN.
12. WHERE REQUIRED ANY BUILDINGS, TROUGHS, FENCES AND OTHER STRUCTURES ON SITE ARE TO BE REMOVED AS DIRECTED BY THE SUPERINTENDENT. THE COST OF REMOVAL IS TO BE INCLUDED IN THE OVERALL EARTHWORKS FIGURE UNLESS A SPECIFIC ITEM FOR REMOVAL IS DENOTED IN THE SCHEDULE.
13. NO BLASTING TO BE CARRIED OUT WITHOUT OBTAINING COUNCIL AND SUPERINTENDENT'S WRITTEN PERMISSION. RESTRICTED BLASTING WITHIN 20m OF WATER MAINS AND WITHIN 6m OF TELSTRA CONDUITS.
14. THE CONTRACTOR SHALL OBTAIN A ROAD OPENING PERMIT FROM THE RELEVANT AUTHORITY FOR ANY WORKS WITHIN EXISTING ROAD RESERVES AND COMPLY WITH THE REQUIREMENTS.
15. FOR THE DURATION OF PROCLAIMED WATER RESTRICTIONS THE CONTRACTOR SHALL CONFORM TO THE RESTRICTIONS AND ANY OTHER WATER CONSERVATION REQUIREMENTS IMPOSED BY THE WATER AGENCY.
16. ALL TREES AND SHRUBS ARE TO BE RETAINED UNLESS OTHERWISE SHOWN. IF CONSTRUCTION NECESSITATES THEIR REMOVAL, WRITTEN PERMISSION MUST BE OBTAINED FROM THE SUPERINTENDENT.
17. ALL TREES AND SHRUBS MUST BE PRESERVED AND PROTECTED AT ALL TIMES. IF CONSTRUCTION NECESSITATES THEIR REMOVAL, WRITTEN PERMISSION MUST BE OBTAINED FROM THE SUPERINTENDENT. TREES NOT SPECIFIED FOR REMOVAL ARE TO BE PROTECTED WITH APPROPRIATE EXCLUSION FENCING PRIOR TO COMMENCEMENT OF ANY WORKS.
18. NO NATIVE VEGETATION SHALL BE DESTROYED, FELLED, LOPPED RINGBARKED OR UPROOTED WITHOUT THE CONSENT OF THE RESPONSIBLE AUTHORITY. VEGETATION AND TREES ARE TO BE PROTECTED WITH APPROPRIATE EXCLUSION FENCING PRIOR TO COMMENCEMENT OF ANY WORKS.
19. DURING THE CONSTRUCTION AND MAINTENANCE PERIOD SILT FENCES ARE TO BE PLACED DOWNSTREAM OF ALL EXPOSED AREAS, AND SILT BARRIERS ARE TO BE PLACED UPSTREAM OF ALL PITS. THE SILT FENCES AND SILT BARRIERS ARE TO BE CHECKED AND MAINTAINED UNTIL THE END OF THE MAINTENANCE PERIOD.
20. ALL EXCAVATED ROCK AND SURPLUS SPOIL TO BE REMOVED AND DISPOSED OFF SITE UNLESS NOTED OTHERWISE.
21. FILLING MATERIAL IS TO BE IN ACCORDANCE WITH THE SPECIFICATION, AS 3798-2007 & TO THE SATISFACTION OF COUNCIL AND THE SUPERINTENDENT.
22. THE CONTRACTOR IS TO HAND OR HYDROEXCAVATE PROVE ALL EXISTING SERVICES EFFECTING THE WORKS PRIOR TO COMMENCEMENT OF CONSTRUCTION. THE CONTRACTOR IS TO NOTIFY THE SUPERINTENDENT OF ANY SERVICES THAT MAY HINDER THE SAFE CONSTRUCTION OF THE WORKS SUCH THAT THE DESIGN CAN BE ALTERED AS REQUIRED.
23. ALL DRAINAGE PIT LIDS ARE TO BE LOCKABLE UNLESS OTHERWISE NOTED.

FLORA & FAUNA NOTES

1. REFER TO REPORT *BIODIVERSITY ASSESSMENT: CORIYULE AND SCARBOROUGH ROADS, CURLEWIS, VICTORIA (ECOLOGY & HERITAGE PARTNERS, 2018)* FOR DETAILS OF FLORA & FAUNA
2. A PLANNING PERMIT IS REQUIRED TO REMOVE A PATCH OF COASTAL DUNE SCRUB ON SITE. NO WORKS WILL PROCEED UNTIL CONFIRMATION OF PERMIT APPROVAL IS PROVIDED BY THE SUPERINTENDENT.

DESIGN FLOW NOTES

1. CITY OF GREATER GEELONG HAVE PROVIDED SPIIRE WITH A DESIGN FLOW OF 1.9m3/s, FOR USE IN THIS DESIGN. NO VALIDATION OF HYDROLOGY HAS BEEN UNDERTAKEN BY SPIIRE.

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WARNING
BEWARE OF UNDERGROUND/OVERHEAD SERVICES
THE LOCATION OF SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.SPECIAL CONSIDERATION SHOULD BE GIVEN TO CONSTRUCTION PROCEDURES UNDER OVERHEAD ELECTRICITY TRANSMISSION LINES.

GEOWEB NOTES

1. GEOFABRICS 'GEOWEB' IS A CONFINEMENT SYSTEM WHICH IMPROVES THE STRUCTURAL PERFORMANCE OF SOIL AND PREVENTS EROSION.
2. GEOWEB IS PROPOSED FOR USE TO PROVIDE STABILITY OF THE ACCESS TRACK.
3. THE DETAILED DESIGN OF THE GEOWEB SYSTEM, INCLUDING ANCHORING, IS SUBJECT TO FULL ASSESSMENT BY THE SUPPLIER (GEOFABRICS) REFER GEOFABRICS FOR FULL DETAILS.

RAILPIPE NOTES

1. DUE TO HIGH VELOCITIES AND SCOUR POTENTIAL THROUGH THE PIPES DOWN THE EMBANKMENT, FRANKISCHE "RAIL PIPE" IS PROPOSED
2. "RAIL PIPE" IS A HIGH QUALITY POLYPROPYLENE PRODUCT WHICH IS EXTREMELY HARD WEARING AND HAS BEEN CONFIRMED, BY THE SUPPLIER, TO BE APPROPRIATE FOR THIS DESIGN.
3. DETAILED DESIGN OF THE "RAIL PIPE", INCLUDING ANCHORING REQUIREMENTS, IS SUBJECT TO FULL REVIEW AND ASSESSMENT BY FRANKISCHE
4. SHOULD AN ALTERNATE PRODUCT BE USED, THIS MUST DEMONSTRATE EQUIVALENT PERFORMANCE.
5. THE RAILPIPE WILL BE UNPERFORATED.
6. RAIL PIPE SPECIFIED IS PP SN16 ID600 SMOOTH BORE.

CULTURAL HERITAGE NOTES

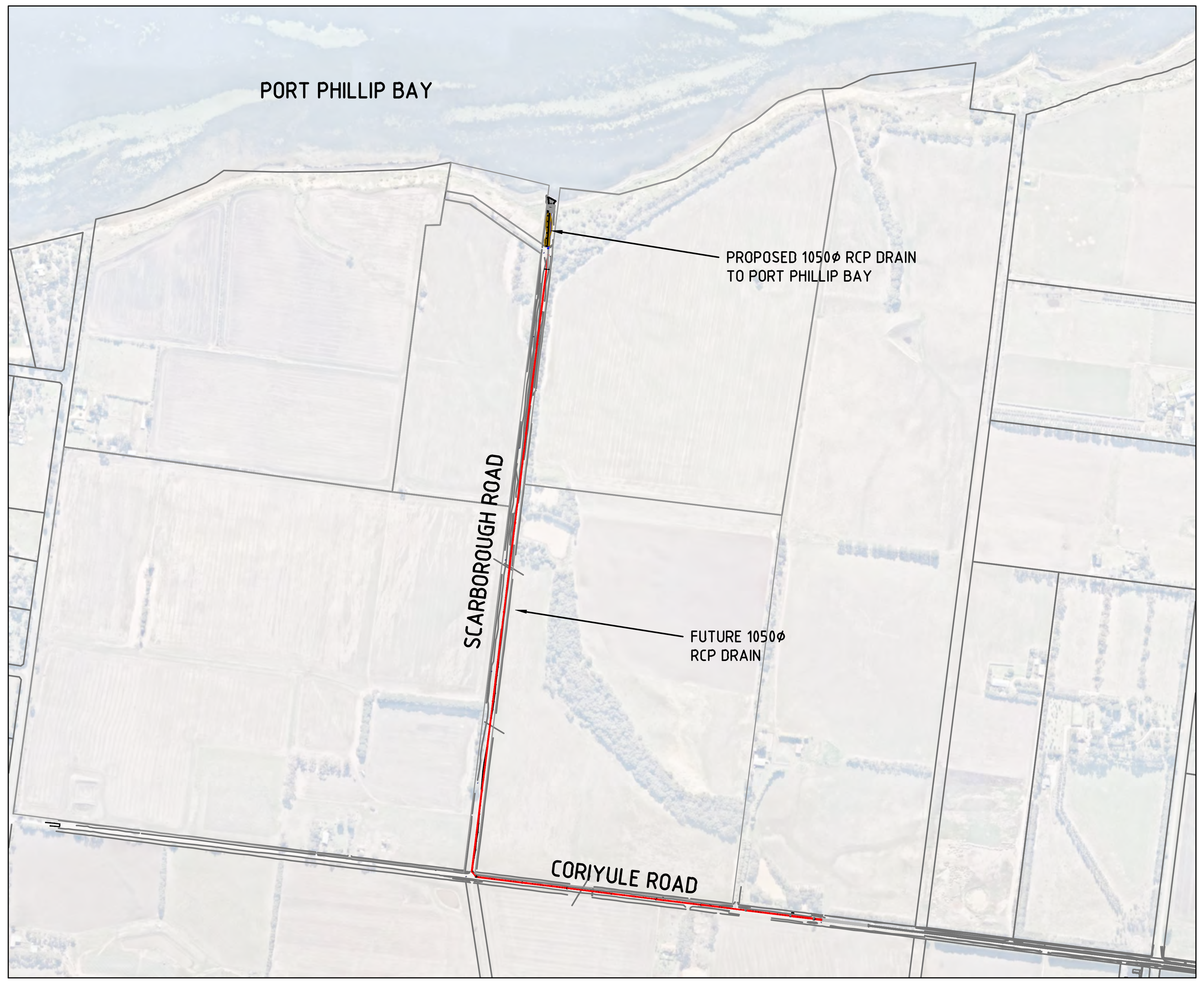
1. A BENCHMARK HERITAGE MANAGEMENT ASSESSMENT FOUND NO REGISTERED ABORIGINAL PLACES LOCATED IN THE ACTIVITY AREA.
2. A BENCHMARK HERITAGE MANAGEMENT PLAN (2019) PROVIDED SPECIFIC MEASURES WHICH MUST BE ADHERED TO, IN RELATION TO MANAGEMENT OF CULTURAL HERITAGE.

SEA LEVEL NOTES

1. SEA LEVELS SHOWN ARE TO AUSTRALIAN HEIGHT DATUM.
2. HIGHEST ASTRONOMICAL TIDE SHOWN IS REFERENCED FROM THE 'OUR COAST INUNDATION REPORT (ANTT, 2013 & PoMC, 2013)' FOR GEELONG LOCATION.
3. SEA LEVEL RISE PREDICTIONS AS A RESULT OF CLIMATE CHANGE ARE REFERENCED FROM 'DELWP APPLICATION FOR CONSENT OF COASTAL CROWN LAND 2019'.

GAP FLOW NOTES

1. FLOWS FROM THE EXISTING DAM ON SCARBOROUGH ROAD SPILL OVER SCARBOROUGH RD AND PARTIALLY FLOW DOWN SCARBOROUGH RD IN A NORTHERLY DIRECTION.
2. IT IS UNDERSTOOD THAT COUNCIL PROPOSE TO INSTALL A CULVERT UNDER SCARBOROUGH RD, THIS WILL CONNECT THE EXISTING DAM WITH THE EXISTING FLOW PATH TO THE WEST OF SCARBOROUGH RD (REFER TO WD200) AND DIRECT THESE OVERLAND FLOWS FROM THE OUTFALL WORKS.



LOCALITY PLAN

SCALE: NOT TO SCALE
MELWAY / VICROADS: MAP 457/J7

NOTE:
NO WORKS WILL BE UNDERTAKEN UNTIL ALL RELEVANT APPROVALS HAVE BEEN OBTAINED AND CONFIRMED BY THE SUPERINTENDENT. THIS INCLUDES, BUT IS NOT LIMITED TO, A MARINE AND COASTAL ACT CONSENT, AUTHORIZED BY DELWP.

LEGEND

DESCRIPTION	EXISTING	PROPOSED
COUNCIL STORMWATER DRAIN & PIT		
STORMWATER DRAINAGE PROPERTY INLETS		
COUNCIL STORMWATER PITS		
STORM WATER DRAINAGE PIT NUMBERS	EX 1	1
STORM WATER DRAINAGE PIPE SIZES	1050ø	1050ø
FENCES		
TOP OF BATTER		
EXISTING SURFACE CONTOURS	52.00	
GUIDE POSTS		
MEAN HIGHER LOW WATER (-0.10)		
GEELONGS HIGHEST ASTRONOMICAL TIDE (0.70)		
2040 HIGHEST ASTRONOMICAL TIDE (0.90)		
2100 HIGHEST ASTRONOMICAL TIDE (1.50)		
OUTLET PIT		
ROCK BEACHING		
CRUSHED ROCK AREA FOR MAINTENANCE		
GEOWEB CELLULAR CONFINEMENT		
BACKFILL MATERIAL		
IN SITU MATERIAL		
TOPSOIL AND HYDROSEED		
CLAY FILL		
VEHICULAR ACCESS TRACK		
SWING GATE		
FEATURE AND LEVEL SURVEY EXTENT BOUNDARY		

DRAWING SCHEDULE

REFERENCE	DESCRIPTION	REVISION	SHEET No.
WD100	FACE SHEET	A	1
WD200	FACE PLAN	A	2
WD201	DETAILED PLAN	A	3
WD220	LONGITUDINAL SECTION	A	4
WD221	OUTLET PIT DETAILS	A	5
WD222	OUTLET PIPE SECTIONS	A	6
WD224	TYPICAL DETAILS	A	7
CGG702	SWING GATE ENTRY (LAYOUT)	0	8
CGG703	SWING GATE ENTRY (DETAIL)	0	9

Rev	Amendments	Approved	Date
A	ISSUED TO COUNCIL		

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SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
FACE SHEET
CITY OF GREATER GEELONG

PRELIMINARY Drg No 306542WD100 Rev A

file name 306542WD100 MD.dwg layout name WD100 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

file name 306542WD200 MD.dwg layout name WD200 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

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H 1:3000
SCALE @ A3
0 30 60 90 120 150

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SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
FACE PLAN

CITY OF GREATER GEELONG

PRELIMINARY

Drg No 306542WD200 Rev A

NOTE:

1. DTM SHOWN WITHIN THE SITE (EXISTING FENCING) WAS DERIVED FROM LEVEL SURVEY PROVIDED BY COUNCIL.
2. DTM SHOWN OUTSIDE THE SITE WAS DERIVED FROM LIDAR SURVEY.
3. THE INTERFACE BETWEEN THE TWO DTM'S DOES NOT MATCH WELL AND FOR CLARITY LIDAR IS NOT SHOWN TO IMMEDIATE SURROUNDS OF THE OUTLET PIT

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H 1:200
SCALE @ A1
0 2 4 6 8 10

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SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
DETAILED PLAN

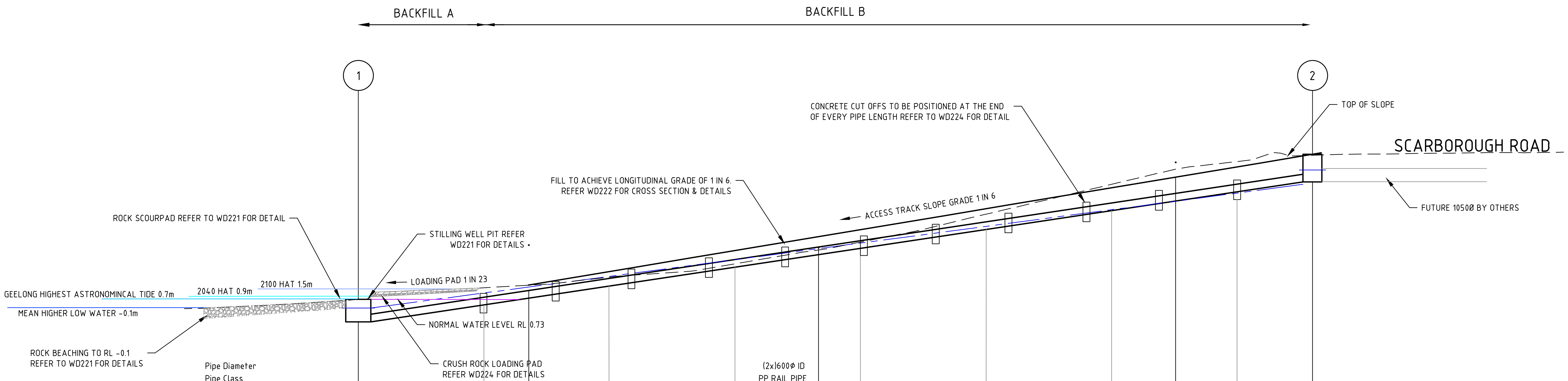
CITY OF GREATER GEELONG

PRELIMINARY Drg No 306542WD201 Rev A

file name 306542WD200 MD.dwg layout name WD201 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

NOTE:

1. VELOCITIES BETWEEN PITS 1-2 ARE CALCULATED TO BE APPROXIMATELY 10M/S. REFER STRUCTURAL DESIGN OF PIT 1 FOR EROSION CONTROLS
2. REFER TO WD224 FOR BACKFILL A & B DETAILS



Pipe Diameter						(2x)600Ø ID						
Pipe Class						PP RAIL PIPE						
Pipe Grade						1 in 7						
Velocity (m/s)						Vf=11.802						
Pipe Flow (m3/s)						Qa=1.900						
Pipe Capacity (m3/s)						Qcap=10.219						
DATUM	-12.00											
DEPTH TO INVERT	1.783 1.783	1.363		1.146	1.318		1.481	1.648	1.816		1.980	2.193
DESIGN INVERT LEVEL	-1.100 -1.100	0.223		1.72	3.225		4.725	6.228	7.727		9.228	10.043 10.118
HYDRAULIC GRADE LEVEL	0.000	1.166		2.488	3.824		5.145	6.467	7.796		9.118	9.845 10.981
FINISHED SURFACE LEVEL				2.875	4.542		6.218	7.872	9.551		11.207	12.236
EXISTING SURFACE LEVEL	0.683	1.585		2.433	3.488		5.231	7.432	9.815		11.627	12.152
CHAINAGE	0.000	10.000	13.576	20.000	30.000	L=75.999m 36.663		50.000	60.000	65.093	70.000	75.999

file name 306542WD220 MD.dwg layout name WD220 plotted by Denver Hall
file location G:\30\306542\CIVIL\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

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H 1:500 SCALE @ A1 0 5 10 15 20 25
V 1:50 0 0.5 1.0 1.5 2.0 2.5

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SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN

DETAIL DESIGN PLAN
PIPE AND ACCESS TRACK LONG SECTION

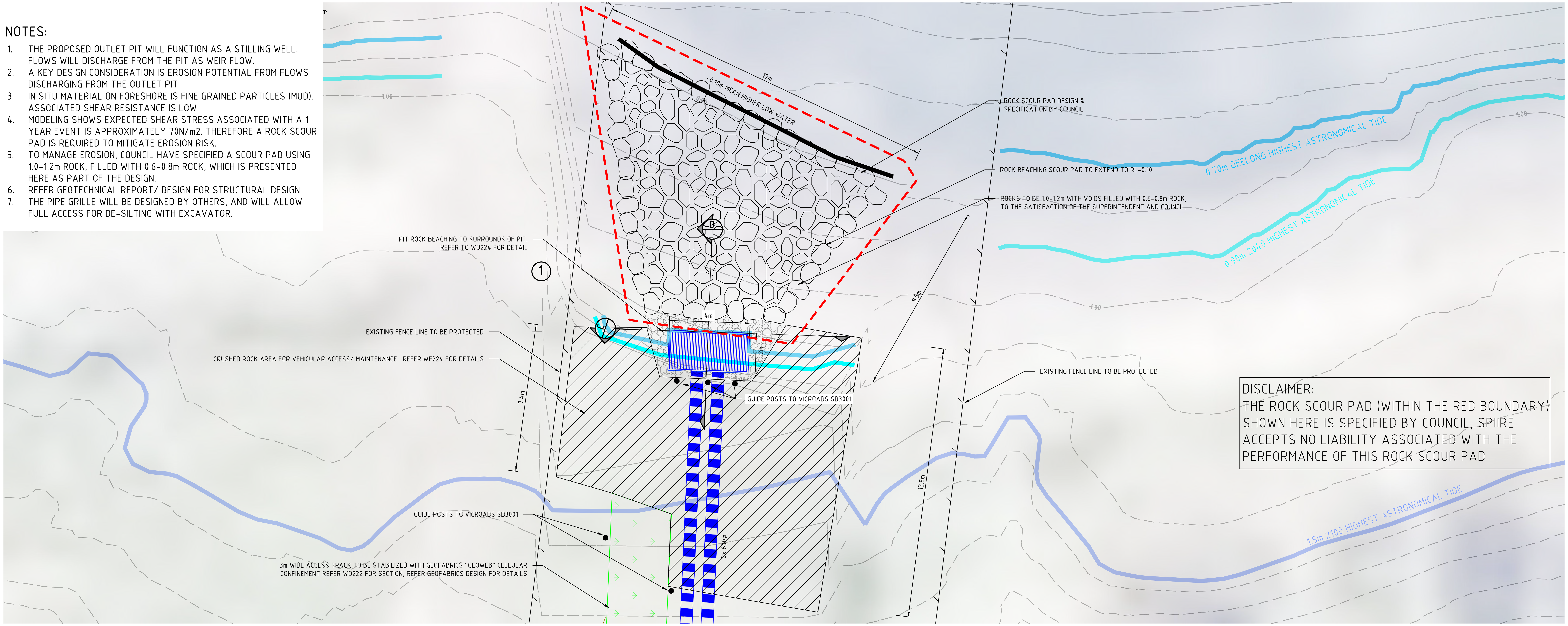
CITY OF GREATER GEELONG

PRELIMINARY

Drg No 306542WD220 Rev A

NOTES:

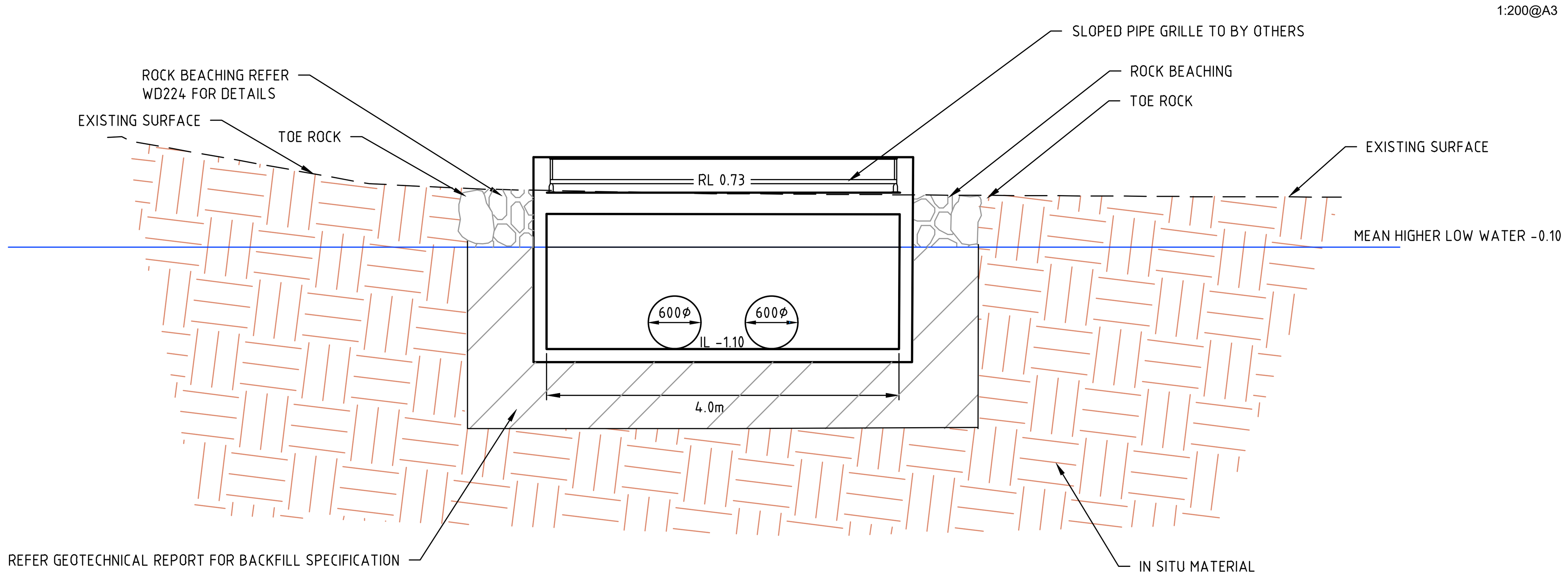
1. THE PROPOSED OUTLET PIT WILL FUNCTION AS A STILLING WELL. FLOWS WILL DISCHARGE FROM THE PIT AS WEIR FLOW.
2. A KEY DESIGN CONSIDERATION IS EROSION POTENTIAL FROM FLOWS DISCHARGING FROM THE OUTLET PIT.
3. IN SITU MATERIAL ON FORESHORE IS FINE GRAINED PARTICLES (MUD). ASSOCIATED SHEAR RESISTANCE IS LOW
4. MODELING SHOWS EXPECTED SHEAR STRESS ASSOCIATED WITH A 1 YEAR EVENT IS APPROXIMATELY 70N/m2. THEREFORE A ROCK SCOUR PAD IS REQUIRED TO MITIGATE EROSION RISK.
5. TO MANAGE EROSION, COUNCIL HAVE SPECIFIED A SCOUR PAD USING 1.0-1.2m ROCK, FILLED WITH 0.6-0.8m ROCK, WHICH IS PRESENTED HERE AS PART OF THE DESIGN.
6. REFER GEOTECHNICAL REPORT/ DESIGN FOR STRUCTURAL DESIGN
7. THE PIPE GRILLE WILL BE DESIGNED BY OTHERS, AND WILL ALLOW FULL ACCESS FOR DE-SILTING WITH EXCAVATOR.



DISCLAIMER:
THE ROCK SCOUR PAD (WITHIN THE RED BOUNDARY) SHOWN HERE IS SPECIFIED BY COUNCIL, SPIIRE ACCEPTS NO LIABILITY ASSOCIATED WITH THE PERFORMANCE OF THIS ROCK SCOUR PAD

OUTLET PIT 1 DETAIL PLAN

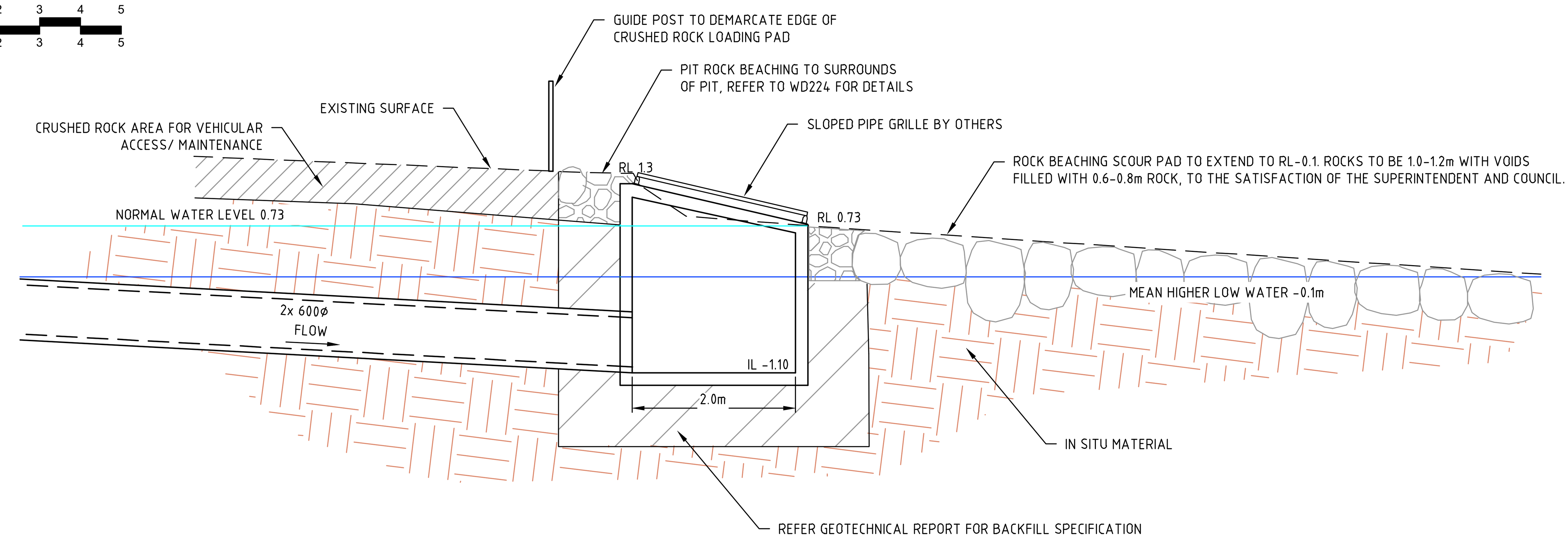
1:100@A1 SCALE 1:200@A3 — 0 1 2 3 4 5



SECTION C - OUTLET PIT 1 DETAILS

1:50@A1 SCALE 1:100@A3 — 0 0.5 1 1.5 2 2.5

NOTE:
THE GEOMETRY AND FUNCTIONALITY OF OUTLET PIT 1 IS SHOWN HERE. FOR FULL CONSTRUCTION DETAILS, REFER STRUCTURAL PLANS BY P.J. YTTRUP



SECTION D - OUTLET PIT 1 DETAILS

1:50@A1 SCALE 1:100@A3 — 0 0.5 1 1.5 2 2.5

file name 306542WD220 MD.dwg layout name WD221 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

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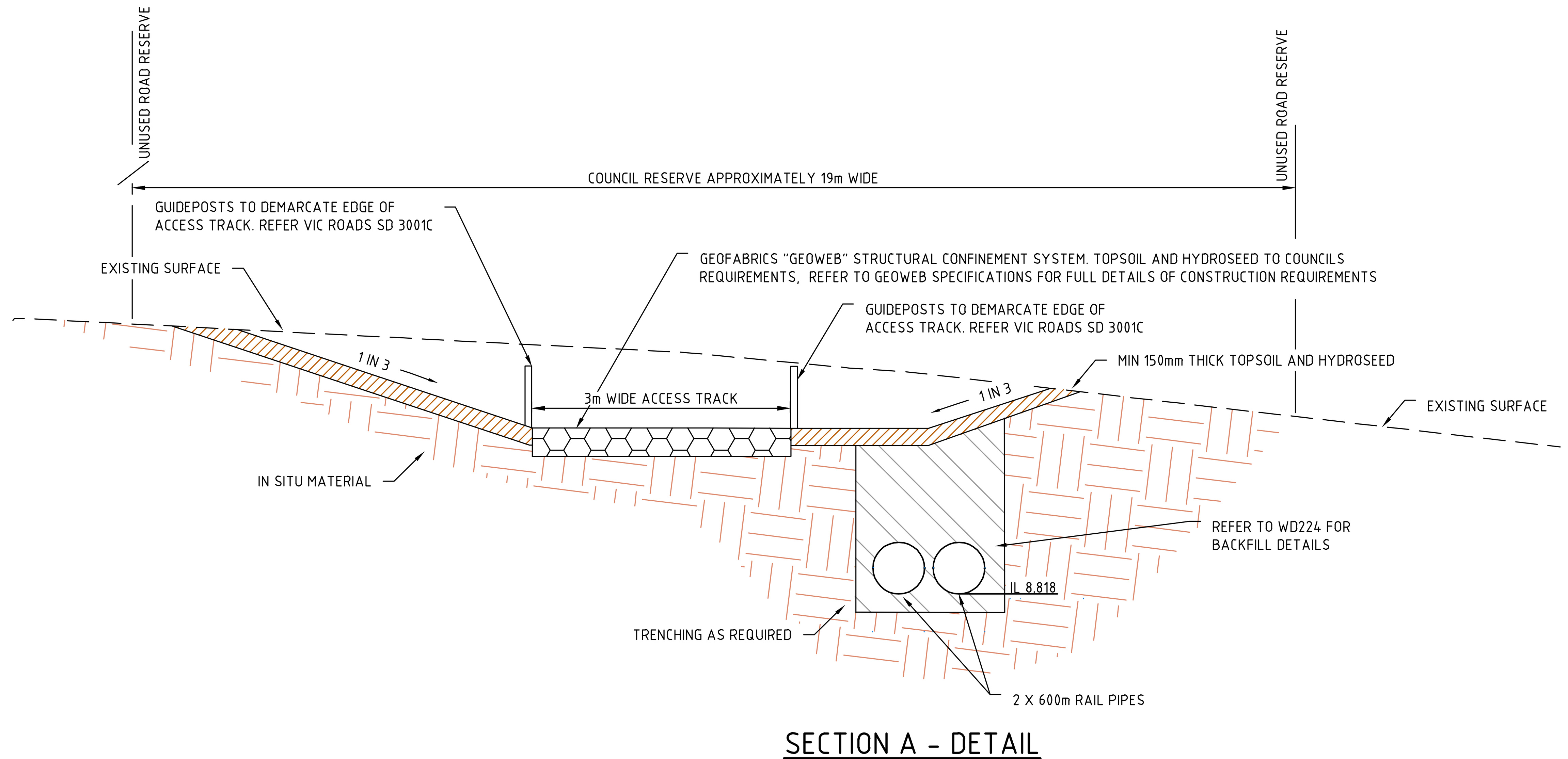
SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
PIT DETAILS

CITY OF GREATER GEELONG

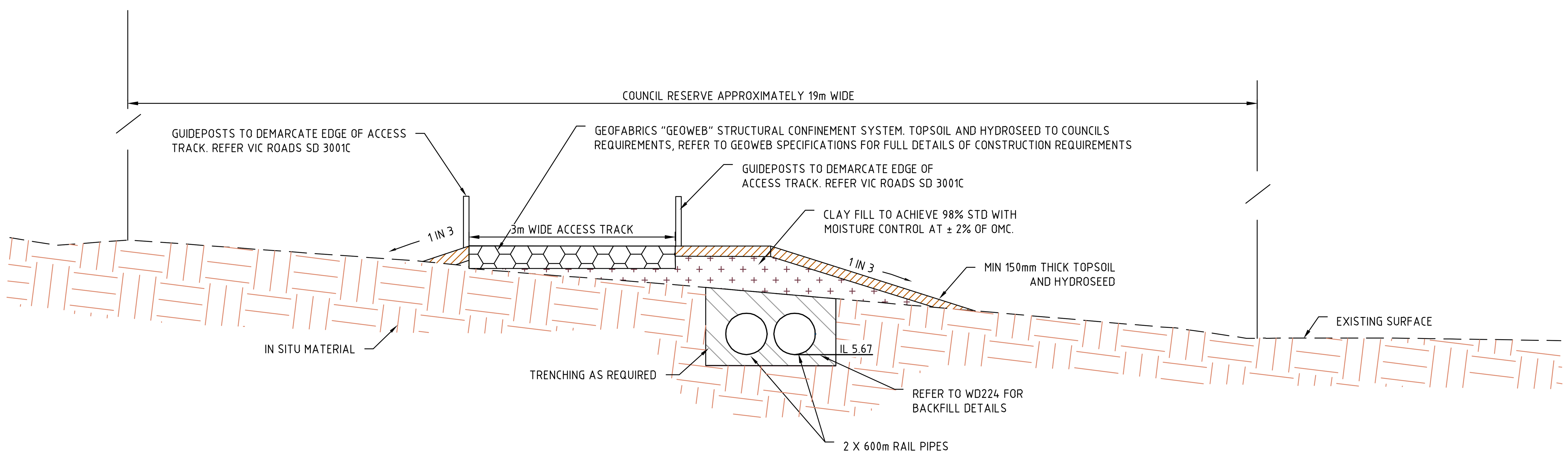
PRELIMINARY Drg No **306542WD221** Rev **A**

NOTES:
1. THE GEOWEB CONFINEMENT SYSTEM SHOWN HERE IS INDICATIVE ONLY. FOR FULL DETAILED DESIGN, INCLUDING SUB GRADE AND ANCHORING SYSTEM REFER GEOFABRICS DESIGN.



SECTION A - DETAIL

NOT TO SCALE



SECTION B - DETAIL

NOT TO SCALE

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H 1:50 SCALE @ A1 0 0.5 1.0 1.5 2.0 2.5

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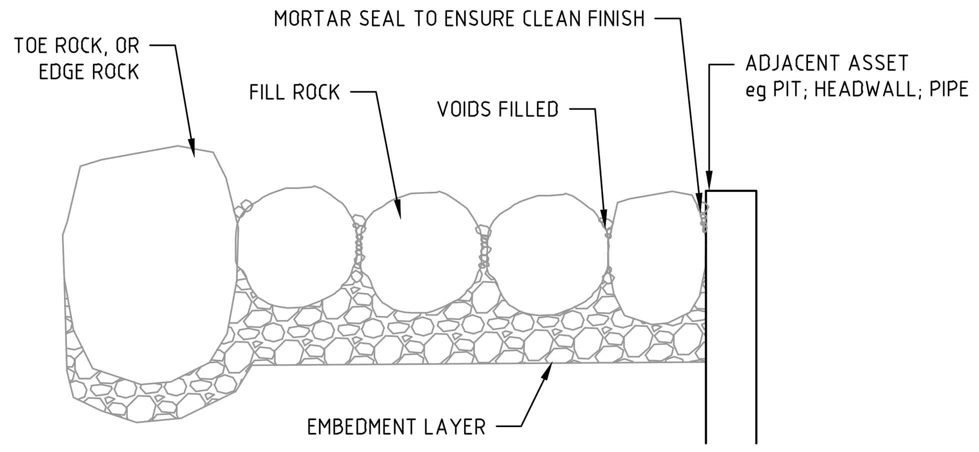
SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
OUTLET PIPE DETAIL

CITY OF GREATER GEELONG

PRELIMINARY Drg No 306542WD222 Rev A

file name 306542WD220 MD.dwg layout name WD222 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets



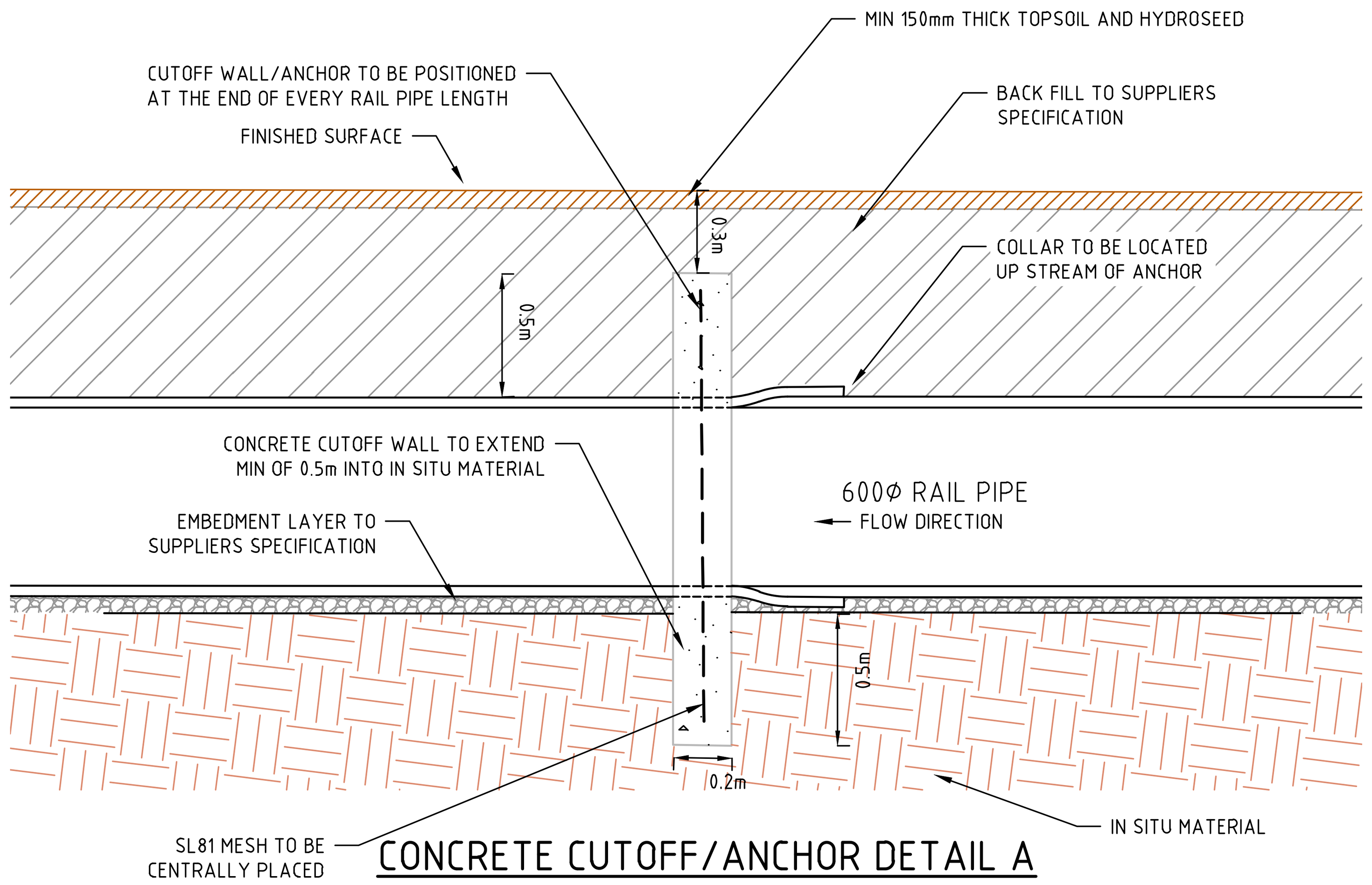
EMBEDMENT LAYER: 150mm (MIN.) THICK LAYER, COMPACTED WELL GRADED CEMENT STABILISED FCR (0-150mm DIAMETER)

TOE OR EDGE ROCKS: 600 - 800 mm DIA. 2/3 EMBEDDED

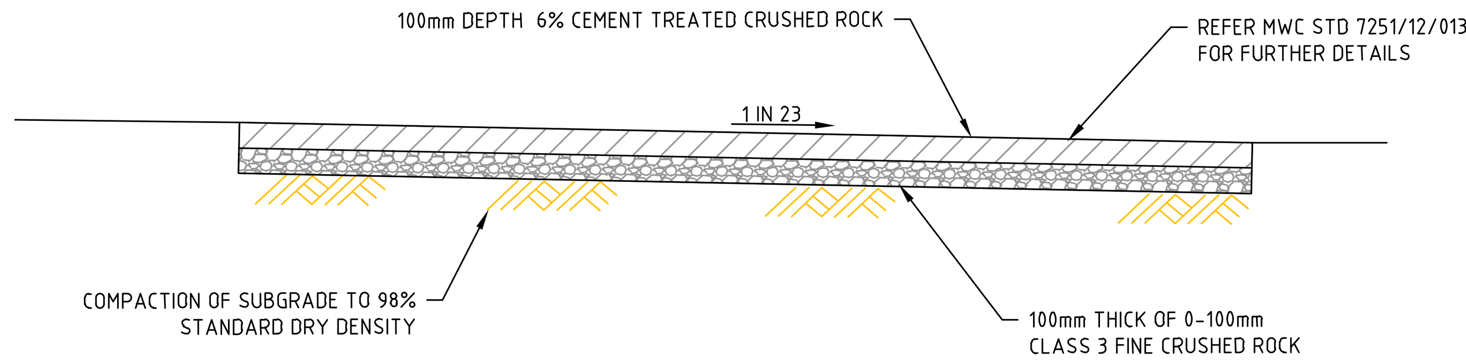
FILL ROCKS: GRADED 350-500mm DIA. ANGULAR, LOCKED, WELL ROCKS INTERLOCKED IN PLACE.

