

# HENLEY BROOK AVENUE EXTENSION

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## CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Prepared for: City of Swan

Report Date: 30 June 2023

Version: 1

Report No. 2023-761

The logo for PGV Environmental is located at the bottom of the page. It features the letters 'PGV' in a large, bold, white sans-serif font. Below 'PGV', the word 'ENVIRONMENTAL' is written in a smaller, white, all-caps sans-serif font. The background of the logo area is a vibrant orange with a subtle, curved, wavy pattern.

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# 1 INTRODUCTION

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## 1.1 Background

The City of Swan is in the process of widening Henley Brook Avenue south of Gngara Road and extending the Road through to just south of Henley Street (Figure 1). The proposed road works are within an unmade part of the road reserve at the northern end and mostly through private lots at the southern end (Figure 2).

The widening and extension work will result in the clearing of some native vegetation. An application for a Clearing permit has been submitted to the Department of Water and Environmental Regulation (DWER) (CPS 9953/1).

PGV Environmental was commissioned by the City of Swan to prepare a Construction Environmental Management Plan (CEMP) to be implemented during works to manage the impact of the proposed road works as required by DWER.

## 1.2 Information Requested

DWER identified a number of risk factors for land degradation to be managed. The factors identified that require management for the construction of the road extension to prevent land degradation are:

- Wind erosion;
- Water erosion;
- Subsurface acidification;
- Flood risk;
- Waterlogging; and
- Phosphorus export risk.

The CEMP includes management measures for dust prevention and stabilisation to minimise the risk of wind and water erosion during clearing and construction to prevent flooding and waterlogging and drainage design to include management of nutrients.

Given that most of the proposed road extension and surrounds are cleared of vegetation it is unlikely that the clearing for the construction of the road will have an impact on subsurface acidification exacerbated by the removal of the small amount of vegetation for the road. Pursuant to the *Contaminated Sites Act 2006* an investigation and if required Acid Sulphate Soils (ASS) Management Plan will be prepared for the road construction. *WAPC Acid Sulphate Soils Planning Guidelines* (WAPC, 2009) indicate that “acid sulphate soils are technically manageable in the majority of cases” which would be applicable to the site.

The assessment of the Clearing Permit raised the following factors to be addressed as outlined in Water Quality Protection Notices (WQPN) as the proposed extension is located in a Public Drinking Water Source Area (PDWSA). The site is partly located within the Priority 2 (P2), Priority 3 (P3) and Priority 3\* (P3\*) as proclaimed under the *Rights in Water and Irrigation Act 1914* (RiWI Act).

P2 areas are normally assigned over rural land and are managed to minimise water quality risks. P3 areas are generally assigned over urban land, with the aim of managing water quality risks. In the Perth metropolitan area, strategic rezoning sometimes results in special priority 3\* (P3\*) areas, which recognise the increased risks to water quality and additional best management practices are required.

Specifically, the request from DWER states:

*The preliminary assessment identified that the application area is located within the Priority 2 (P2), Priority 3 (P3) and Priority 3\* (P3\*) PDWSA proclaimed under the Rights in Water and Irrigation Act 1914 (RiWI Act)).*

*Advice received from the department's Water Source Protection Planning branch indicates that road construction and upgrades would be considered a land use that is compatible with conditions in a P2, P3 and P3\* area. However, the Water Source Protection Planning branch has advised that additional information (under specifications) is required to determine whether the proposed road construction and upgrades meets condition 37 specified in WQPN 25 and WQPN's 10, 28, 29, 44, 56 83, 84 and the associated brochure, noting the best environmental practices are applied to the application area*

Condition 37 of the WQPN states:

*In accordance with Roads to reuse: Product specification – recycled road base and recycled drainage rock:*

- *Do not use recycled drainage rock in PDWSAs.*
- *Do not use recycled road base in P1 areas, WHPZs and RPZs.*

The City of Swan confirms that they will not be using recycled drainage rock and recycled road base due to the proximity of the PDWSA.

Management measures under the WQPNs as detailed in the advice include:

- WQPN 10: Contaminant spills – Emergency response plan (DWER, 2020)
- WQPN 28: Mechanical servicing and workshops (DWER, 2013a)
- WQPN 29: Mobile mechanical servicing and cleaning (DWER, 2013b)
- WQPN 44: Roads near sensitive water resources (DWER, 2006)
- WQPN 56: Tanks for fuel and chemical storage near sensitive water resources (DWER, 2018)
- WQPN 83: Infrastructure corridors near sensitive water resources (DWER, 2007)
- WQPN 84: Rehabilitation of disturbed land in PDWSAs (DWER, 2009)
- Brochure: Construction depots near sensitive water resources (DWER, 2008)

Information with regard to WQPNs 10, 44, 83 and 84 and additional details are provided in the CEMP.

WQPNs 28, 29, 56 and the Brochure are not addressed for the following reasons: There are no mechanical workshops or servicing proposed on the site. No fuels or oils will be stored on the site. There will be no on-site servicing or cleaning or depots constructed as part of the road extension works. There will be machinery stored on the site within a compound of hardstand.

The advice from DWER also identified the wetland habitats that are impacted by the proposed clearing for the road extension and provided the following advice:

*The preliminary assessment identified that the proposed clearing intersects the St Leonards Creek and intersects 'Multiple use' palusplains (wetlands) (UFI 13758 and UFI 13396), which includes vegetation growing in association with a watercourse / wetland. The proposed clearing may result in the deterioration of surface water quality.*

*Further information is required as to how the above risks to watercourse and wetland values (including surface water quality) resulting from the proposed clearing are proposed to be minimised or managed.*

*A construction environmental management plan (or similar) outlining the strategies and procedures that will be implemented to minimise the impacts of clearing on water quality is recommended to be provided.*

The area of the road works that intersects St Leonards Creek is already predominantly cleared of native vegetation. The management measures included in the CEMP address the impacts on water quality in surrounding wetland areas.

### **1.3 Scope of Works**

The CEMP has been prepared to manage the relevant factors as required by DWER and includes the following:

- Dust management procedures to manage the impacts of potential wind erosion;
- Management of surface water during clearing and construction to prevent waterlogging, water erosion and offsite impacts on surrounding wetland areas;
- Road design and stormwater controls to manage nutrients and petroleum derivatives in stormwater and ensure that there is no contaminant export from the road and ensure water quality and quantity in St Leonards Creek are maintained;
- Stormwater controls to ensure there is no sedimentation in St Leonards Creek;
- An emergency response plan for any potential spills during clearing and construction;
- Hygiene protocols to prevent the spread of dieback disease and other soil-borne pathogens;
- Management of the crossing of St Leonards Creek to ensure impacts on the creekline are minimised; and
- Landscaping strategies to be used in the road reserve.

## 2 EXISTING ENVIRONMENT

### 2.1 Topography

The site is mostly flat 30-32 m Australian Height Datum (AHD) with a central ridge line rising up to 40m AHD (Figure 2).

### 2.2 Geology and Soils

The site is mapped on the Bassendean Dune System and consists of very low relief, leached, grey siliceous Pleistocene sand dunes, intervening sandy and clayey swamps and gently undulating plains (Bolland, 1998). These soils are very leached, infertile and mildly acidic (DPIRD, 2023).

The soil phases mapped on the site are:

- Bassendean, Jandakot Phase (212Bs\_Ja) which is associated with low, gently sloping dunes on Aeolian sands. The soils are described as grey sand over pale yellow sands generally underlain by humic and iron podzols;
- Bassendean Yanga Phase (Bassendean) Phase (212Bs\_Ya) which are located on poorly drained flats on alluvial deposits. The soils are semi-wet soils, yellow-brown shallow sands and grey deep sandy duplexes and are usually associated with dense *Melaleuca* scrub; and
- Bassendean Joel Phase (212Bs\_J) which are poorly drained depressions with humus podzols; and
- VC - Valley complex (Bassendean) (212Bs\_VC) which are variable soils associated with drainage lines associated with St Leonards Creek (DPIRD, 2023).

The Land Degradation Risk Categories of the soil phases are outlined in Table 1.

**Table 1: Land Degradation Risk Categories**

Soil Type	Wind Erosion	Water Erosion	Subsurface Acidification	Flood Risk	Waterlogging	Phosphorus Export Risk
212Bs_Ja	50-70% of map unit has a high to extreme wind erosion risk	<3% of map unit has a high to extreme water erosion risk	>70% of map unit has a high subsurface acidification risk or is presently acid	<3% of the map unit has a moderate to high flood risk	<3% of map unit has a moderate to very high waterlogging risk	>70% of map unit has a high to extreme phosphorus export risk
212Bs_Ya	10-30% of map unit has a high to extreme wind erosion risk	<3% of map unit has a high to extreme water erosion risk	>70% of map unit has a high subsurface acidification risk or is presently acid	<3% of the map unit has a moderate to high flood risk	>70% of map unit has a moderate to very high waterlogging risk	10-30% of map unit has a high to extreme phosphorus export risk



Soil Type	Wind Erosion	Water Erosion	Subsurface Acidification	Flood Risk	Waterlogging	Phosphorus Export Risk
212Bs_J	10-30% of map unit has a high to extreme wind erosion risk	50-70% of map unit has a high to extreme water erosion risk	>70% of map unit has a high subsurface acidification risk or is presently acid	50-70% of the map unit has a moderate to high flood risk	>70% of map unit has a moderate to very high waterlogging risk	>70% of map unit has a high to extreme phosphorus export risk
212Bs_VC	3-10% of map unit has a high to extreme wind erosion risk	>70% of map unit has a high to extreme water erosion risk	>70% of map unit has a high subsurface acidification risk or is presently acid	>70% of the map unit has a moderate to high flood risk	>70% of map unit has a moderate to very high waterlogging risk	>70% of map unit has a high to extreme phosphorus export risk

Source – DPIRD, 2023

## 2.3 Hydrology

### 2.3.1 Groundwater

The site is on the Perth Surficial Swan and Mirrabooka aquifer. The Superficial Swan overlays the Leederville aquifer which is further described as the sub area Wanneroo member under the site and consists of poorly sorted fine – to medium-grained quartz with feldspar and occasionally trace heavy minerals. This overlays the Yarragadee aquifer (DoW, 2015).

Groundwater flows generally to the south-east and is between 27mAHD and 30mAHD (DWER, 2023). The depth to groundwater from the natural surface ranges from approximately 3 to 5m (DoW, 2015b). Annual average maximum water levels will be higher than the May 2003 levels as indicated.

### 2.3.2 Surface Water

The southern end of the road extension works site passes through a ‘Multiple Use’ palusplain wetland (UFI 13396) (shown in blue on Plate 1). The wetland in this location is highly modified and largely cleared of native vegetation.

**Plate 1: Wetland Mapping (National Map, 2023)**



The southern part of the extension also crosses over a portion of the northern arm of St Leonards Creek. In this location the creek has been highly modified into a drain. The aerial photograph from 1965 (Landgate, 2023) shows the creekline has been excavated (Plate 2), most likely to facilitate draining of the Multiple Use palusplain wetland.

**Plate 2: St Leonards Creek Excavation in 1965**



## 2.4 Vegetation

### 2.4.1 Vegetation Description

The road reserve in the northern part of the site is mostly cleared and does not contain native vegetation but is dominated by weeds including non-native Geraldton Wax (*Chamelaucium*

*uncinatum*). A few *Acacia saligna* (Orange Wattle) shrubs and *Adenanthos cygnorum* (Woolly Bush) occur in the northern half.

The vegetation in the central part of the site is a mixture of planted trees such as River Red Gums (*Eucalyptus camaldulensis*) and Tuart (*Eucalyptus gomphocephala*) and scattered remnant native Jarrah (*Eucalyptus marginata*), Banksia trees (*Banksia attenuata*, *B. menziesii*) and Marri (*Corymbia calophylla*) trees. Most of the Marri trees are young (Plate 8), however several large trees also occur.

#### **2.4.2 Vegetation Condition**

The vegetation condition of the road reserve is in Completely Degraded condition, according to the condition scale of Keighery (1994) published in Bush Forever (Government of Western Australia, 2000).

### **3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN**

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#### **3.1 Site access**

Access to the site will not be possible for the public during road construction. A temporary or permanent fence will be constructed at the limit of the road reserve, where there are no existing fences, prior to clearing and maintained for the duration of the works. The fence will be at least 1800 mm high and will be inspected weekly to ensure its function and placement are maintained. Contractor access points will only be from the existing roads.

Fencing will be inspected daily to ensure it is intact and repairs undertaken as needed as soon as possible after any damage has been reported.

#### **Management Measures**

**M1** Fencing to be erected around to site to prevent public access

**M2** Access to the site to be from existing roads

**M3** Daily inspections of fencing and timely repair of any damage

#### **3.2 Dust Management**

##### **3.2.1 Objective**

To prevent offsite impacts of dust from wind erosion prone soils.

##### **3.2.2 Site Classification**

The site is graded as Classification 2 – Low Risk in accordance with the *A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and other Related Activities* (DEC, 2011) as per the Site Classification Assessment Chart for Uncontaminated Dust.

##### **3.2.3 Timing**

The soil types on the site have a risk of wind erosion and therefore can have a risk of producing dust. The works are proposed to be undertaken in winter and therefore the risk of dust being produced is lowered due to the wet soils at that time of the year. Works may extent into summer at which time management measures as contained in the CEMP will be employed.

##### **3.2.4 Hours of Operation**

No works will be carried out after 5:00pm or before 7:00am Monday to Friday and not at all on Sundays or public holidays. Work will only be undertaken on Saturdays unless required.

##### **3.2.5 Advisory Notices**

Advisory notices are not required for Classification 2 sites, however residents of properties adjoining the road have been made aware of the intended works. A letter will be sent two weeks prior to commencement advising of the timing and extent of works.

### **3.2.6 Speed Limits**

Low speeds will be maintained during construction in the road reserve to minimise dust generation. Signage will be erected to indicate appropriate travelling speeds.

### **3.2.7 Access Roads**

Access roads are sealed and are not likely to cause an increased nuisance dust issue. If excessive dirt from operations is spilt onto roads that then create significant dust, the management of the dust will be the same as in the areas of active works.

### **3.2.8 Stripped and Stockpiled Soil**

Topsoil will not be stripped in high wind or adverse conditions. Any stockpiles that are generated will be managed in accordance with Guidelines (DEC, 2011) and the contractor will:

- Locate stockpiles in sheltered areas where possible.
- Limit the height and slope of the stockpiles to reduce wind pick up;
- Orient stockpiles lengthwise into the wind so they offer the minimum cross-sectional area to prevailing winds;
- Stabilise stockpiles with mulch or hydromulch if stockpiles are producing nuisance dust; and
- Limit activity to the downwind side of the stockpile.

### **3.2.9 Water Carts**

The soil will be kept damp whilst machinery is working by use of a water cart. The water cart will be kept onsite at all times and will be able to commence watering within 12 hours during the working week and 48 hrs over weekends of a reported dust complaint.

### **3.2.10 Stabilisation**

Approved hydro-mulching equipment will be instructed to be deployed by the City in the event of sustained dust generation from soil piles or exposed banks.

### **3.2.11 Monitoring**

Dust will be monitored by visual observation from the construction site and stockpiles. Installation of dust monitoring equipment is not proposed due to the low risk of dust being an issue.

### **3.2.12 Complaints Management**

The contractor will be notified of any dust related complaint by either the complainant, the Department of Water and Environment Regulation (DWER) or the Local Authority. In the event that justifiable complaint is received, there will be a set protocol to be followed:

1. The site supervisor is informed of the complaint;
2. The site supervisor will contact the appropriate manager;
3. Upon verification of the legitimacy of the complaint the site supervisor will identify the source for the complaint and if possible provide an immediate solution;
4. If an immediate solution is not available the site supervisor will liaise with the manager to develop possible solutions;
5. Works that create dust will be ceased on-site until a solution can be implemented;

6. Upon the implementation of any solution site supervisor will report to the manager; and
7. The complainant will be informed of the actions taken and asked for feedback.

All complaints, actions and outcomes will be recorded and maintained for auditing for the duration of the construction period.

### **Management Measures**

- M4** No works will be carried out after 5:00pm or before 7:00am Monday to Saturday and not at all on Sundays or public holidays
- M5** Low speed limits to be implemented on the site and signage installed at access points
- M6** Stockpiles to be located in sheltered areas, lengthways to prevailing winds with limited height and slope
- M7** Stabilise stockpiles with mulch or hydromulch if stockpiles are producing nuisance dust
- M8** Water carts to be present in dry conditions
- M9** Complaints register to be set up by the contractor
- M10** All complaints, actions and outcomes will be recorded and maintained for auditing for the duration of the construction period
- M11** Visual monitoring for dust to be undertaken during works

## **3.3 Surface Water Management**

### **3.3.1 Stormwater**

The construction of the road may create areas where surface run-off is exacerbated during construction works. Stormwater will be captured in temporary drainage swales and infiltrated within the road footprint.

The long-term drainage treatment for the proposed extension of Henley Brook Avenue will include a retention basin to be constructed on the north-western side of St Leonards Brook (Appendix 1). The retention basin will retain first flush events, in accordance with the Henley Brook Structure Plan Local Water Management Strategy (LWMS) (Emerge, 2020). The basin will be planted with native vegetation to encourage biological nutrient uptake, consistent with the *Vegetation guidelines for stormwater biofilters in the south-west of Western Australia* (Monash University, 2014). The species chosen will have extensive and fine root systems, be relatively fast growing, be able to withstand temporary and regular inundation, and have long growing seasons. A sufficient density of plants of at least 6/m<sup>2</sup> is recommended to provide adequate initial coverage and room for growth. Species will be native and planting in accordance with WQPN 84.

### **Management Measures**

- M12** Stormwater runoff during construction to be managed in temporary swales

- M13** Drainage swales will be planted with native species as per the Henley Brook Structure Plan LWMS

### **3.3.2 Erosion and Sedimentation**

All batters will be constructed to the specified grade and will be stabilised as soon as possible after they are constructed. The retention basin to be constructed on the west side of the road and close to St Leonards Creek will ensure that soil is not washed into the creekline. Steep road batters will be stabilised with Jute mats or vegetated in accordance with the Landscape Management Plan with stone pitching in areas of surface water overflow to prevent erosion.

During construction any stockpiles showing evidence of water erosion will be stabilised with mulch or hydromulch.

Monitoring of stockpiles, newly contoured land, and batters will be undertaken to inspect for signs of water erosion. Inspections will be undertaken on a weekly basis or after significant rainfall greater than the 1/1 ARI (16 mm in 15 minutes).

#### **Management Measures**

- M14** Batters to be constructed to specified grades
- M15** Batters to be stabilised as soon as possible after construction
- M16** A retention basin will be constructed near St Leonards Creek to capture first flush stormwater events
- M17** Batters to be vegetated and stone pitching to be used in stormwater overflow areas
- M18** Stabilise stockpiles showing signs of water erosion with mulch or hydromulch
- M19** Areas of open soil will be inspected weekly or after a 1/1 ARI rainfall event for signs of water erosion or sedimentation

### **3.4 Wetland Protection**

The footprint of the road runs through St Leonards Creek which is a highly modified creekline that transports water downstream in winter/spring. The creekline has been completely cleared in the past and excavated to provide a drainage function to the surrounding land. Box culverts will be installed under the road at the creek crossing to ensure the function of the creekline is maintained. The construction of the crossover of the creekline will be undertaken in accordance with requirements of the Bed and Banks licence.