VOIDS: ALL VOIDS TO BE FILLED AND WASHED THROUGH WITH 0-40 DIA. WELL GRADED ROCK.

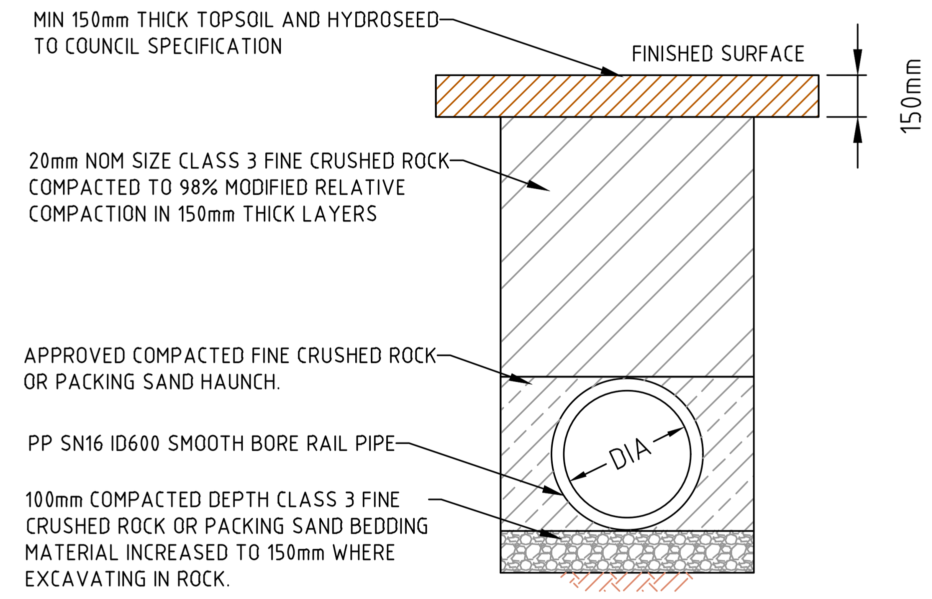
TYPICAL ROCK WORK DETAIL
(NOT TO SCALE)



CONCRETE CUTOFF/ANCHOR DETAIL A
(NOT TO SCALE)

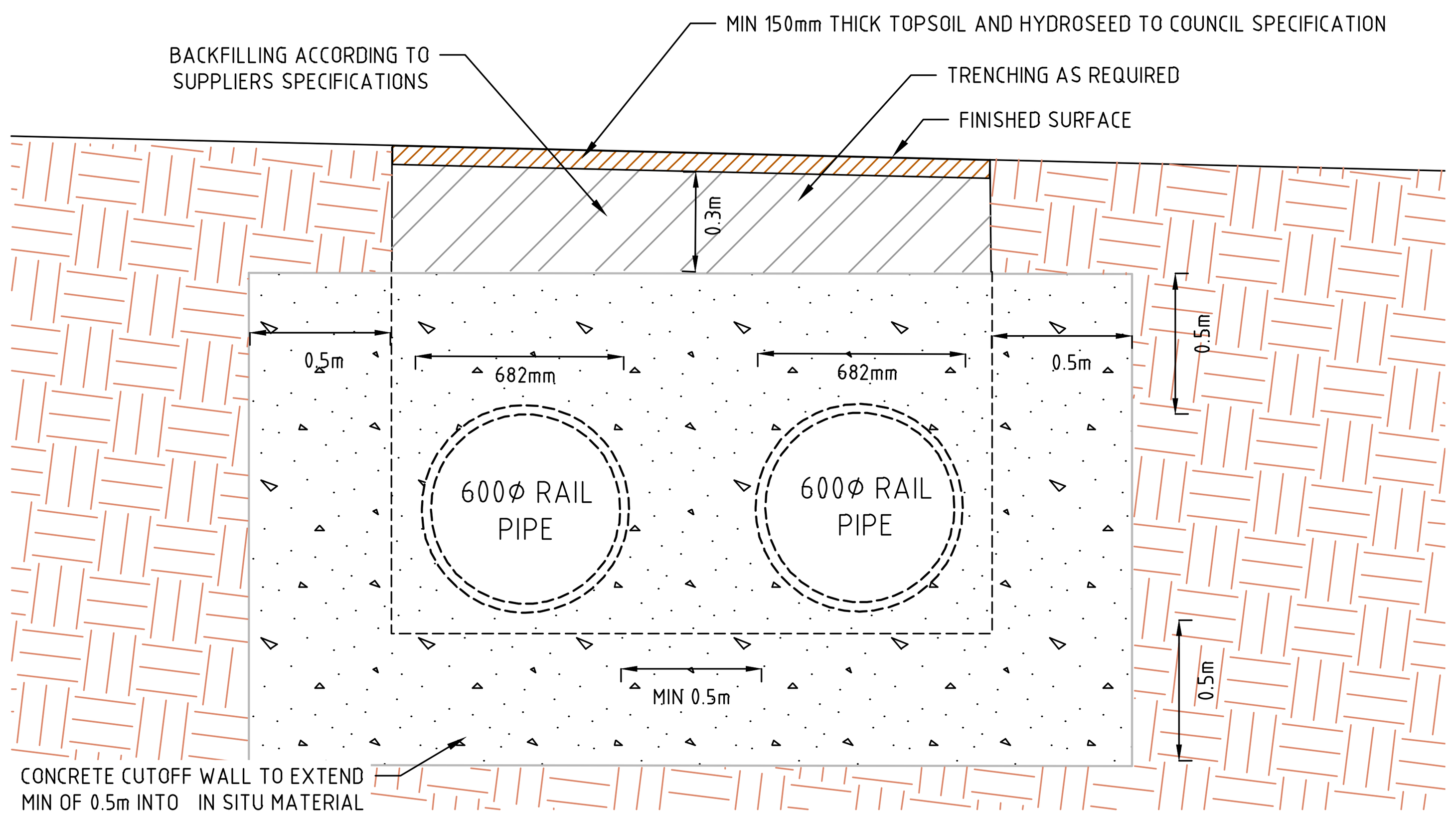


CRUSHED ROCK ACCESS DETAIL
SCALE 1:25,A1

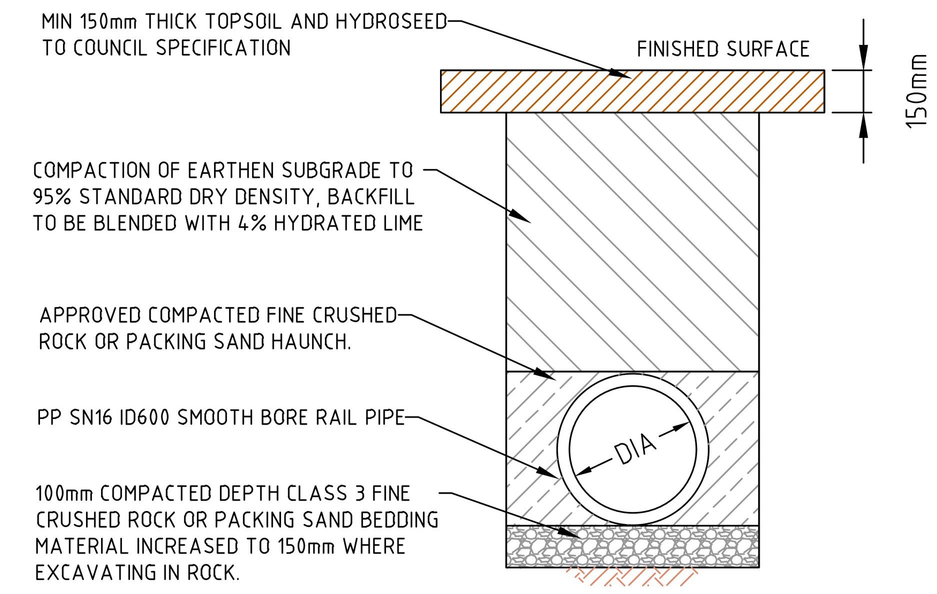


TRENCH DETAIL BACKFILL A
(NOT TO SCALE)

EXAMPLE OF WELL INTERLOCKED ROCKWORK WITH SEALED VOIDS



CONCRETE CUTOFF/ANCHOR DETAIL B
(NOT TO SCALE)



TRENCH DETAIL BACKFILL B
(NOT TO SCALE)

file name 306542WD220 MD.dwg layout name WD224 plotted by Denver Hall
file location G:\30\306542\Civil\ACAD plot date 28/11/2019 9:37 AM Sheet of Sheets

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H 1:50 SCALE @ A1 0 0.5 1.0 1.5 2.0 2.5

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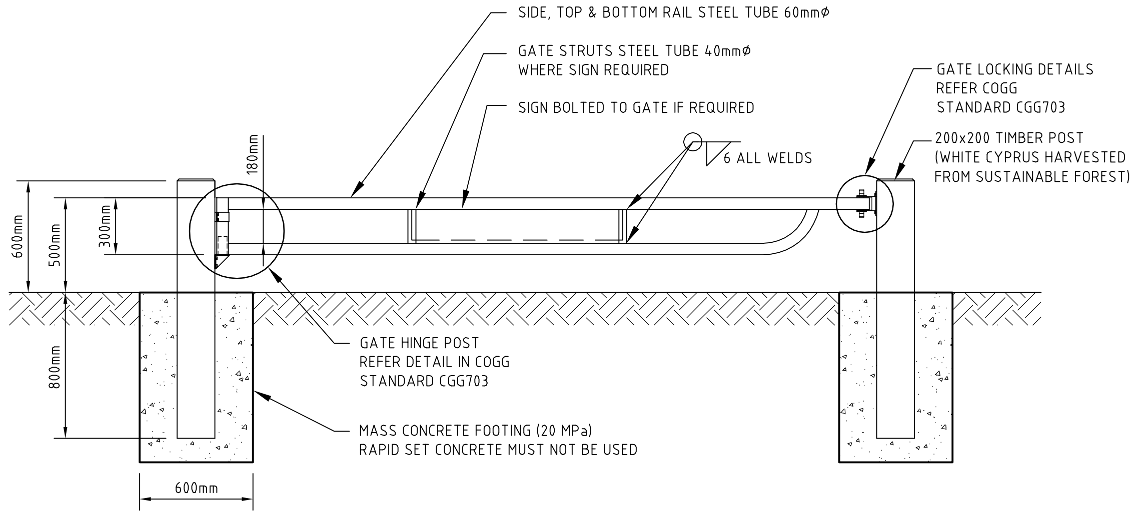
SCARBOROUGH ROAD CURLEWIS OUTFALL DRAIN
DETAIL DESIGN PLAN
TYPICAL DETAILS

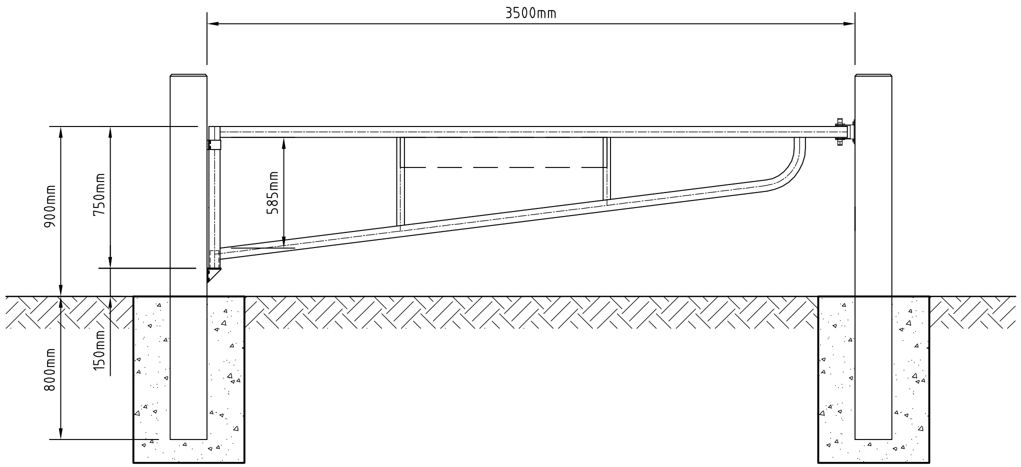
CITY OF GREATER GEELONG

PRELIMINARY Drg No **306542WD224** Rev **A**

LOW HEIGHT GATE



FULL HEIGHT GATE



VER	APPD.	DATE	AMENDMENT
0		APR 08	REVISED AND REISSUED

REFERENCES: CGG703

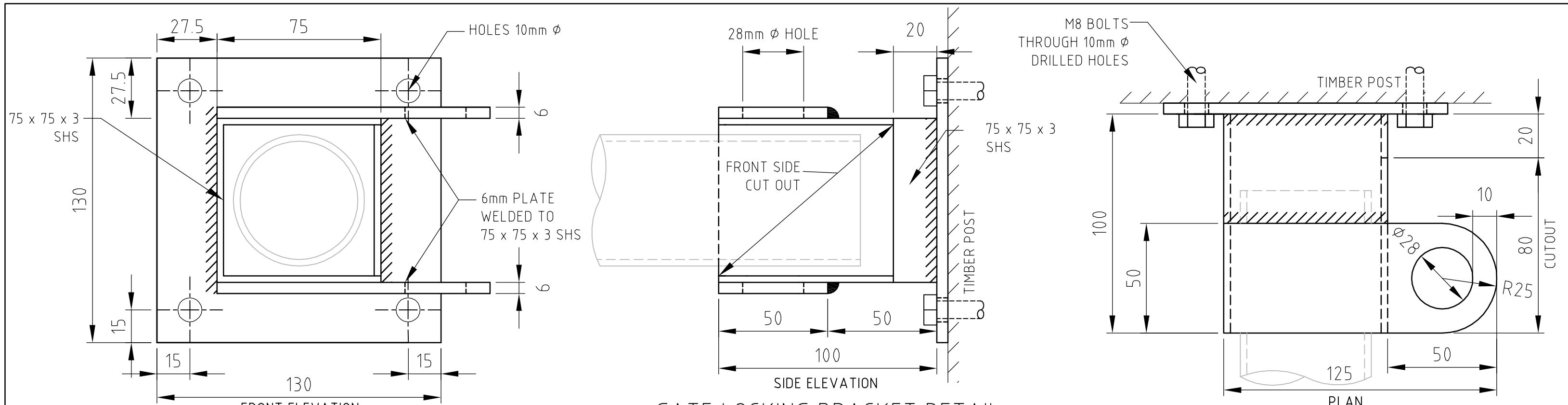
APPROVED:
D Hannah
Manager Engineering Services
Date: April 2008

CITY OF GREATER GEELONG
DESIGN UNIT
ENGINEERING SERVICES

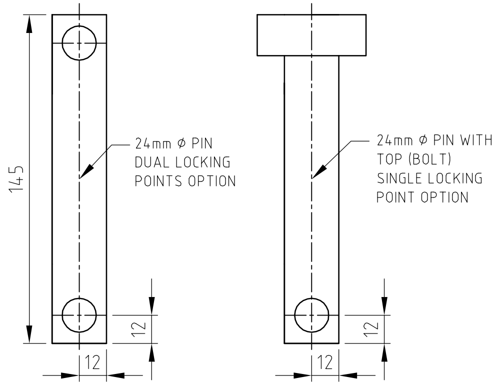
STANDARD DETAIL
SWING GATE ENTRY (LAYOUT)

DRAWING No: CGG702

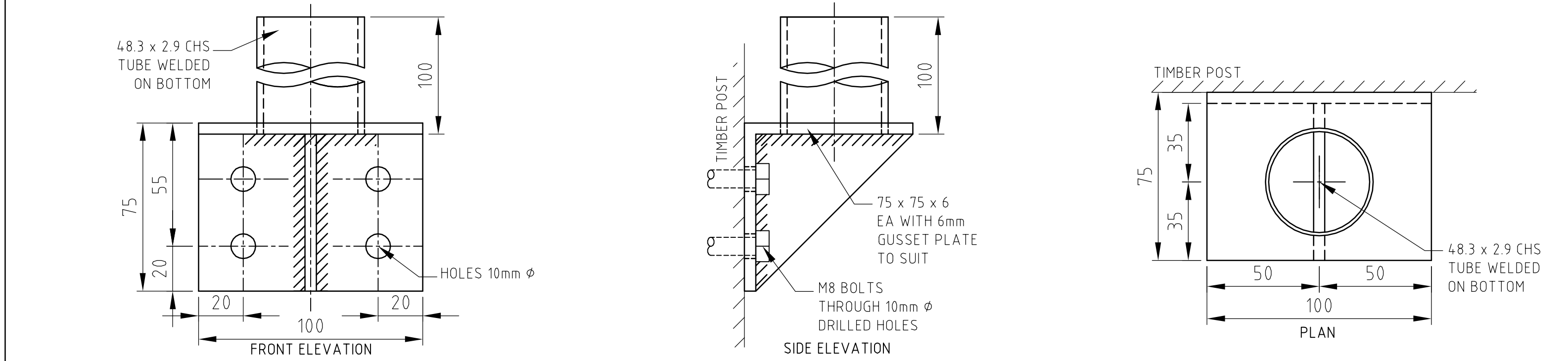
AMENDMENT: 0



GATE LOCKING BRACKET DETAIL

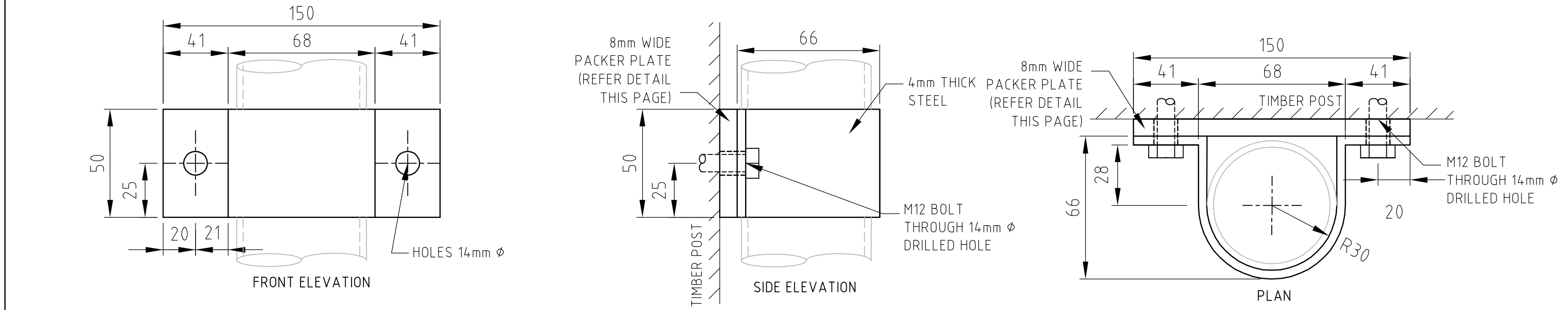


GATE LOCKING PIN DETAIL
(TWO ALTERNATIVES)

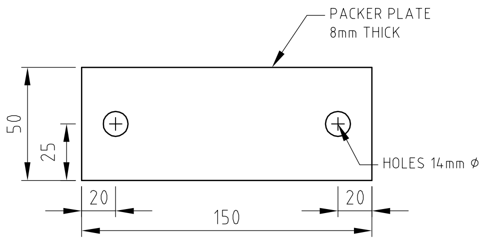


LOWER HINGE BRACKET DETAIL

NOTES:
- ALL BRACKETS AND FITTINGS TO BE GALVINISED
- ALL WELDS TO BE 5mm FW WHERE SHOWN



TOP HINGE BRACKET DETAIL



TOP HINGE PACKER PLATE DETAIL

VER	APPD.	DATE	AMENDMENT
0		APR 08	REVISED AND REISSUED

REFERENCES: CGG702

APPROVED:
D Hannah
Manager Engineering Services
Date: April 2008

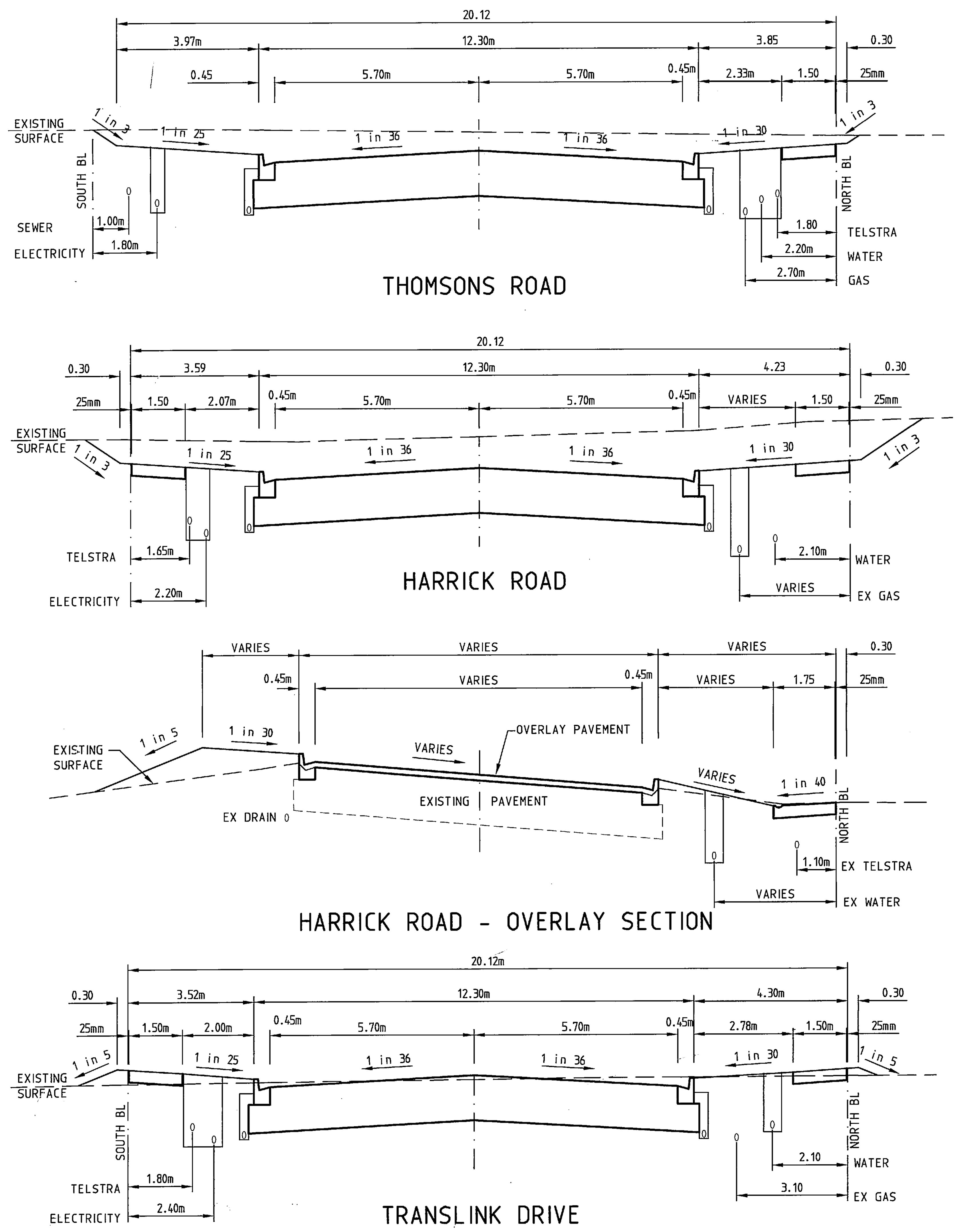
CITY OF GREATER GEELONG
DESIGN UNIT
ENGINEERING SERVICES

STANDARD DETAIL
SWING GATE ENTRY (DETAIL)

DRAWING No: CGG703

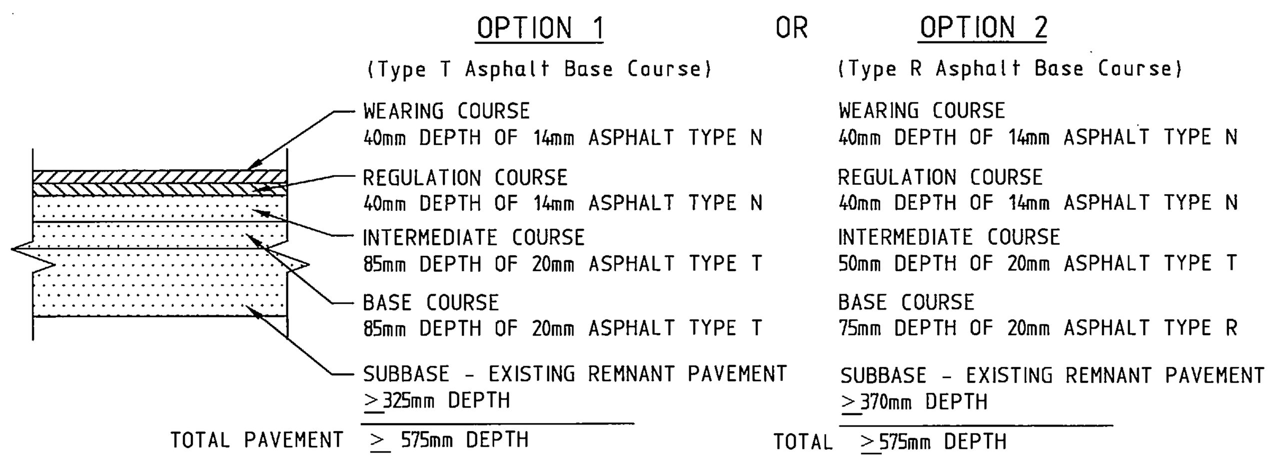
AMENDMENT: 0

11111E 02 R1



TYPICAL CROSS SECTIONS

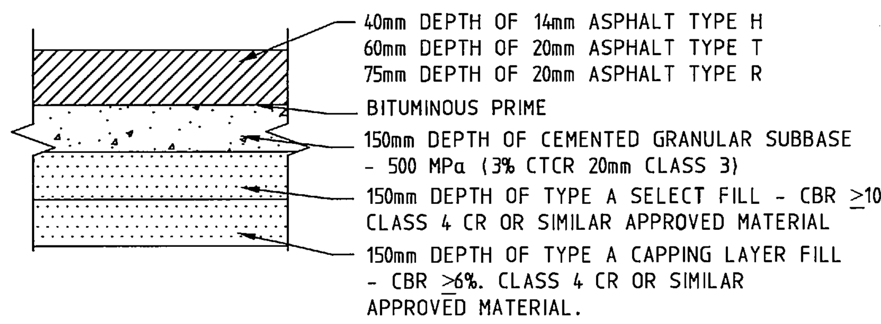
SCALE: HORIZONTAL 1:100 VERTICAL 1:50



(KEILOR PARK DRIVE/HARRICK RD INTERSECTION)

PAVEMENT RECONSTRUCTION DETAILS

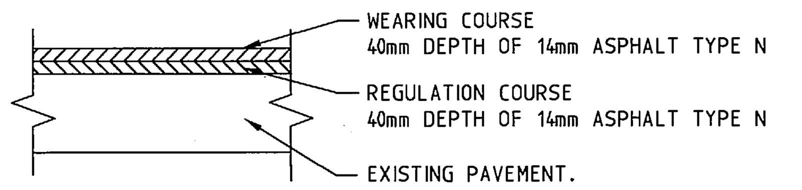
NOT TO SCALE



(THOMSONS ROAD, HARRICK RD & TRANSLINK DRIVE)

ASPHALT PAVEMENT TYPE A DETAILS

NOT TO SCALE



(HARRICK RD CH80-363)

ASPHALT PAVEMENT OVERLAY DETAILS

(REFER TO BOWMAN GEOTECH REPORT)

TYPE A SELECT FILL
IT IS RECOMMENDED THAT THE TYPE A SELECT FILL CONSISTS OF SUITABLE IMPORTED MATERIALS WITH A SWELL <2.5%.

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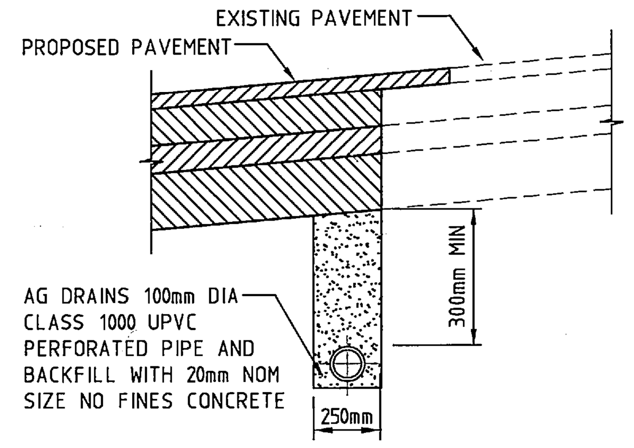
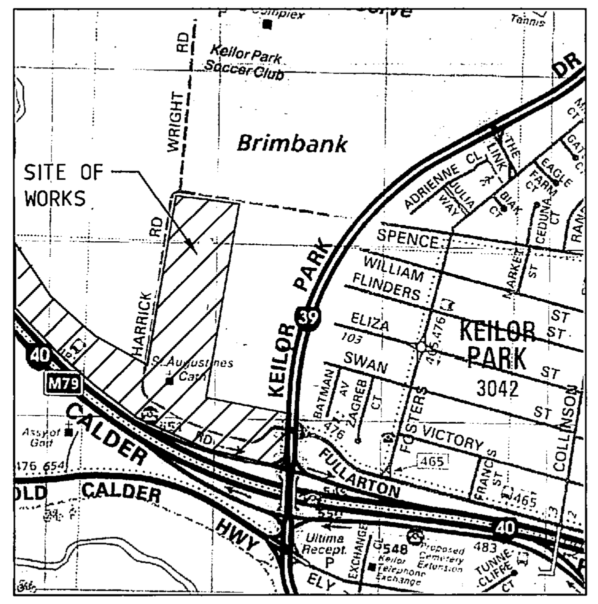
- PERMEABILITY $<5\times10^{-7}$ cm/sec
- SWELL <2.5%

PLEASE NOTE: TYPE A SELECT FILL & CAPPING LAYER MATERIAL MUST BE TO THE SATISFACTION OF THE COUNCIL SUPERVISING ENGINEER.



SUB-SURFACE DRAINAGE AT INTERSECTING PAVEMENTS

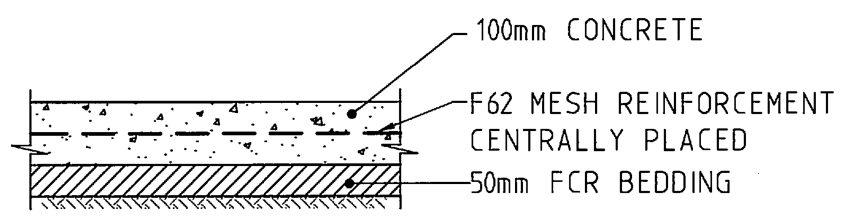


LOCALITY PLAN

NOT TO SCALE
MELWAY REF: 15-B7

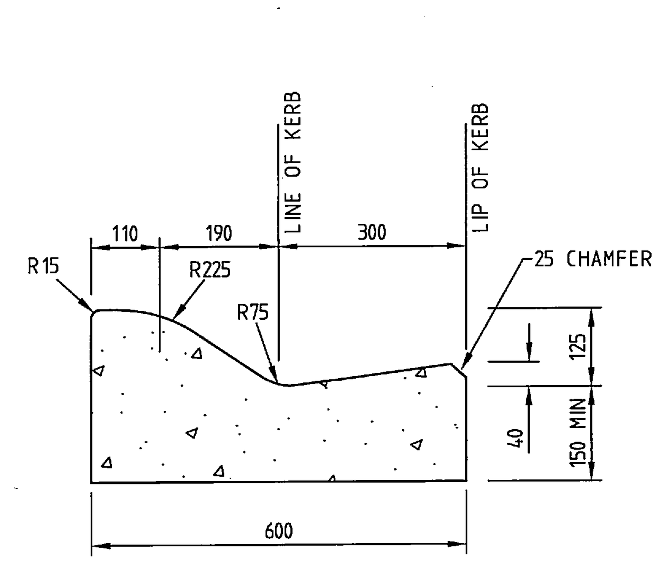
NORTH

SHEET INDEX & REVISION DETAIL		
SHEET	DESCRIPTION	REVISION
1	LOCALITY PLAN, STANDARD NOTES, KERB & PAVEMENT DETAILS, TYPICAL CROSS SECTIONS & DRAWING INDEX	E
2	LAYOUT PLAN - SHEET 1	C
3	LAYOUT PLAN - SHEET 2	C
4	DETAIL PLAN - SHEET 1 of 4	F
5	DETAIL PLAN - SHEET 2 of 4	C
6	DETAIL PLAN - SHEET 3 of 4	H
7	OUTFALL DRAINAGE DETAIL PLAN - SHEET 4 of 4	C
8	LONGITUDINAL SECTION - HARRICK ROAD OVERLAY	B
9	LONGITUDINAL SECTION - HARRICK ROAD	B
10	LONGITUDINAL SECTIONS - THOMSONS ROAD & TRANSLINK DRIVE	B
11	CROSS SECTIONS - HARRICK ROAD OVERLAY SHEET 1	C
12	CROSS SECTIONS - HARRICK ROAD OVERLAY SHEET 2	C
13	CROSS SECTIONS - HARRICK ROAD SHEET 1	B
14	CROSS SECTIONS - HARRICK ROAD SHEET 2	B
15	CROSS SECTIONS - HARRICK ROAD SHEET 3	B
16	CROSS SECTIONS - HARRICK ROAD SHEET 4	B
17	CROSS SECTIONS - THOMSONS ROAD	B
18	CROSS SECTIONS - TRANSLINK DRIVE	B
19	INTERSECTION DETAILS - SHEET 1	D
20	INTERSECTION DETAILS - SHEET 2	C
21	INTERSECTION DETAIL, LINEMARKING & SIGNAGE - SHEET 3	C
22	HARRICK RD/KEILOR PARK DRV - LINEMARKING & SIGNAGE -SHEET 4	C
23	DRAINAGE LONGITUDINAL SECTIONS - SHEET 1 of 5	C
24	DRAINAGE LONGITUDINAL SECTIONS - SHEET 2 of 5	D
25	DRAINAGE LONGITUDINAL SECTIONS - SHEET 3 of 5	E
26	DRAINAGE LONGITUDINAL SECTIONS - SHEET 4 of 5	C
27	DRAINAGE OUTFALL DETAIL & PIT SCHEDULE - SHEET 5 of 5	D



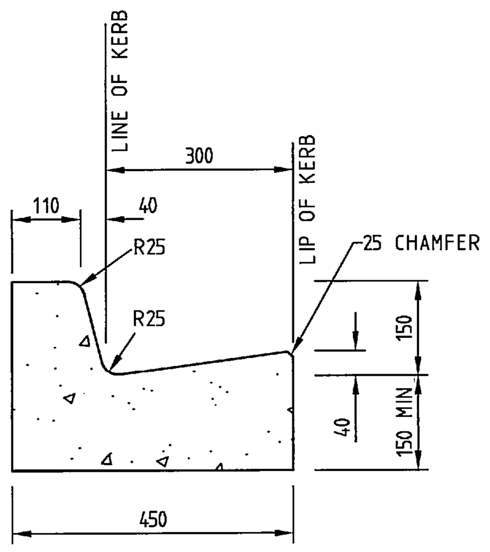
FOOTPATH DETAIL

SCALE 1:10



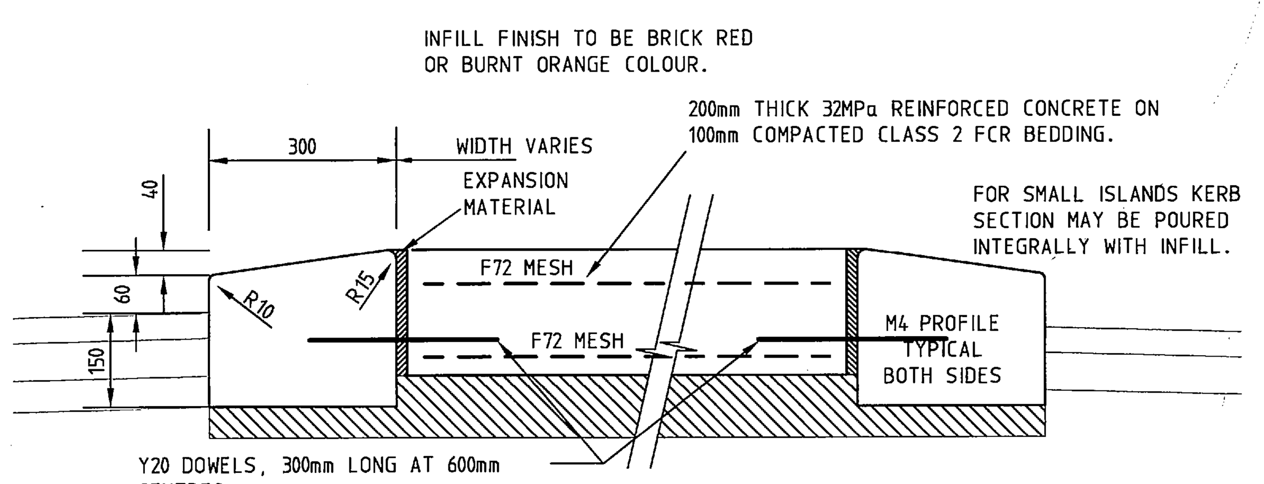
SM2
SEMI-MOUNTABLE KERB DETAIL

SCALE 1:10



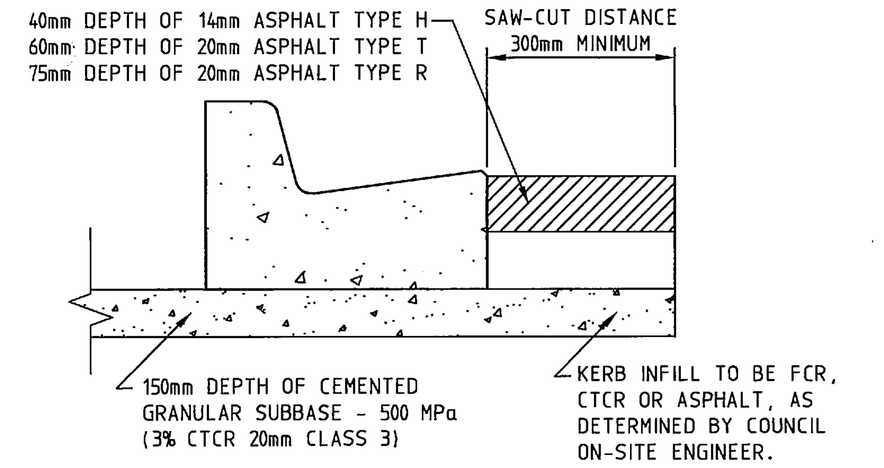
B2
BARRIER KERB DETAIL

SCALE 1:10



M4 ISLAND DETAIL

SCALE 1:10



KERB & CHANNEL REPLACEMENT DETAIL

NOT TO SCALE

NOTES:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE PLANS APPROVED BY COUNCIL, CURRENT AS 2124-1992 GENERAL CONDITIONS, CURRENT CITY OF BRIMBANK STANDARD DRAWINGS AND SPECIFICATIONS FOR ROADS AND DRAINAGE WORKS IN LAND DEVELOPMENTS AND TO THE SATISFACTION OF THE CITY OF BRIMBANK SURVEILLANCE COORDINATOR OR HIS REPRESENTATIVE.
2. COUNCIL'S SURVEILLANCE COORDINATOR IS TO BE NOTIFIED IN WRITING, SEVEN (7) DAYS PRIOR TO THE COMMENCEMENT OF WORKS.
3. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO THE COMMENCEMENT OF WORKS AND ARE TO PROTECTED AT ALL TIMES DURING CONSTRUCTION. COUNCIL AND RELEVANT AUTHORITIES TO BE NOTIFIED PRIOR TO THE COMMENCEMENT OF WORK GIVING AT LEAST 48hrs NOTICE.
4. ALL TRENCHING SHALL COMPLY WITH THE CODE OF PRACTICE FOR TRENCHES. BEFORE COMMENCING EXCAVATION ON ANY TRENCH GREATER THAN 1.50m IN DEPTH, A NOTICE IS TO BE SENT TO THE VICTORIAN WORKCOVER AUTHORITY IN ACCORDANCE WITH THE CODE. THE CONTRACTOR MUST ALSO OBSERVE THE PROVISIONS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT 1985 AND IT'S RELEVANT CODES OF PRACTICE.
5. ALL DIMENSIONS & LEVELS SHOWN ON THESE PLANS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES THUS FOUND MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY AND PRIOR TO THE COMMENCEMENT OF WORKS. FAILURE TO DO SO WILL CAUSE THE CONTRACTOR TO FORFEIT ANY RIGHTS TO COMPENSATION UNDER CLAUSE 28.3 OF THE GENERAL CONDITIONS.
6. THE CONTRACTOR MUST MAINTAIN THE CONSTRUCTION AREA IN A SAFE CONDITION AND MUST ENSURE THAT ADEQUATE BARRIERS, LIGHTS AND SIGNS ARE INSTALLED AND MAINTAINED WHERE NECESSARY IN ACCORDANCE WITH AS 1742.3-1996 AND AS DIRECTED BY THE SUPERINTENDENT.
7. THE CONTRACTOR IS TO SUPPLY AND ESTABLISH APPROVED MEASURES TO CONTROL STORMWATER DISCHARGES DURING CONSTRUCTION AND MAINTENANCE PERIOD. REFER DEPARTMENT OF SUSTAINABILITY & INFRASTRUCTURE PUBLICATIONS "GUIDELINES FOR MINIMISING SOIL EROSION AND SEDIMENTATION FROM CONSTRUCTION SITES" AND "CONTROL OF SOIL EROSION FOR CONSTRUCTION SITES". A SITE MANAGEMENT PLAN IS TO BE SUBMITTED TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO COMMENCEMENT ON SITE. NO SURPLUS TREES, VEGETATION OR OTHER MATERIAL IS TO BE BURNT ON SITE.
8. ALL SITEWORKS AND DEWATERING TO BE CARRIED OUT IN ACCORDANCE WITH EPA REQUIREMENTS (REFER EPA PUBLICATION "ENVIRONMENTAL GUIDELINES FOR MAJOR COSNTRUCTION SITES"). ON SITE TREATMENT OF SITE WATER MAY BE REQUIRED PRIOR TO ANY DISCHARGE TO THE STORMWATER DRAINAGE SYSTEM.
9. ALL TREES AND SHRUBS TO BE RETAINED UNLESS PRIOR APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT AUTHORITY BECAUSE ROAD CONSTRUCTION NECESSITATES THEIR REMOVAL, OR REMOVAL IS DIRECTED BY THE AUTHORISED ENGINEER. TREES TO BE REMOVED ARE TO BE SUITABLY LABELLED. WHEN IT IS PROPOSED TO REMOVE EXISTING TREES IN ROAD RESERVES OR COUNCIL RESERVES, CONSULTATION IS TO OCCUR WITH COUNCIL'S PARKS AND GARDENS DEPARTMENT.
10. CUT BATTERS ARE TO BE GRASSED AND MULCHED WITH A MIXTURE OF CHOPPED GRASS, HAY, STRAW, AND BITUMINOUS EMULSION. NATURE STRIPS AND DISTURBED AREAS ARE TO BE TOP-SOILED AND SEEDED ON COMPLETION OF WORKS TO THE SATISFACTION OF THE ENGINEER. ALL ALLOTMENTS TO BE EVENLY GRADED TO CREATE AN ATTRACTIVE APPEARANCE. ALL DEAD TREES, OLD FENCES AND OTHER DEBRIS ARE TO BE TAKEN UP AND REMOVED.
11. WHERE THE CUT EXCEEDS 1.00m, ACCESS RAMPS ARE TO BE PROVIDED ONTO EACH ALLOTMENT FROM THE VEHICLE CROSSING TO THE NATURAL SURFACE AT A MAXIMUM GRADE OF 1 in 10 FOR 2.50m FROM BACK OF PATH, THEN 1 in 4 TO THE NATURAL SURFACE.
12. FILL AREAS ARE TO BE STRIPPED OF TOPSOIL AND VEGETABLE MATTER, FILLED AND TOPSOIL REPLACED TO OBTAIN FINAL FILL LEVELS AS STATED. FILLING WORKS AND FILL COMPACTION TO CONFORM TO AS 1289 5.1.1 - 1993 (-95% S.C.T.D.) AND AS 3798-1996. - GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS. ALL FILL MATERIAL TO BE IN ACCORDANCE WITH EPA CLEAN FILL GUIDELINES AND TO BE TYPE B COMMON FILL IN ACCORDANCE WITH SECTION 204 - EARTHWORKS IN COUNCIL'S SPECIFICATIONS. THE PARAMETERS FOR TYPE B FILL MATERIAL SHALL BE, MINIMUM SOAKED CBR of 3%, MAXIMUM SWELL OF 2.5%, MAXIMUM PERMEABILITY OF 5 x 10-7cm/s & MAXIMUM BOULDER SIZE OF 150mm. THE MINIMUM DEPTH OF ALL FILL AREAS WITHIN THE ROAD RESERVE, INCLUDING NATURE STRIPS & UNDER FOOTPATHS, SHALL BE 600mm. COMPACTION TESTING TO BE CARRIED OUT IN ACCORDANCE WITH STANDARDS BY NATA REGISTERED LABORATORY AND RESULTS SUBMITTED TO SUPERINTENDENT.
13. DRAINAGE AND PITS TO BE SET OUT FROM OFFSETS SHOWN RATHER THAN FROM PIPE CENTRELINE CHAINAGES. DRAINAGE OFFSETS ARE READ FROM THE CENTRELINE OF PIPE TO THE ADJACENT TITLE BOUNDARY AND ARE 1.00m FROM TITLE BOUNDARY UNLESS OTHERWISE SHOWN. ALL DRAINAGE LINES TO BE LAID TO THE LEVELS AS SHOWN AND LEVELS MUST BE CHECKED AT PITS.
14. WHERE DRAINAGE PIPES ARE LOCATED WITHIN NATURE STRIPS, THE TRENCH SHALL BE BACKFILLED WITH COMPACTED CLASS 3 F.C.R UP TO A LEVEL WHERE THE 45 DEGREE INFLUENCE LINE FROM THE T.O.K. INTERSECTS WITH THE NEAREST TRENCH SIDE.
15. CONCRETE DRAINAGE PIPES TO BE CLASS '2' REINFORCED CONCRETE TO AS 4058 OR FIBRE REINFORCED CEMENT TO MANUFACTURERS SPECIFICATIONS, BEDDED, & BACKFILLED AS SPECIFIED. ALL PIPES TO BE RUBBER RING JOINTED. RUBBER RINGS NEED TO BE TO MANUFACTURERS SPECIFICATIONS. PIPES ARE NOT TO HAVE ANY PLUGS.
16. AGRICULTURAL DRAINS TO BE PROVIDED BEHIND ALL KERBS AND SHOULD HAVE SUITABLE OUTLET. REFER TO COUNCIL'S STANDARD DRAWING S110 FOR BACKFILL MATERIAL ETC. SOME WORKS MAY REQUIRE SPECIAL CONSIDERATION EG. VICROADS STANDARDS.
17. LOTS DENOTED THUS "H" TO BE PROVIDED WITH A 100mm DIAMETER HOUSE DRAIN LOCATED 5.00m FROM THE LOW CORNER OF LOT UNLESS OTHERWISE NOTED. PROPERTY INLET CONNECTIONS TO EASEMENT DRAINS ARE TO BE CONSTRUCTED USING MANUFACTURED "T" PIECES AND ARE TO BE LOCATED 1.0M FROM LOW CORNER OF LOT UNLESS OTHERWISE SHOWN.
18. 100mm DIAMETER SUBSOIL DRAINS TO BE PLACED BEHIND ALL KERB AND CHANNEL, CONCRETE EDGE STRIPS AND WHERE DIRECTED BY THE ENGINEER.
19. PROVIDE CONDUITS FOR UNDERGROUND SERVICES TO DETAILS SHOWN BEFORE PAVEMENT CONSTRUCTION. GAS CONDUITS TO BE 50mm CLASS 12 PVC & WATER CONDUITS TO BE 225mm CLASS 12 PVC TO AS 1477 EXTENDING 500mm BEHIND KERBS.
20. SERVICE CONDUITS ARE TO BE PROVIDED UNDER FOOTPATHS EXTENDING INTO ALLOTMENTS - LOCATION TO BE MARKED ON THE FOOTPATH AND KERB.
21. EXISTING, NATURAL AND MANMADE DEPRESSIONS TO BE EXCAVATED TO A FIRM BASE AND BACKFILLED AS SPECIFIED. CONSULTING ENGINEER TO BE NOTIFIED WHEN EXCAVATED TO A FIRM BASE. NO FILLING IS TO BE PLACED PRIOR TO SITES BEING INSPECTED AND LEVELS TAKEN.
22. MELBOURNE WATER TO BE NOTIFIED THREE (3) CLEAR DAYS PRIOR TO COMMENCEMENT OF WORKS UNDER THEIR CONTROL. ALL THESE WORKS TO BE CARRIED OUT TO THE SATISFACTION OF MELBOURNE WATER BY A MELBOURNE WATER REGISTERED CONTRACTOR.
23. ALL STREET NAME SIGNS ARE TO BE INSTALLED COUNCIL'S STANDARD STREET NAME DESIGN WITH CLASS 1 OR CLASS 2 REFLECTIVE SHEETING.
ALL REGULATORY AND HAZARD DIRECTIONAL SIGNS TO BE CLASS 1 REFLECTIVE MATERIAL AND ALL WARNING SIGNS TO BE CLASS 2 REFLECTIVE MATERIAL TO APPROVED AUSTRALIAN STANDARDS.
LINE MARKINGS TO BE REFECTIVE LONG LIFE MARKINGS. ALL TRANSVERSE LINES INCLUDING OTHER MARKINGS ie ARROWS, MESSAGES ON PAVEMENTS, DIAGONAL AND CHEVRON MARKINGS. MARKINGS OF PARKING & LOADING AREAS & KERB MARKINGS TO BE INSTALLED IN TROWEL ON DEGADUR.
LONGITUDINAL LINES TO BE INSTALLED IN THERMOPLASTIC MATERIAL.
24. VICROADS ROADWORK SIGNING CODE OF PRACTICE WHICH COMPLIES WITH AUSTRALIAN STANDARD 1742.3-1996 IS TO BE ADHERED TO DURING CONSTRUCTION WORKS. A SEPARATE TRAFFIC MANAGEMENT PLAN IS TO BE SUBMITTED TO COUNCIL AND VICROADS FOR APPROVAL BEFORE TO ANY WORKS ON KEILOR PARK DRIVE CAN COMMENCE.
25. LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM.
26. DISTRIBUTION PITS WITHIN FOOTPATHS ARE TO BE A MINIMUM OF 300mm WITHIN THE EDGE OF THE PATH. CONCRETE IS TO BE PLACED AROUND ELECTRICAL DISTRIBUTION PITS TO A MINIMUM DEPTH OF 200mm.
27. TELSTRA ARE TO BE NOTIFIED 7 DAYS PRIOR TO THE PLACEMENT OF CONCRETE WORKS.
28. TELSTRA CONTRACTOR TO INSTALL ENVELOPER PIPE 1.00m INTO EACH LOT AT A DEPTH OF 300mm BELOW FINISHED SURFACE PRIOR TO FOOTPATH CONSTRUCTION. MARK LOCATION WITH "T" PLACED ON ROAD SIDE OF FOOTPATH.
29. CONTRACTOR MUST CONTACT TELSTRA (P. FEBO) PH. 9632 6384 FOR FINAL CONDUIT PLAN PRIOR TO COMMENCEMENT OF WORK.
30. THE CONTRACTOR MUST LIASE WITH TELSTRA REGARDING THEIR REQUIREMENTS FOR THE EXCAVATION, BEDDING AND BACKFILLING OF CABLES & CONDUITS AND WILL BE RESPONSIBLE FOR THESE ASSETS UNTIL THE PROJECT IS PLACED ON MAINTENANCE BY COUNCIL.
31. TACTILE GROUND SURFACE INDICATORS TO BE PROVIDED AT ALL PRAM CROSSINGS IN ACCORDANCE WITH DISABILITY DISCRIMINATION ACT (DDA) REQUIREMENTS.
32. ALL RADII ARE MEASURED TO THE LIP OF KERB.

Rev.	Revision Description	Designed	Date
E	Drawings Issued As Constructed. Note 19 Amended.	ST	6.09.05
	AS CONSTRUCTED	ST	05.07.05
D	PAVEMENT RECONSTRUCTION DETAIL ADDED.	ST	8.03.05
C	REVISION TABLE UPDATED	ST	27.01.05
B	COUNCIL AMENDMENTS - M4 ISLAND DETAIL UPDATED, PAVEMENT NOTES UPDATED	ST	21.12.04
A	COUNCIL AMENDMENTS	ST	17.11.04

Designed by Steve Tough Feb 2004
Checked by John Knibbs 26/10/2004
Authorised by CW 27.01.05
Approved by Council 27 Jan. 2005

Scale bar: 2 1 0 2 4 — 1:100; 1 0.5 0 1 2 — 1:50
Original sheet size A1

As Constructed

MILLAR Merrigan
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
PROJECT MANAGEMENT
Quality Endorsed Company
Land Development Consultants
Office 126 Merrindale Drive, Croydon, Victoria Mail PO Box 247, Croydon, Victoria 3136
Telephone (03) 8720 9500 Facsimile (03) 8720 9501
Email eng@millarmerrigan.com.au Web Site www.millarmerrigan.com.au

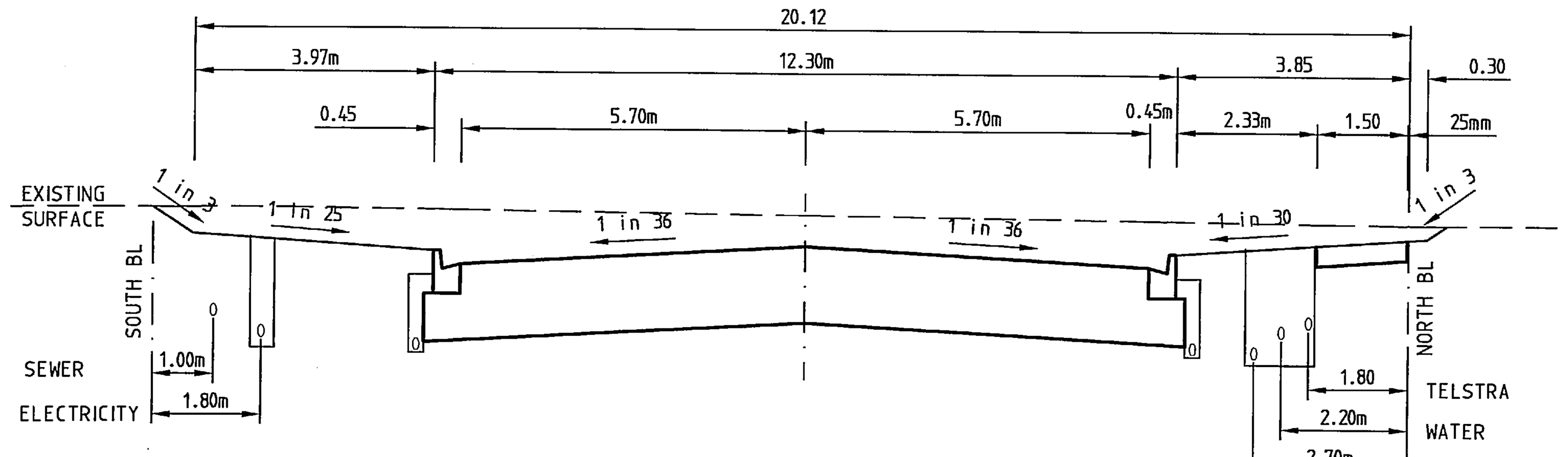
Translink Business Park Stage 2

Keilor

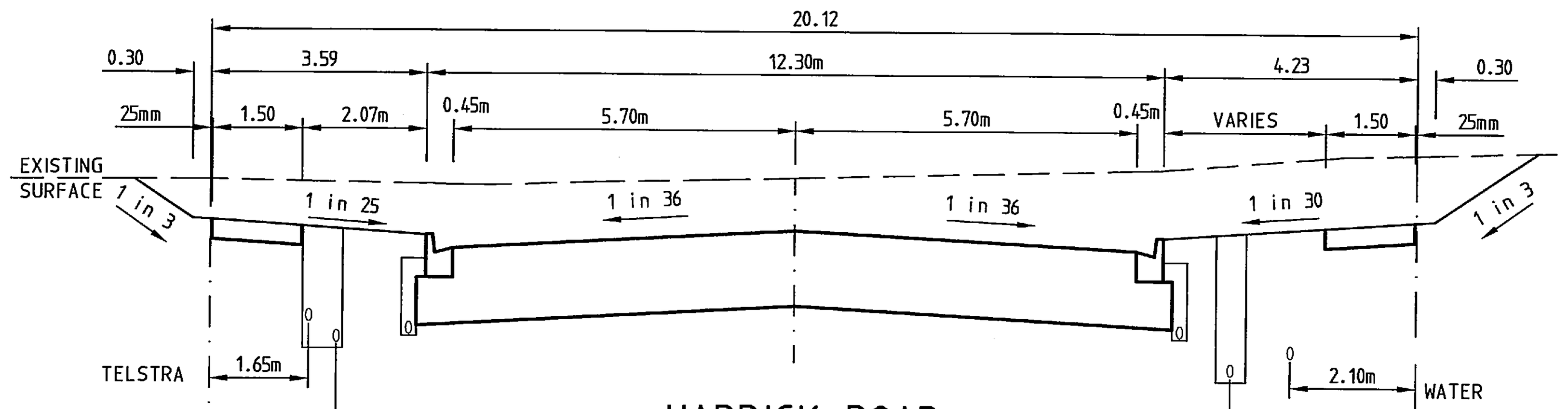
Brimbank City Council

Locality Plan, Notes, Kerb & Pavement Details Typical Cross Sections & Drawing Index

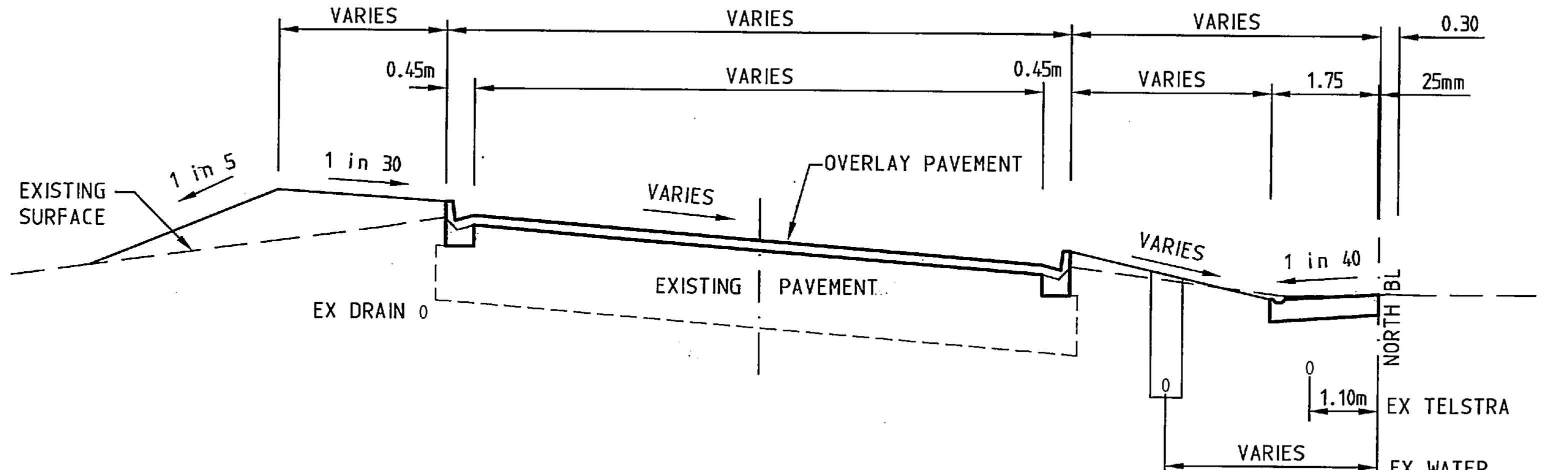
Drawing No. 11111E 02 R1 Sheet 1 of 27 Issue No. 8 Date 22 Oct. 2005



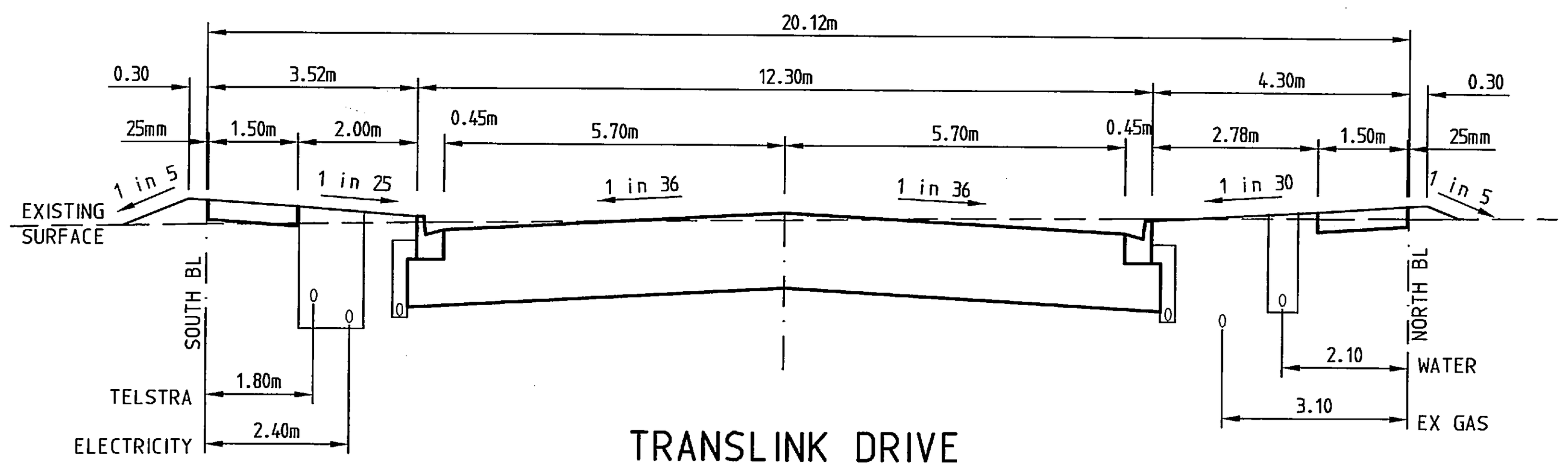
THOMSONS ROAD



HARRICK ROAD



HARRICK ROAD - OVERLAY SECTION

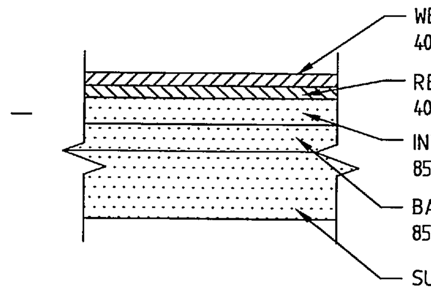


TRANSLINK DRIVE

TYPICAL CROSS SECTIONS

SCALE: HORIZONTAL 1:100 VERTICAL 1:50

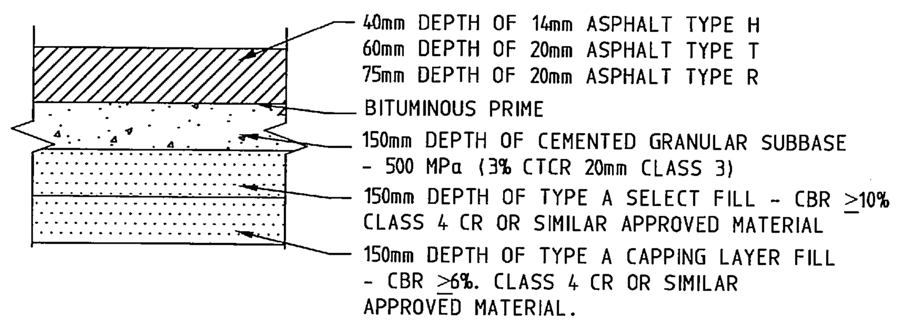
OPTION 1 (Type T Asphalt Base Course)	OR	OPTION 2 (Type R Asphalt Base Course)
WEARING COURSE 40mm DEPTH OF 14mm ASPHALT TYPE N		WEARING COURSE 40mm DEPTH OF 14mm ASPHALT TYPE N
REGULATION COURSE 40mm DEPTH OF 14mm ASPHALT TYPE N		REGULATION COURSE 40mm DEPTH OF 14mm ASPHALT TYPE N
INTERMEDIATE COURSE 85mm DEPTH OF 20mm ASPHALT TYPE T		INTERMEDIATE COURSE 50mm DEPTH OF 20mm ASPHALT TYPE T
BASE COURSE 85mm DEPTH OF 20mm ASPHALT TYPE T		BASE COURSE 75mm DEPTH OF 20mm ASPHALT TYPE R
SUBBASE - EXISTING REMNANT PAVEMENT ≥325mm DEPTH		SUBBASE - EXISTING REMNANT PAVEMENT ≥370mm DEPTH
TOTAL PAVEMENT ≥ 575mm DEPTH		TOTAL ≥575mm DEPTH



(KEILOR PARK DRIVE/HARRICK RD INTERSECTION)

PAVEMENT RECONSTRUCTION DETAILS

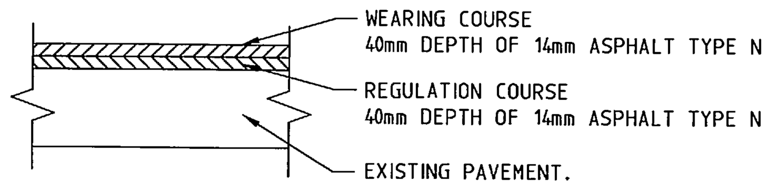
NOT TO SCALE



(THOMSONS ROAD, HARRICK RD & TRANSLINK DRIVE)

ASPHALT PAVEMENT TYPE A DETAILS

NOT TO SCALE



(HARRICK RD CH80-363)

ASPHALT PAVEMENT OVERLAY DETAILS

(REFER TO BOWMAN GEOTECH REPORT)

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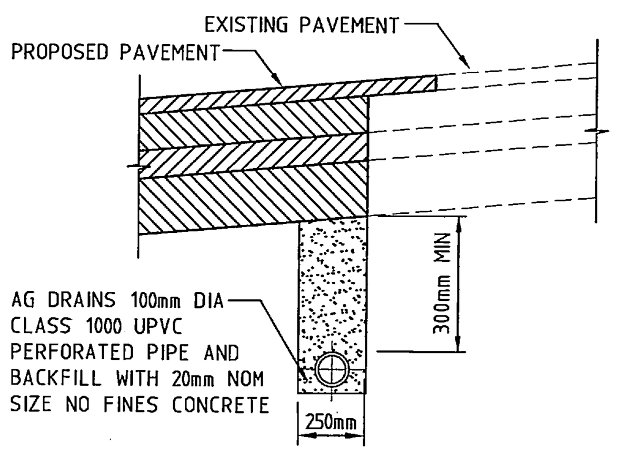
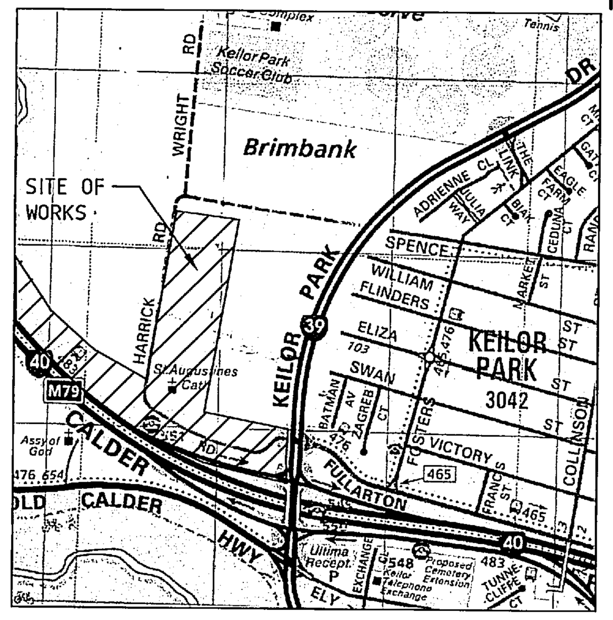
* SWELL < 2.5%

PLEASE NOTE: TYPE A SELECT FILL & CAPPING LAYER MATERIAL MUST BE TO THE SATISFACTION OF THE COUNCIL SUPERVISING ENGINEER.

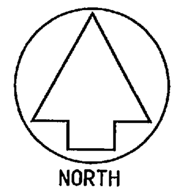


SUB-SURFACE DRAINAGE AT INTERSECTING PAVEMENTS

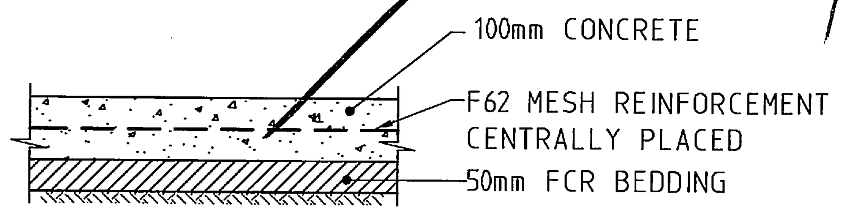


LOCALITY PLAN

NOT TO SCALE
MELWAY REF: 15-B7

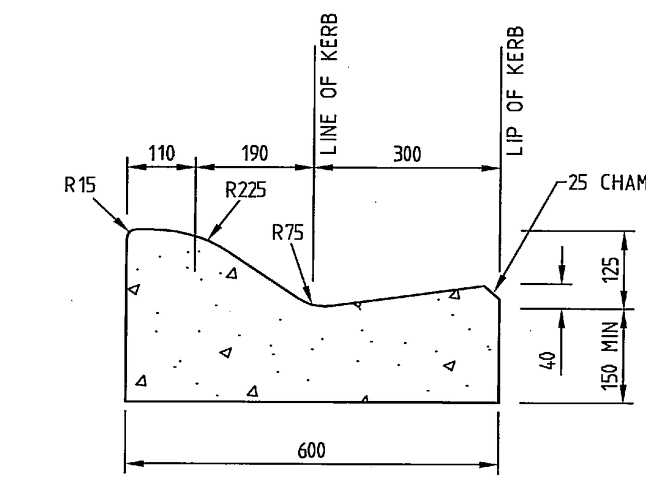


SHEET	DESCRIPTION	REVISION
1	LOCALITY PLAN, STANDARD NOTES, KERB & PAVEMENT DETAILS, TYPICAL CROSS SECTIONS & DRAWING INDEX	D
2	LAYOUT PLAN - SHEET 1	C
3	LAYOUT PLAN - SHEET 2	C
4	DETAIL PLAN - SHEET 1 of 4	E
5	DETAIL PLAN - SHEET 2 of 4	C
6	DETAIL PLAN - SHEET 3 of 4	G
7	OUTFALL DRAINAGE DETAIL PLAN - SHEET 4 of 4	C
8	LONGITUDINAL SECTION - HARRICK ROAD OVERLAY	B
9	LONGITUDINAL SECTION - HARRICK ROAD	B
10	LONGITUDINAL SECTIONS - THOMSONS ROAD & TRANSLINK DRIVE	B
11	CROSS SECTIONS - HARRICK ROAD OVERLAY SHEET 1	C
12	CROSS SECTIONS - HARRICK ROAD OVERLAY SHEET 2	C
13	CROSS SECTIONS - HARRICK ROAD SHEET 1	B
14	CROSS SECTIONS - HARRICK ROAD SHEET 2	B
15	CROSS SECTIONS - HARRICK ROAD SHEET 3	B
16	CROSS SECTIONS - HARRICK ROAD SHEET 4	B
17	CROSS SECTIONS - THOMSONS ROAD	B
18	CROSS SECTIONS - TRANSLINK DRIVE	B
19	INTERSECTION DETAILS - SHEET 1	C
20	INTERSECTION DETAILS - SHEET 2	C
21	INTERSECTION DETAIL, LINEMARKING & SIGNAGE - SHEET 3	C
22	HARRICK RD/KEILOR PARK DRV - LINEMARKING & SIGNAGE -SHEET 4	C
23	DRAINAGE LONGITUDINAL SECTIONS - SHEET 1 of 5	C
24	DRAINAGE LONGITUDINAL SECTIONS - SHEET 2 of 5	D
25	DRAINAGE LONGITUDINAL SECTIONS - SHEET 3 of 5	E
26	DRAINAGE LONGITUDINAL SECTIONS - SHEET 4 of 5	C
27	DRAINAGE OUTFALL DETAIL & PIT SCHEDULE - SHEET 5 of 5	D



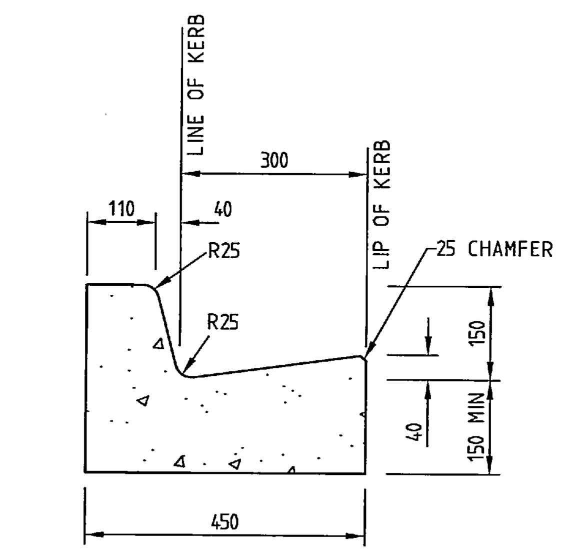
FOOTPATH DETAIL

SCALE 1:10



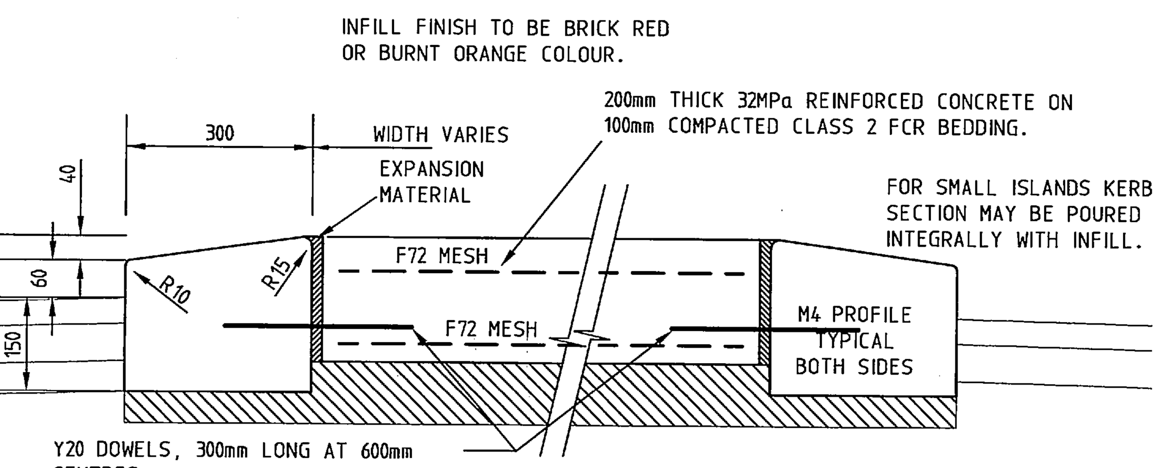
SM2 SEMI-MOUNTABLE KERB DETAIL

SCALE 1:10



B2 BARRIER KERB DETAIL

SCALE 1:10



M4 ISLAND DETAIL

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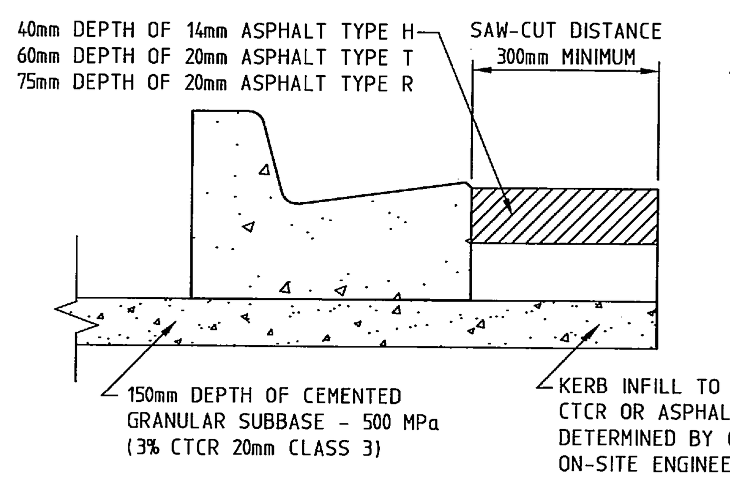