#### **Management Measures**

- M20** St Leonards Creek crossover to be constructed using boxed culverts to ensure pre development water flows are maintained.

### 3.5 Spills Management

To mitigate the risk of localised spill of hydrocarbon or other contaminant during construction the following will be undertaken:

- All portable toilets will be located in flat areas and managed by an appropriate contractor;
- No hydrocarbons or other hazardous materials will be stored in the construction area; and
- All vehicles will contain a spill kit and any hydrocarbon spills will be cleaned up appropriately.

#### Management Measures

**M21** Portable toilets to be placed on level ground

**M22** No storage of hazardous materials to be stored on site

**M23** All vehicles to contain spill kits

### 3.6 Emergency Response Plan

An Emergency Response Plan as per WQPN 10: Contaminant spills – Emergency response plan will be implemented. In the event of a serious emergency at the site, the following procedure will be followed:

1. Stop work.
2. All personnel shall leave the work zone and return to the emergency assembly area.
3. Await further instructions from the Construction Contractor and/or appointed representative.

Personnel will not return to the work area unless advised to do so by the Construction Contractor or an appointed representative. The Construction Contractor will notify the relevant service as to the details regarding any emergency as outlined in Table 4.

**Table 2: Emergency Contact Information**

Name	Contact Number
Ambulance / Police / Fire Brigade	000
Department of Environment Regulation Pollution Response Services (24/7)	1300 784 782
Wildcare helpline	(08) 9474 9055
City of Swan	(08) 9267 9267

Records will be kept of any incidents, accidents, hazardous situations, unusual events and unsafe health exposures and the corrective action taken. Emergency procedures and contact telephone numbers will be available on site at all times at a central location.

#### Management Measures

**M24** Emergency procedure to be available on-site and followed if an emergency occurs

**M25** Reporting of any emergencies as required



## 3.7 Dieback

### 3.7.1 Dieback Status

There are very few native plants remaining in the road reserve and as such the area is deemed to be 'Uninterpretable' for dieback.

### 3.7.2 Dieback Management

*Phytophthora* Dieback (*Phytophthora cinnamomi*) is a soil-borne pathogen that infects the roots of vulnerable species, limiting the roots ability to take up water, thereby weakening or killing the host plant. The spores of *Phytophthora* Dieback are transported by water and in soil. In sloping areas *Phytophthora* dieback spreads quickly in surface and sub-surface water flows. It spreads slower up-slope and on flat ground because it is restricted to movement by root-to-root contact.

Hygiene management procedures will be implemented on the site with signage erected at all access points to the development area. The signs should include the following procedures:

- Vehicle inspection protocols to ensure the vehicle is free from soil/organic material prior to entry and exit;
- Brush down of contaminated vehicles and machinery in dry weather
- Wash down of contaminated vehicles and machinery used in clearing with suitable disinfectant such as bleach dilution, methylated spirits or an approved product such as Phytoclean during wet weather.

The spread of *Phytophthora* Dieback is more prevalent in the winter months when the soil is wet and overland flows can spread the disease quickly. Initial clearing works will be scheduled as much as possible in drier conditions when the development areas are not waterlogged or have flowing water down drainage channels.

To prevent transfer of potentially infected soil into adjoining areas there will be no access to the adjoining areas outside of designated access points and no soil will be pushed into these areas. Earthworks will ensure that no contours are created that drain surface water from the development area to the bushland. Stockpiles of soil and mulch will be located and oriented as per the dust management plan (Section 3.2).

All soils or mulch to be imported to the site during works will be disease and pathogen free. All tubestock used for landscaping will be free of dieback. Any building materials will be free from soil.

#### Management Measures

**M23** Soil in the construction footprint will be stabilised so it is not prone to water erosion and being washed into adjoining areas.

**M24** The following hygiene protocols will be followed:

- Vehicle inspection protocols to ensure the vehicle is free from soil/organic material prior to entry and exit;
- Brush down of contaminated vehicles and machinery in dry weather

- Wash down of contaminated vehicles and machinery used in clearing with suitable disinfectant such as bleach dilution, methylated spirits or an approved product such as Phytoclean during wet weather.

**M25** Clearing works will be scheduled as much as possible when areas do not have flowing water or are waterlogged.

**M26** There will be no soil pushed to the outside of the road footprint

**M27** All imported landscaping and revegetation materials (i.e. soil, mulch, seedlings) brought onsite will be weed and certified dieback free.

**M28** Imported pipes, stone pitching materials and other construction materials are to be free of mud and soil.

### **3.8 Landscaping**

Landscaping in the drainage basin will be made up of largely native species. The retention basin will be planted with a mixed of reeds to trap any sediments and utilise any nutrient run-off to ensure that no nutrients are exported from the road.

#### **Management Measure**

**M29** Landscaping to be mixture of native species with appropriate nutrient stripping species to be used in drainage infrastructure

### **3.9 Induction**

The Construction Environmental Management Plan will be supplied by the Construction Superintendent to contractors on the site and the induction will address all management procedures and requirements outlined in this plan.

#### **Management Measure**

**M30** CEMP to be provided as part of Induction Package

## 4 SUMMARY OF MANAGEMENT PLAN

**Table 3: Summary of Management Plan**

Factor	No.	Management Action
Access	<b>M1</b>	Fencing to be erected around to site to prevent public access
	<b>M2</b>	Access to the site to be from existing roads
	<b>M3</b>	Daily inspections of fencing and timely repair of any damage
Dust Management	<b>M4</b>	No works will be carried out after 5:00pm or before 7:00am Monday to Saturday and not at all on Sundays or public holidays
	<b>M5</b>	Low speed limits to be implemented on the site and signage installed at access points
	<b>M6</b>	Stockpiles to be located in sheltered areas, lengthways to prevailing winds with limited height and slope;
	<b>M7</b>	Stabilise stockpiles with mulch or hydromulch if stockpiles are producing nuisance dust
	<b>M8</b>	Water carts to be present in dry conditions
	<b>M9</b>	Complaints register to be set up by the contractor
	<b>M10</b>	All complaints, actions and outcomes will be recorded and maintained for auditing for the duration of the construction period
Stormwater	<b>M11</b>	Visual monitoring for dust to be undertaken during works
	<b>M12</b>	Stormwater runoff during construction to be managed in temporary swales
Erosion and Sedimentation	<b>M13</b>	Drainage swales will be planted with native species as per the Henley Brook Structure Plan LWMS
	<b>M14</b>	Batters to be constructed to specified grades
	<b>M15</b>	Batters to be stabilised as soon as possible after construction
	<b>M16</b>	A retention basin will be constructed near St Leonards Creek to capture first flush stormwater events
	<b>M17</b>	Batters to be vegetated and stone pitching to be used in stormwater overflow areas
	<b>M18</b>	Stabilise stockpiles showing signs of water erosion with mulch or hydromulch
Wetland Protection	<b>M19</b>	Areas of open soil will be inspected weekly or after a 1/1 ARI rainfall event for signs of water erosion or sedimentation
	<b>M20</b>	St Leonards Creek crossover to be constructed using boxed culverts to ensure pre development water flows are maintained.
Spills Management	<b>M21</b>	Portable toilets to be placed on level ground
	<b>M22</b>	No storage of hazardous materials to be stored on site
	<b>M23</b>	All vehicles to contain spill kits
Emergency Response Plan	<b>M24</b>	Emergency procedure to be available on-site and followed if an emergency occurs
	<b>M25</b>	Reporting of any emergencies as required

Factor	No.	Management Action
Dieback	<b>M23</b>	Soil in the construction footprint will be stabilised so it is not prone to water erosion and being washed into adjoining areas.
	<b>M24</b>	The following hygiene protocols will be followed: <ul style="list-style-type: none"> <li>• Vehicle inspection protocols to ensure the vehicle is free from soil/organic material prior to entry and exit;</li> <li>• Brush down of contaminated vehicles and machinery in dry weather</li> <li>• Wash down of contaminated vehicles and machinery used in clearing with suitable disinfectant such as bleach dilution, methylated spirits or an approved product such as Phytoclean during wet weather.</li> </ul>
	<b>M25</b>	Clearing works will be scheduled as much as possible when areas do not have flowing water or are waterlogged.
	<b>M26</b>	There will be no soil pushed to the outside of the road footprint
	<b>M27</b>	All imported landscaping and revegetation materials (i.e. soil, mulch, seedlings) brought onsite will be weed and certified dieback free.
	<b>M28</b>	Imported pipes, stone pitching materials and other construction materials are to be free of mud and soil.
Landscaping	<b>M29</b>	Landscaping to be mixture of native species with appropriate nutrient stripping species to be used in drainage infrastructure
Induction	<b>M30</b>	CEMP to be provided as part of Induction Package