KERB & CHANNEL REPLACEMENT DETAIL

NOT TO SCALE

NOTES:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE PLANS APPROVED BY COUNCIL, CURRENT AS 2124-1992 GENERAL CONDITIONS, CURRENT CITY OF BRIMBANK STANDARD DRAWINGS AND SPECIFICATIONS FOR ROADS AND DRAINAGE WORKS IN LAND DEVELOPMENTS AND TO THE SATISFACTION OF THE CITY OF BRIMBANK SURVEILLANCE COORDINATOR OR HIS REPRESENTATIVE.
2. COUNCIL'S SURVEILLANCE COORDINATOR IS TO BE NOTIFIED IN WRITING, SEVEN (7) DAYS PRIOR TO THE COMMENCEMENT OF WORKS.
3. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO THE COMMENCEMENT OF WORKS AND ARE TO PROTECTED AT ALL TIMES DURING CONSTRUCTION. COUNCIL AND RELEVANT AUTHORITIES TO BE NOTIFIED PRIOR TO THE COMMENCEMENT OF WORK GIVING AT LEAST 48hrs NOTICE.
4. ALL TRENCHING SHALL COMPLY WITH THE CODE OF PRACTICE FOR TRENCHES. BEFORE COMMENCING EXCAVATION ON ANY TRENCH GREATER THAN 1.50m IN DEPTH, A NOTICE IS TO BE SENT TO THE VICTORIAN WORKCOVER AUTHORITY IN ACCORDANCE WITH THE CODE. THE CONTRACTOR MUST ALSO OBSERVE THE PROVISIONS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT 1985 AND IT'S RELEVANT CODES OF PRACTICE.
5. ALL DIMENSIONS & LEVELS SHOWN ON THESE PLANS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES THUS FOUND MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY AND PRIOR TO THE COMMENCEMENT OF WORKS. FAILURE TO DO SO WILL CAUSE THE CONTRACTOR TO FORFEIT ANY RIGHTS TO COMPENSATION UNDER CLAUSE 28.3 OF THE GENERAL CONDITIONS.
6. THE CONTRACTOR MUST MAINTAIN THE CONSTRUCTION AREA IN A SAFE CONDITION AND MUST ENSURE THAT ADEQUATE BARRIERS, LIGHTS AND SIGNS ARE INSTALLED AND MAINTAINED WHERE NECESSARY IN ACCORDANCE WITH AS 1742.3-1996 AND AS DIRECTED BY THE SUPERINTENDENT.
7. THE CONTRACTOR IS TO SUPPLY AND ESTABLISH APPROVED MEASURES TO CONTROL STORMWATER DISCHARGES DURING CONSTRUCTION AND MAINTENANCE PERIOD. REFER DEPARTMENT OF SUSTAINABILITY & INFRASTRUCTURE PUBLICATIONS "GUIDELINES FOR MINIMISING SOIL EROSION AND SEDIMENTATION FROM CONSTRUCTION SITES" AND "CONTROL OF SOIL EROSION FOR CONSTRUCTION SITES". A SITE MANAGEMENT PLAN IS TO BE SUBMITTED TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO COMMENCEMENT ON SITE. NO SURPLUS TREES, VEGETATION OR OTHER MATERIAL IS TO BE BURNT ON SITE.
8. ALL SITEWORKS AND DEWATERING TO BE CARRIED OUT IN ACCORDANCE WITH EPA REQUIREMENTS (REFER EPA PUBLICATION "ENVIRONMENTAL GUIDELINES FOR MAJOR COSNTRUCTION SITES"). ON SITE TREATMENT OF SITE WATER MAY BE REQUIRED PRIOR TO ANY DISCHARGE TO THE STORMWATER DRAINAGE SYSTEM.
9. ALL TREES AND SHRUBS TO BE RETAINED UNLESS PRIOR APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT AUTHORITY BECAUSE ROAD CONSTRUCTION NECESSITATES THEIR REMOVAL, OR REMOVAL IS DIRECTED BY THE AUTHORISED ENGINEER. TREES TO BE REMOVED ARE TO BE SUITABLY LABELLED. WHEN IT IS PROPOSED TO REMOVE EXISTING TREES IN ROAD RESERVES OR COUNCIL RESERVES, CONSULTATION IS TO OCCUR WITH COUNCIL'S PARKS AND GARDENS DEPARTMENT.
10. CUT BATTERS ARE TO BE GRASSED AND MULCHED WITH A MIXTURE OF CHOPPED GRASS, HAY, STRAW, AND BITUMINOUS EMULSION. NATURE STRIPS AND DISTURBED AREAS ARE TO BE TOP-SOILED AND SEEDED ON COMPLETION OF WORKS TO THE SATISFACTION OF THE ENGINEER. ALL ALLOTMENTS TO BE EVENLY GRADED TO CREATE AN ATTRACTIVE APPEARANCE. ALL DEAD TREES, OLD FENCES AND OTHER DEBRIS ARE TO BE TAKEN UP AND REMOVED.
11. WHERE THE CUT EXCEEDS 1.00m, ACCESS RAMPS ARE TO BE PROVIDED ONTO EACH ALLOTMENT FROM THE VEHICLE CROSSING TO THE NATURAL SURFACE AT A MAXIMUM GRADE OF 1 in 10 FOR 2.50m FROM BACK OF PATH, THEN 1 in 4 TO THE NATURAL SURFACE.
12. FILL AREAS ARE TO BE STRIPPED OF TOPSOIL AND VEGETABLE MATTER, FILLED AND TOPSOIL REPLACED TO OBTAIN FINAL FILL LEVELS AS STATED. FILLING WORKS AND FILL COMPACTION TO CONFORM TO AS 1289 5.1.1 - 1993 (-95% S.C.T.D.) AND AS 3798-1996. - GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS. ALL FILL MATERIAL TO BE IN ACCORDANCE WITH EPA CLEAN FILL GUIDELINES AND TO BE TYPE B COMMON FILL IN ACCORDANCE WITH SECTION 204 - EARTHWORKS IN COUNCIL'S SPECIFICATIONS. THE PARAMETERS FOR TYPE B FILL MATERIAL SHALL BE, MINIMUM SOAKED CBR of 3%, MAXIMUM SWELL OF 2.5%, MAXIMUM PERMEABILITY OF 5 x 10-7cm/s & MAXIMUM BOULDER SIZE OF 150mm. THE MINIMUM DEPTH OF ALL FILL AREAS WITHIN THE ROAD RESERVE, INCLUDING NATURE STRIPS & UNDER FOOTPATHS, SHALL BE 600mm. COMPACTION TESTING TO BE CARRIED OUT IN ACCORDANCE WITH STANDARDS BY NATA REGISTERED LABORATORY AND RESULTS SUBMITTED TO SUPERINTENDENT.
13. DRAINAGE AND PITS TO BE SET OUT FROM OFFSETS SHOWN RATHER THAN FROM PIPE CENTRELINE CHAINAGES. DRAINAGE OFFSETS ARE READ FROM THE CENTRELINE OF PIPE TO THE ADJACENT TITLE BOUNDARY AND ARE 1.00m FROM TITLE BOUNDARY UNLESS OTHERWISE SHOWN. ALL DRAINAGE LINES TO BE LAID TO THE LEVELS AS SHOWN AND LEVELS MUST BE CHECKED AT PITS.
14. WHERE DRAINAGE PIPES ARE LOCATED WITHIN NATURE STRIPS, THE TRENCH SHALL BE BACKFILLED WITH COMPACTED CLASS 3 F.C.R UP TO A LEVEL WHERE THE 45 DEGREE INFLUENCE LINE FROM THE T.O.K. INTERSECTS WITH THE NEAREST TRENCH SIDE.
15. CONCRETE DRAINAGE PIPES TO BE CLASS '2' REINFORCED CONCRETE TO AS 4058 OR FIBRE REINFORCED CEMENT TO MANUFACTURERS SPECIFICATIONS, BEDDED, & BACKFILLED AS SPECIFIED. ALL PIPES TO BE RUBBER RING JOINTED. RUBBER RINGS NEED TO BE TO MANUFACTURERS SPECIFICATIONS. PIPES ARE NOT TO HAVE ANY PLUGS.
16. AGRICULTURAL DRAINS TO BE PROVIDED BEHIND ALL KERBS AND SHOULD HAVE SUITABLE OUTLET. REFER TO COUNCIL'S STANDARD DRAWING S110 FOR BACKFILL MATERIAL ETC. SOME WORKS MAY REQUIRE SPECIAL CONSIDERATION EG. VICROADS STANDARDS.
17. LOTS DENOTED THUS "H" TO BE PROVIDED WITH A 100mm DIAMETER HOUSE DRAIN LOCATED 5.00m FROM THE LOW CORNER OF LOT UNLESS OTHERWISE NOTED. PROPERTY INLET CONNECTIONS TO EASEMENT DRAINS ARE TO BE CONSTRUCTED USING MANUFACTURED "T" PIECES AND ARE TO BE LOCATED 1.0M FROM LOW CORNER OF LOT UNLESS OTHERWISE SHOWN.
18. 100mm DIAMETER SUBSOIL DRAINS TO BE PLACED BEHIND ALL KERB AND CHANNEL, CONCRETE EDGE STRIPS AND WHERE DIRECTED BY THE ENGINEER.
19. PROVIDE CONDUITS FOR UNDERGROUND SERVICES TO DETAILS SHOWN BEFORE PAVEMENT CONSTRUCTION. GAS AND WATER CONDUITS TO BE 40mm CLASS 12 PVC TO AS 1477 EXTENDING 500mm BEHIND KERBS.
20. SERVICE CONDUITS ARE TO BE PROVIDED UNDER FOOTPATHS EXTENDING INTO ALLOTMENTS - LOCATION TO BE MARKED ON THE FOOTPATH AND KERB.
21. EXISTING, NATURAL AND MANMADE DEPRESSIONS TO BE EXCAVATED TO A FIRM BASE AND BACKFILLED AS SPECIFIED. CONSULTING ENGINEER TO BE NOTIFIED WHEN EXCAVATED TO A FIRM BASE. NO FILLING IS TO BE PLACED PRIOR TO SITES BEING INSPECTED AND LEVELS TAKEN.
22. MELBOURNE WATER TO BE NOTIFIED THREE (3) CLEAR DAYS PRIOR TO COMMENCEMENT OF WORKS UNDER THEIR CONTROL. ALL THESE WORKS TO BE CARRIED OUT TO THE SATISFACTION OF MELBOURNE WATER BY A MELBOURNE WATER REGISTERED CONTRACTOR.
23. ALL STREET NAME SIGNS ARE TO BE INSTALLED COUNCIL'S STANDARD STREET NAME DESIGN WITH CLASS 1 OR CLASS 2 REFLECTIVE SHEETING.
ALL REGULATORY AND HAZARD DIRECTIONAL SIGNS TO BE CLASS 1 REFLECTIVE MATERIAL AND ALL WARNING SIGNS TO BE CLASS 2 REFLECTIVE MATERIAL TO APPROVED AUSTRALIAN STANDARDS.
LINE MARKINGS TO BE REFECTIVE LONG LIFE MARKINGS. ALL TRANSVERSE LINES INCLUDING OTHER MARKINGS ie ARROWS, MESSAGES ON PAVEMENTS, DIAGONAL AND CHEVRON MARKINGS. MARKINGS OF PARKING & LOADING AREAS & KERB MARKINGS TO BE INSTALLED IN TROWEL ON DEGADUR.
LONGITUDINAL LINES TO BE INSTALLED IN THERMOPLASTIC MATERIAL.
24. VICROADS ROADWORK SIGNING CODE OF PRACTICE WHICH COMPLIES WITH AUSTRALIAN STANDARD 1742.3-1996 IS TO BE ADHERED TO DURING CONSTRUCTION WORKS. A SEPARATE TRAFFIC MANAGEMENT PLAN IS TO BE SUBMITTED TO COUNCIL AND VICROADS FOR APPROVAL BEFORE TO ANY WORKS ON KEILOR PARK DRIVE CAN COMMENCE.
25. LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM.
26. DISTRIBUTION PITS WITHIN FOOTPATHS ARE TO BE A MINIMUM OF 300mm WITHIN THE EDGE OF THE PATH. CONCRETE IS TO BE PLACED AROUND ELECTRICAL DISTRIBUTION PITS TO A MINIMUM DEPTH OF 200mm.
27. TELSTRA ARE TO BE NOTIFIED 7 DAYS PRIOR TO THE PLACEMENT OF CONCRETE WORKS.
28. TELSTRA CONTRACTOR TO INSTALL ENVELOPER PIPE 1.00m INTO EACH LOT AT A DEPTH OF 300mm BELOW FINISHED SURFACE PRIOR TO FOOTPATH CONSTRUCTION. MARK LOCATION WITH "T" PLACED ON ROAD SIDE OF FOOTPATH.
29. CONTRACTOR MUST CONTACT TELSTRA (P. FEBO) PH. 9632 6384 FOR FINAL CONDUIT PLAN PRIOR TO COMMENCEMENT OF WORK.
30. THE CONTRACTOR MUST LIASE WITH TELSTRA REGARDING THEIR REQUIREMENTS FOR THE EXCAVATION, BEDDING AND BACKFILLING OF CABLES & CONDUITS AND WILL BE RESPONSIBLE FOR THESE ASSETS UNTIL THE PROJECT IS PLACED ON MAINTENANCE BY COUNCIL.
31. TACTILE GROUND SURFACE INDICATORS TO BE PROVIDED AT ALL PRAM CROSSINGS IN ACCORDANCE WITH DISABILITY DISCRIMINATION ACT (DDA) REQUIREMENTS.
32. ALL RADII ARE MEASURED TO THE LIP OF KERB.

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
D	PAVEMENT RECONSTRUCTION DETAIL ADDED.	ST	8.03.05
C	REVISION TABLE UPDATED	ST	27.01.05
B	COUNCIL AMENDMENTS - M4 ISLAND DETAIL UPDATED, PAVEMENT NOTES UPDATED	ST	21.12.04
A	COUNCIL AMENDMENTS	ST	17.11.04

Designed by Steve Tough Feb 2004 | Authorised by CW 27.01.05
Checked by John Knibbs 26/10/2004 | Approved by Council 27 Jan. 2005

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Locality Plan, Notes, Kerb & Pavement Details
Typical Cross Sections & Drawing Index

Drawing No. **11111E 02 R1** Sheet 1 of 27 Issue No. **6** Date 22 Aug. 2005

SERVICES OFFSET TABLE

LOCATION	WATER	GAS	TELSTRA	TELE-COMMUNICATIONS	ELECTRICITY	FOOTWAY
THOMSONS ROAD	1.80 S	2.70 N	1.70 N	-	2.20 N	3.97 N 3.85 S
TRANSLINK DRIVE	2.10 N	EXISTING 3.10 N	1.80 S	-	2.40 S	4.30 N 3.52 S
HARRICK ROAD (NEW)	2.1-3.10 E	EXISTING VARIES E	1.65 W	1.75 W	2.20 W	4.23 E 3.59 W
HARRICK ROAD (OVERLAY)	EXISTING VARIES N	EXISTING VARIES N	EXISTING VARIES N	-	EXISTING VARIES N	VARIES

FOR CONTINUATION REFER DWG. No. 11111E 02 R3

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	TELECOMMUNICATIONS OFFSET ADDED TO TABLE	ST	16/02/05
B	Issued for Construction	ST	27.01.05
A	OFFSET TABLE UPDATED	ST	17/11/04

Designed by Steve Tough Feb 2004

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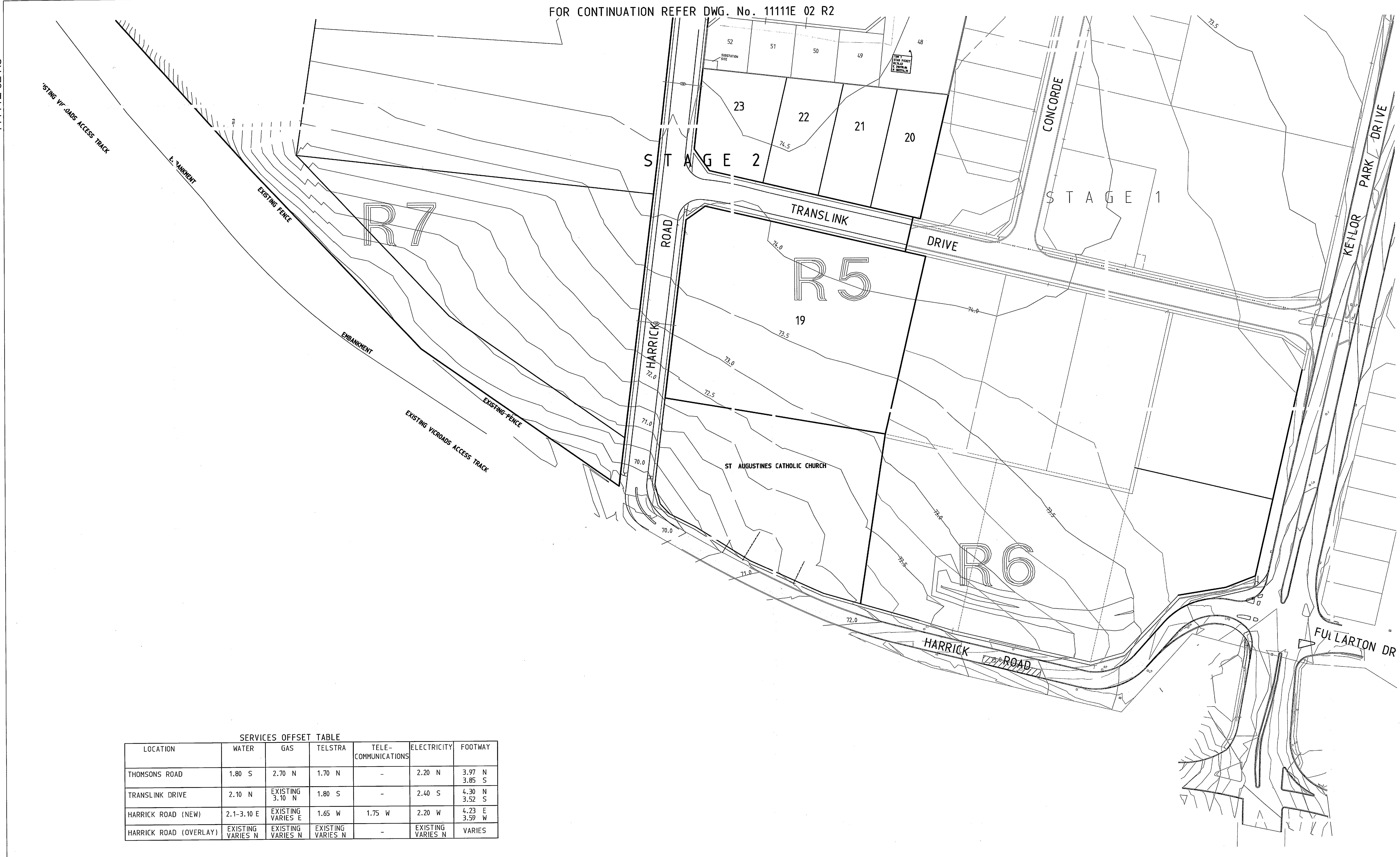
Layout Plan - Sheet 1

Drawing No. **11111E 02 R2**

FOR CONTINUATION REFER DWG. No. 11111E 02 R2



SERVICES OFFSET TABLE

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HARRICK ROAD (OVERLAY)	EXISTING VARIES N	EXISTING VARIES N	EXISTING VARIES N	-	EXISTING VARIES N	VARIES

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C	TELECOMMUNICATIONS OFFSET ADDED TO TABLE	ST	16/02/05
B	Issued for Construction	ST	27.01.05
A	OFFSET TABLE UPDATED	ST	17/11/04

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Layout Plan - Sheet 2

Drawing No. **11111E 02 R3**

11111E 02 R4

FOR CONTINUATION REFER DWG. NO. 11111E 02 R5

Rev.	Revision Description	Designed	Date
F	AS CONSTRUCTED DETAIL AMENDED AT WRIGHT/HARRICK/THOMPSON	JK	22/10/05
	Drawings Issued As Constructed.	ST	22.08.05
E	LOT 56A & 56B SERVICES ADDED (GW CONDUITS, PIT 2/40A & 450dia PROP CONN	ST	08/04/05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - GW CONDUITS ADDED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004 | Authorized by CW 27.01.05

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Sheet 2 of 4

Drawing No. **11111E 02 R4**

11111E 02 R4

FOR CONTINUATION REFER DWG. NO. 11111E 02 R5

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
E	LOT 56A & 56B SERVICES ADDED (GW CONDUITS, PIT 2/40A & 450dia PROP CONN	ST	08/04/05
D	PIT 2/41 RELOCATED & LAYBACK ADDED FOR HARRICK COTTAGE	ST	16/03/05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - GW CONDUITS ADDED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004 | Authorized by CW 27.01.05

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Sheet 1 of 4

Drawing No. **11111E 02 R4** Sheet 4 of 27

11111E 02 R5

FOR CONTINUATION REFER DWG. NO. 11111E 02 R4

FOR CONTINUATION REFER DWG. NO. 11111E 02 R6

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - GW CONDUITS ADDED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

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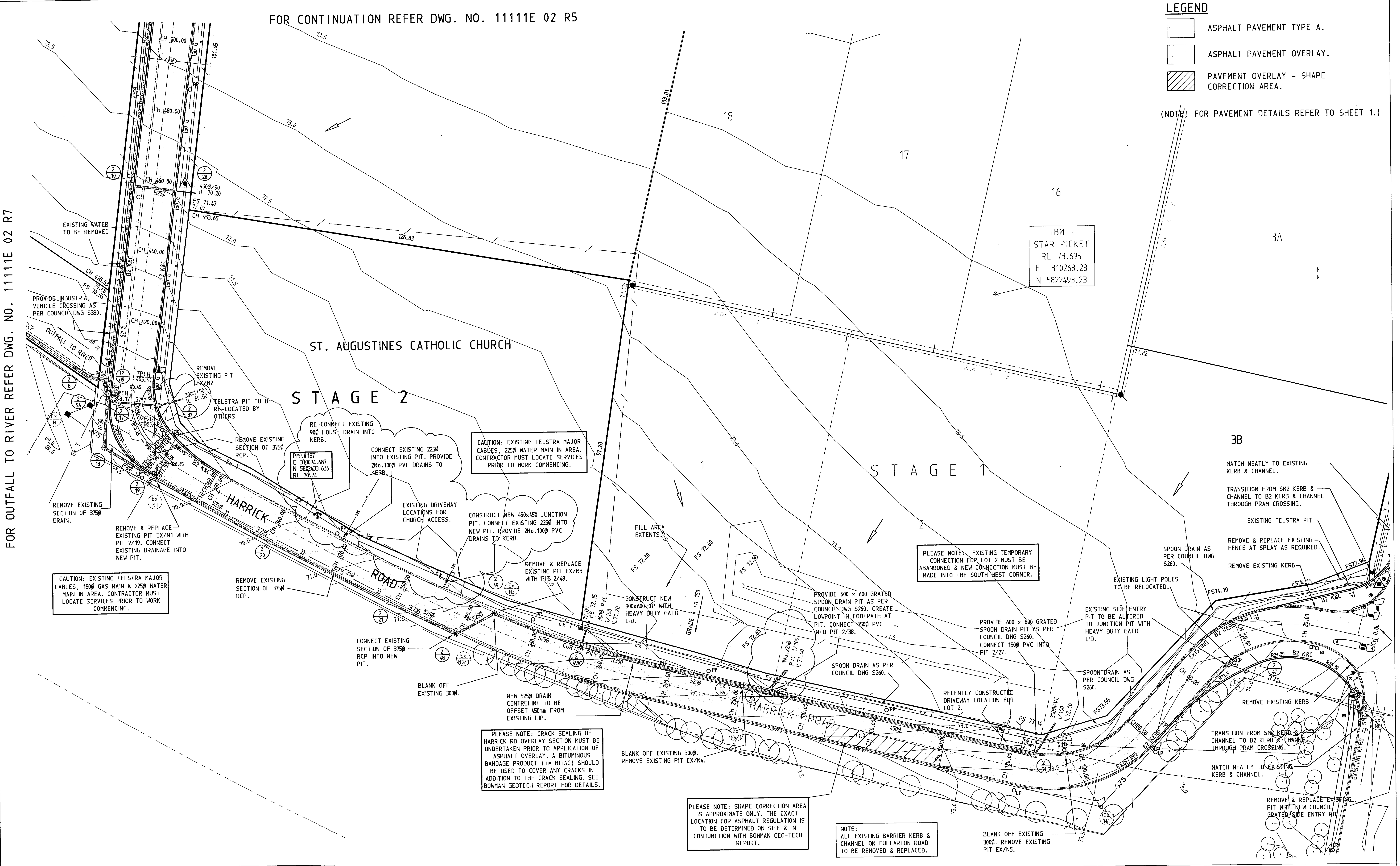
Detail Plan
Sheet 2 of 4

Drawing No. **11111E 02 R5**

11111E 02 R6



Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
G	KEILOR PARK DVE INTERSECTION REVISED	ST	26/05/05
F	DRAINAGE DETAILS ADDED FOR CHURCH, PROP CONNS LOT 1 & 2 UPDATED	ST	22/04/05
E	CHURCH SPLAY & FOOTPATH AMENDED	ST	29/03/05
D	Issued for Construction	ST	27.01.05
C	DRAINAGE LINE FROM PIT 2/48 TO 2/51 INCLUDED	ST	27/01/05
B	COUNCIL AMENDMENTS - HARRICK RD NOTES UPDATED, CROSSING ADDED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
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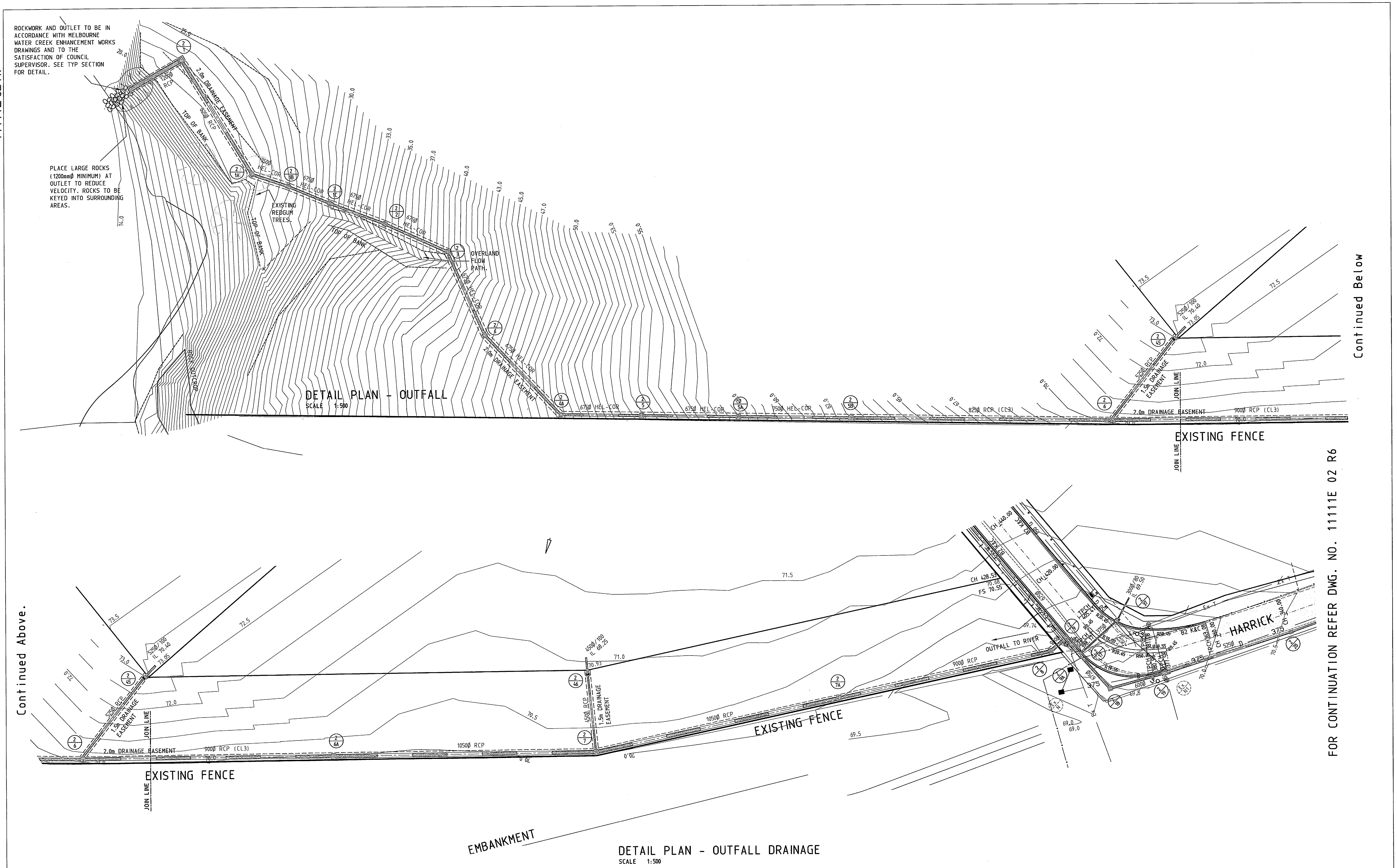
Sheet 3 of 4
Drawing No. 11111E 02 R6



DETAIL PLAN - OUTFALL DRAINAGE

SCALE 1:500

	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - OUTFALL LOCATION UPDATED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04
Rev.	Revision Description	Designed	Date

Designed by Steve Tough Feb 2004

Checked by John Knibbs 26/10/04

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Telephone (03) 8720 9500 Facsimile (03) 8720 9501
Email eng@millarmerrigan.com.au Web Site www.millarmerrigan.com.au

Translink Business Park Stage 2

Keilor

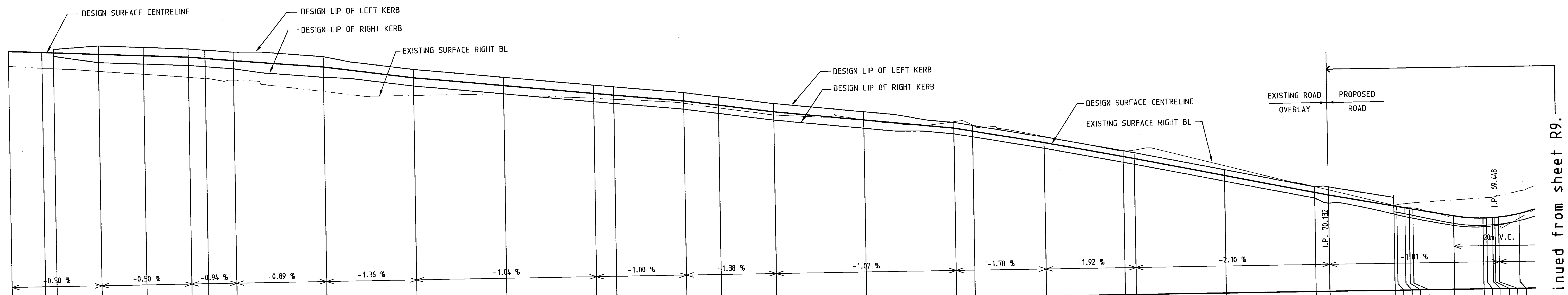
Brimbank City Council

Outfall Drainage Detail Plan

Sheet 4 of 4

Drawing No. **11111E 02 R7** Sheet 7 of 27

11111E 02 R8



Continued from sheet R9.

DATUM68

CENTRELINE CHAINAGE	DESIGN CL SURFACE LEVEL	LEFT DESIGN LIP OF KERB	RIGHT DESIGN LIP OF KERB	EXISTING LEFT BUILDING LINE	EXISTING RIGHT BUILDING LINE	
70.00					73.485	
77.43					73.429	
80.00	73.789	73.865	73.688		73.411	
90.00	73.739	73.899	73.531		73.336	
100.00	73.689	73.847	73.481		73.253	
110.00	73.639	73.795	73.431		73.168	
113.71	73.604	73.759	73.395		73.127	
120.00	73.545	73.705	73.338		73.087	
140.00	73.367	73.572	73.115		72.801	
160.00	73.094	73.253	72.887		72.679	
180.00	72.886	73.044	72.680		72.672	
200.00	72.678	72.836	72.470		72.545	
204.46	72.633	72.791	72.425		72.517	
220.00	72.478	72.637	72.270		72.401	
227.74	72.372	72.531	72.164		72.284	
240.00	72.203	72.361	71.995		72.109	
260.00	71.981	72.147	71.781		71.969	
280.00	71.775	71.875	71.623		71.891	
284.14	71.701	71.802	71.549		71.810	
300.00	71.419	71.521	71.267		71.531	
317.54	71.082	71.185	70.930		71.181	
320.00	71.035	71.138	70.883		71.192	
340.00	70.615	70.729	70.475		70.818	
360.00	70.195	70.320	70.068		70.324	
363.07	70.132	70.312	69.949		70.246	RTP
377.57	69.869				69.880	LTP
378.22	69.858				69.864	
380.00	69.825				69.834	
380.98	69.808				69.824	LTP
381.77	69.793				69.815	RTP
390.82	69.629					
397.35	69.570					LTP
398.17	69.571					
399.47	69.576					
400.00	69.580					
400.82	69.587					
405.41	69.660	69.502	69.502	69.557		RTP

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

10 5 0 10 20 1:500 Horz.
1 0.5 0 1 2 1:50 Vert.
Original sheet size A1

As Constructed

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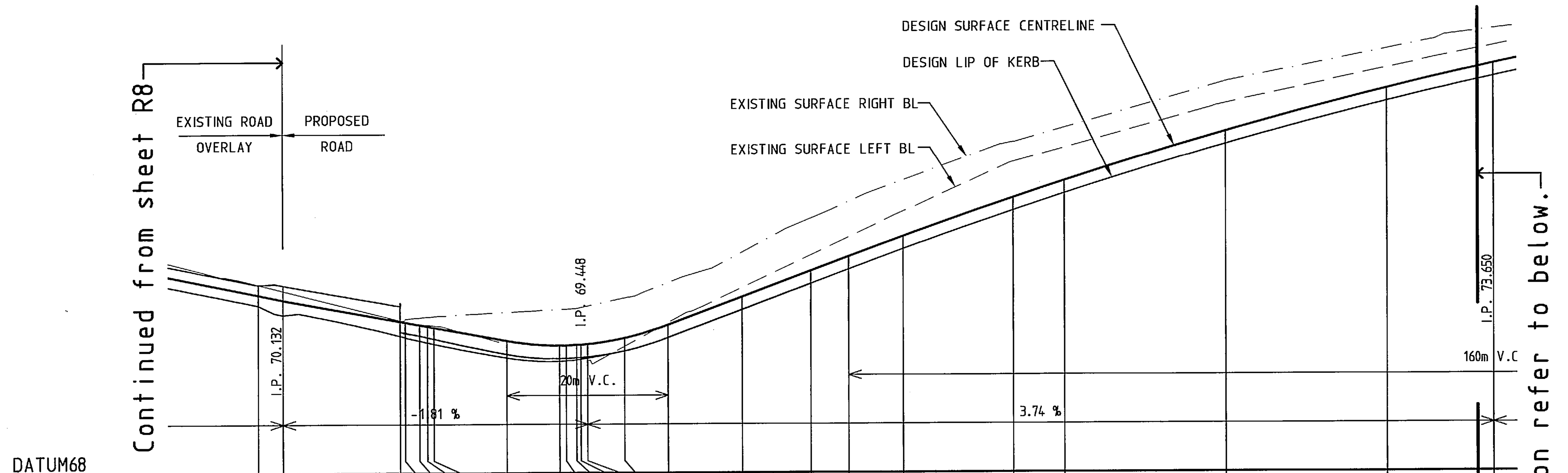
Translink Business Park Stage 2

Keilor
Brimbank City Council

Harrick Road Overlay
Longitudinal Section

Drawing No. **11111E 02 R8**
Sheet 8 of 27

Continued from sheet R8

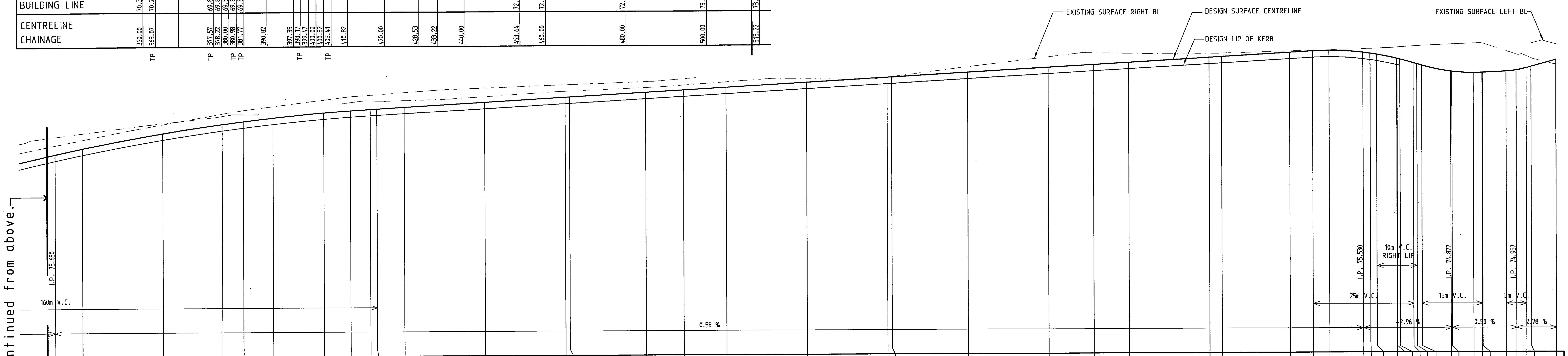


DATUM68

CENTRELINE CHAINAGE	DESIGN CL SURFACE LEVEL	LEFT DESIGN LIP OF KERB	RIGHT DESIGN LIP OF KERB	EXISTING LEFT BUILDING LINE	EXISTING RIGHT BUILDING LINE	
360.00	70.195	70.320	70.068		70.324	
363.07	70.132	70.312	69.949		70.246	TP
377.57	69.869				69.880	TP
378.22	69.858				69.864	
380.00	69.825				69.834	
380.98	69.808				69.824	TP
381.77	69.793				69.815	TP
390.82	69.629					
397.35	69.570					TP
398.17	69.571					
399.47	69.576					
400.00	69.580					
400.82	69.587					
405.41	69.660	69.502	69.502	69.557		TP
410.82	69.822	69.664	69.664	69.848		
420.00	70.165	70.007	70.007	70.276		
428.53	70.484	70.325	70.325	70.677		
433.22	70.659	70.501	70.501	70.897		
440.00	70.908	70.750	70.750	71.213		
453.64	71.382	71.223	71.223	71.820	72.067	
460.00	71.590	71.431	71.431	71.993	72.240	
480.00	72.192	72.034	72.034	72.536	72.803	
500.00	72.715	72.557	72.557	72.967	73.202	
513.22	73.018	72.860	72.860	73.239	73.446	

For continuation refer to below.

Continued from above.



CENTRELINE CHAINAGE	DESIGN CL SURFACE LEVEL	LEFT DESIGN LIP OF KERB	RIGHT DESIGN LIP OF KERB	EXISTING LEFT BUILDING LINE	EXISTING RIGHT BUILDING LINE	
513.22	73.018	72.860	72.860	73.239	73.446	
520.00	73.160	73.001	73.001	73.372	73.530	
540.00	73.525	73.367	73.367	73.745	73.772	
554.74	73.744	73.586		74.001	73.943	RTP
560.00	73.812	73.653		74.091	73.982	
567.39	73.898	73.739		74.184		
580.00	74.019	73.861		74.339		
586.64	74.070	73.912		74.418	74.273	
591.56	74.103	73.945		74.454	74.313	RTP
593.22	74.113	73.954	73.954	74.466	74.309	
600.00	74.152	73.994	73.994	74.514	74.317	
620.00	74.268	74.109	74.109	74.619	74.408	
640.00	74.383	74.225	74.225	74.693	74.531	
641.10	74.390	74.231	74.231	74.696	74.536	
660.00	74.499	74.341	74.341	74.763	74.616	
669.38	74.553	74.395	74.395	74.829	74.673	
680.00	74.615	74.456	74.456		74.748	
700.00	74.730	74.572	74.572		74.813	
720.00	74.846	74.688	74.688		74.848	
721.10	74.852	74.694	74.694		74.861	
740.00	74.962	74.803	74.803		75.097	
760.00	75.078	74.919	74.919		75.336	
771.24	75.143	74.984	74.984		75.431	
780.00	75.193	75.035	75.035		75.415	
800.00	75.309	75.151	75.151		75.401	
803.10	75.327	75.168	75.168		75.410	
820.00	75.425	75.266	75.266		75.454	
825.72	75.458	75.299	75.299		75.471	
829.81	75.470	75.311	75.311		75.483	
838.22	75.420	75.261	75.261		75.507	
840.00	75.396	75.238	75.238		75.513	
841.61	75.371	75.213	75.213		75.573	
846.61	75.270	75.112	75.144		75.545	RTP
846.70	75.268	75.110			75.546	
847.40	75.251				75.551	LTP
850.72	75.160				75.573	
851.61	75.134				75.584	
852.81	75.099				75.584	
860.00	74.946				75.617	
860.31	74.942				75.618	
865.64	74.909				75.638	
867.81	74.915			0.000	75.638	
867.90	74.915			0.000	75.637	
873.78	74.944			0.000	75.446	
876.28	74.971			0.000	75.365	
878.78	75.026			0.000	75.324	
880.00	75.060			75.636	75.272	
886.15	75.231			75.613	75.111	

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS - VC AT CH 838.22 EXTENDED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan 2005

10 5 0 10 20 1:500 Horz.
1 0.5 0 1 2 1:50 Vert.
Original sheet size A1

As Constructed

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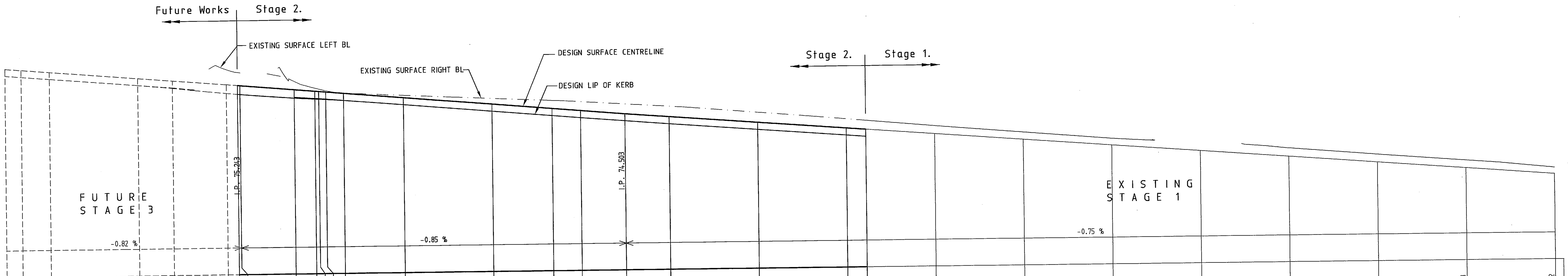
Translink Business Park Stage 2

Keilor
Brimbank City Council

Harrick Road
Longitudinal Section

Drawing No. 11111E 02 R9

11111E 02 R10

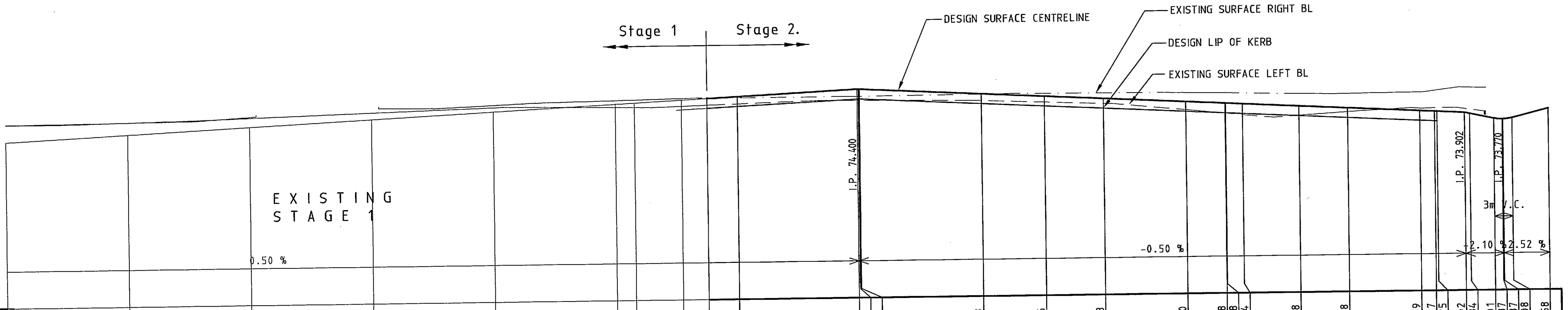


DATUM 71

CENTRELINE CHAINAGE	DESIGN CL SURFACE LEVEL	LEFT DESIGN LIP OF KERB	RIGHT DESIGN LIP OF KERB	EXISTING LEFT BUILDING LINE	EXISTING RIGHT BUILDING LINE	
450.00	75.675	75.521	75.521			
453.64	75.646	75.492	75.492			
460.00	75.594	75.440	75.440			
480.00	75.431	75.277	75.277			
487.82	75.367	75.203	75.213			
500.00	75.268	75.073		75.604		
502.49	75.248	75.051		75.538		
503.06	75.243	75.046		75.532		
515.32	75.139	74.951			75.324	LTP
520.00	75.099	74.923	74.937		75.167	
520.85	75.092	74.919	74.931		75.145	LTP
522.44	75.078	74.911	74.920		75.103	
526.48	75.044	74.885	74.885		75.047	RTP
540.00	74.929	74.770	74.770		74.982	
560.00	74.758	74.600	74.600		74.887	
573.58	74.643	74.484	74.484		74.824	
580.00	74.588	74.430	74.430		74.788	
590.00	74.503	74.350	74.350		74.725	
600.00	74.428	74.269	74.269		74.661	
620.00	74.277	74.119	74.119		74.502	
640.00	74.127	73.968	73.968		74.331	
644.42	74.093	73.935	73.935		74.292	
660.00	73.976				74.153	
680.00	73.826				73.988	
700.00	73.675				73.824	
720.00	73.525					
740.00	73.374				73.560	
760.00	73.223				73.398	
780.00	73.073				73.245	
800.00	72.922				73.064	

LONGITUDINAL SECTION - THOMSONS ROAD

SCALE H 1:500 V 1:50



DATUM 71

CENTRELINE	DESIGN CL SURFACE LEVEL	LEFT DESIGN LIP OF KERB	RIGHT DESIGN LIP OF KERB	EXISTING LEFT BUILDING LINE	EXISTING RIGHT BUILDING LINE	
160.00	73.802			74.000	74.000	
180.00	73.902			74.048	74.064	
200.00	74.002			74.110		
220.00	74.102			74.171	74.208	
240.00	74.202			74.151	74.261	
243.13	74.218			74.147	74.267	
250.83	74.256	74.098	74.098	74.156	74.281	
255.00	74.277	74.119	74.119	74.169	74.284	
260.00	74.302	74.144	74.144	74.183	74.283	
279.63	74.400	74.238	74.238	74.216	74.281	
279.83	74.399	74.239	74.239	74.216	74.281	
280.00	74.398	74.240	74.240	74.216	74.281	
300.00	74.298	74.140	74.140	74.188	74.293	
310.33	74.246	74.088	74.088	74.151	74.293	
320.00	74.198	74.040	74.040	74.116	74.288	
333.50	74.130	73.972	73.972	73.998	74.276	TP
339.93	74.098	73.940	73.940	73.934	74.264	TP
340.00	74.098	73.940	73.940	73.933	74.264	
342.78	74.084	73.926	73.926	73.906	74.258	
352.01	74.038	73.879	73.879	73.885	74.240	TP
360.00	73.998	73.840	73.840	73.935	74.231	
371.83	73.939	73.780	73.780	73.980	74.242	
374.25	73.927	73.768	73.768	73.981	74.267	RTP
374.65	73.925	73.766		73.981	74.272	LTP
379.16	73.902			73.964	74.314	
380.00	73.884			73.952	74.311	
383.95	73.801					
385.31	73.787					
385.45	73.787					
386.95	73.808					
392.90	73.958					

LONGITUDINAL SECTION - TRANSLINK DRIVE

SCALE H 1:500 V 1:50

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004 | Authorized by CW 27.01.05

Checked by John Knibbs 26/10/04 | Approved by Council 27 Jan. 2005

10 5 0 10 20 1:500 Horz.
1 0.5 0 1 2 1:50 Vert.
Original sheet size A1

As Constructed

M I L L A R Merrigan
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
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Translink Business Park Stage 2