## 5 REFERENCES

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# FIGURES



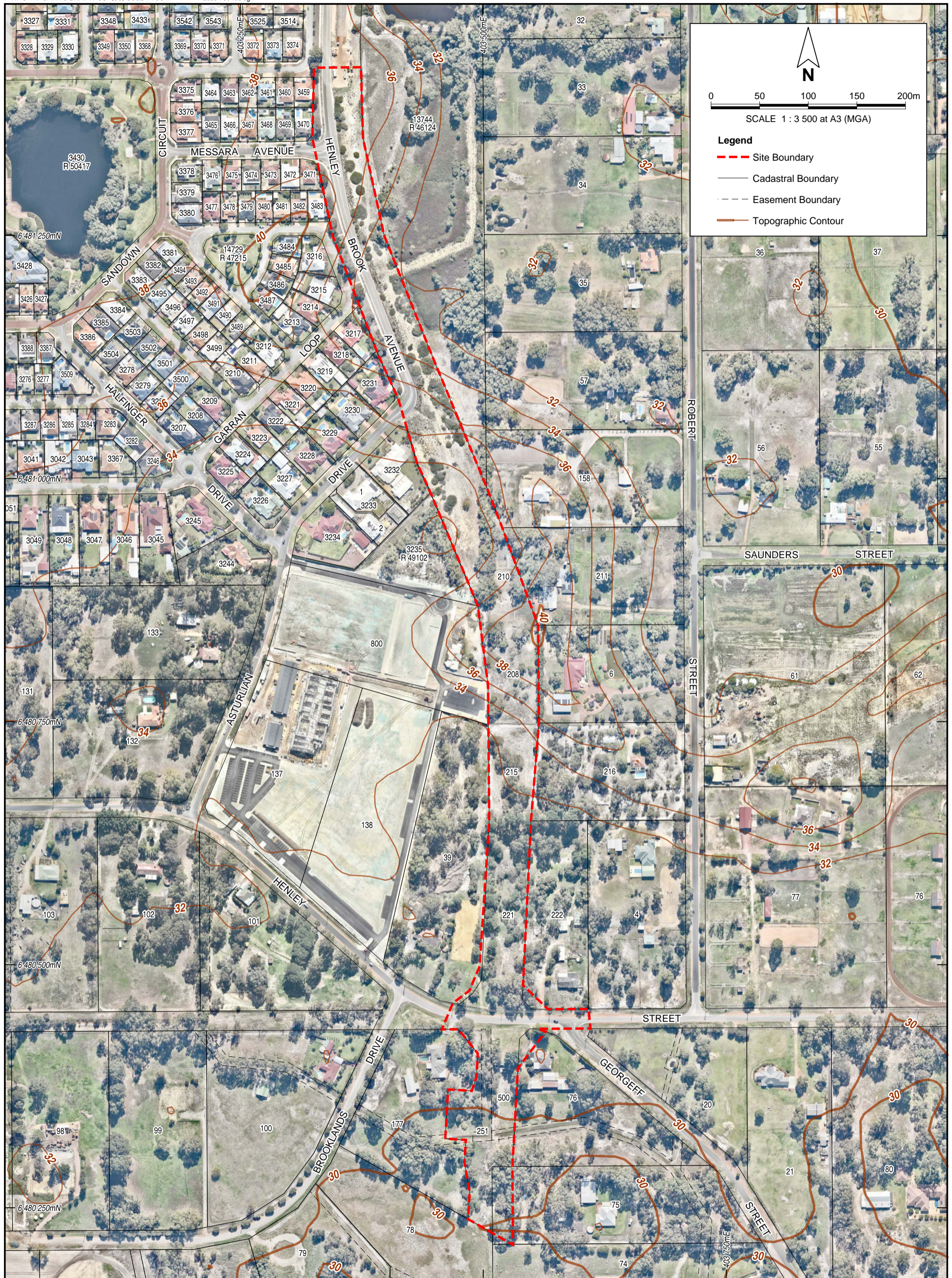
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Drawn: P. van der Moezel	Date: 23 Jun 2023
Job: 10542 Rpt: 2023-761	Revision: A

City of Swan  
 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN  
 HENLEY BROOK AVENUE ROAD WORKS  
  
**SITE LOCATION**

**Figure 1**





N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

**Legend**

- - - Site Boundary
- Cadastral Boundary
- Easement Boundary
- Topographic Contour



City of Swan  
CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN  
HENLEY BROOK AVENUE ROAD WORKS

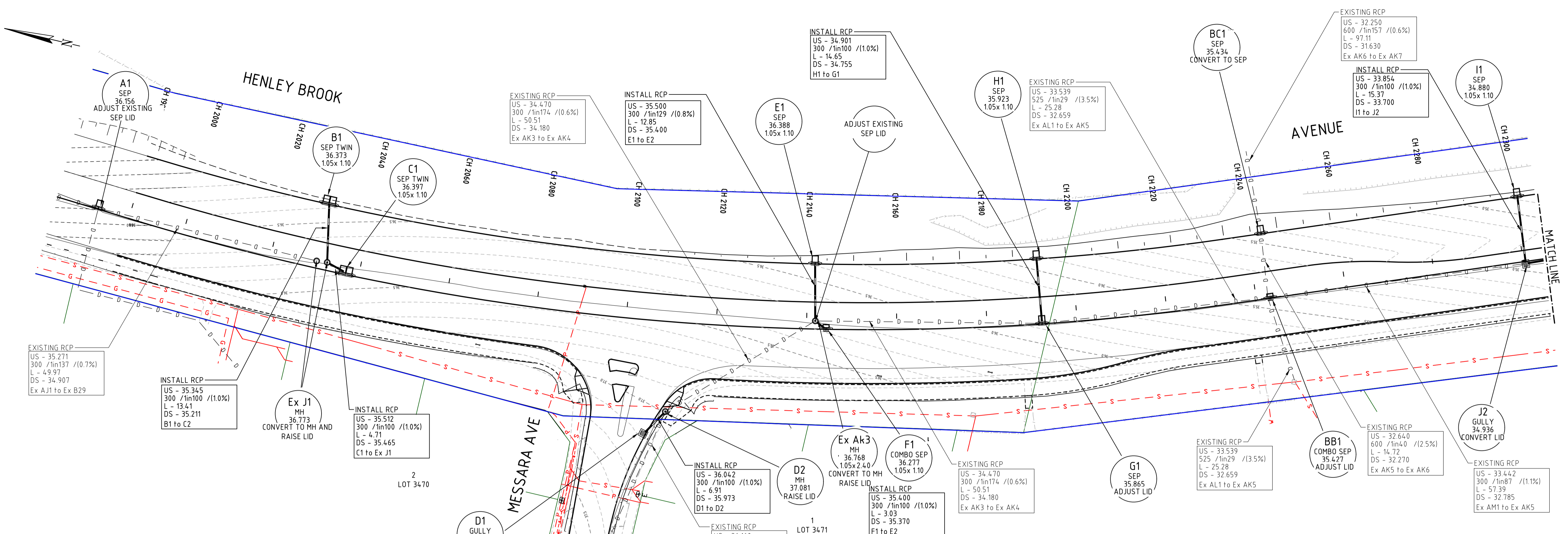
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Job: 10542 Rpt: 2023-761 Revision: A

**SITE BOUNDARY AND TOPOGRAPHY**

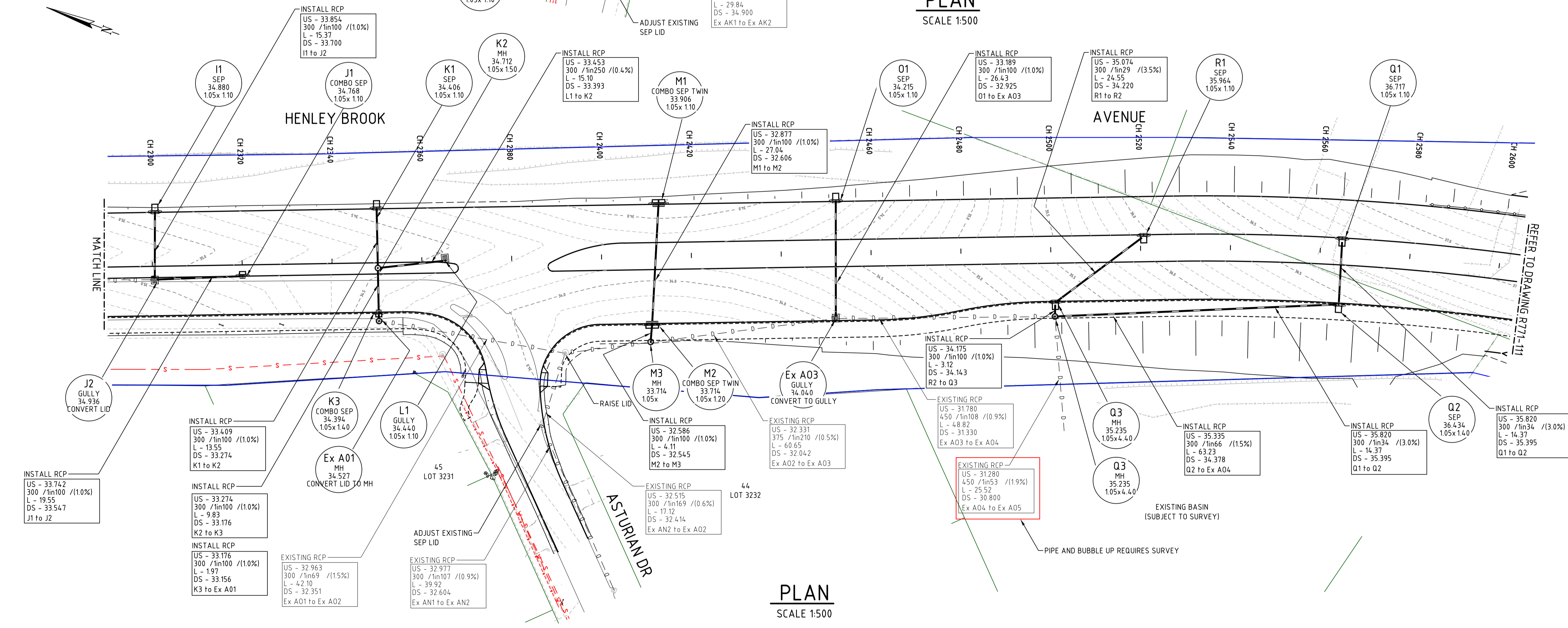
**Figure 2**

CADASTRAL SOURCE: Landgate, May 2023.  
AERIAL PHOTOGRAPH SOURCE: NearMap, flown April 2023.

**APPENDIX 1**  
**Drainage Design**



**PLAN**  
SCALE 1:500



**PLAN**  
SCALE 1:500

**LEGEND**

**PROPOSED**

- SEALED EDGE
- KERB FACE
- DRAINAGE RCP
- SEP, MANHOLE, GULLY, HEADWALL
- MANHOLE, GULLY, HEADWALL
- CONCRETE: FOOTPATH
- PRAM RAMP
- OPEN DRAIN
- CONTOUR 100mm INTERVAL

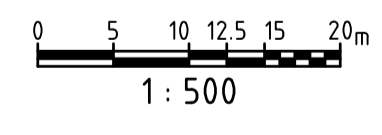
**EXISTING**

- KERB
- PATH
- BOUNDARY: LINE, PEG
- FENCE
- DRAINAGE: PIPE, JUNCTION, GULLY
- TELECOMS: UG LINE/OPTIC FIBRE, PIT, PILLAR
- WATER: UG PIPE, METER, VALVE, HYDRANT
- OVERHEAD POWER: LINE, POLE
- POWER: UG LINE, PIT, DOME
- SEWER: LINE, PIT
- GAS HIGH PRESSURE

**PIT NAME** D2  
**PIT TYPE** MH  
**SETOUT RL** 16.190  
**LENGTH (m)** 16.190  
**DIA x DEPTH** 1.2 x 2.3

**UP STREAM INVERT** US - 15.022  
**PIPE SIZE/GRADE** 300 / 1in108 / (10.9%)  
**LENGTH (m)** L - 39.00  
**DOWN STREAM INVERT** DS - 14.661

**MH = MANHOLE**  
**SEP = SIDE ENTRY PIT**



**CAUTION**

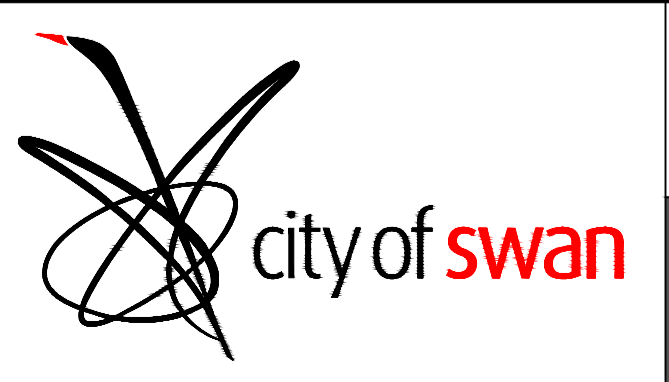
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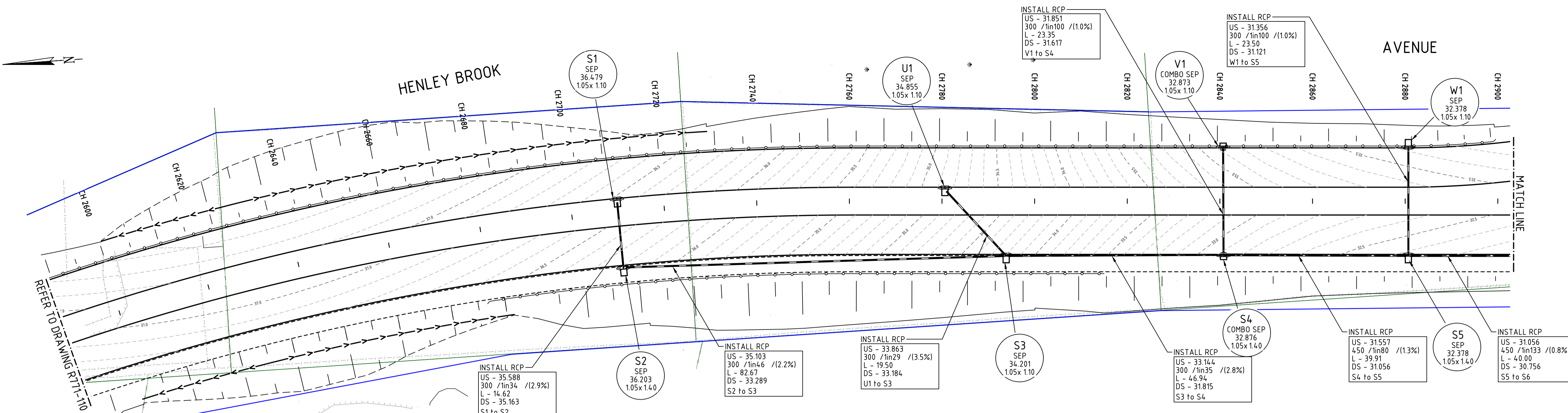
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 DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
 MESSARA AVENUE TO PARK STREET  
 DUAL CARRIAGEWAY  
 DRAINAGE PLAN SHEET 1 OF 4



DRAWING No: R771-110  
 REV No: 0

**OPERATIONS**



**PLAN**  
SCALE 1:500

**LEGEND**

**PROPOSED**

- SEALED EDGE
- KERB FACE
- DRAINAGE RCP
- SEP, MANHOLE, GULLY, HEADWALL
- MANHOLE, GULLY, HEADWALL
- CONCRETE: FOOTPATH
- PRAM RAMP
- OPEN DRAIN
- CONTOUR 100mm INTERVAL

**EXISTING**

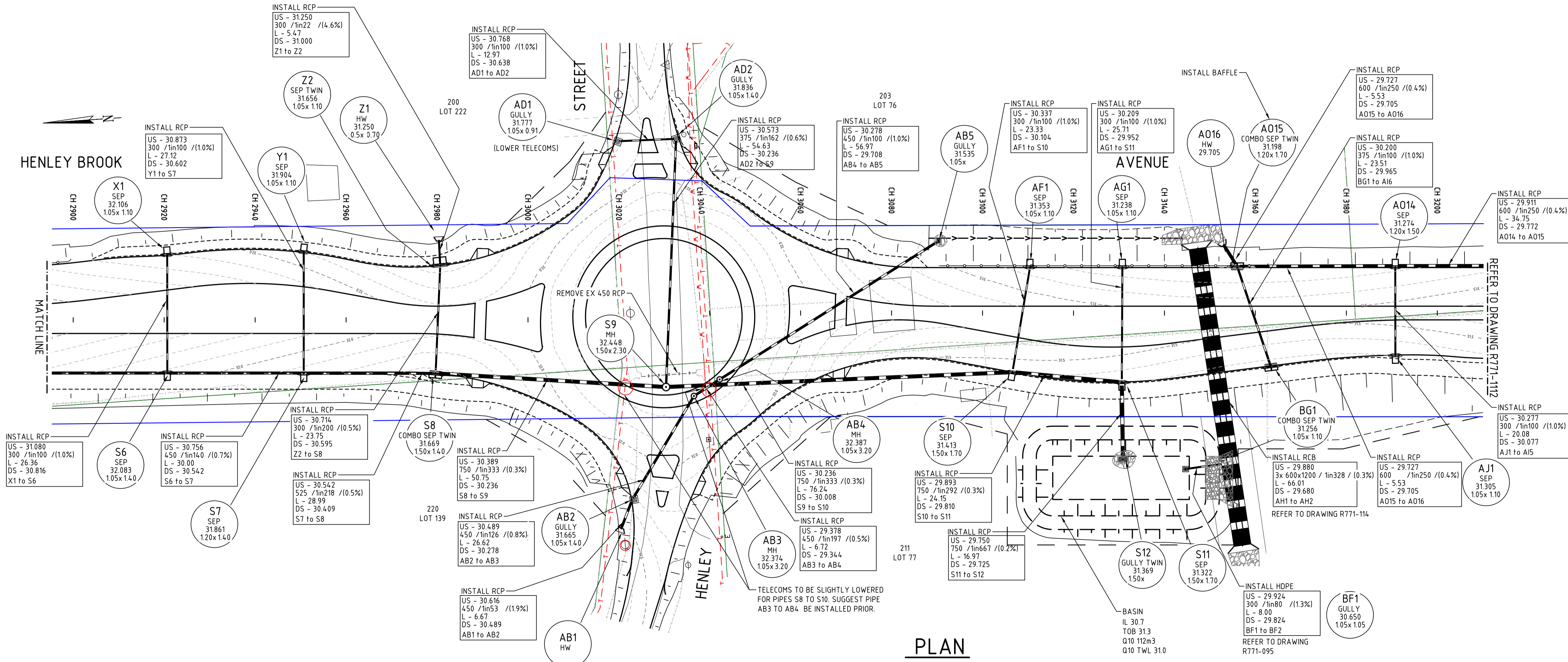
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- PATH
- BOUNDARY: LINE, PEG
- FENCE
- DRAINAGE: PIPE, JUNCTION, GULLY
- TELECOMS: UG LINE/OPTIC FIBRE, PIT, PILLAR
- WATER: UG PIPE, METER, VALVE, HYDRANT
- OVERHEAD POWER: LINE, POLE
- POWER: UG LINE, PIT, DOME
- SEWER: LINE, PIT
- GAS HIGH PRESSURE

**PIT NAME**

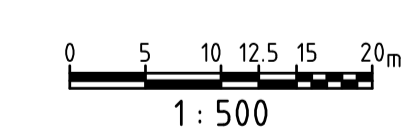
- PIT TYPE
- SETOUT RL
- DIA x DEPTH

**MH = MANHOLE**  
**SEP = SIDE ENTRY PIT**

**UP STREAM INVERT** US - 15.022  
**PIPE SIZE/GRADE** 375 /in108 (10.9%)  
**LENGTH (m)** L - 39.00  
**DOWN STREAM INVERT** DS - 14.661