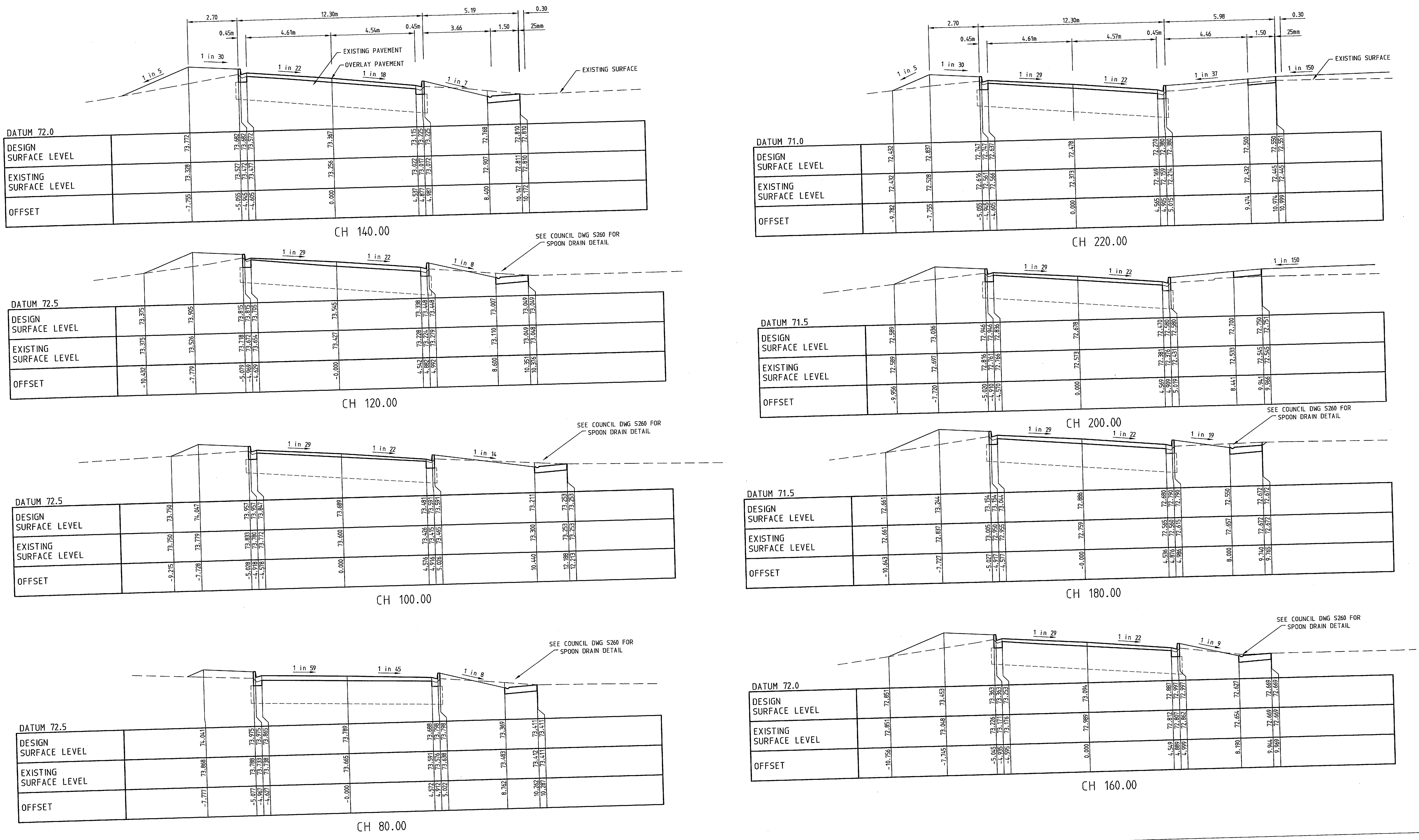
Keilor

Brimbank City Council

Thomsons Road & Translink Drive Longitudinal Sections

Drawing No. **11111E 02 R10** Sheet 10 of 27

11111E 02 R11



Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	COUNCIL AMENDMENTS	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005

1:100 Horiz.
1:50 Vert.
Original sheet size A1

As Constructed

MILLAR Merrigan
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
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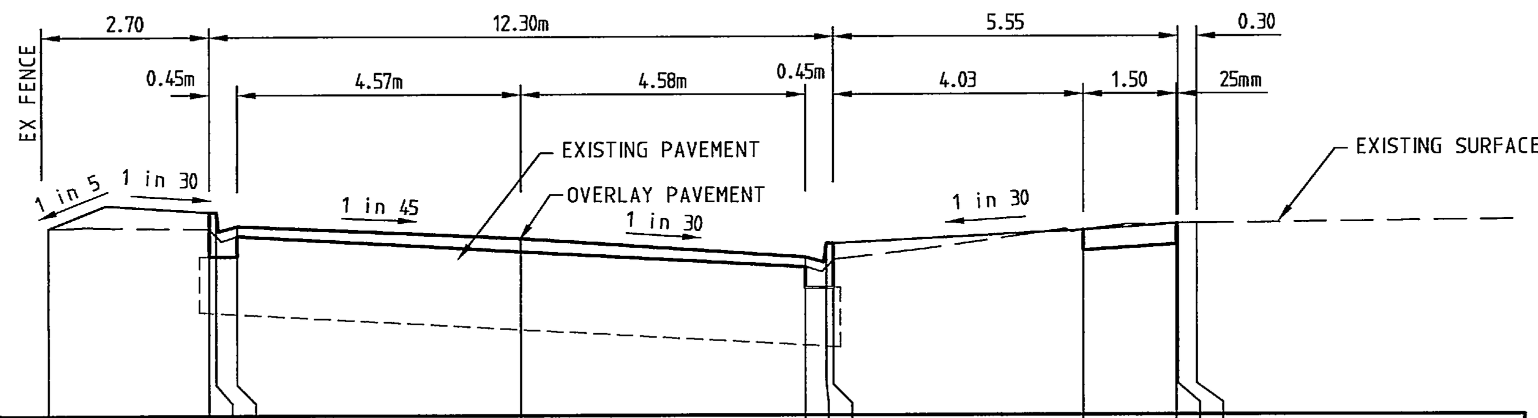
Quality Endorsed Company

Translink Business Park Stage 2

Keilor
Brimbank City Council

Harrick Road Overlay
Cross Sections sheet 1

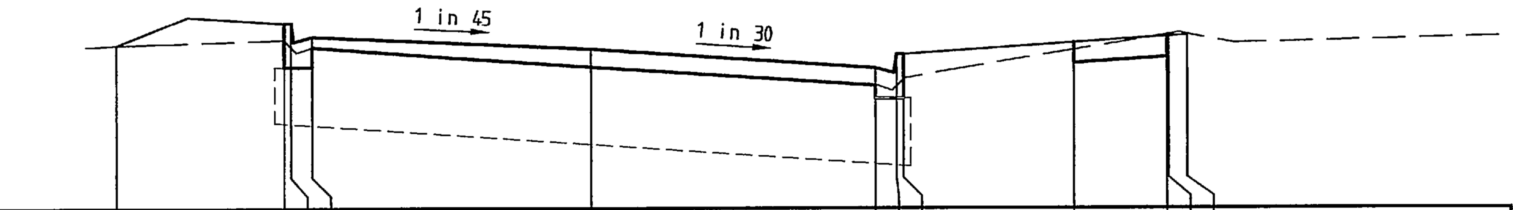
Drawing No. **11111E 02 R11** Sheet 11 of 27



DATUM 70.0

DESIGN SURFACE LEVEL		71.631	71.631	71.521	71.419	71.267	71.377	71.377	71.511	71.561	71.562	71.572
EXISTING SURFACE LEVEL		71.498	71.443	71.439	71.314	71.190	71.184	71.239	71.482	71.531	71.531	71.533
OFFSET	-7.610	-5.020	-4.910	-4.570	0.000	4.577	4.917	5.027	9.053	10.553	10.578	10.878

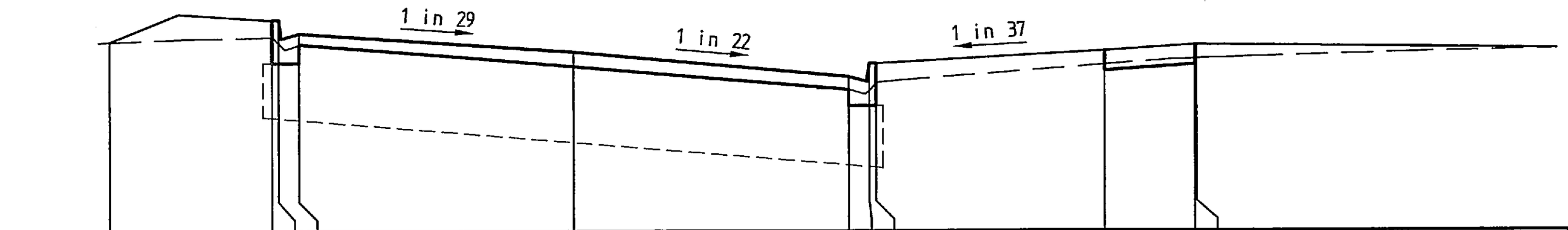
CH 300.00



DATUM 71.0

DESIGN SURFACE LEVEL	71.807	71.985	71.985	71.875	71.775	71.623	71.733	71.733	71.824	71.874	71.875	71.885
EXISTING SURFACE LEVEL	71.807	71.847	71.792	71.788	71.632	71.482	71.475	71.530	71.768	71.889	71.891	71.891
OFFSET	-7.643	-4.943	-4.833	-4.493	0.000	4.576	4.916	5.026	7.769	9.269	9.294	9.594

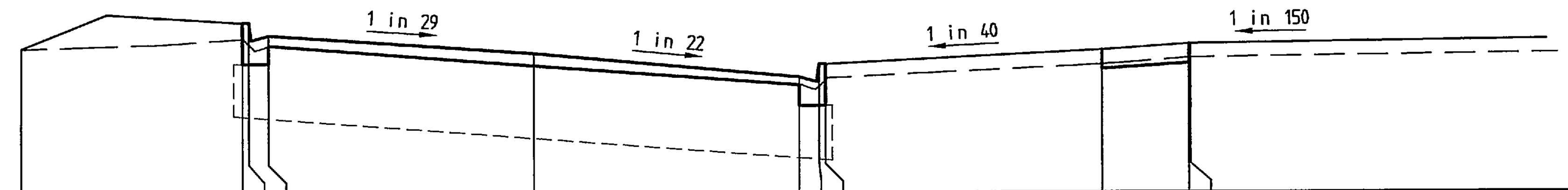
CH 280.00



DATUM 70.5

DESIGN SURFACE LEVEL	72.081	72.257	72.257	72.147	71.989	71.781	71.891	71.891	71.995	72.045	72.046
EXISTING SURFACE LEVEL	72.081	72.115	72.065	72.051	71.868	71.674	71.664	71.718	71.879	71.927	71.928
OFFSET	-7.719	-5.019	-4.909	-4.569	-0.000	4.576	4.916	5.026	8.830	10.330	10.355

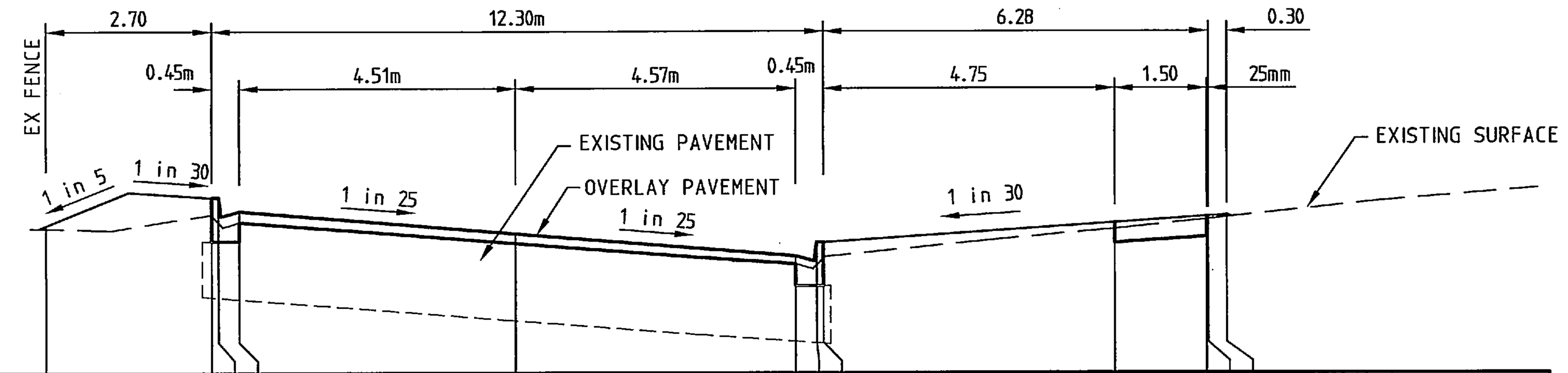
CH 260.00



DATUM 71.0

DESIGN SURFACE LEVEL	72.269	72.471	72.471	72.361	72.203	71.995	72.105	72.105	72.225	72.275	72.276
EXISTING SURFACE LEVEL	72.269	72.333	72.284	72.269	72.098	71.928	71.915	71.969	72.101	72.108	72.109
OFFSET	-8.840	-5.027	-4.917	-4.577	0.000	4.576	4.916	5.026	9.795	11.295	11.320

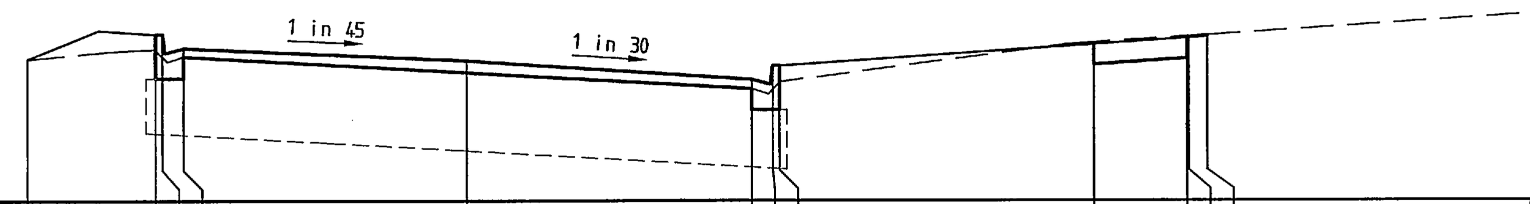
CH 240.00



DATUM 69.0

DESIGN SURFACE LEVEL	70.512	70.422	70.422	70.312	70.132	69.949	70.059	70.059	70.218	70.268	70.269	70.279
EXISTING SURFACE LEVEL		70.274	70.220	70.225	70.052	69.885	69.873	69.928	70.168	70.245	70.247	70.262
OFFSET	-7.660	-4.960	-4.850	-4.510	-0.000	4.567	4.907	5.017	9.771	11.271	11.296	11.596

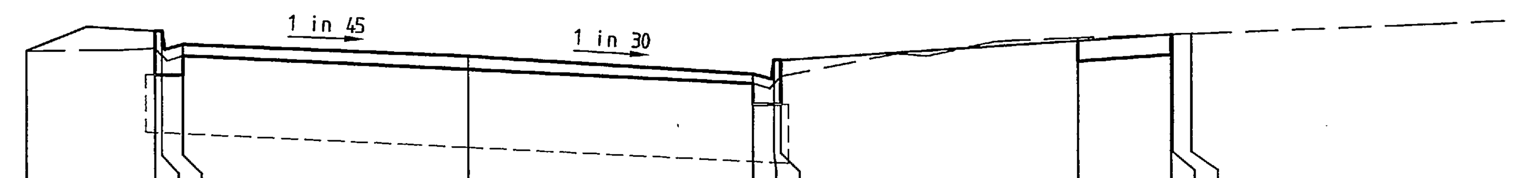
CH 363.07



DATUM 69.5

DESIGN SURFACE LEVEL		70.839	70.839	70.729	70.627	70.475	70.585	70.585	70.754	70.804	70.804	70.814
EXISTING SURFACE LEVEL		70.714	70.659	70.659	70.532	70.399	70.393	70.449	70.768	70.817	70.818	70.828
OFFSET	-7.070	-5.010	-4.900	-4.560	0.000	4.582	4.922	5.032	10.089	11.589	11.614	11.914

CH 340.00



DATUM 70.0

DESIGN SURFACE LEVEL		71.248	71.248	71.138	71.035	70.883	70.993	70.993	71.152	71.202	71.203	71.213
EXISTING SURFACE LEVEL		71.103	71.048	71.045	70.930	70.807	70.802	70.857	71.165	71.192	71.192	71.198
OFFSET	-7.110	-5.043	-4.933	-4.593	0.000	4.578	4.918	5.028	9.810	11.310	11.335	11.635

CH 320.00

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	COUNCIL AMENDMENTS	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by cw 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

2 1 0 2 4 1:100 Horiz.
1 0.5 0 1 2 1:50 Vert.
Original sheet size A1

As Constructed

MILLAR Merrigan
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PROJECT MANAGEMENT
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Land Development Consultants
Office 126 Merrindale Drive, Croydon, Victoria Mail PO Box 247, Croydon, Victoria 3136
Telephone (03) 8720 9500 Facsimile (03) 8720 9501
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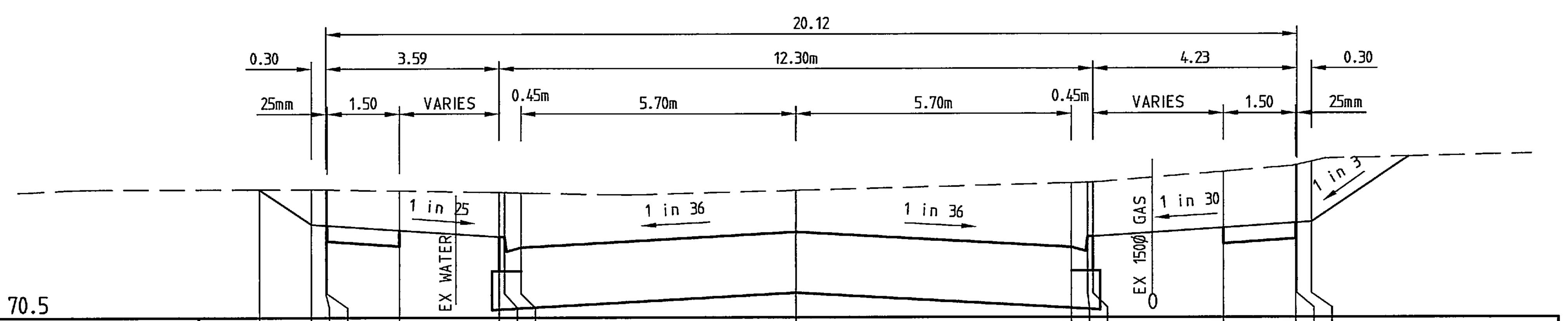
Translink Business Park Stage 2

Keilor
Brimbank City Council

Harrick Road Overlay
Cross Sections sheet 2

Drawing No. **11111E 02 R12** Sheet 12 of 27

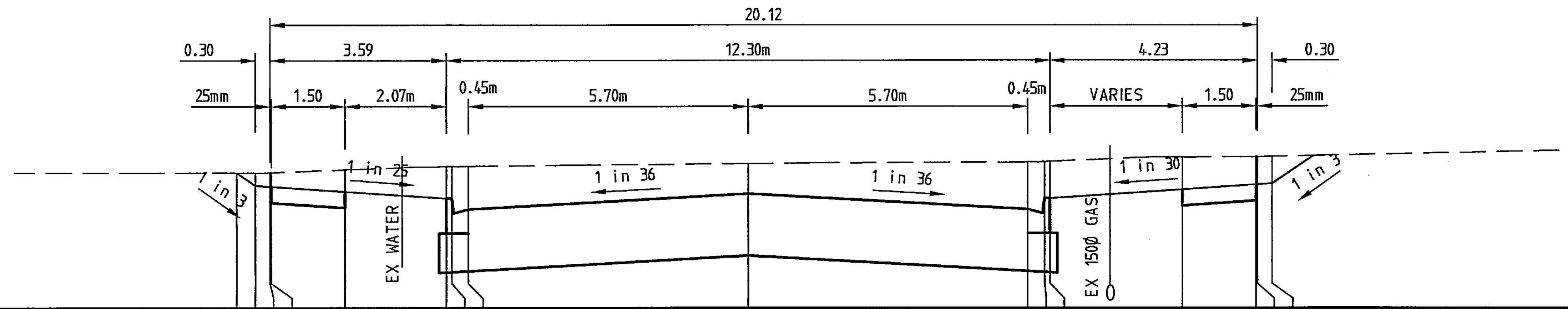
11111E 02 R13



DATUM 70.5

DESIGN SURFACE LEVEL	71.820	71.463	71.453	71.452	71.402	71.333	71.333	71.223	71.381	71.223	71.333	71.333	71.423	71.473	71.474	71.484
EXISTING SURFACE LEVEL	71.820	71.820	71.820	71.820	71.807	71.789	71.788	71.785	71.809	71.883	71.888	71.889	71.999	72.064	72.067	72.102
OFFSET	-11.115	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

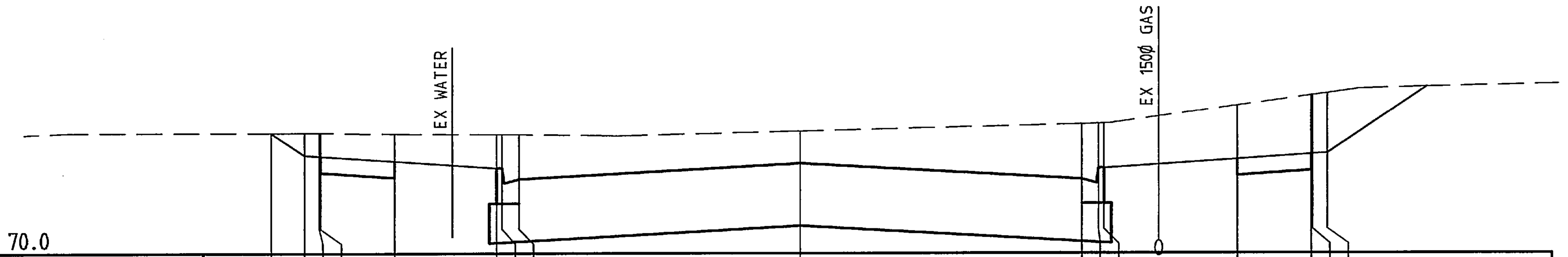
CH 453.64



DATUM 72.0

DESIGN SURFACE LEVEL	73.367	73.241	73.231	73.230	73.180	73.111	73.111	73.001	73.160	73.001	73.111	73.111	73.201	73.251	73.252	73.262
EXISTING SURFACE LEVEL	73.367	73.367	73.371	73.372	73.401	73.433	73.433	73.436	73.464	73.477	73.481	73.483	73.527	73.530	73.530	73.533
OFFSET	-10.420	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

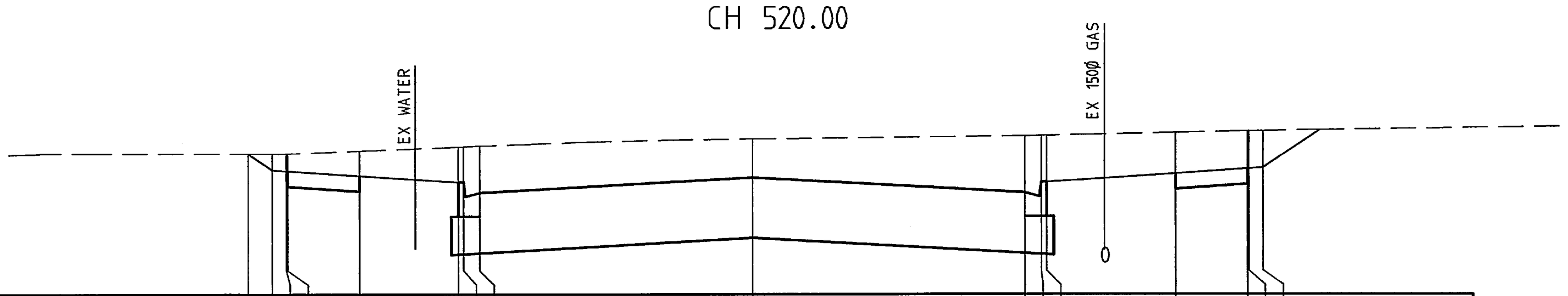
CH 520.00



DATUM 70.0

DESIGN SURFACE LEVEL	71.214	70.989	70.979	70.979	70.929	70.860	70.860	70.750	70.908	70.750	70.860	70.860	70.950	71.000	71.001	71.011
EXISTING SURFACE LEVEL	71.214	71.214	71.213	71.213	71.208	71.200	71.199	71.198	71.234	71.305	71.309	71.311	71.492	71.596	71.598	71.618
OFFSET	-10.715	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

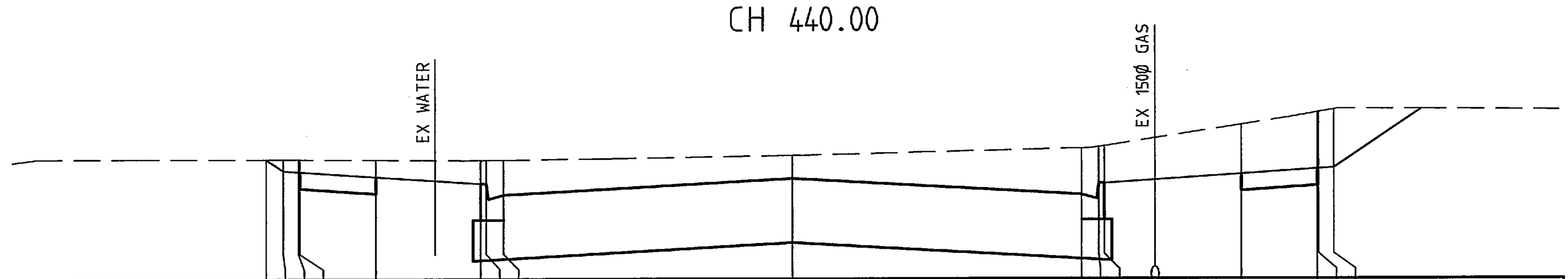
CH 440.00



DATUM 71.5

DESIGN SURFACE LEVEL	72.964	72.797	72.787	72.786	72.736	72.667	72.667	72.557	72.715	72.557	72.667	72.667	72.757	72.807	72.808	72.818
EXISTING SURFACE LEVEL	72.964	72.964	72.967	72.968	72.998	73.038	73.041	73.047	73.120	73.153	73.155	73.157	73.186	73.201	73.202	73.204
OFFSET	-10.544	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

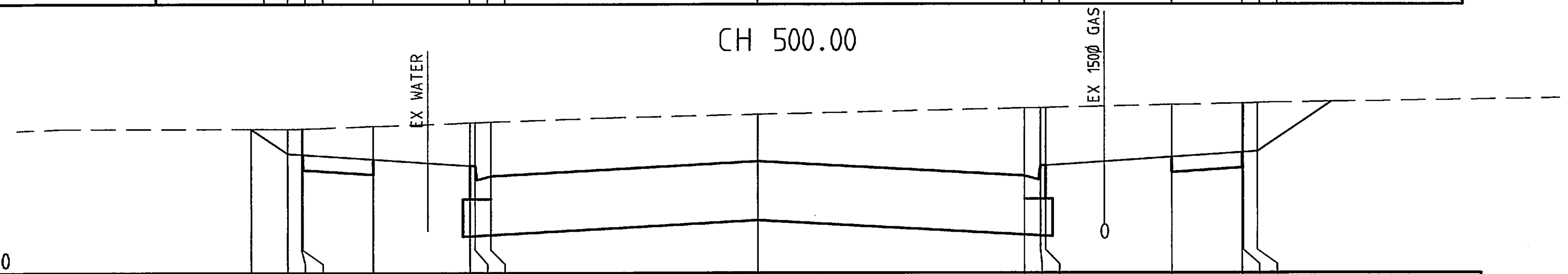
CH 500.00



DATUM 69.5

DESIGN SURFACE LEVEL	70.678	70.565	70.555	70.554	70.504	70.435	70.435	70.325	70.484	70.325	70.435	70.435	70.525	70.575	70.576	70.586
EXISTING SURFACE LEVEL	70.678	70.678	70.677	70.677	70.671	70.665	70.666	70.668	70.710	70.780	70.792	70.801	71.007	71.128	71.130	71.156
OFFSET	-10.379	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

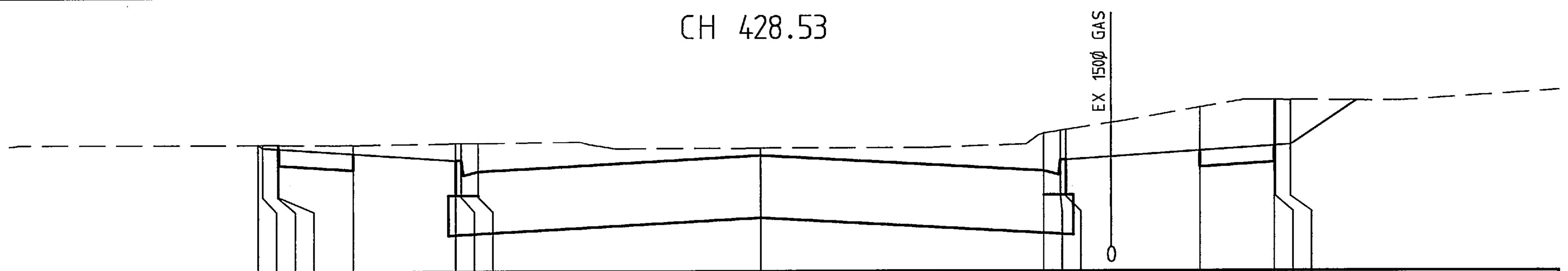
CH 428.53



DATUM 71.0

DESIGN SURFACE LEVEL	72.533	72.273	72.263	72.262	72.212	72.144	72.144	72.034	72.192	72.034	72.144	72.144	72.234	72.284	72.284	72.294
EXISTING SURFACE LEVEL	72.533	72.533	72.536	72.537	72.564	72.600	72.602	72.608	72.689	72.753	72.756	72.757	72.788	72.803	72.803	72.807
OFFSET	-10.822	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

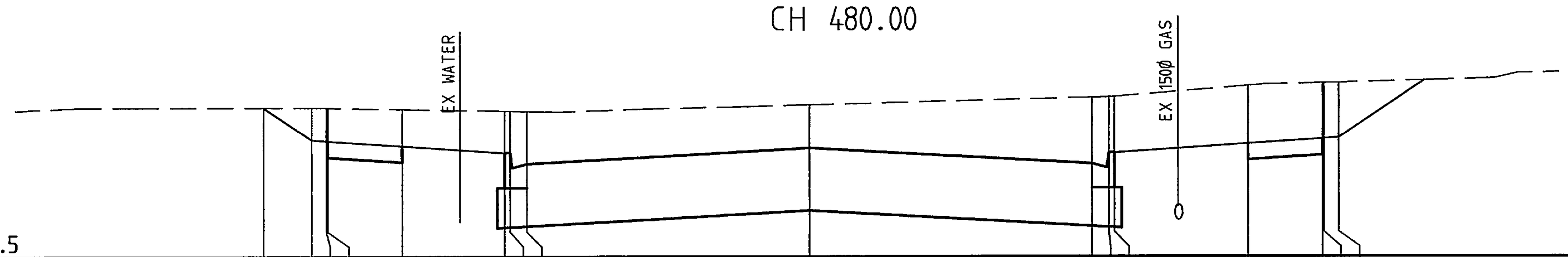
CH 480.00



DATUM 69.0

DESIGN SURFACE LEVEL	70.277	70.246	70.236	70.235	70.185	70.117	70.117	70.007	70.165	70.007	70.117	70.117	70.207	70.257	70.257	70.267
EXISTING SURFACE LEVEL	70.277	70.277	70.276	70.276	70.273	70.287	70.288	70.290	70.236	70.384	70.412	70.420	70.642	70.714	70.714	70.713
OFFSET	-10.135	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

CH 420.00



DATUM 70.5

DESIGN SURFACE LEVEL	71.994	71.671	71.661	71.660	71.610	71.541	71.541	71.431	71.590	71.431	71.541	71.541	71.631	71.681	71.682	71.692
EXISTING SURFACE LEVEL	71.994	71.994	71.993	71.993	71.981	71.964	71.963	71.960	72.023	72.096	72.101	72.104	72.214	72.239	72.240	72.244
OFFSET	-11.012	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

CH 460.00

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	AMENDMENTS - EXISTING GAS & WATER INDICATED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005
1:100 Horiz.
1:50 Vert.
Original sheet size A1

As Constructed

MILLAR Merrigan Land Development Consultants
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
PROJECT MANAGEMENT
Quality System Quality Endorsed Company
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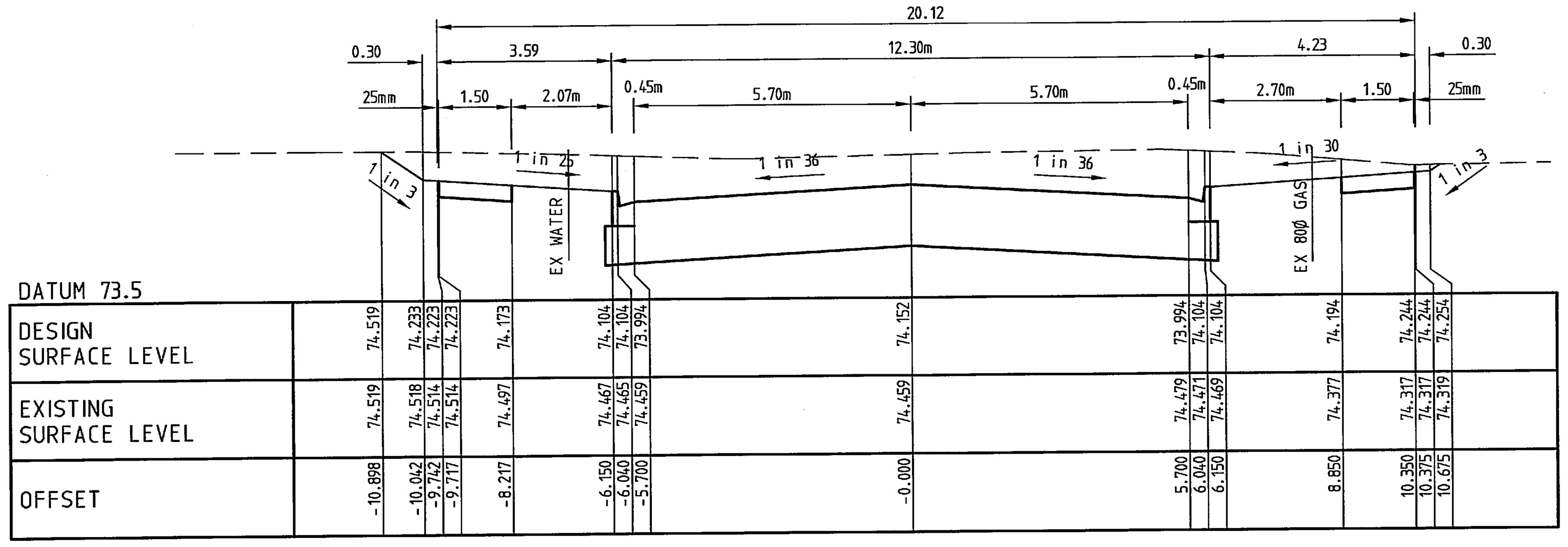
Translink Business Park Stage 2

Keilor
Brimbank City Council

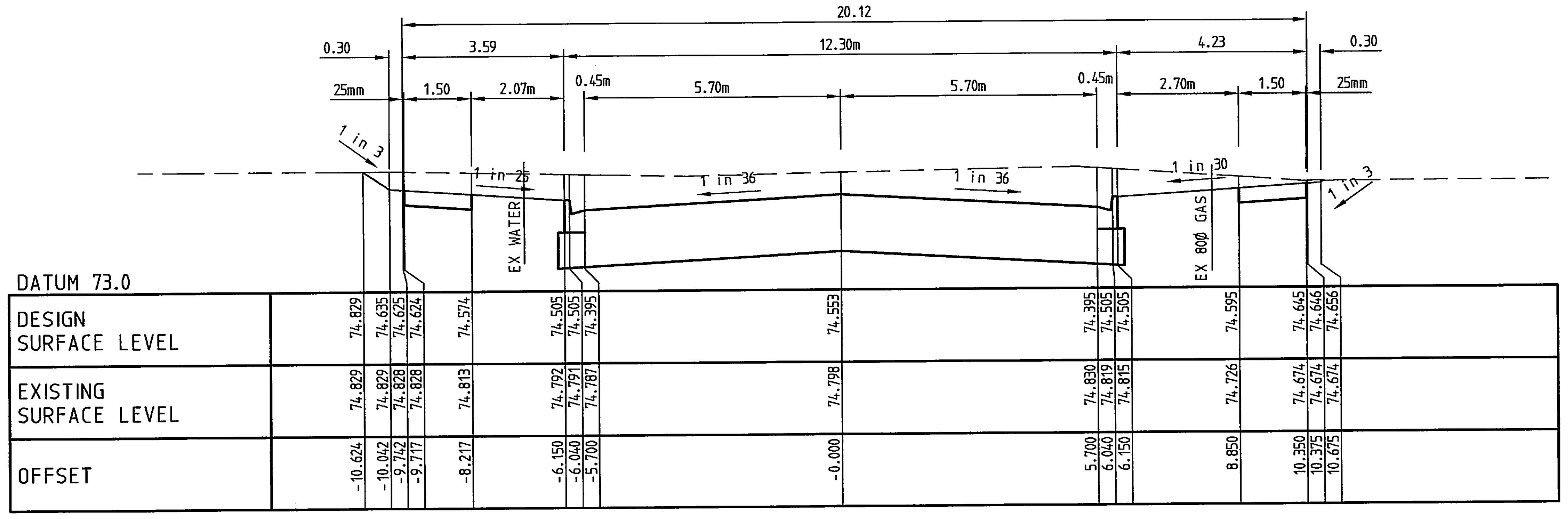
Harrick Road
Cross Sections sheet 1

Drawing No. 11111E 02 R13

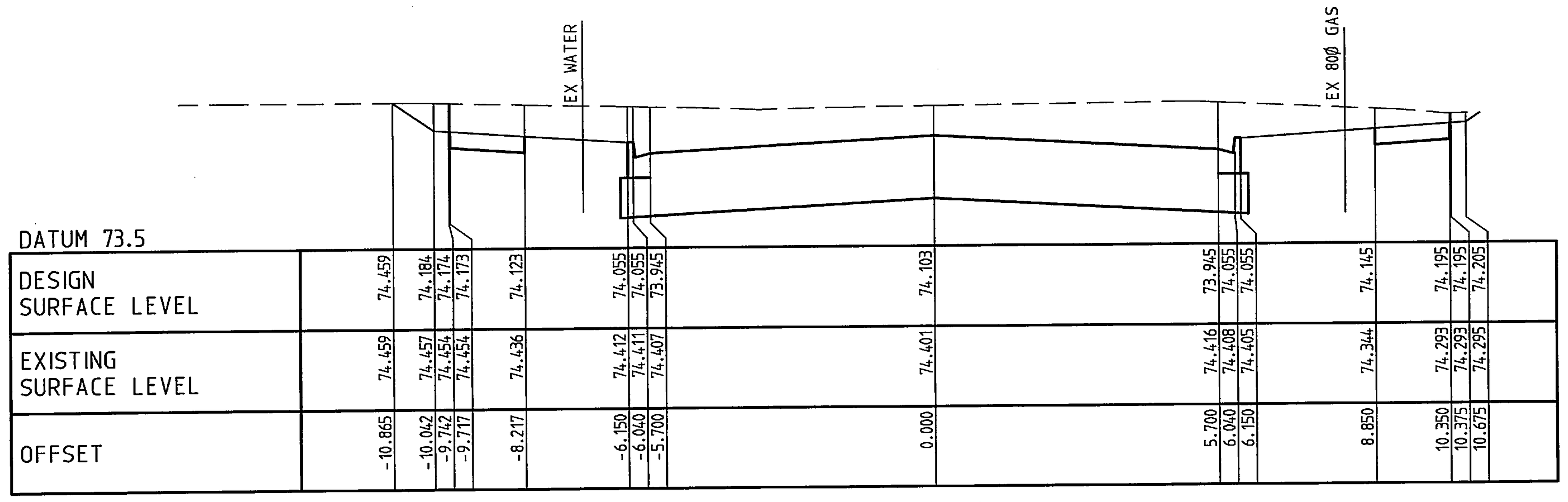
11111E 02 R14



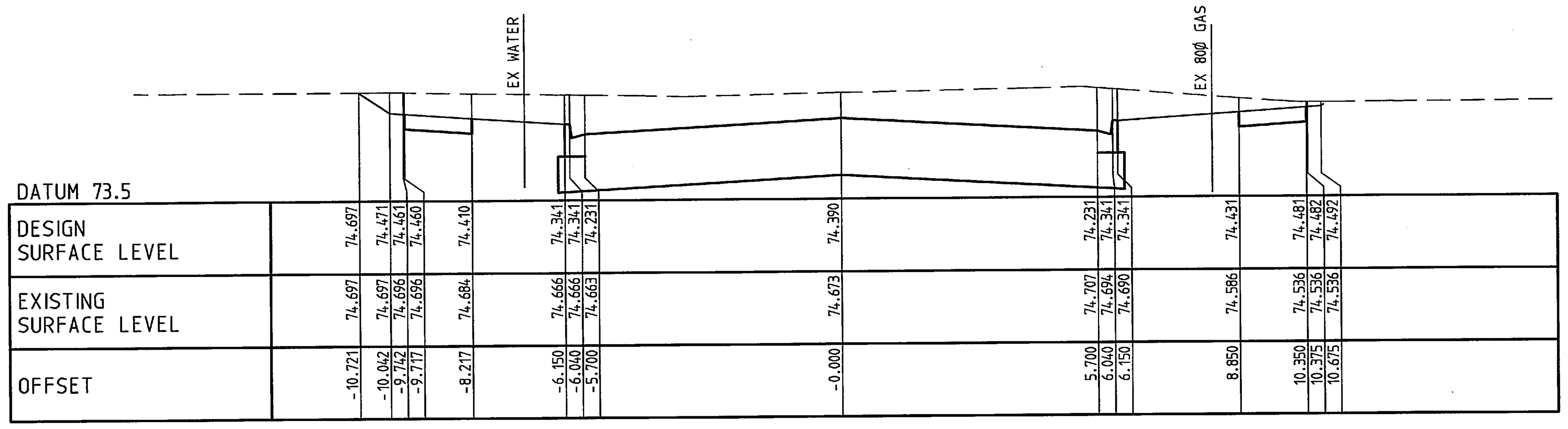
CH 600.00



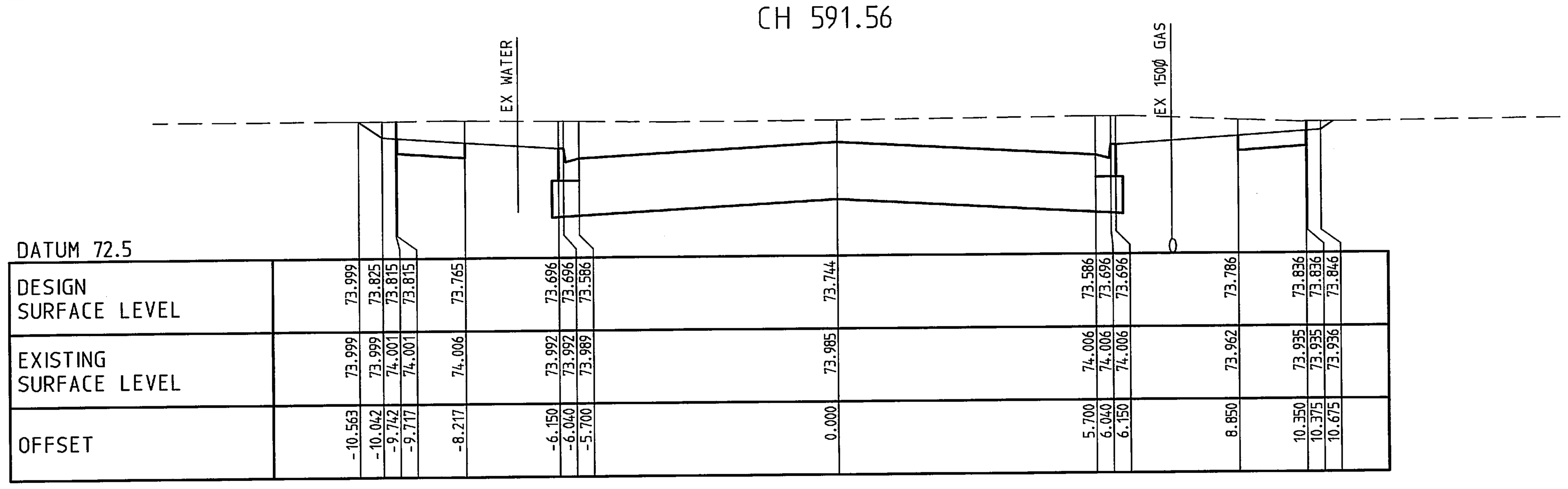
CH 669.38



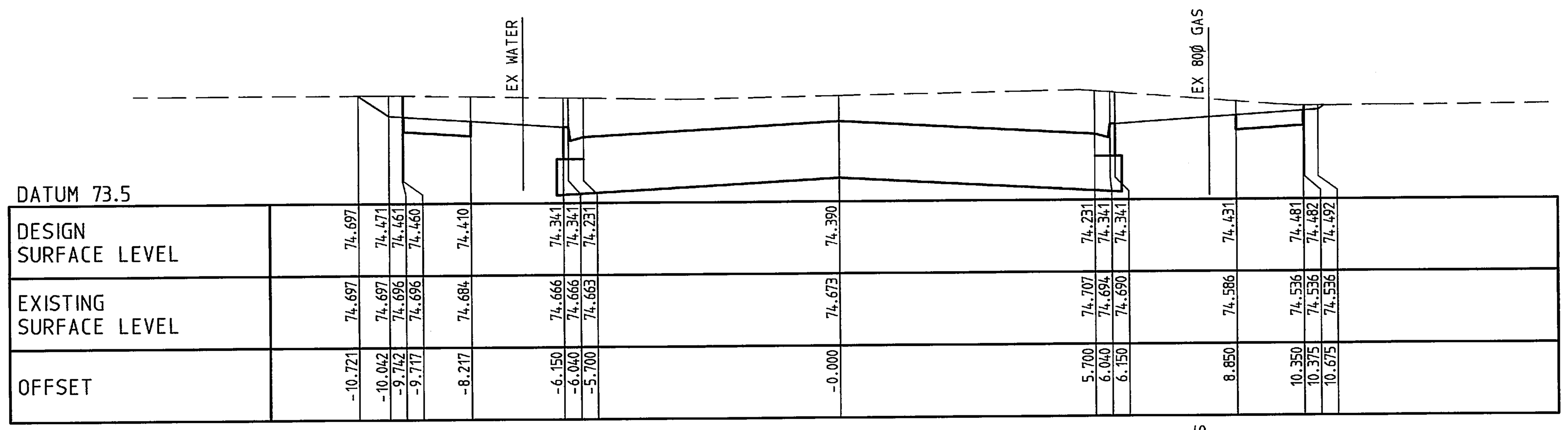
CH 591.56



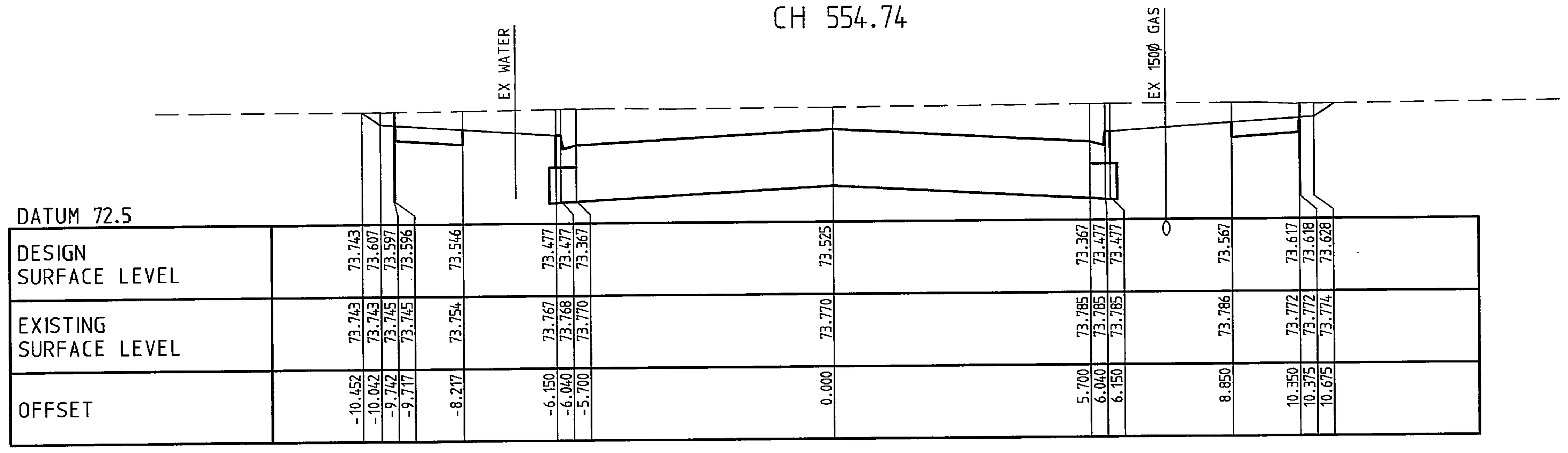
CH 660.00



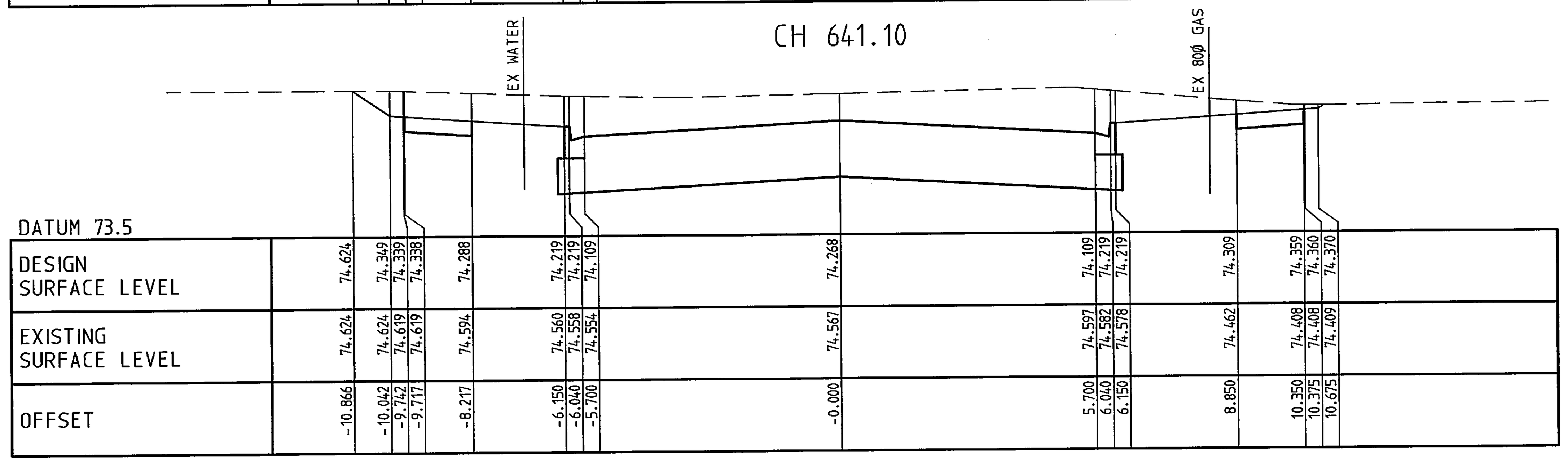
CH 554.74



CH 641.10



CH 540.00



CH 620.00

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	AMENDMENTS - EXISTING GAS & WATER INDICATED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

1:100 Horiz.
1:50 Vert.
Original sheet size A1

As Constructed

MILLAR Merrigan
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
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Land Development Consultants
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Quality Endorsed Company

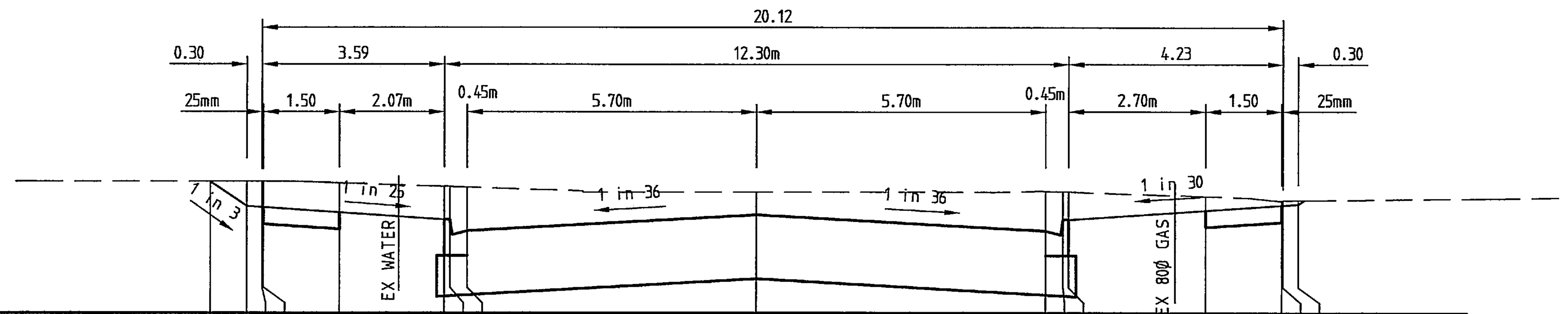
Translink Business Park Stage 2

Keilor
Brimbank City Council

Harrick Road
Cross Sections sheet 2

Drawing No. **11111E 02 R14** Sheet 14 of 27

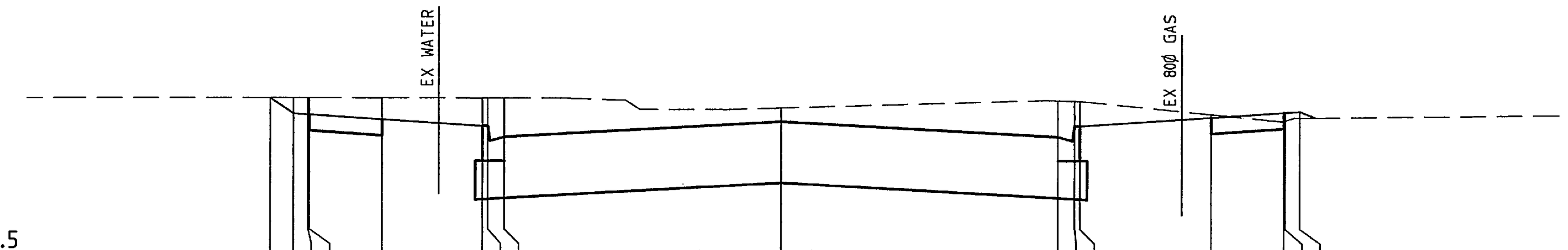
11111E 02 R15



DATUM 74.0

DESIGN SURFACE LEVEL	75.283	75.043	75.033	75.032	74.982	74.913	74.913	74.803	74.962	74.803	74.913	74.913	75.003	75.053	75.054	75.064
EXISTING SURFACE LEVEL	75.283	75.283	75.283	75.283	75.270	75.237	75.235	75.230	75.180	75.192	75.187	75.185	75.141	75.096	75.097	75.102
OFFSET	-10.760	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

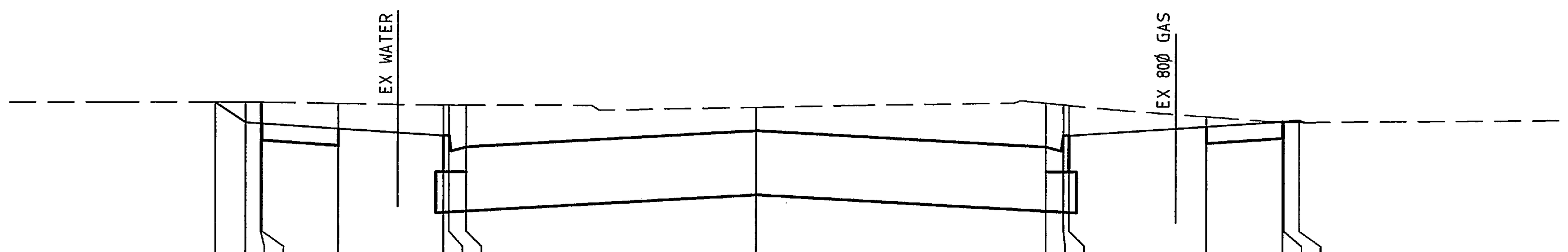
CH 740.00



DATUM 73.5

DESIGN SURFACE LEVEL	75.093	74.934	74.924	74.923	74.873	74.804	74.804	74.694	74.852	74.694	74.804	74.804	74.894	74.944	74.945	74.955
EXISTING SURFACE LEVEL	75.093	75.093	75.093	75.093	75.092	75.090	75.090	75.089	74.992	75.064	75.059	75.057	74.927	74.857	74.861	74.890
OFFSET	-10.519	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

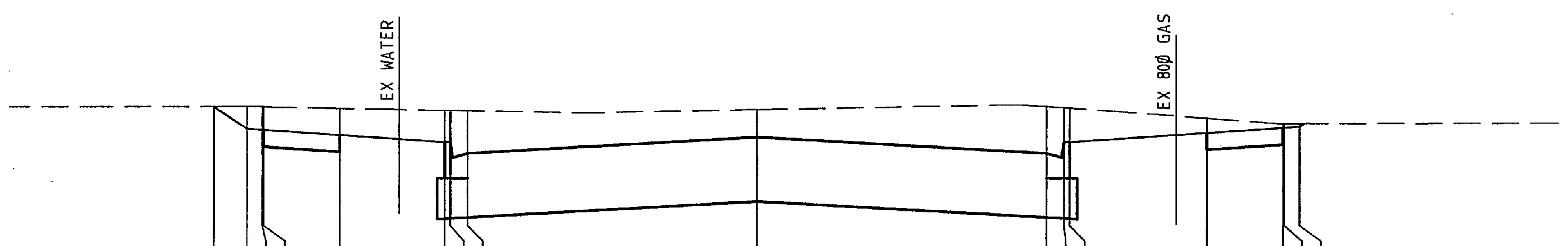
CH 721.10



DATUM 73.5

DESIGN SURFACE LEVEL	75.009	74.812	74.802	74.801	74.751	74.682	74.682	74.572	74.730	74.572	74.682	74.682	74.772	74.822	74.823	74.833
EXISTING SURFACE LEVEL	75.009	75.009	75.009	75.009	74.997	74.979	74.978	74.977	74.959	74.999	74.983	74.978	74.868	74.813	74.813	74.814
OFFSET	-10.634	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

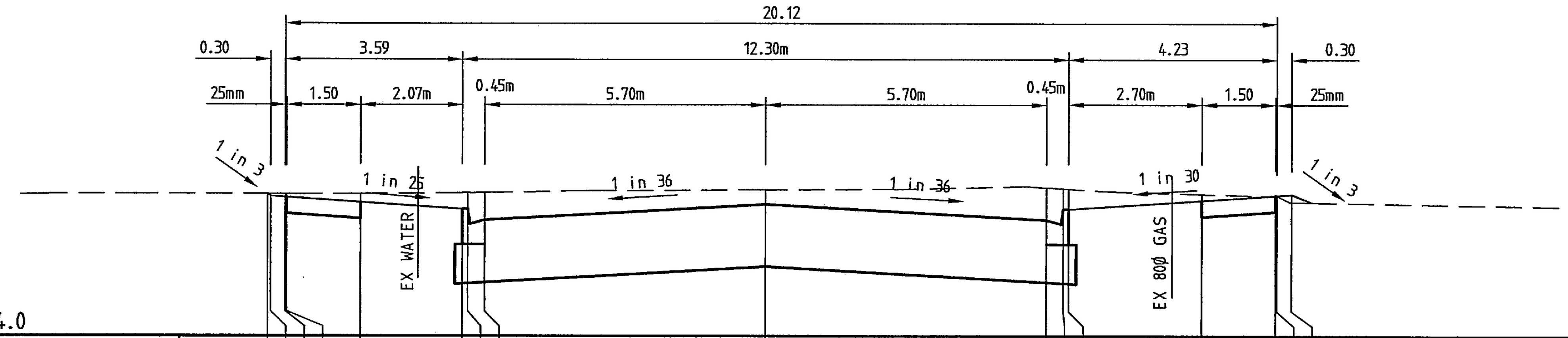
CH 700.00



DATUM 73.5

DESIGN SURFACE LEVEL	74.914	74.696	74.686	74.685	74.635	74.566	74.566	74.456	74.615	74.456	74.566	74.566	74.656	74.706	74.707	74.717
EXISTING SURFACE LEVEL	74.914	74.914	74.914	74.914	74.899	74.880	74.879	74.876	74.886	74.915	74.903	74.900	74.803	74.748	74.748	74.749
OFFSET	-10.695	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

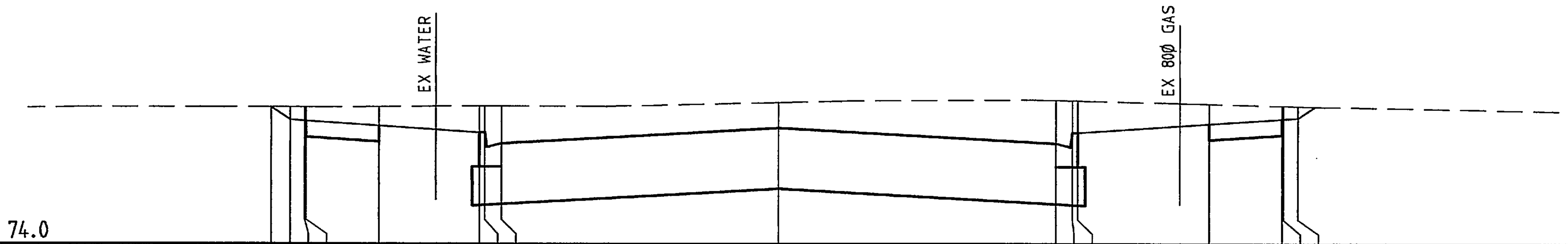
CH 680.00



DATUM 74.0

DESIGN SURFACE LEVEL	75.429	75.408	75.398	75.397	75.347	75.278	75.278	75.168	75.327	75.168	75.278	75.278	75.368	75.418	75.419	75.429
EXISTING SURFACE LEVEL	75.429	75.429	75.429	75.429	75.434	75.441	75.442	75.443	75.472	75.497	75.486	75.483	75.431	75.410	75.410	75.352
OFFSET	-10.103	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

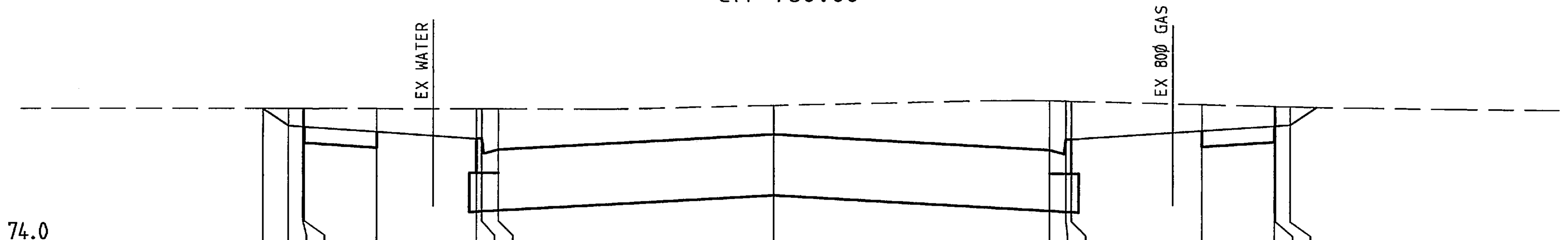
CH 803.10



DATUM 74.0

DESIGN SURFACE LEVEL	75.404	75.275	75.265	75.264	75.214	75.145	75.145	75.035	75.193	75.035	75.145	75.145	75.235	75.285	75.286	75.296
EXISTING SURFACE LEVEL	75.404	75.404	75.404	75.404	75.409	75.413	75.413	75.413	75.454	75.477	75.473	75.471	75.440	75.419	75.418	75.415
OFFSET	-10.431	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

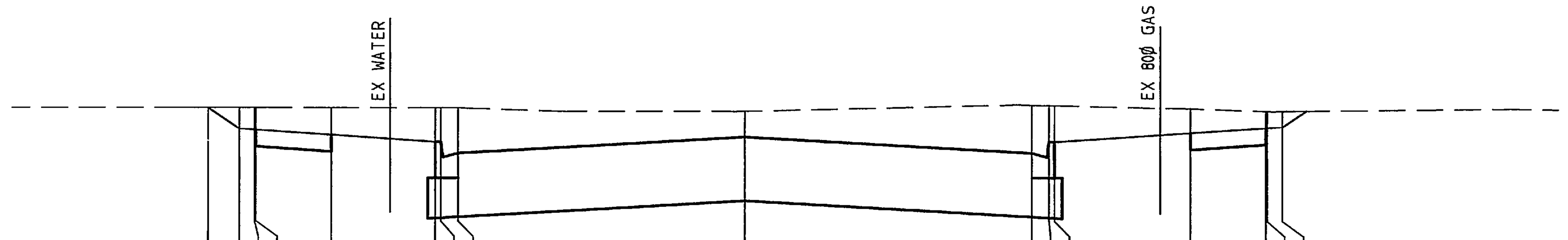
CH 780.00



DATUM 74.0

DESIGN SURFACE LEVEL	75.399	75.224	75.214	75.213	75.163	75.094	75.094	74.984	75.143	74.984	75.094	75.094	75.184	75.234	75.235	75.245
EXISTING SURFACE LEVEL	75.399	75.399	75.399	75.399	75.400	75.399	75.399	75.399	75.439	75.489	75.485	75.484	75.453	75.436	75.435	75.432
OFFSET	-10.566	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

CH 771.24



DATUM 74.0

DESIGN SURFACE LEVEL	75.366	75.159	75.149	75.148	75.098	75.029	75.029	74.919	75.078	74.919	75.029	75.029	75.119	75.169	75.170	75.180
EXISTING SURFACE LEVEL	75.366	75.366	75.366	75.366	75.366	75.365	75.365	75.365	75.334	75.394	75.390	75.389	75.361	75.336	75.336	75.335
OFFSET	-10.663	-10.042	-9.742	-9.717	-8.217	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.850	10.350	10.375	10.675

CH 760.00

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	AMENDMENTS - EXISTING GAS & WATER INDICATED	S	17/11/04

Designed by Steve Tough Feb 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005

2 1 0 2 4 1:100 Horiz.
1 0.5 0 1 2 1:50 Vert.
Original sheet size A1

As Constructed

M I L L A R
Merrigan
Land Development Consultants
TOWN PLANNING
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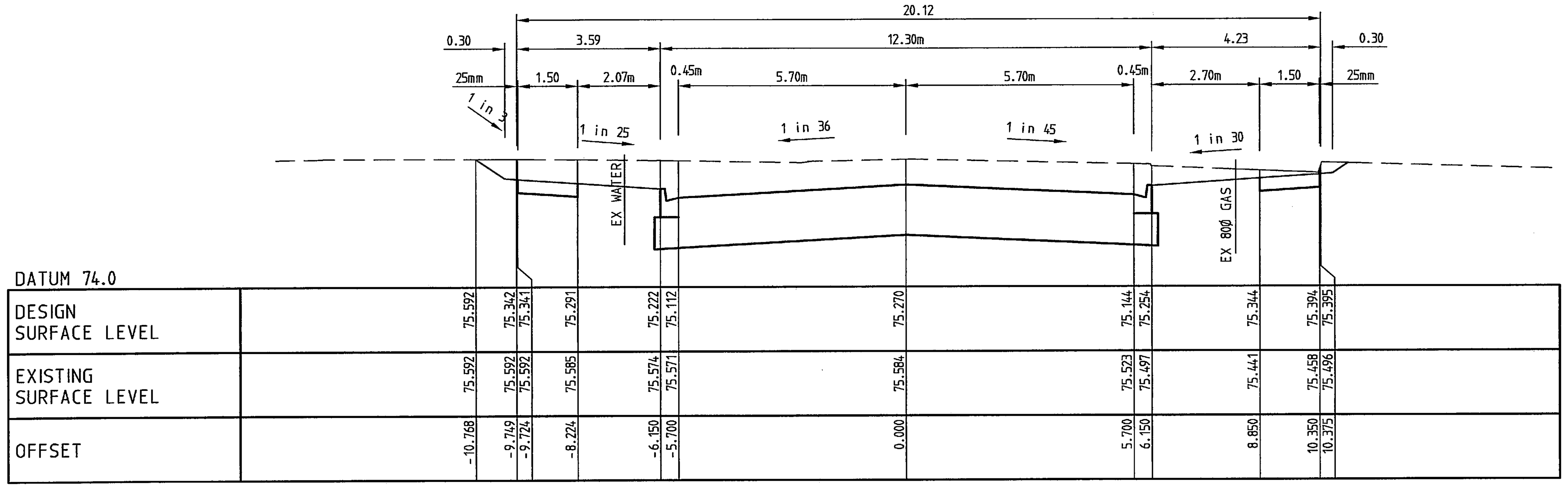
Translink Business Park Stage 2

Keilor
Brimbank City Council

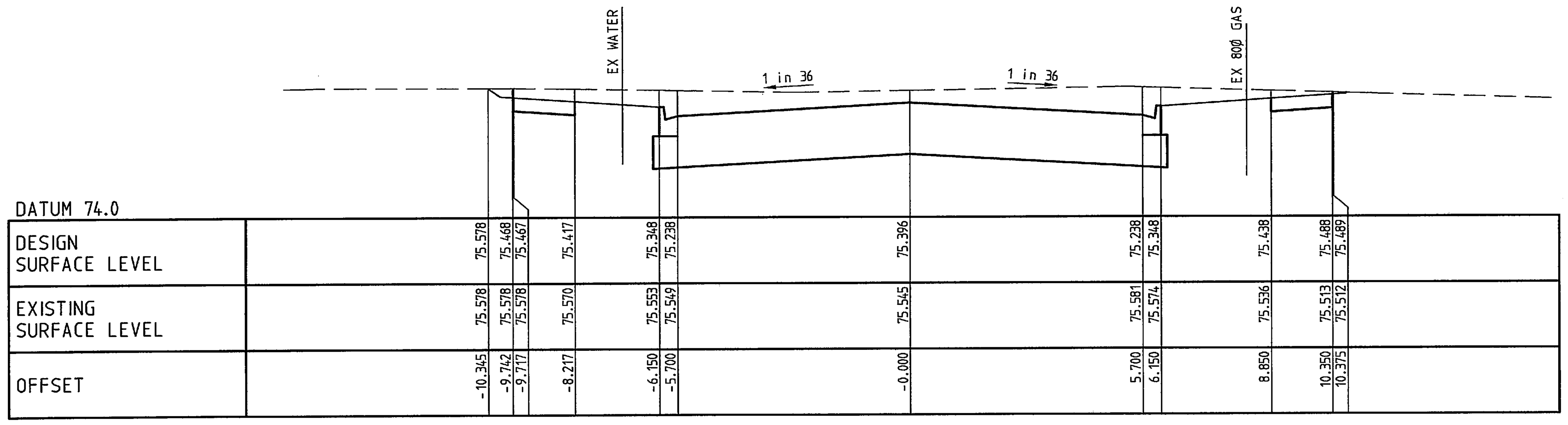
Harrick Road
Cross Sections sheet 3

Drawing No. **11111E 02 R15**

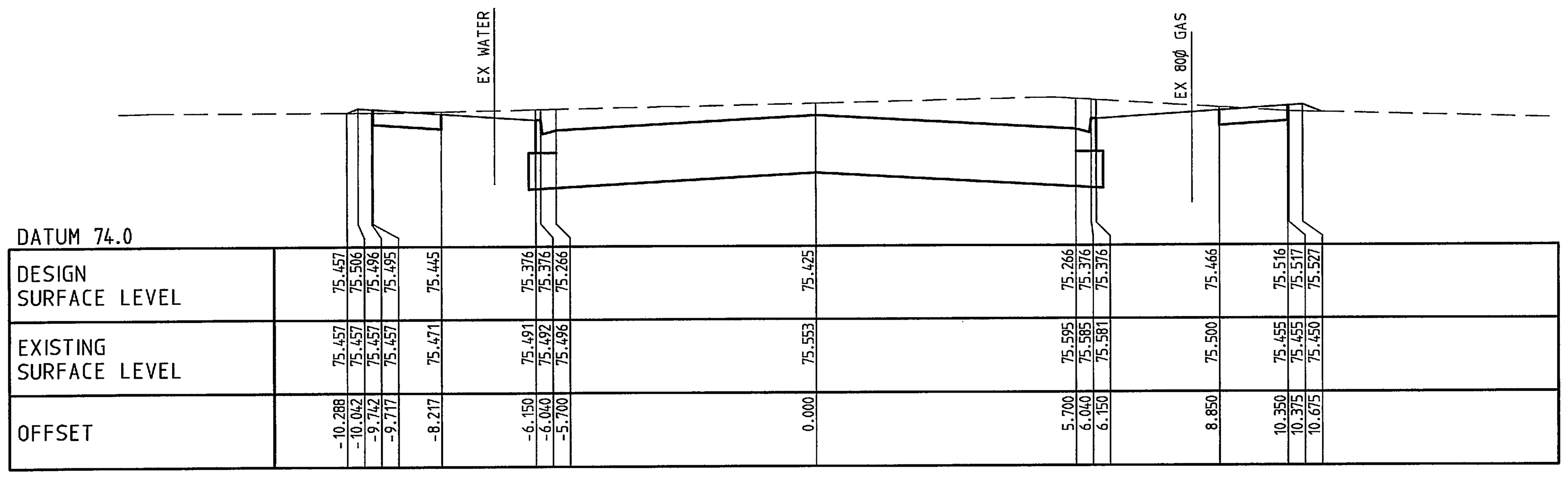
11111E 02 R16



TPCH 846.61



CH 840.00



CH 820.00

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS - SECTIONS CH 840 & CH846.61 UPDATED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005
1:100 Horiz.
1:50 Vert.
Original sheet size A1

As Constructed

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TOWN PLANNING
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Quality Endorsed Company
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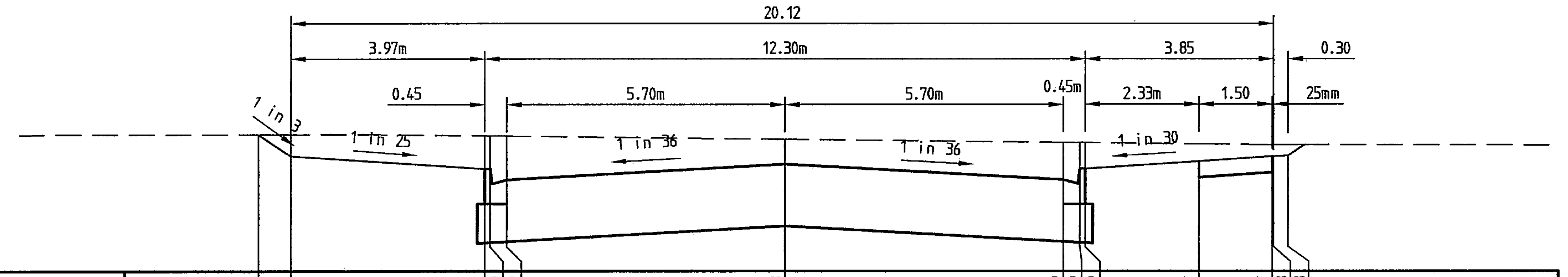
Telephone (03) 8720 9500 Facsimile (03) 8720 9501
Email eng@millarmerrigan.com.au Web Site www.millarmerrigan.com.au

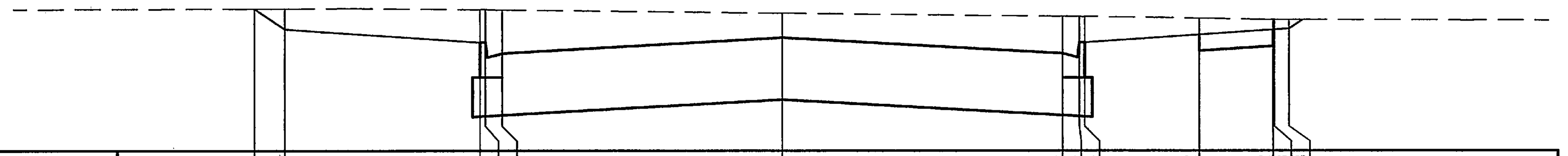
Translink Business Park Stage 2
Keilor
Brimbank City Council
Harrick Road
Cross Sections sheet 4
Drawing No. **11111E 02 R16**



DATUM 73.5

DESIGN SURFACE LEVEL	74.892	74.672	74.540	74.540	74.430	74.588	74.430	74.540	74.540	74.617	74.667	74.668	74.678
EXISTING SURFACE LEVEL	74.892	74.892	74.880	74.880	74.878	74.845	74.813	74.811	74.810	74.797	74.788	74.788	74.788
OFFSET	-10.779	-10.120	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

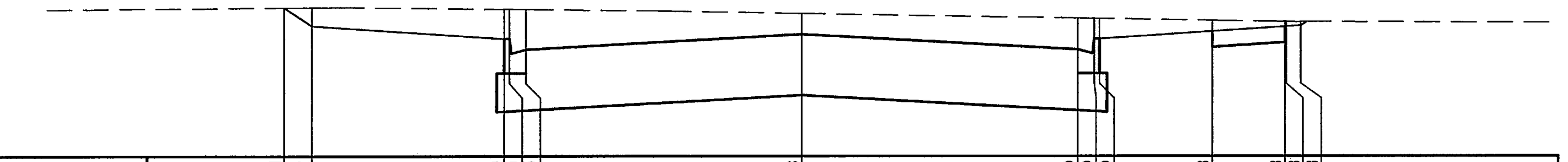
CH 580.00



DATUM 73.5

DESIGN SURFACE LEVEL	74.932	74.727	74.594	74.594	74.484	74.643	74.484	74.594	74.594	74.672	74.722	74.723	74.733
EXISTING SURFACE LEVEL	74.932	74.934	74.924	74.923	74.921	74.888	74.855	74.853	74.853	74.837	74.824	74.824	74.823
OFFSET	-10.735	-10.120	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

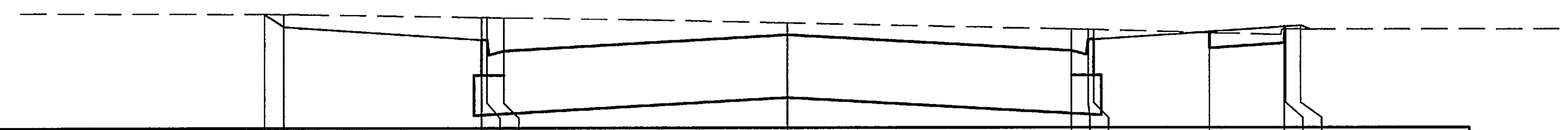
CH 573.58



DATUM 73.5

DESIGN SURFACE LEVEL	75.031	74.842	74.710	74.710	74.600	74.758	74.600	74.710	74.710	74.788	74.838	74.838	74.848
EXISTING SURFACE LEVEL	75.031	75.034	75.017	75.016	75.014	74.973	74.924	74.921	74.920	74.900	74.887	74.887	74.886
OFFSET	-10.687	-10.120	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

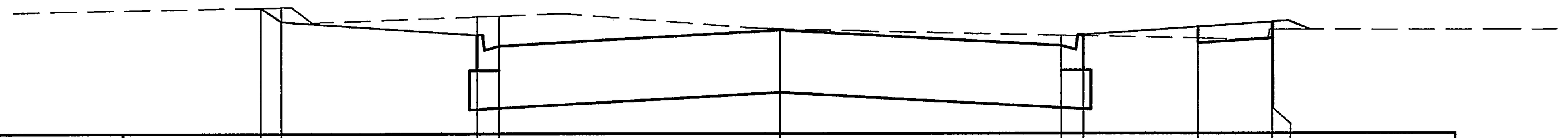
CH 560.00



DATUM 74.0

DESIGN SURFACE LEVEL	75.141	75.013	74.880	74.880	74.770	74.929	74.770	74.880	74.880	74.958	75.008	75.009	75.019
EXISTING SURFACE LEVEL	75.141	75.140	75.108	75.107	75.104	75.048	74.984	74.979	74.978	74.947	74.981	74.981	74.981
OFFSET	-10.503	-10.120	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

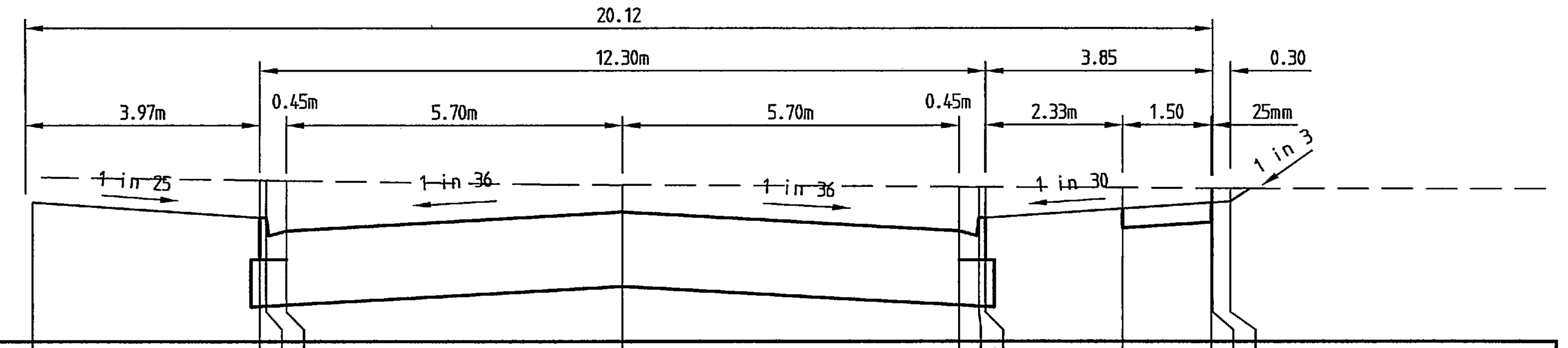
CH 540.00



DATUM 74.0

DESIGN SURFACE LEVEL	75.268	75.128	74.995	74.885	75.044	74.885	74.995	75.073	75.123	75.124
EXISTING SURFACE LEVEL	75.268	75.271	75.178	75.186	75.055	74.988	74.983	74.957	75.046	75.046
OFFSET	-10.539	-10.120	-6.150	-5.700	-0.000	5.700	6.150	8.475	9.975	10.000

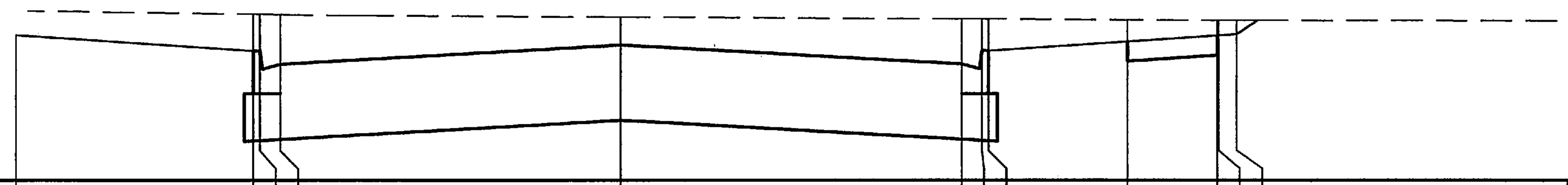
CH 526.48



DATUM 73.0

DESIGN SURFACE LEVEL	74.173	74.045	74.045	73.935	74.093	73.935	74.045	74.045	74.123	74.173	74.173	74.183
EXISTING SURFACE LEVEL		74.359	74.358	74.356	74.320	74.304	74.303	74.303	74.296	74.292	74.292	74.292
OFFSET	-10.000	-6.150	-6.040	-5.700	0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

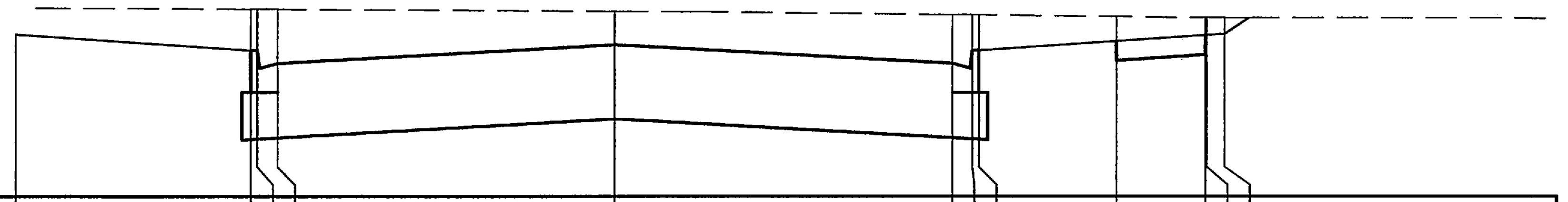
CH 644.42



DATUM 73.5

DESIGN SURFACE LEVEL	74.211	74.078	74.078	73.968	74.127	73.968	74.078	74.078	74.156	74.206	74.207	74.217
EXISTING SURFACE LEVEL		74.385	74.384	74.382	74.360	74.344	74.343	74.342	74.336	74.332	74.332	74.331
OFFSET	-10.120	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

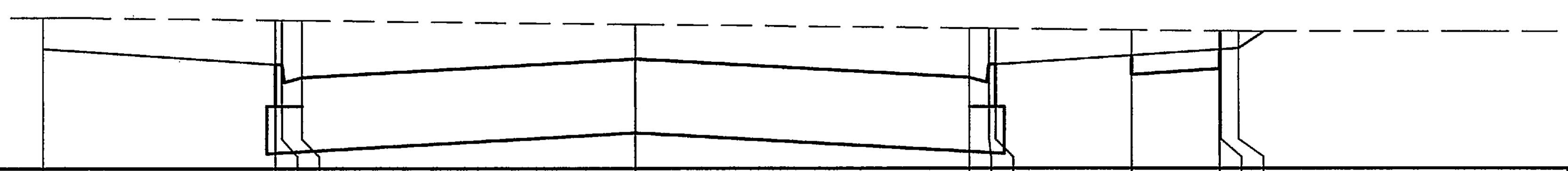
CH 640.00



DATUM 73.5

DESIGN SURFACE LEVEL	74.361	74.229	74.229	74.119	74.277	74.119	74.229	74.229	74.306	74.356	74.357	74.367
EXISTING SURFACE LEVEL		74.574	74.573	74.572	74.556	74.527	74.525	74.525	74.511	74.502	74.502	74.502
OFFSET	-10.120	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

CH 620.00



DATUM 73.5

DESIGN SURFACE LEVEL	74.512	74.379	74.379	74.269	74.428	74.269	74.379	74.379	74.457	74.507	74.508	74.518
EXISTING SURFACE LEVEL	74.772	74.754	74.754	74.752	74.719	74.686	74.684	74.683	74.670	74.661	74.661	74.661
OFFSET	-10.120	-6.150	-6.040	-5.700	-0.000	5.700	6.040	6.150	8.475	9.975	10.000	10.300

CH 600.00

Rev.	Revision Description	Designed	Date
	Drawings issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	AMENDMENTS - CH526.48 ADDED	ST	17/11/04

Designed by Steve Tough Feb 2004

Checked by John Knibbs 26/10/04

Authorized by CW 27.01.05

Approved by Council 27 Jan. 2005

2 1 0 2 4 1:100 Horiz.