**PLAN**  
SCALE 1:500



**CAUTION**

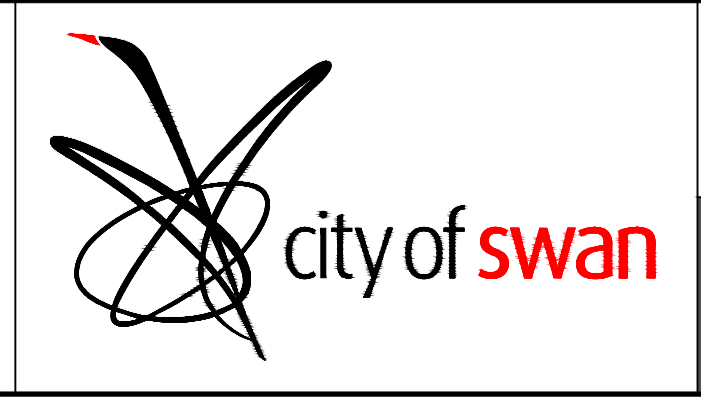
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DESIGNED D.WEERTS	CHECKED	DATE	DRAWN C.CAYATTE

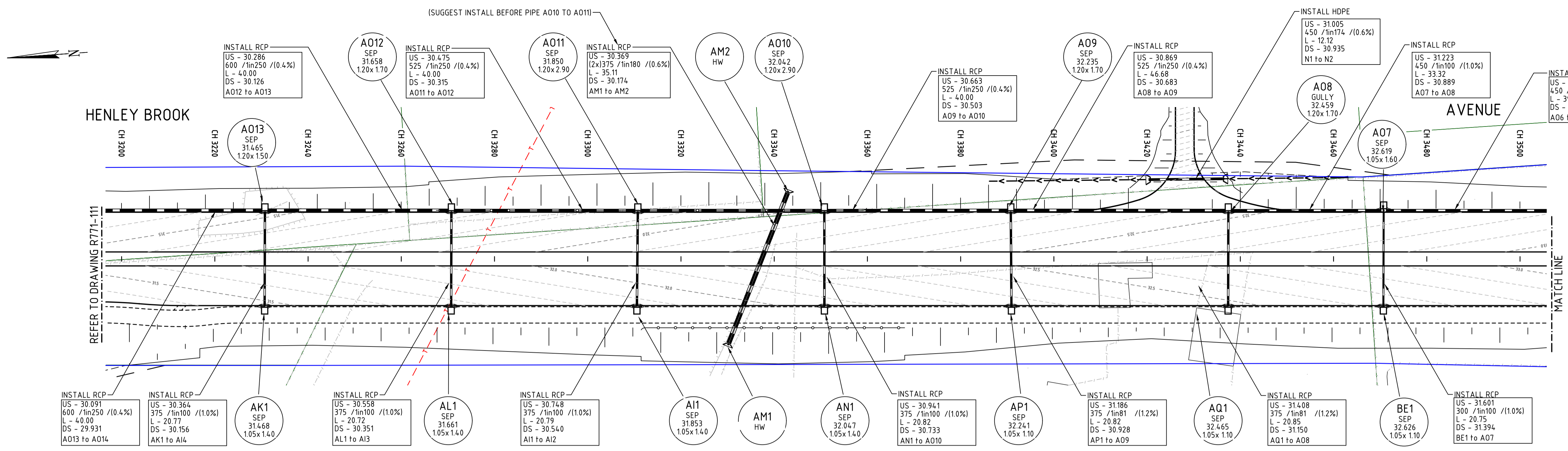
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DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PLAN SHEET 2 OF 4



DRAWING No: R771-111  
REV No: 0

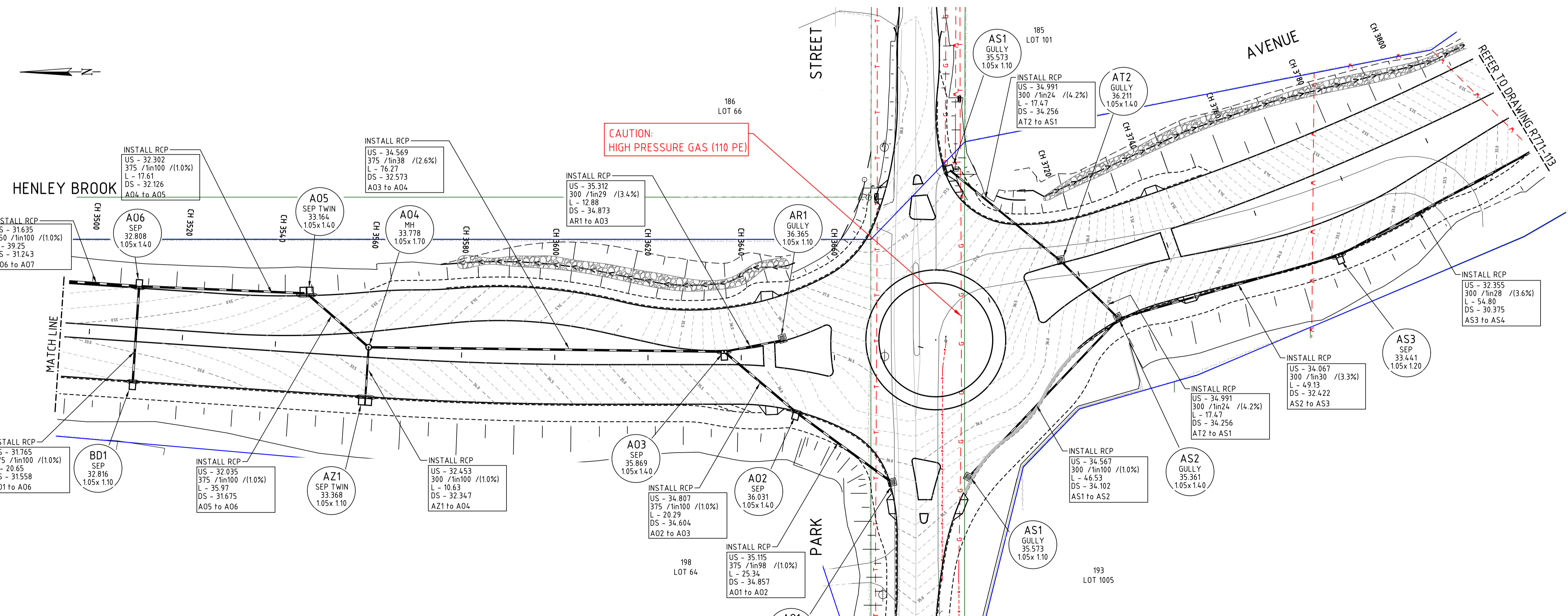
**OPERATIONS**



PLAN  
SCALE 1:500

LEGEND  
PROPOSED

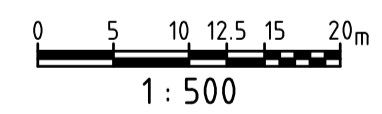
- SEALED EDGE
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  - SEP, MANHOLE, GULLY, HEADWALL
  - CONCRETE: FOOTPATH
  - PRAM RAMP
  - OPEN DRAIN
  - CONTOUR 100mm INTERVAL
- 
- PIT NAME
  - PIT TYPE
  - SETOUT RL
  - DIA x DEPTH
  - MH = MANHOLE
  - SEP = SIDE ENTRY PIT
- 
- UP STREAM INVERT
  - PIPE SIZE/GRADE
  - LENGTH (m)
  - DOWN STREAM INVERT



PLAN  
SCALE 1:500

EXISTING

- KERB
- PATH
- BOUNDARY: LINE, PEG
- FENCE
- DRAINAGE: PIPE, JUNCTION, GULLY
- TELECOMS: UG LINE/OPTIC FIBRE, PIT, PILLAR
- WATER: UG PIPE, METER, VALVE, HYDRANT
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- POWER: UG LINE, PIT, DOME
- SEWER: LINE, PIT
- GAS HIGH PRESSURE



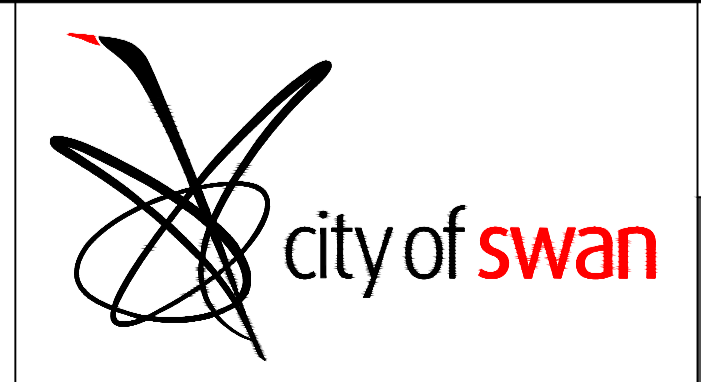
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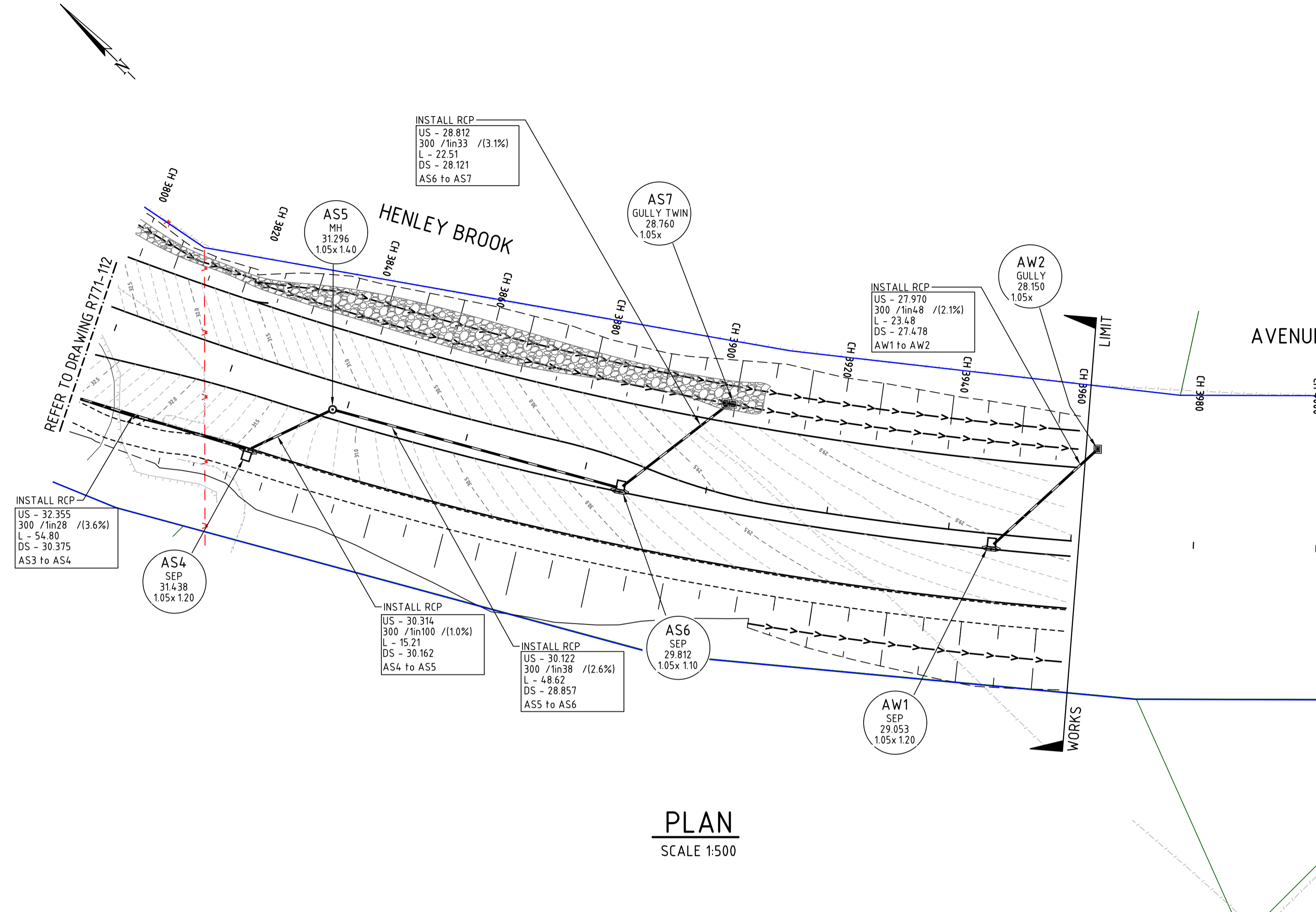
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SCALE: 1:500 (A1)  
DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PLAN SHEET 3 OF 4



DRAWING No: <b>R771-112</b>	REV No: <b>0</b>
<b>OPERATIONS</b>	



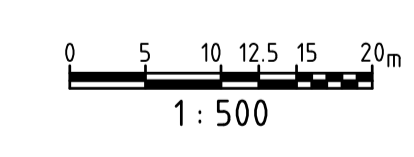
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SCALE 1:500

**LEGEND**  
PROPOSED

- SEALED EDGE
  - KERB FACE
  - DRAINAGE RCP
  - SEP, MANHOLE, GULLY, HEADWALL
  - MANHOLE, GULLY, HEADWALL
  - CONCRETE: FOOTPATH
  - PRAM RAMP
  - OPEN DRAIN
  - CONTOUR 100mm INTERVAL
- PIT NAME: D2  
PIT TYPE: MH  
SETOUT RL: 16.190  
DIA x DEPTH: 1.2 x 2.3
- UP STREAM INVERT: US - 15.022  
PIPE SIZE/GRADE: 375 / 1in108 / (0.9%)  
LENGTH (m): L - 39.00  
DOWN STREAM INVERT: DS - 14.661
- MH = MANHOLE  
SEP = SIDE ENTRY PIT

**EXISTING**

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**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PLAN SHEET 4 OF 4