1 0.5 0 1 2 1:50 Vert.

Original sheet size A1

As Constructed

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Translink Business Park Stage 2

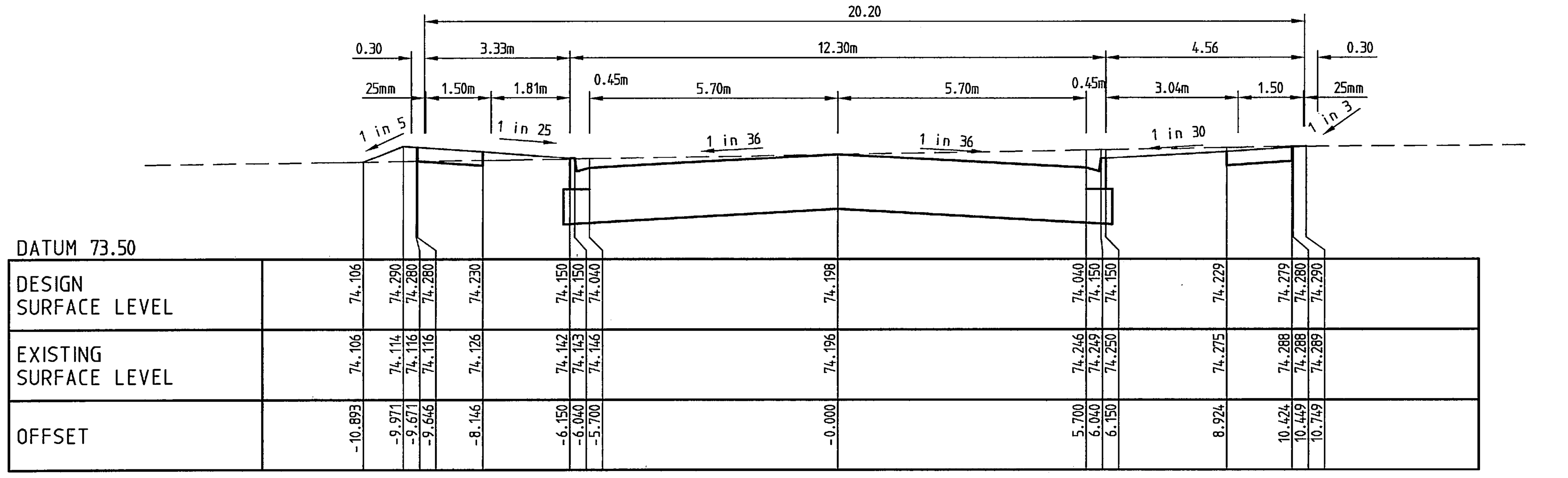
Keilor

Brimbank City Council

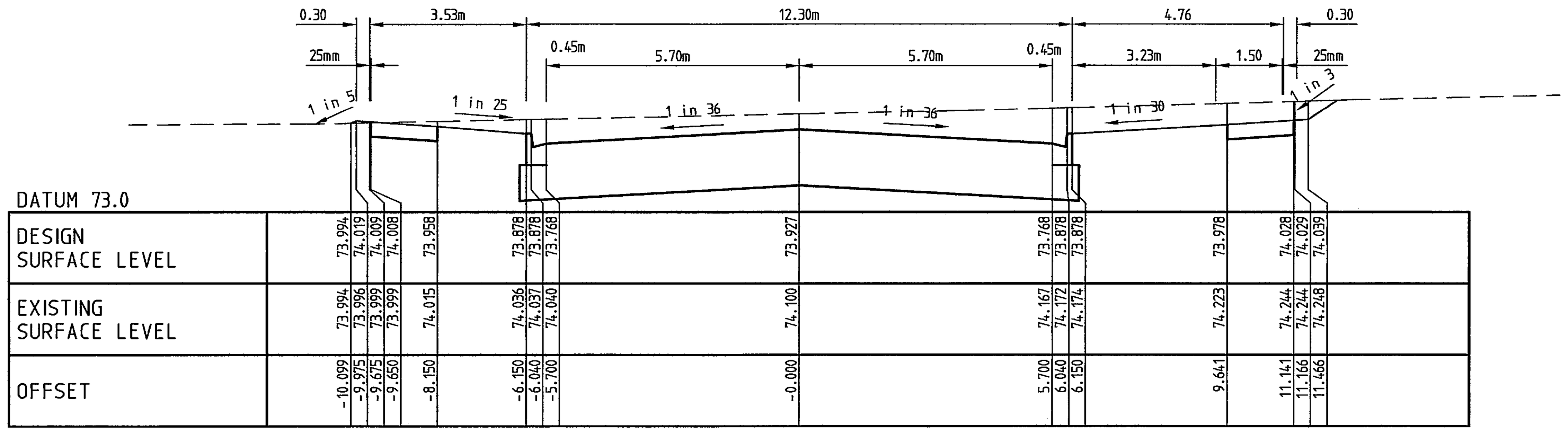
Thomsons Road Cross Sections

Drawing No. **11111E 02 R17**

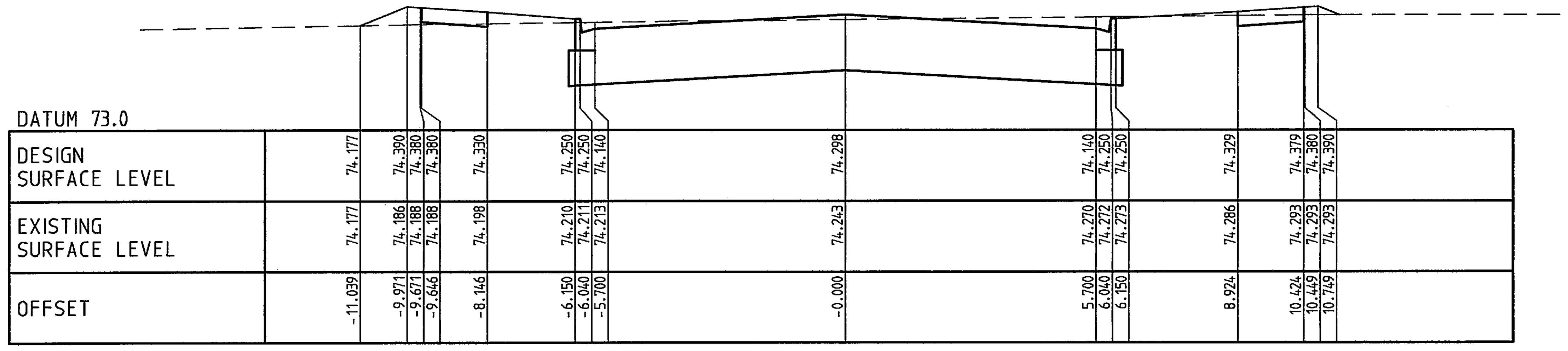
11111E 02 R18



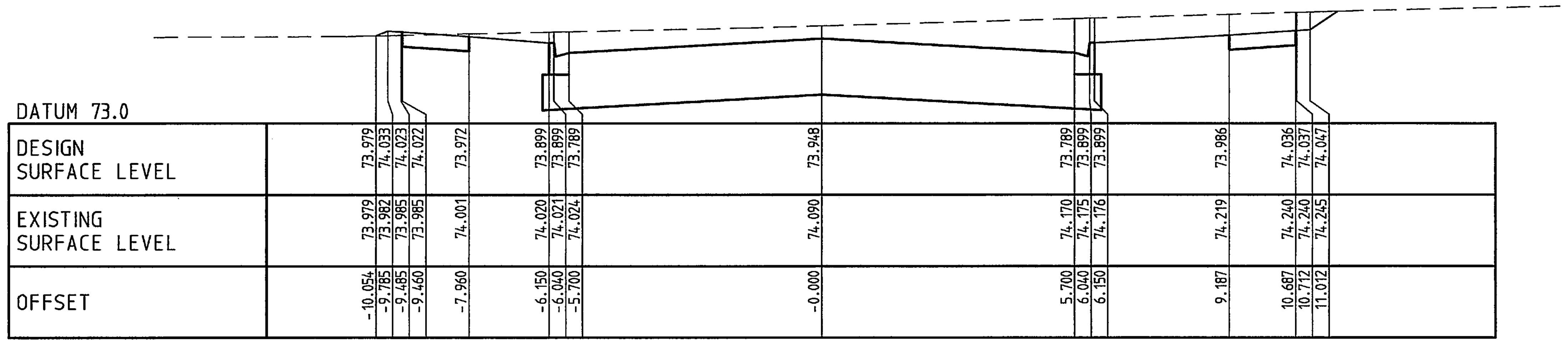
CH 320.00



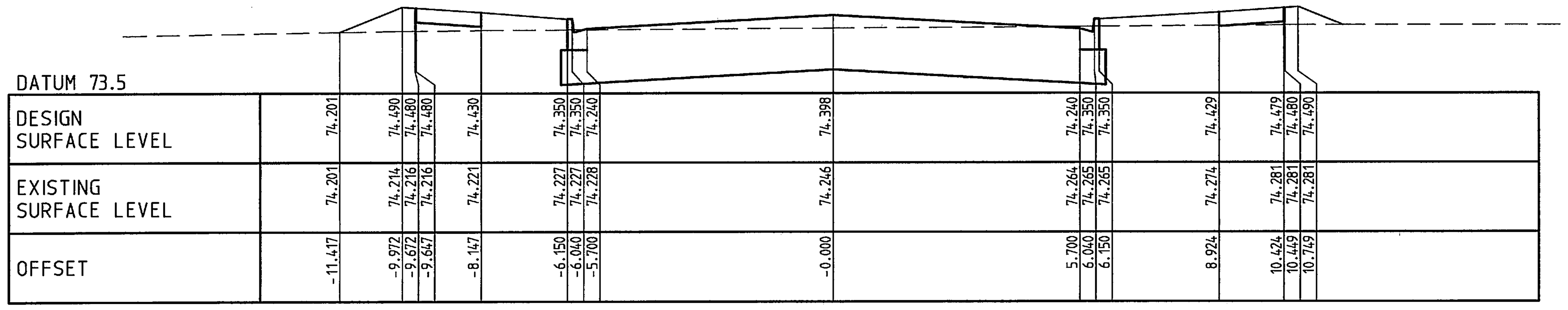
CH 374.25



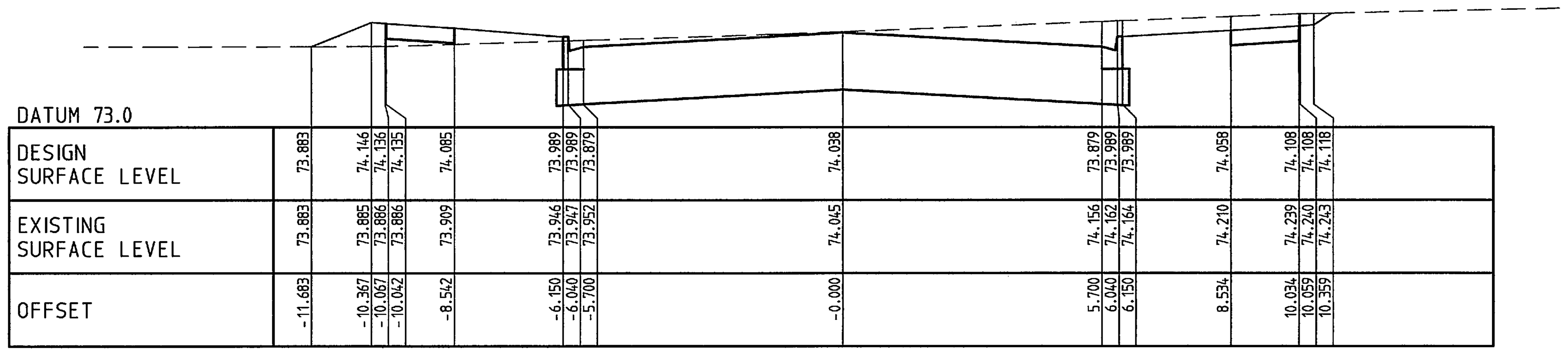
CH 300.00



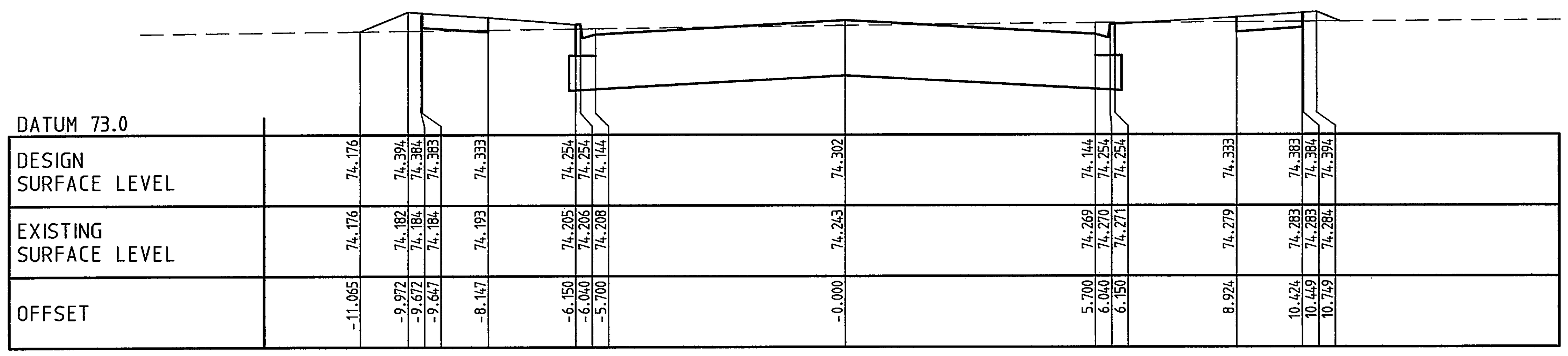
CH 370.00



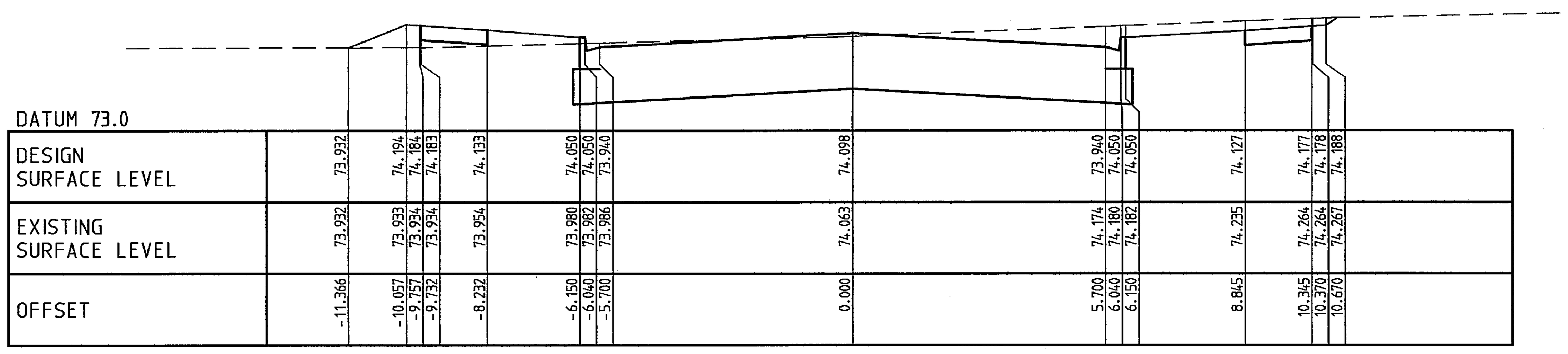
CH 280.00



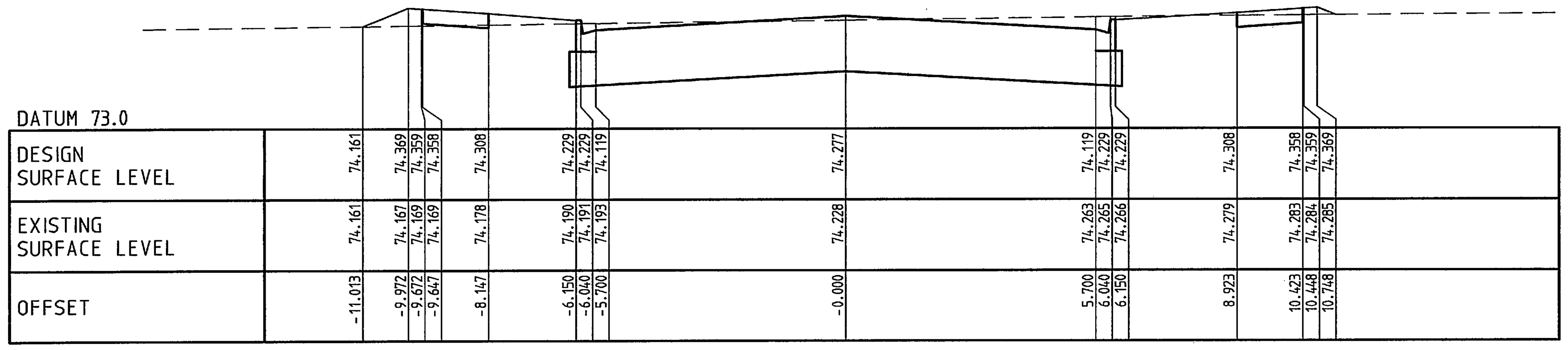
CH 352.01



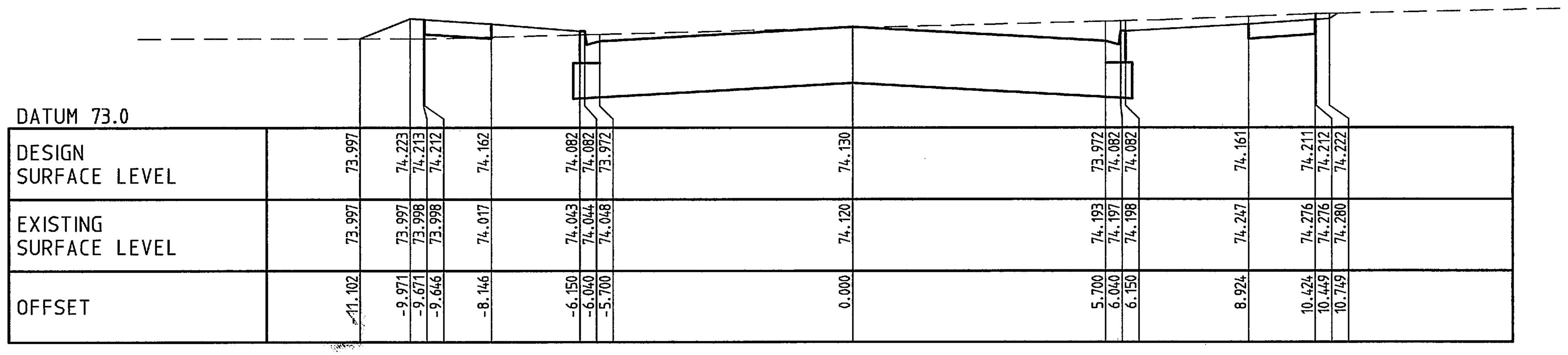
CH 260.00



CH 339.93



CH 255.00



CH 333.50

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
B	Issued for Construction	ST	27.01.05
A	SECTIONS CH 255 - CH 300 ADDED	ST	17/11/04

Designed by Steve Tough Feb 2004

Checked by John Knibbs 26/10/04

Authorized by CW 27.01.05

Approved by Council 27 Jan. 2005

2 1 0 2 4 1:100 Horiz.

1 0.5 0 1 2 1:50 Vert.

Original sheet size A1

As Constructed

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Translink Business Park Stage 2

Keilor

Brimbank City Council

Translink Drive
Cross Sections

Drawing No. 11111E 02 R18 Sheet 18 of 27

11111E 02 R19

Rev.	Revision Description	Designed	Date
D	AS CONSTRUCTED DETAIL AMENDED AT WRIGHT/HARRICK/THOMPSON	JK	21.10.05
	Drawings Issued As Constructed.	ST	05.07.05
C	Issued for Construction	ST	27.01.05
B	COUNCIL AMENDMENTS	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005
1:250
Original sheet size A1
North

As Constructed

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Translink Business Park Stage 2

Keilor
Brimbank City Council

Intersection Details
Sheet 1 of 3

Drawing No. 11111E 02 R19

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	COUNCIL AMENDMENTS	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005
1:250
Original sheet size A1
North

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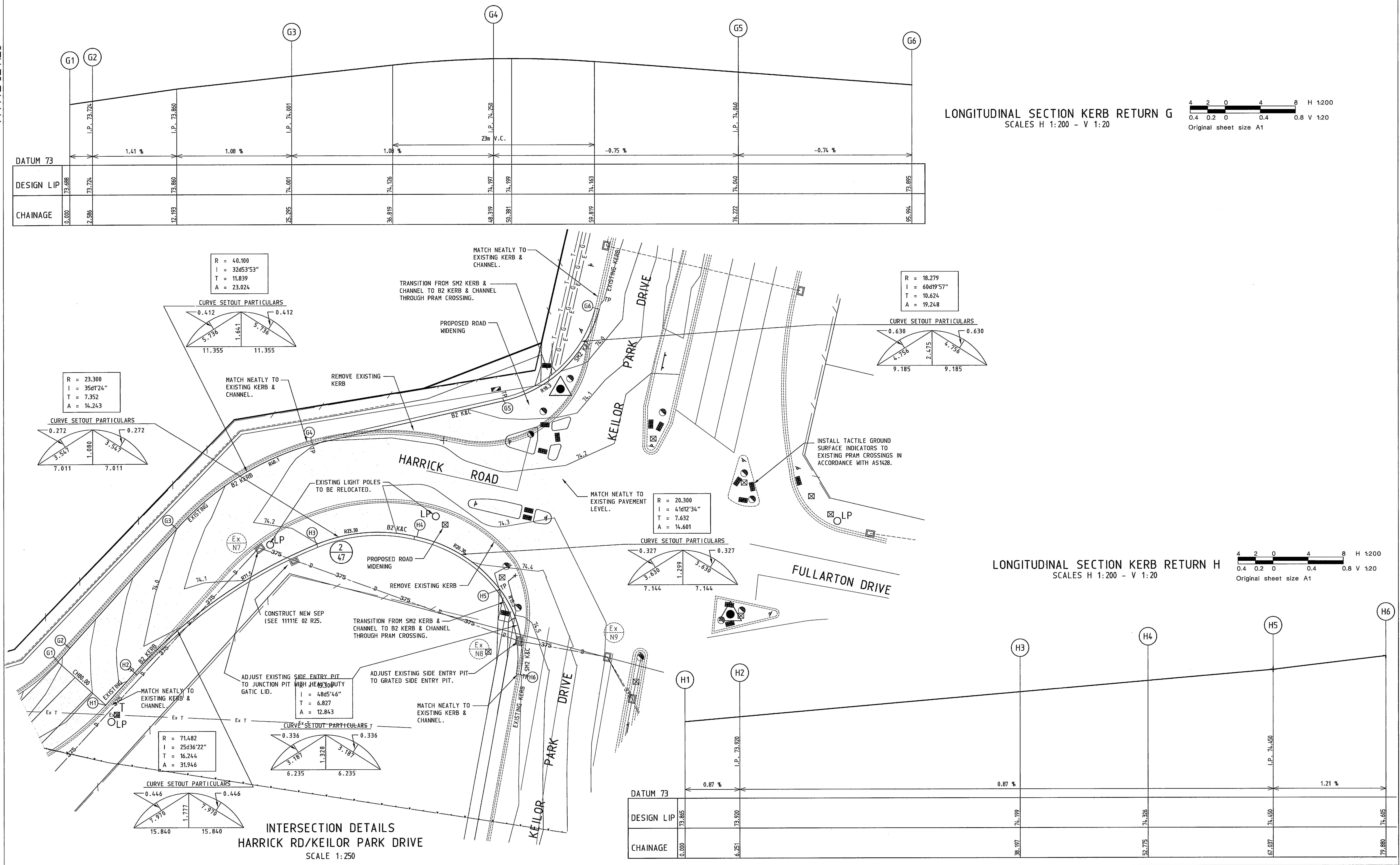
Translink Business Park Stage 2

Keilor
Brimbank City Council

Intersection Details
Sheet 1 of 3

Drawing No. **11111E 02 R19**



Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	INTERSECTION AMENDED. KERB G ALTERED TO AVOID TELSTRA PIT	ST	25/05/05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004 — Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04 — Approved by Council 27 Jan. 2005
5 2.5 0 5 10 1:250 — North
Original sheet size A1

As Constructed

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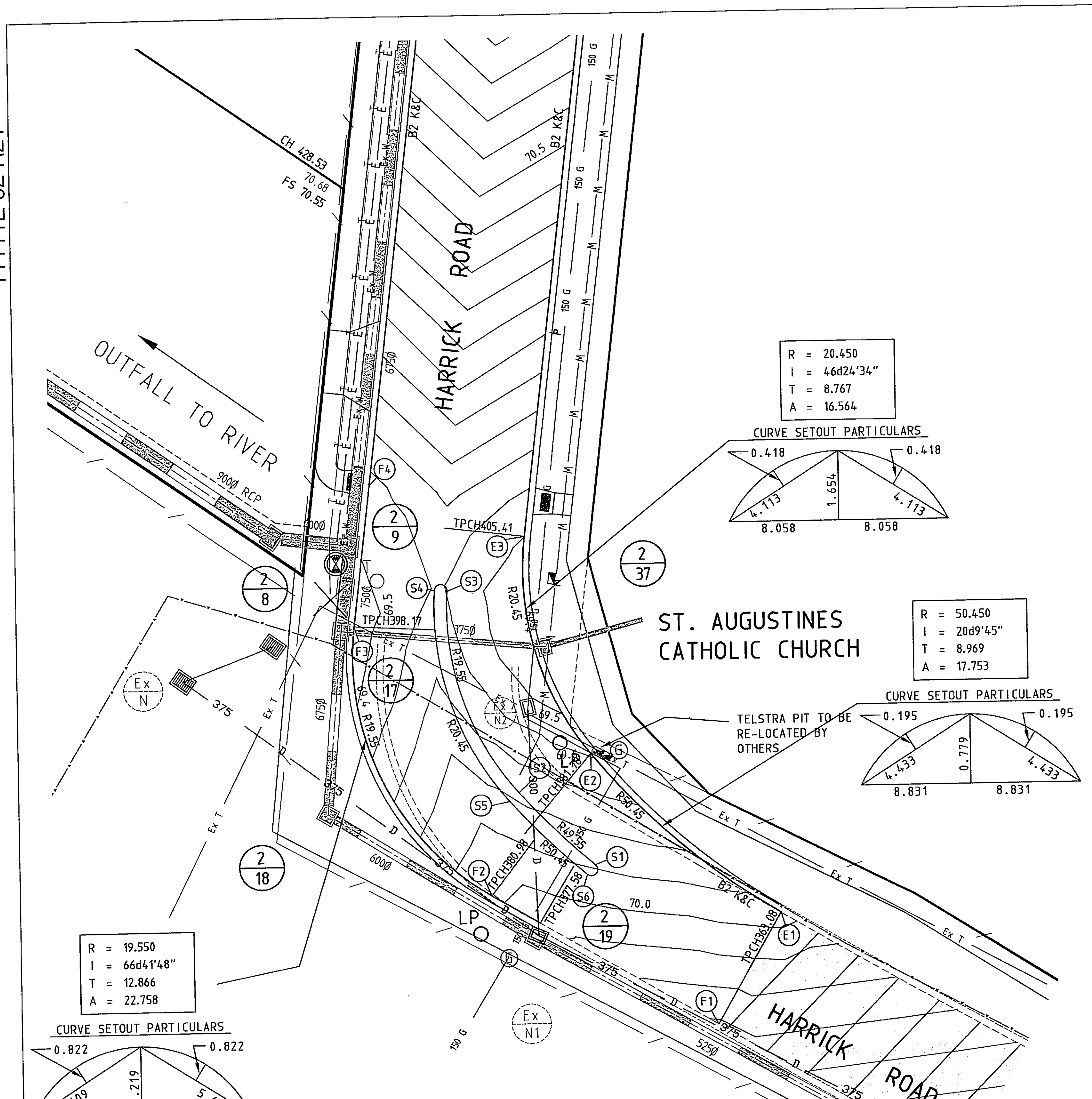
Translink Business Park Stage 2

Keilor
Brimbank City Council

Intersection Details
Sheet 2 of 3

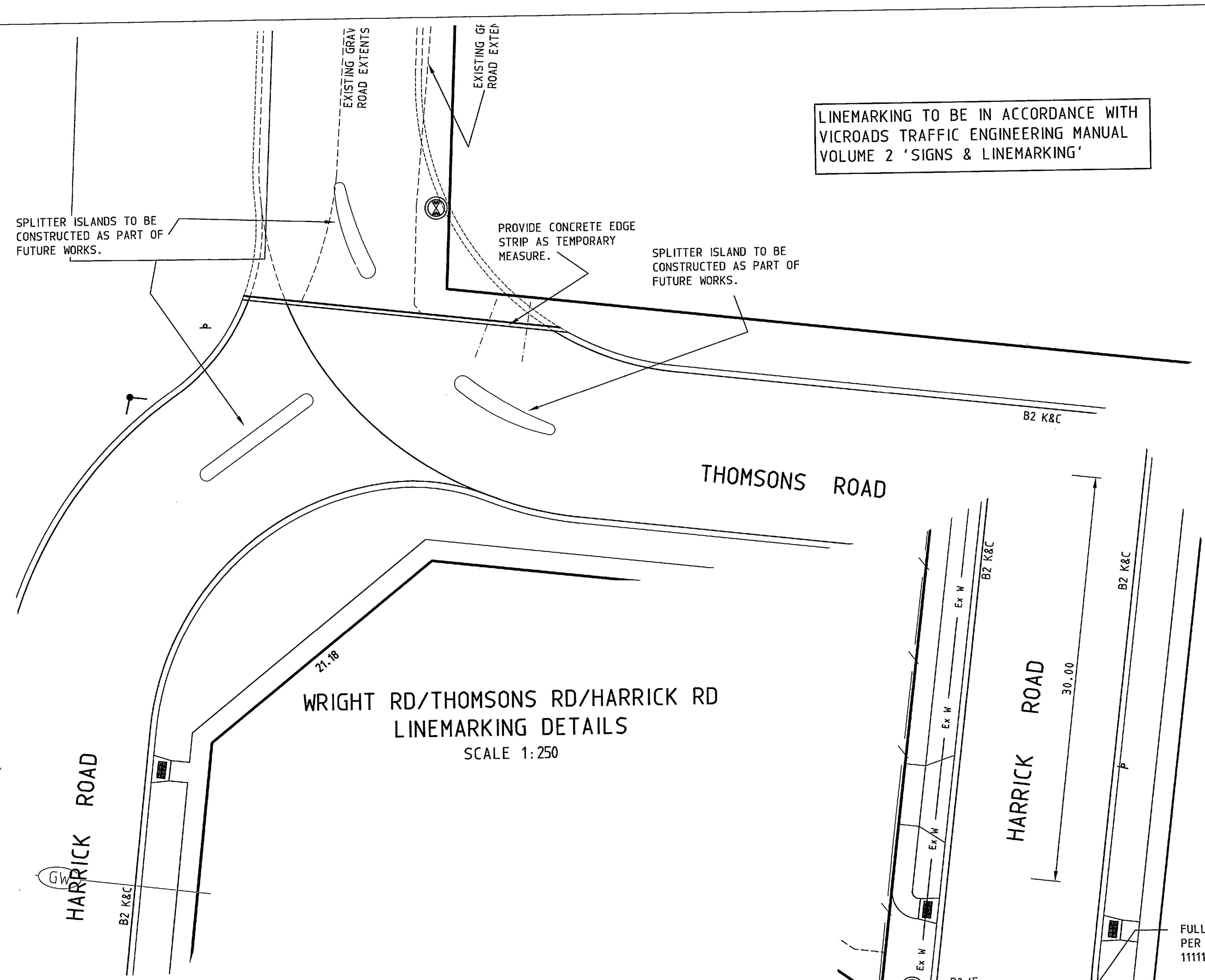
Drawing No. **11111E 02 R20** Sheet 20 of 27

11111E 02 R21



INTERSECTION DETAILS
HARRICK ROAD
SCALE 1:250

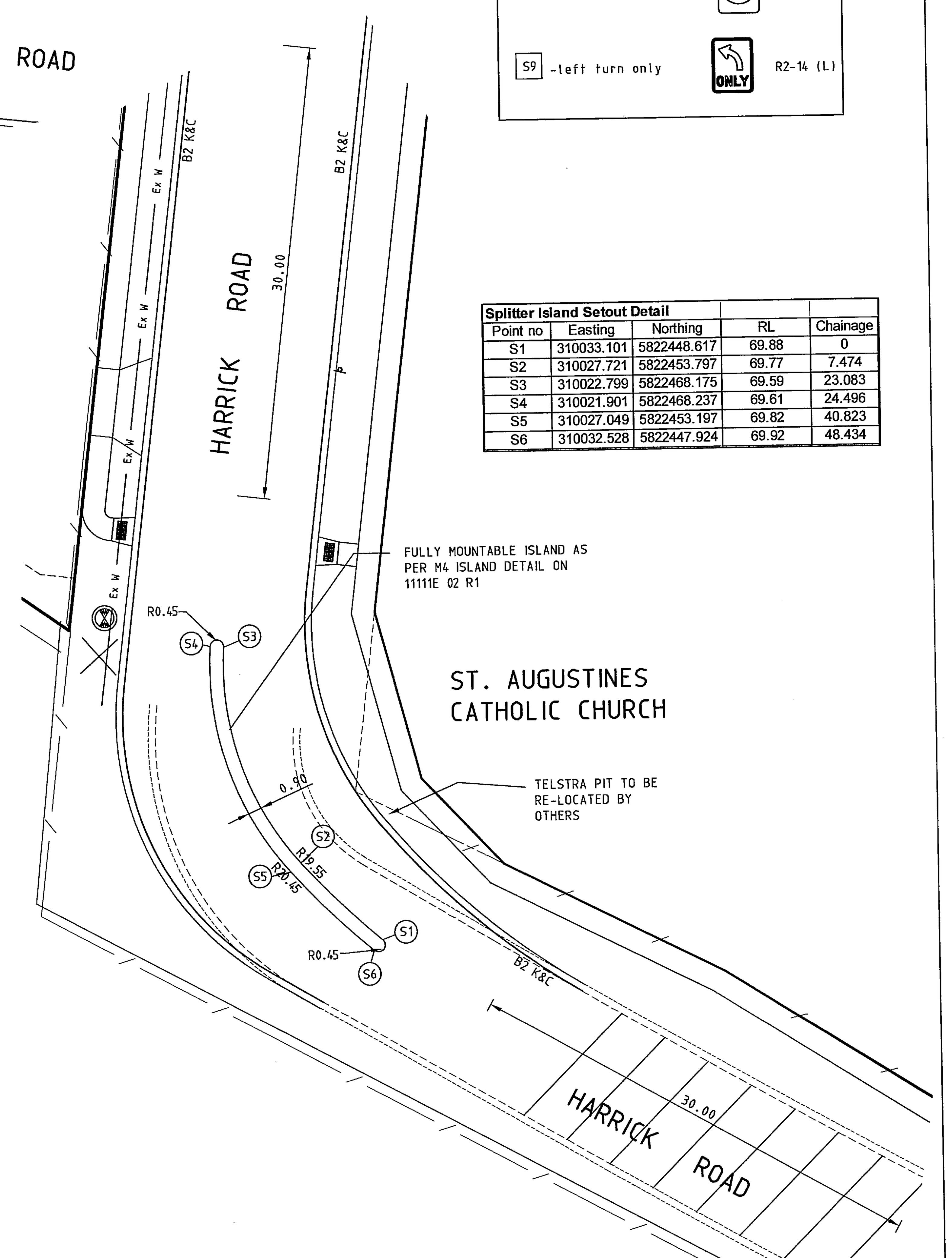
LINEMARKING TO BE IN ACCORDANCE WITH VICROADS TRAFFIC ENGINEERING MANUAL VOLUME 2 'SIGNS & LINEMARKING'



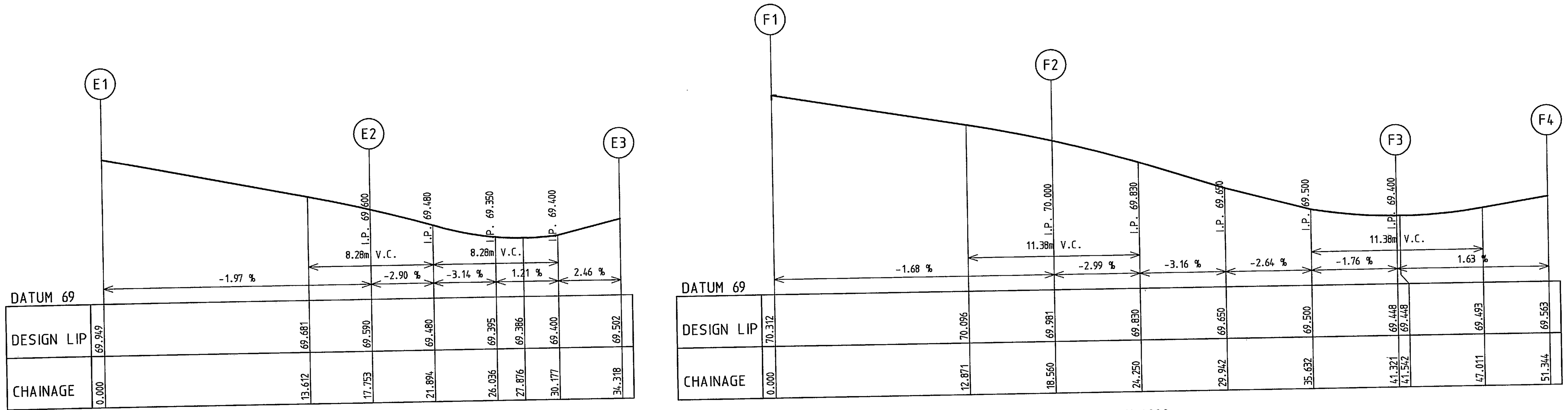
WRIGHT RD/THOMSONS RD/HARRICK RD
LINEMARKING DETAILS
SCALE 1:250

TRAFFIC SIGNS LEGEND		
S1 - keep left sign		R2-3A (L)
S2 - hazard sign		D4-1-2A
S3 - give way sign		R1-2A
S4 - hazard sign		D4-1-3
S5 - hazard sign		D4-1-2A
S6 - two way hazard.		D4-V105 A
S7 - one way sign	ONE WAY	R2-2A (L)
S8 - speed advisory sign	80	R4-1B
S9 - left turn only	ONLY	R2-14 (L)

Splitter Island Setout Detail				
Point no	Easting	Northing	RL	Chainage
S1	310033.101	5822448.617	69.88	0
S2	310027.721	5822453.797	69.77	7.474
S3	310022.799	5822468.175	69.59	23.083
S4	310021.901	5822468.237	69.61	24.496
S5	310027.049	5822453.197	69.82	40.823
S6	310032.528	5822447.924	69.92	48.434



HARRICK ROAD
LINEMARKING DETAILS
SCALE 1:250



LONGITUDINAL SECTION KERB RETURNS E & F
SCALES H 1:200 - V 1:20

H 1:200
V 1:20
Original sheet size A1

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	LINEMARKING AMENDED	ST	21/12/04
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005
1:250
Original sheet size A1
North

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Quality Endorsed Company

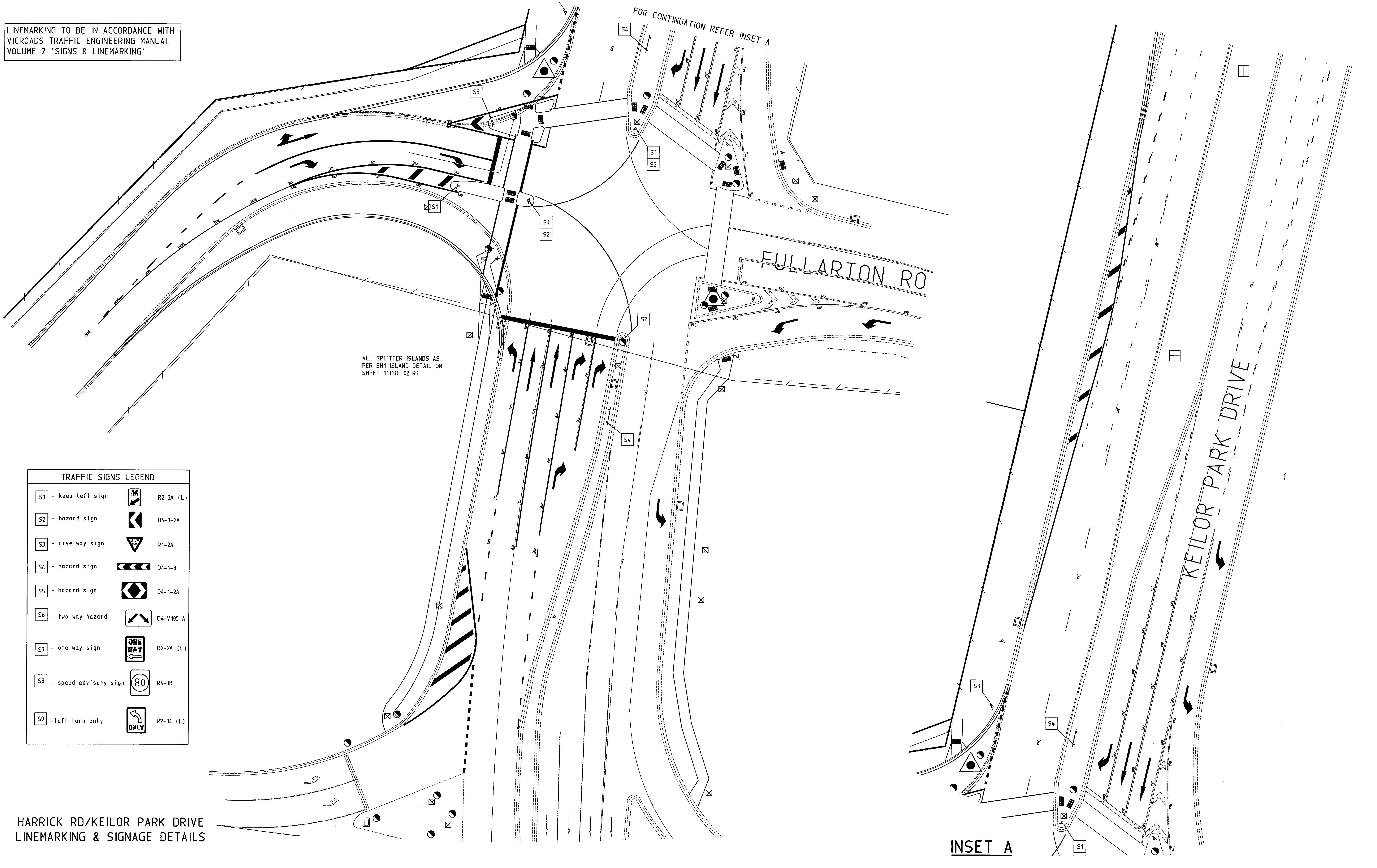
Translink Business Park Stage 2

Keilor
Brimbank City Council

Intersection Detail & Linemarking
Sheet 3 of 3

Drawing No. 11111E 02 R21

11111E 02 R22



HARRICK RD/KEILOR PARK DRIVE
LINEMARKING & SIGNAGE DETAILS

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	LINEMARKING AMENDED AROUND NORTH WEST SPLITTER ISLAND	ST	25/05/05
B	Issued for Construction	ST	27.01.05
A	COUNCIL AMENDMENTS	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

5 2.5 0 5 10 1:250

North

Original sheet size A1

As Constructed

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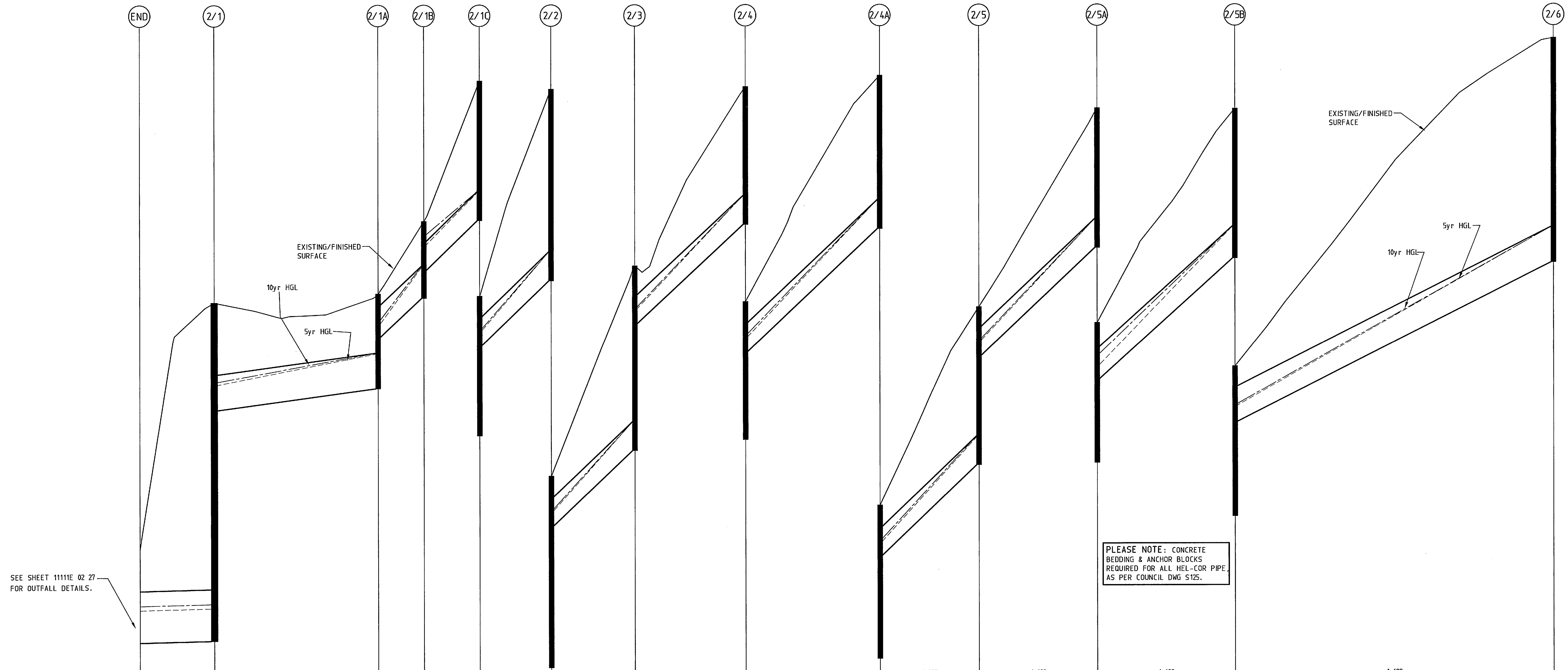
Translink Business Park Stage 2

Keilor

Brimbank City Council

Harrick Road/Keilor Park Drive
Linemarking & Signage Details

Drawing No. **11111E 02 R22** Sheet 22 of 27



PLEASE NOTE: CONCRETE BEDDING & ANCHOR BLOCKS REQUIRED FOR ALL HEL-COR PIPE, AS PER COUNCIL DWG S125.

Pipe	Design Discharge (m3/s)	Pipe Capacity(m3/s)	Full Velocity(m/s)	Actual Velocity (m/s)	Pipe Diameter (mm)	Pipe Grade
END – 2/1	1.629	1.945	1.670	1.866	1200 RCP	1 in 437
2/1 – 2/1A	1.629	1.706	3.090	3.522	825 RCP	1 in 76.8
2/1A – 2/1B	1.629	3.357	5.630	5.961	750 HEL-COR	1 in 12
2/1B – 2/1C	1.629	2.594	5.380	6.007	675 HEL-COR	1 in 11.3
2/1C – 2/2	1.629	2.613	5.420	6.045	675 HEL-COR	1 in 11.2
2/2 – 2/3	1.629	2.610	5.420	6.039	675 HEL-COR	1 in 11.2
2/3 – 2/4	1.629	2.601	5.400	6.022	675 HEL-COR	1 in 11.3
2/4 – 2/4A	1.629	2.630	5.460	6.078	675 HEL-COR	1 in 11
2/4A – 2/5	1.629	2.627	5.450	6.071	675 HEL-COR	1 in 11.1
2/5 – 2/5A	1.629	2.624	5.450	6.066	675 HEL-COR	1 in 11.1
2/5A – 2/5B	1.629	3.418	5.730	6.043	750 HEL-COR	1 in 11.5
2/5B – 2/6	1.629	3.330	6.040	6.005	825 RCP CLASS 3	1 in 20.2

DATUM R.L. 13 (END), 18 (2/1C), 27 (2/2), 32 (2/4), 42 (2/4A), 47 (2/5A), 53 (2/5B)

Pit	DEPTH TO INVERT	DESIGN INVERT LEVEL	FINISHED SURFACE LEVEL	NATURAL SURFACE LEVEL	CHAINAGE
END	2.174 / 2.174	16.100 / 16.100	18.274	18.274	0.000
2/1	7.460 / 2.100	16.140 / 21.500	23.600	24.000	17.461
2/1A	2.204 / 1.004	22.000 / 23.200	24.204	24.204	55.883
2/1B	1.784 / 1.134	24.100 / 24.750	25.884	25.884	66.644
2/1C	3.249 / 1.149	25.900 / 28.000	29.149	29.149	79.694
2/2	4.458 / 1.158	29.500 / 32.800	33.958	33.958	96.460
2/3	4.290 / 1.340	34.550 / 37.500	38.840	38.840	116.065
2/4	3.209 / 1.159	39.800 / 41.850	43.009	43.009	142.014
2/4A	3.565 / 1.165	44.700 / 47.100	48.265	48.265	173.456
2/5	3.678 / 1.128	49.200 / 51.750	52.878	52.878	196.680
2/5A	3.255 / 1.305	54.250 / 56.200	57.505	57.505	224.386
2/5B	3.488 / 1.288	59.000 / 61.200	62.488	62.488	256.685
2/6	5.229 / 5.129	64.900 / 65.000	70.129	70.129	331.321

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - OUTFALL UPDATED	ST	21/12/04
A	COUNCIL AMENDMENTS - PIPE SIZES UPDATED	ST	17/11/04

Designed by Steve Tough Au 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

10 5 0 10 20 1:500
1 0.5 0 1 2 1:50
Original sheet size A1
North

As Constructed

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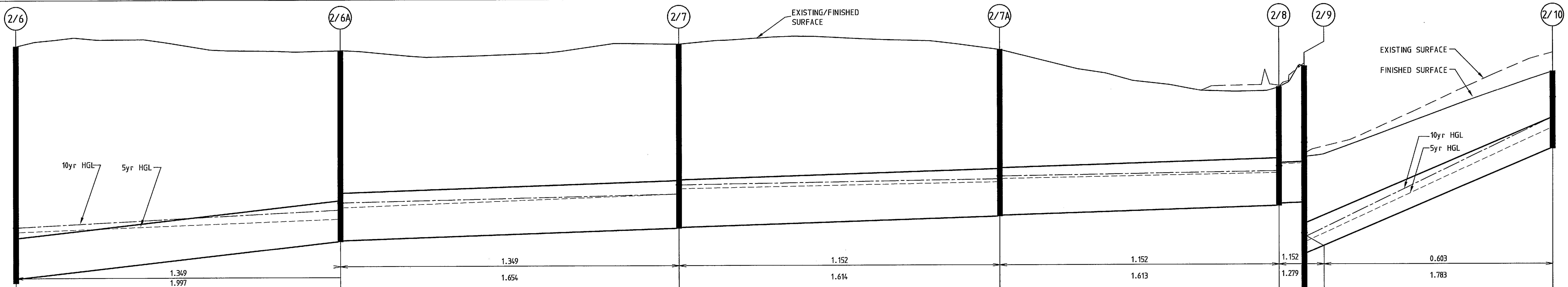
Translink Business Park Stage 2

Keilor

Brimbank City Council

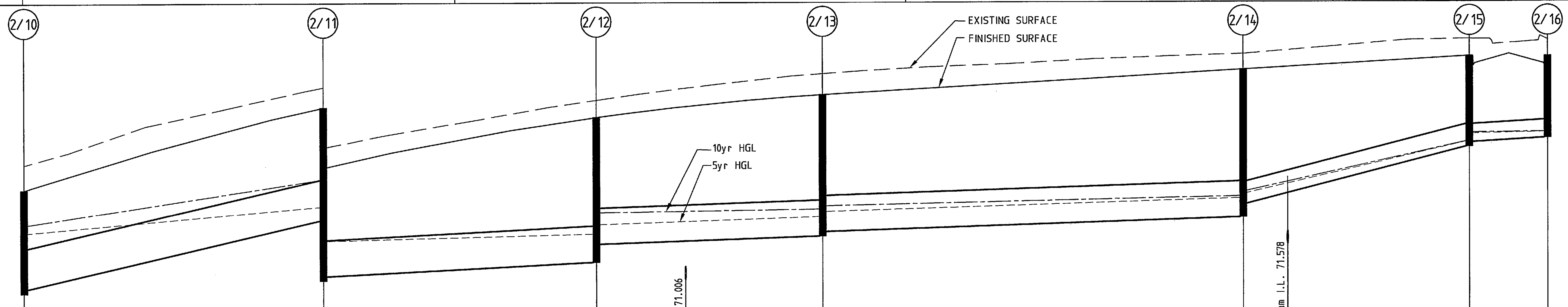
Drainage Longitudinal Section
Sheet 1 of 5

Drawing No. 11111E 02 R23 Sheet 23 of 27



	2/6 – 2/6A	2/6A – 2/7	2/7 – 2/7A	2/7A – 2/8	2/8 – 2/9	2/9 – 2/10
Design Discharge (m3/s)	1.349	1.349	1.152	1.152	1.152	0.603
Pipe Capacity(m3/s)	1.997	1.654	1.614	1.613	1.279	1.783
Full Velocity(m/s)	3.040	1.850	1.810	1.810	1.720	4.840
Actual Velocity (m/s)	3.261	2.066	1.965	1.964	1.750	4.369
Pipe Diameter (mm)	900 CLASS 3	1050	1050	1050	900	675
Pipe Grade	1 in 89.7	1 in 295	1 in 310	1 in 310	1 in 200	1 in 24
DATUM R.L.	63					63

	2/6	2/6A	2/7	2/7A	2/8	2/9	2/10
DEPTH TO INVERT	5.229 / 5.129	4.216 / 4.196	4.064 / 4.044	3.682 / 3.662	2.627 / 2.607	3.011 / 2.131	1.712
DESIGN INVERT LEVEL	64.900 / 65.000	65.805 / 65.825	66.080 / 66.100	66.330 / 66.350	66.550 / 66.570	66.620 / 67.500	69.800
FINISHED SURFACE LEVEL	70.129	70.021	70.144	70.012	69.177	69.631	71.512
NATURAL SURFACE LEVEL	70.129	70.021	70.144	70.012	69.209	69.698	71.930
CHAINAGE	331.321	403.496	478.767	550.089	612.162	617.765	672.988



225mm I.L. 71.006

225mm I.L. 71.578

	2/10 – 2/11	2/11 – 2/12	2/12 – 2/13	2/13 – 2/14	2/14 – 2/15	2/15 – 2/16
Design Discharge (m3/s)	0.367	0.362	0.239	0.229	0.033	0.017
Pipe Capacity(m3/s)	1.311	0.451	0.369	0.363	0.276	0.071
Full Velocity(m/s)	3.560	1.540	1.260	1.240	2.500	1.000
Actual Velocity (m/s)	3.052	1.714	1.343	1.313	1.689	0.825
Pipe Diameter (mm)	675	600	600	600	375	300
Pipe Grade	1 in 44.4	1 in 203	1 in 302	1 in 312	1 in 40.2	1 in 187
DATUM R.L.	67	68				

	2/10	2/11	2/12		2/13	2/14		2/15	2/16
DEPTH TO INVERT	1.712 / 1.637	1.874 / 1.799	2.403 / 2.103		2.348 / 2.273	2.454 / 2.229		1.508 / 1.433	1.358
DESIGN INVERT LEVEL	69.800 / 69.875	71.000 / 71.075	71.300 / 71.600	71.649	71.725 / 71.800	72.025 / 72.250	72.426	73.190 / 73.265	73.334
FINISHED SURFACE LEVEL	71.512	72.874	73.703		74.073	74.479		74.697	74.692
NATURAL SURFACE LEVEL	71.930	73.209	73.988		74.421	74.740		74.983	74.963
CHAINAGE	672.993	722.989	768.575	783.459	806.354	876.570	883.984	914.339	927.388

DRAINAGE LONGITUDINAL SECTION
SCALE H 1:500 V 1:50

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
D	DRAINAGE LINE FROM PIT 2/6A - 2/9 REGRADED, PIPE FROM 2/7A-2/8 UPGRADED	ST	01/02/05
C	Issued for Construction	ST	27.01.05
B	COUNCIL AMENDMENTS	ST	21/12/04
A	COUNCIL AMENDMENTS - PIPE SIZES UPDATED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

10 5 0 10 20 1:500
1 0.5 0 1 2 1:50
Original sheet size A1
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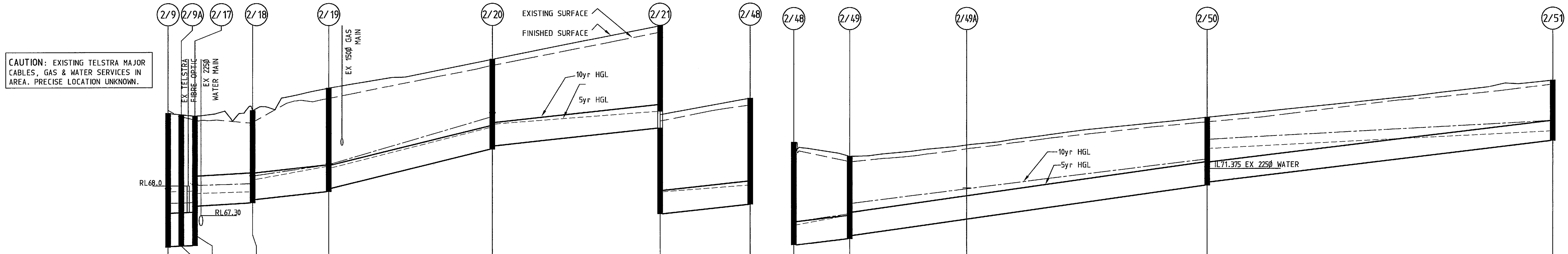
Keilor
Brimbank City Council

Drainage Longitudinal Section
Sheet 2 of 5

Drawing No. **11111E 02 R24**

11111E 02 R25



Pipe	Design Discharge (m3/s)	Pipe Capacity (m3/s)	Full Velocity (m/s)	Actual Velocity (m/s)	Pipe Diameter (mm)	Pipe Grade
2/9 – 2/9A	0.582	0.665	1.460	1.280	750	1 in 305
2/9A – 2/17	0.582	0.665	1.460	1.280	750	1 in 305
2/17 – 2/18	0.458	0.640	1.740	1.887	675	1 in 187
2/18 – 2/19	0.458	0.646	2.210	2.398	600	1 in 98.6
2/19 – 2/20	0.458	0.691	3.090	3.299	525	1 in 42.3
2/20 – 2/21	0.458	0.458	2.050	2.050	525	1 in 96.3
2/21 – 2/48	0.458	0.458	2.050	2.050	525	1 in 96.3

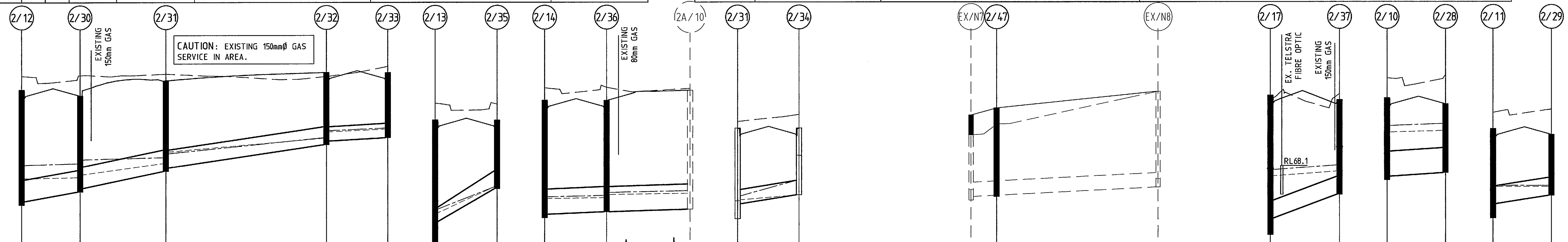
DATUM R.L. 64 (2/9), 66 (2/21)

Pit	Depth to Invert	Design Invert Level	Finished Surface Level	Natural Surface Level	Chainage
2/9	3.011 / 2.991	66.620 / 66.640	69.631	69.698	0.000
2/9A	2.940 / 2.944	66.650 / 66.655	69.599	69.537	3.000
2/17	2.912 / 2.022	66.660 / 67.550	69.572	69.482	6.091
2/18	2.071 / 1.996	67.620 / 67.695	69.691	69.408	19.147
2/19	2.322 / 2.247	67.870 / 67.945	70.192	69.961	36.394
2/20	2.020 / 1.945	68.820 / 68.895	70.841	70.704	73.466
2/21	2.300 / 2.225	69.290 / 69.365	71.590	71.448	111.476
2/48	2.381 / 2.306	69.587 / 69.605	71.968	71.816	131.866

Pipe	Design Discharge (m3/s)	Pipe Capacity (m3/s)	Full Velocity (m/s)	Actual Velocity (m/s)	Pipe Diameter (mm)	Pipe Grade
2/48 – 2/49	0.458	0.521	2.100	2.310	525	1 in 56
2/49 – 2/50	0.458	0.526	2.350	2.220	525	1 in 74
2/50 – 2/51	0.171	0.310	1.950	1.997	450	1 in 84.6

DATUM R.L. 67

Pit	Depth to Invert	Design Invert Level	Finished Surface Level	Natural Surface Level	Chainage
2/48	2.381 / 2.306	69.587 / 69.605	71.968	71.816	0.000
2/49	1.852 / 1.777	69.830 / 69.905	71.652	71.531	12.651
2/49A		70.240			
2/50	1.527 / 1.452	71.000 / 71.075	72.527	72.425	93.610
2/51	1.359	72.000	73.359	73.272	171.849



Pipe	Design Discharge (m3/s)	Pipe Capacity (m3/s)	Full Velocity (m/s)	Actual Velocity (m/s)	Pipe Diameter (mm)	Pipe Grade
2/12 – 2/30	0.143	0.363	2.280	0.900	450	1 in 61.5
2/30 – 2/31	0.138	0.397	2.490	2.267	450	1 in 51.6
2/31 – 2/32	0.067	0.210	1.900	1.694	375	1 in 69.7
2/32 – 2/33	0.056	0.071	1.000	1.109	300	1 in 187
2/13 – 2/35	0.012	0.462	4.190	1.776	300	1 in 19
2/14 – 2/36	0.194	0.278	1.240	1.344	525	1 in 261
2/36 – 2A/10	0.194	0.240	1.070	1.192	525	1 in 351
2/31 – 2/34	0.070	0.117	1.660	1.729	300	1 in 68
EX/N7 – EX/N8	0.029	0.068	0.970	0.933	EX 300	1 in 200
2/17 – 2/37	0.143	0.325	2.940	1.290	375	1 in 29.1
2/10 – 2/28	0.266	0.351	1.570	1.190	525	1 in 164
2/11 – 2/29	0.011	0.209	1.890	1.002	375	1 in 70.3

225mm I.L. 71.338 — 150mm I.L. 71.457

DATUM R.L.: 68 (2/12), 69 (2/13), 69 (2/14), 69 (2/31), 69 (EX/N7), 64 (2/17), 66 (2/10), 68 (2/11)

Pit	Depth to Invert	Design Invert Level	Finished Surface Level	Natural Surface Level	Chainage
2/12	2.403 / 2.328	71.300 / 71.375	73.703	73.988	0.000
2/30	2.004 / 1.929	71.575 / 71.650	73.579	73.999	12.300
2/31	1.891 / 1.816	72.000 / 72.075	73.891	74.032	30.365
2/32	1.504 / 1.429	72.560 / 72.635	74.064	73.981	64.197
2/33	1.357	72.704	74.061	74.189	77.108
2/13	2.573 / 2.123	71.500 / 71.950	74.073	74.421	0.000
2/35	1.433	72.634	74.067	74.402	13.050
2/14	2.454 / 2.379	72.025 / 72.100	74.479	74.740	0.000
2/36	2.323 / 2.323	72.150 / 72.150 / 72.161	74.473	74.750	13.051 / 17.155
		72.191			27.195
2A/10	2.486	72.200	74.686	74.722	30.612
2/31	1.891 / 1.581	72.000 / 72.310	73.891	74.032	0.000
2/34	1.392	72.500	73.892	74.178	12.915
EX/N7	1.363 / 1.288	72.383 / 72.458	73.746	73.746	0.000
2/47	1.829 / 1.824	72.481 / 72.486	74.310	73.968	5.440
EX/N8	2.000	72.655	74.655	74.655	39.360
2/17	2.912 / 2.572	66.660 / 67.000	69.572	69.482	0.000
2/37	1.977	67.500	69.477	69.605	14.572
2/10	1.712 / 1.637	69.800 / 69.875	71.512	71.930	0.000
2/28	1.437	69.950	71.387	71.995	12.300
2/11	1.874 / 1.574	71.000 / 71.300	72.874	73.209	0.000
2/29	1.275	71.475	72.750	73.286	12.300

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
E	DRAINAGE LINES 2/9-2/18 & 2/17-2/37 REGRADED	ST	01/02/05
D	Issued for Construction	ST	27.01.05
C	DRAINAGE LINE PIT 2/48 - 2/51 INCLUDED, LINE FROM PIT 2/22 - 2/27 REMOVED	ST	27/01/05
B	COUNCIL AMENDMENTS - PIPE 2/25/ TO 2/38 UPDATED TO 525 dia	ST	21/12/04
A	COUNCIL AMENDMENTS - PIPE SIZES UPDATED	ST	17/11/04

Designed by Steve Tough Au 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005

Scale 1:500 (10 5 0 10 20) — 1:50 (1 0.5 0 1 2) — Original sheet size A1 — North

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Drainage Longitudinal Sections
Sheet 3 of 5

Drawing No. **11111E 02 R25** Sheet 25 of 27

Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
C	Issued for Construction	ST	27.01.05
B	AMENDMENTS - PIT 2/4M - 2/44 UPDATED	ST	21/12/04
A	COUNCIL AMENDMENTS - PIPE SIZES UPDATED & PIPE LENGTHS ADDED	ST	17/11/04

Designed by Steve Tough Feb 2004
Authorized by CW 27.01.05
Checked by John Knibbs 26/10/04
Approved by Council 27 Jan. 2005

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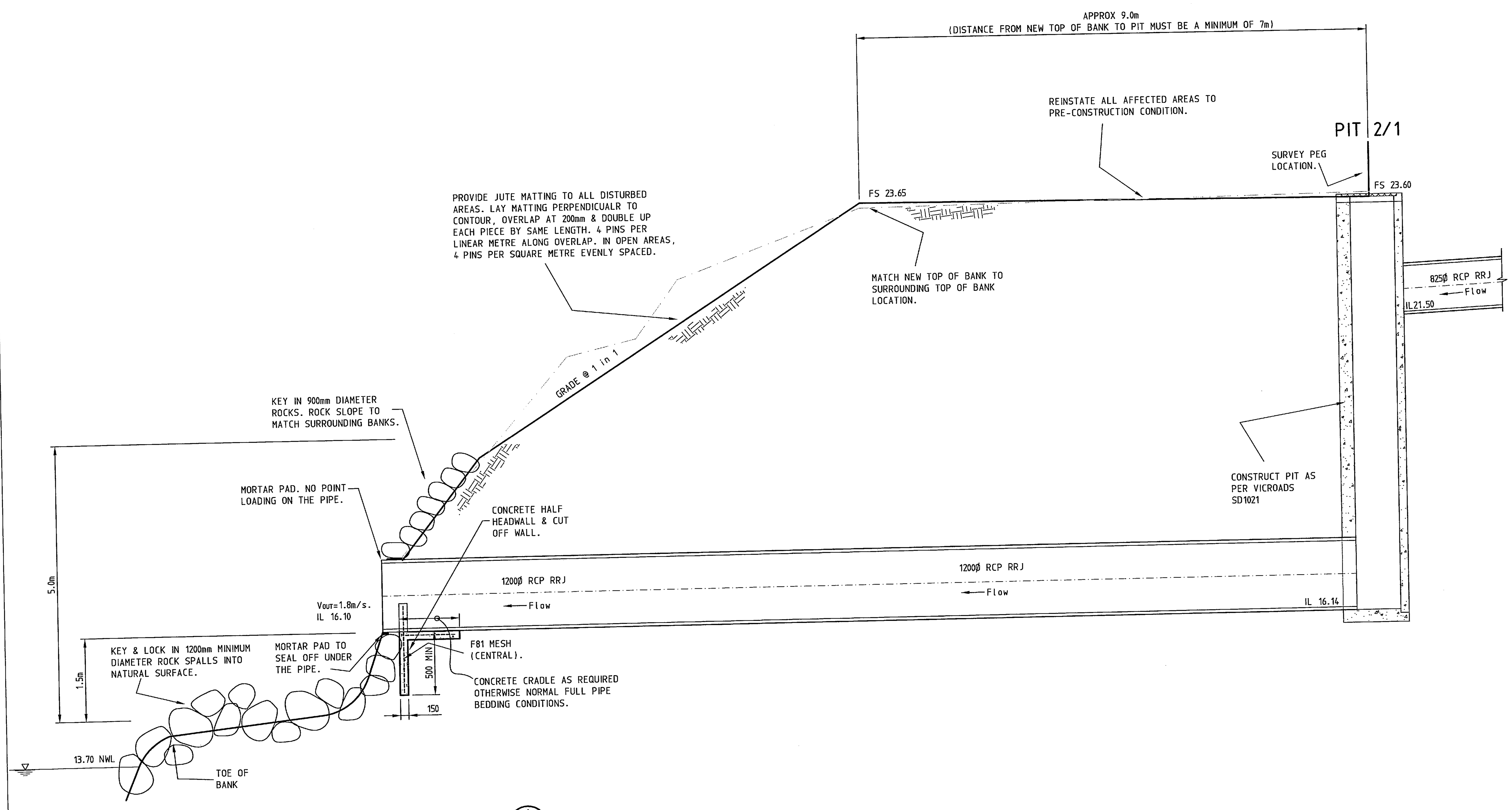
Drainage & Main Drain Longitudinal Section Sheet 4 of 5

Drawing No. 11111E 02 R26

1111E 02 R27

9691



SECTION A
SCALE 1:50

DRAINAGE PIT SCHEDULE

PIT NO.	TYPE	INTERNAL WD	LEN	INLET DIA	INV LEV	OUTLET DIA	INV LEV	PIT FIN RL	DEPTH	REMARKS
2/01	JUNCTION PIT	1350	1050	825	21.500	1200	16.140	23.60	7.46	See Vicroads SD 1020
2/1A	JUNCTION PIT	1200	1200	750	23.200	825	22.000	24.20	2.20	See Vicroads SD 1021
2/1B	JUNCTION PIT	1200	1200	675	24.750	750	24.100	25.91	1.81	See Vicroads SD 1021
2/1C	JUNCTION PIT	1200	1200	675	28.000	675	25.900	29.15	3.25	See Vicroads SD 1021
2/02	JUNCTION PIT	1200	1200	675	32.800	675	29.500	33.96	4.46	See Vicroads SD 1021
2/03	JUNCTION PIT	1200	1200	675	37.500	675	34.550	38.84	4.29	See Vicroads SD 1021
2/04	JUNCTION PIT	1200	1200	675	41.850	675	39.800	43.01	3.21	See Vicroads SD 1021
2/4A	JUNCTION PIT	1200	1200	675	47.100	675	44.700	48.27	3.57	See Vicroads SD 1021
2/05	JUNCTION PIT	1200	1200	675	51.750	675	49.200	52.89	3.69	See Vicroads SD 1021
2/5A	JUNCTION PIT	1200	1200	750	56.200	675	54.250	57.51	3.26	See Vicroads SD 1021
2/5B	JUNCTION PIT	1200	1200	825	61.200	750	59.000	62.49	3.49	See Vicroads SD 1021
2/06	JUNCTION PIT	1200	1200	900	65.000	825	64.900	70.13	5.23	See Vicroads SD 1021
				525	68.000			70.13		
2/6A	JUNCTION PIT	1200	1200	1050	65.880	900	65.805	70.02	4.22	See Vicroads SD 1021
2/07	JUNCTION PIT	1200	1200	1050	66.330	1050	66.255	70.14	3.89	See Vicroads SD 1021
				450	67.500			70.14		
2/7A	JUNCTION PIT	1200	1200	900	66.625	1050	66.550	70.01	3.46	See Vicroads SD 1021
2/08	JUNCTION PIT	1200	1200	900	67.100	900	67.025	69.20	2.17	See Vicroads SD 1021
2/09	JUNCTION PIT	1350	1350	675	67.500	900	67.125	69.60	2.47	See Vicroads SD 1021
				750	67.200			69.60		
2/10	SEP S200 S255	900	1200	675	69.875	675	69.800	71.51	1.71	
				525	69.875			71.51		
2/11	SEP S200 S255	900	900	600	71.075	675	71.000	72.87	1.87	
				375	71.300			72.87		
2/12	SEP S200 S255	900	900	600	71.600	600	71.300	73.70	2.40	
				450	71.375			73.70		
2/13	SEP S200 S255	900	900	600	71.800	600	71.725	74.07	2.35	
				375	71.950			74.07		
2/14	SEP S200 S255	900	600	375	72.250	600	72.025	74.48	2.45	
				525	72.100			74.48		
2/15	SEP S200	900	600	300	73.265	375	73.190	74.70	1.51	
2/16	SEP S200	900	600			300	73.334	74.69	1.36	Provide 225Ø Property Connection (1 in 100 Grade) @ IL 73.40
2/17	SEP S200 S255	900	1200	675	67.300	750	67.225	69.54	2.31	
				375	67.400			69.54		
2/18	JUNCTION PIT S205 S255	900	1200	600	67.695	675	67.620	69.67	2.05	
2/19	SEP S200 S255	900	900	525	67.945	600	67.870	70.20	2.33	
2/20	JUNCTION PIT S205 S255	900	600	525	68.895	525	68.820	70.84	2.02	
2/21	JUNCTION PIT S205 S255	900	600	525	69.365	525	69.220	71.59	2.37	
~~2/22~~	~~JUNCTION PIT S205 S255~~	~~900~~	~~600~~	~~525~~	~~69.730~~	~~525~~	~~69.664~~	~~72.11~~	~~2.44~~	
~~2/23~~	~~JUNCTION PIT S205 S255~~	~~900~~	~~600~~	~~525~~	~~70.310~~	~~525~~	~~70.225~~	~~72.43~~	~~2.21~~	
~~2/24~~	~~JUNCTION PIT S205 S255~~	~~900~~	~~600~~	~~525~~	~~70.850~~	~~525~~	~~70.800~~	~~72.99~~	~~2.19~~	
~~2/25~~	~~JUNCTION PIT S205 S255~~	~~900~~	~~600~~	~~450~~	~~71.000~~	~~525~~	~~70.950~~	~~73.07~~	~~2.12~~	
				~~525~~	~~71.050~~			~~73.07~~		
~~2/26~~	~~SEP S200~~	~~900~~	~~600~~	~~375~~	~~71.950~~	~~EX 375~~	~~71.870~~	~~73.89~~	~~2.02~~	
~~2/27~~	~~GRATED SEP S210~~	~~900~~	~~600~~			~~375~~	~~72.100~~	~~73.37~~	~~1.27~~	~~Provide 375Ø Property Connection (1 in 180 Grade) @ IL72.10~~
2/28	GRATED SEP S210	900	600			525	69.950	71.39	1.44	Provide 525Ø Property Connection (1 in 100 Grade) @ IL70.20
2/29	GRATED SEP S210	900	600			375	71.475	72.75	1.28	
2/30	GRATED SEP S210	900	900	450	71.650	450	71.575	73.58	2.00	
2/31	GRATED SEP S210	900	900	375	72.075	450	72.000	73.89	1.89	
				300	72.310			73.89		
2/32	SEP S200	900	600	300	72.635	375	72.560	74.06	1.50	
2/33	GRATED SEP S210	900	600			300	72.704	74.06	1.36	Provide 225Ø Property Connection (1 in 100 Grade) @ IL 72.71
2/34	SEP S200	900	600			300	72.500	73.89	1.39	Provide 225Ø Property Connection (1 in 80 Grade) @ IL 72.50
2/35	SEP S200	900	600			375	72.634	74.07	1.43	
2/36	SEP S200 S255	900	900	525	72.150	525	72.150	74.47	2.32	Provide 225Ø Property Connection (1 in 100 Grade) @ IL 73.00
2/37	GRATED SEP S210 S255	900	600			375	67.500	69.50	2.00	See Council Dwg S210
~~2/38~~	~~GRATED SEP S210~~	~~900~~	~~600~~			~~525~~	~~71.100~~	~~72.54~~	~~1.44~~	~~Provide 2No. 375Ø Property Connection @ IL71.15~~
2/39	GRATED SEP S210	900	600			300	72.700	74.36	1.66	Provide 225Ø Property Connection (1 in 100 Grade) @ IL 72.75
EX 1/35	EX SEP	900	600	300	72.345			74.23		Provide 225Ø Property Connection (1 in 100 Grade) @ IL 72.50
2/40	SEP S200	900	900	300	73.666	600	73.366	75.10	1.73	Provide 600Ø Property Connection (1 in 250 Grade) @ IL 73.60
2/41	SEP S200	900	600			300	73.735	75.09	1.36	
2/42	SEP S200	900	600			525	72.700	74.16	1.46	
2/43	SEP S200	900	600			375	72.700	74.52	1.82	
2/44	SEP S200	900	600			300	74.123	75.32	1.20	
2/45	JUNCTION PIT S205 S255	900	600			525	70.000	72.95	2.95	Provide 525Ø Property Connection (1 in 100 Grade) @ IL 70.40
2/46	JUNCTION PIT S205 S255	900	600			450	68.200	70.89	2.69	Provide 450Ø Property Connection (1 in 100 Grade) @ IL 68.25
2/47	SEP S200	900	600	EX 300	72.486	EX 300	72.481	74.31	1.83	Construct new SEP over existing 300Ø pipe
2/48	JUNCTION PIT S205 S255	900	900	525	69.605	525	69.587	71.97	2.38	
				EX 375						
2/49	GRATED SEP S210	900	900	525	69.905	525	69.830	71.65	1.82	
2/50	GRATED SEP S210	900	900	450	71.075	525	71.000	72.53	1.53	Provide 2No. 375Ø Property Connection @ IL71.15
2/51	GRATED SEP S210	900	600			450	72.000	73.36	1.36	Provide 375Ø Property Connection (1 in 180 Grade) @ IL72.10

NOT IN CONTRACT

MAIN DRAIN SCHEDULE

PIT NO.	TYPE	INTERNAL WD	LEN	INLET DIA	INV LEV	OUTLET DIA	INV LEV	PIT FIN RL	DEPTH	REMARKS
Exist 1/6	Melbourne Water Junction Pit	900	1650	1350	70.675	1350	70.640	74.18	3.54	Convert Temporary Top to Council Side Entry Cover
				525	71.700					
2/0M	Melbourne Water Junction Pit with Council Junction Pit Cover	900	1650	1350	70.831	1350	70.806	74.40	3.60	See pit detail on MW dwgs sheet 3 Provide blockout for 300 connection
				525	71.260					
2/1M	Melbourne Water Junction Pit with Council Side Entry Cover	900	1650	1350	71.021	1350	70.996	74.70	3.70	See pit detail on MW dwgs sheet 3 Provide blockout for 300 connection
				375	72.300					
2/2M	Melbourne Water Junction Pit with Council Side Entry Cover	2100	1650	1350	71.220	1350	71.195	75.07	3.87	See pit detail on MW dwgs sheet 4
				750	72.550					
2/EXT	Blank End					1350	71.320	75.24	3.92	Provide 1500x1500x100 concrete slab
2/3M	Melbourne Water Junction Pit with Council Side Entry Cover	1200	1200	750	72.728	750	72.703	74.79	2.09	See pit detail on MW dwgs sheet 4
2/4M	Melbourne Water Junction Pit with Council Side Entry Cover	900	900	600	72.950	750	72.800	75.23	2.43	Provide 525Ø Property Connection (1 in 240 Grade) @ IL 73.20

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Rev.	Revision Description	Designed	Date
	Drawings Issued As Constructed.	ST	22.08.05
		ST	27.01.05
D	issued for Construction	ST	27/01/05
C	PIT SCHEDULE UPDATED	ST	21/12/04
B	COUNCIL AMENDMENTS - PIT SCHEDULE UPDATED & OUTFALL DETAIL ADDED	ST	17/11/04
A	PIT 2/0M ADDED & PIT SCHEDULE AMENDED		

Designed by Steve Tough Au 2004
Checked by John Knibbs 26/10/04
Authorized by CW 27.01.05
Approved by Council 27 Jan. 2005

10 5 0 10 20 1:500
1 0.5 0 1 2 1:50
Original sheet size A1
North

As Constructed

MILLAR Merrigan
TOWN PLANNING
URBAN DESIGN
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE DESIGN
PROJECT MANAGEMENT
Quality Endorsed Company
Land Development Consultants
Office 126 Merrindale Drive, Croydon, Victoria Mail PO Box 247, Croydon, Victoria 3136
Telephone (03) 8720 9500 Facsimile (03) 8720 9501
Email eng@millarmerrigan.com.au Web Site www.millarmerrigan.com.au

Translink Business Park Stage 2

Keilor
Brimbank City Council

Outfall Detail & Pit Schedule
Sheet 5 of 5

Drawing No. 11111E 02 R27

For information on this report:

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