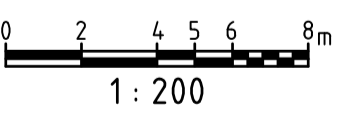
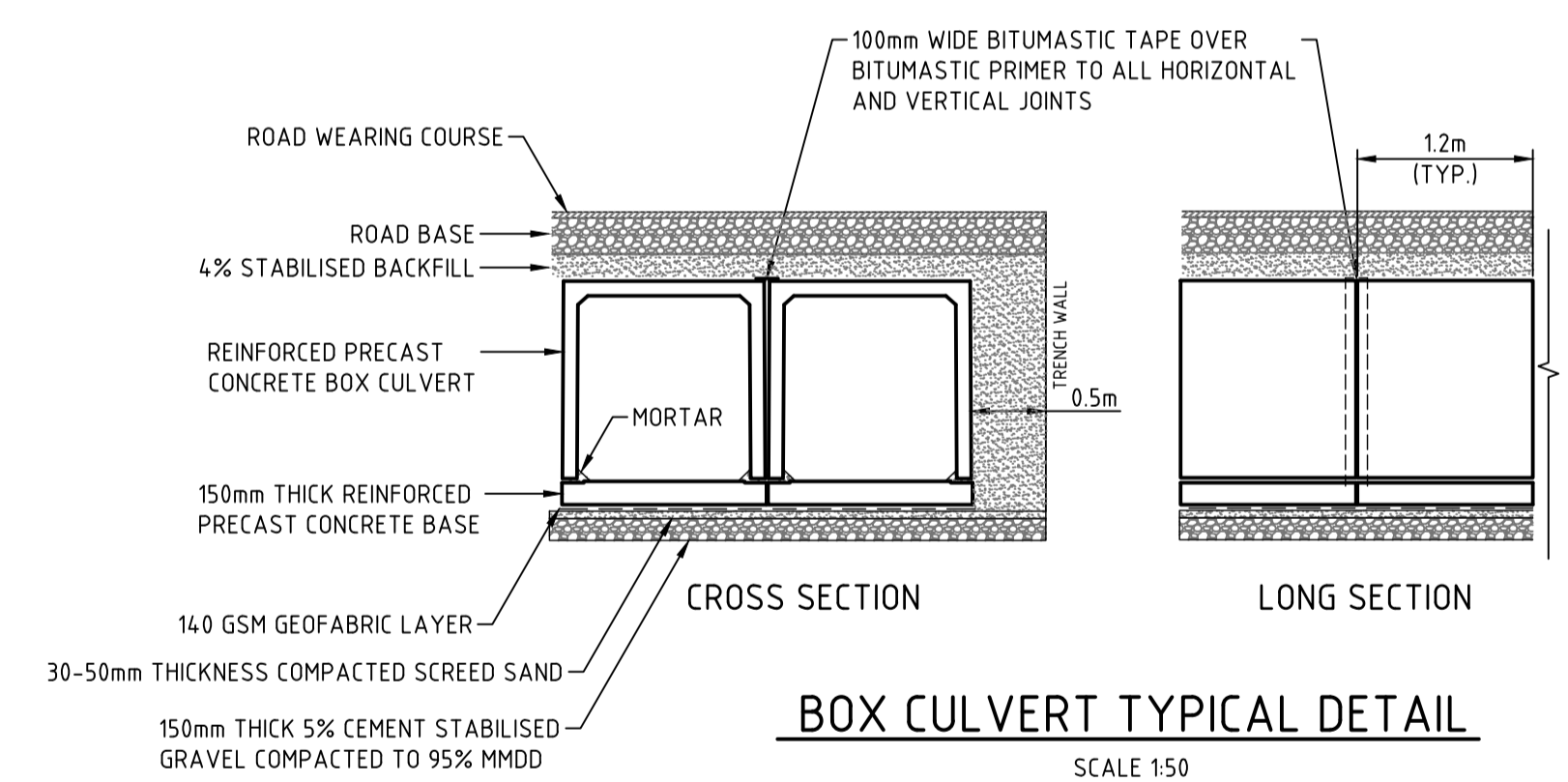
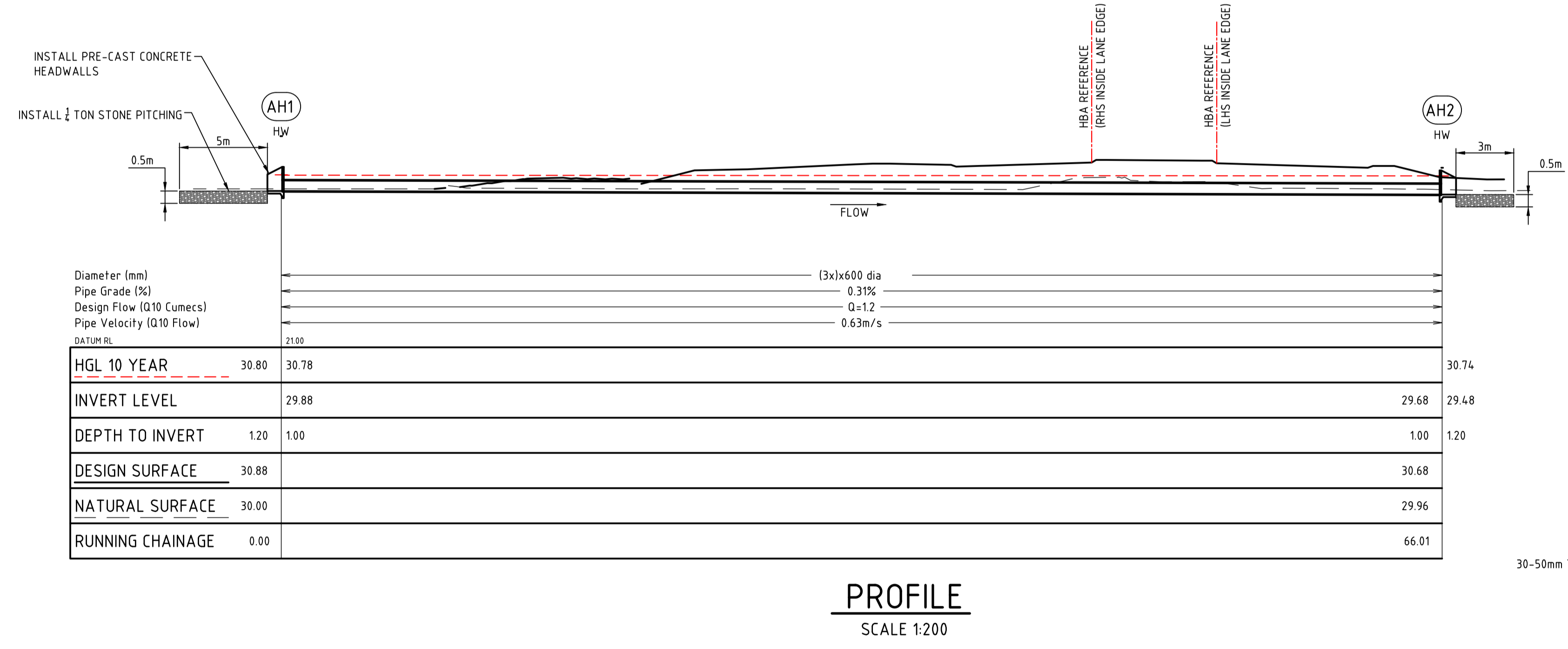
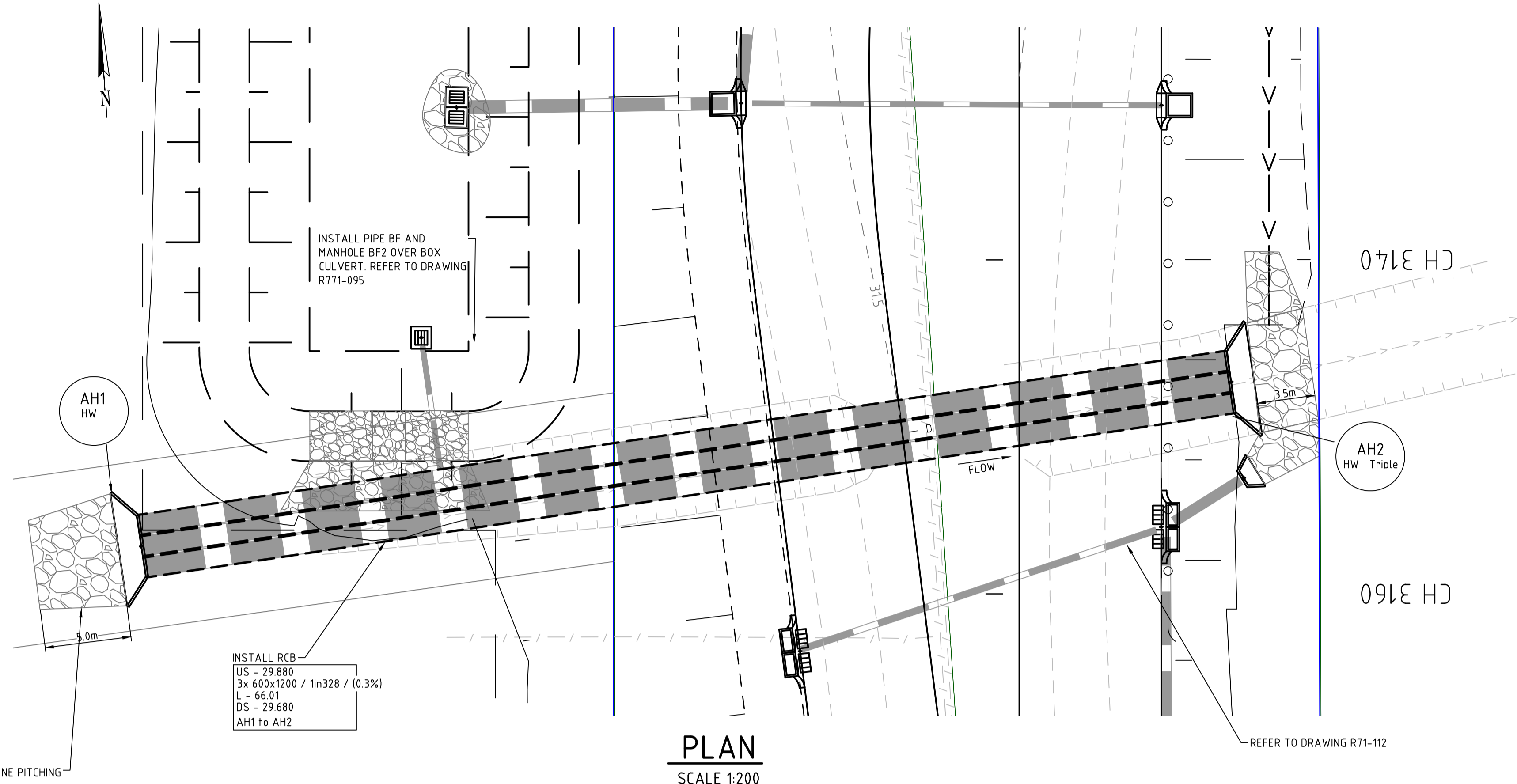


DRAWING No: R771-113  
REV No: 0

**OPERATIONS**

**NOTES:**

1. ALL CONCRETE PRODUCTS TO COMPLY WITH AS 3610 FORM WORK FOR CONCRETE AND AS 3600 - CONCRETE STRUCTURES.
2. BOX CULVERTS:
  - 2.1. ARE TO BE MANUFACTURED AND INSTALLED AS PER AS1597 AUSTRALIAN STANDARDS FOR PRECAST REINFORCED CONCRETE BOX CULVERTS.
  - 2.2. PRECAST BASE SLABS SHALL BE SUPPORTED ON A BED ZONE OF 150mm THICK GRAVEL BACKFILL CEMENT STABILISED TO 5%, A 50mm THICK COMPACTED SCREED SAND LAYER AND GEOFABRIC (REFER TO TYPICAL DETAIL).
  - 2.3. PRECAST CROWN UNITS SHALL BE PLACED ON A BED OF MORTAR IN THE RECESSES IN THE BASE SLAB. ANY GAPS BETWEEN THE SIDE WALLS AND THE SIDES OF THE RECESSES SHALL BE PACKED WITH CEMENT MORTAR. LIFTING HOLES AND BUTT JOINTS BETWEEN THE ENDS OF UNITS SHALL BE PACKED OR SEALED WITH CEMENT MORTAR OR GROUT OF A CONSISTENCY THAT ENSURES FILLING OF THE VOID.
  - 2.4. STEEL LIFTING HOOKS SHALL BE CUT FLUSH WITH THE SURFACE OF THE CONCRETE, CLEANED TO BRIGHT METAL AND COATED WITH TWO COATS OF COAL TAR EPOXY OR EQUIVALENT APPROVED BY THE SUPERINTENDENT. ALTERNATIVELY, THEY SHALL BE SEALED WITH EPOXY MORTAR.
  - 2.5. THE GAP BETWEEN MULTI CELL CULVERTS, TYPICALLY 15mm, SHALL BE PROVIDED BETWEEN ADJACENT CELLS. THIS GAP SHALL BE FILLED WITH CEMENT MORTAR OR GROUT. ALTERNATIVELY GAPS CAN BE COVERED WITH A 150mm WIDE BITUMASTIC PRIMER AND TAPE OR A GEOFABRIC MEMBRANE SUITABLY PLACED ACROSS THE SPAN OF THE CULVERTS.
  - 2.6. ALL MORTAR JOINTS SHALL BE PROTECTED FROM THE SUN AND CURED IN AN APPROVED MANNER FOR NOT LESS THAN 48 HOURS.
  - 2.7. ALL EXTERNAL SURFACES OF JOINTS BETWEEN PRECAST CROWN UNITS, BOTH LATERALLY AND LONGITUDINALLY, SHALL BE COVERED FULL LENGTH, AND MINIMUM 250mm WIDTH, WITH STRIPS OF NON-WOVEN GEOTEXTILE OF MINIMUM MASS 270 GRAMS PER SQUARE METRE IN ACCORDANCE WITH AUSTRROADS GUIDE TO GEOTEXTILES.
3. FOUNDATION & BACKFILL
  - 3.1. ALL SOFT, YIELDING OR UNSUITABLE MATERIAL SHALL BE REMOVED FROM THE FOUNDATION AND REPLACED WITH ORDINARY BACKFILL MATERIAL AS DIRECTED BY THE SUPERINTENDENT
  - 3.2. CEMENT STABILISED BACKFILL MATERIAL SHALL CONSIST OF BASECOURSE MATERIAL, OR OTHER SUITABLE MATERIAL APPROVED BY THE SUPERINTENDENT, STABILISED IN THE PROPORTION OF 100KG OF TYPE GP CEMENT TO ONE CUBIC METRE OF UNCOMPACTED BACKFILL MATERIAL
  - 3.3. EXCAVATIONS SHALL BE KEPT FREE FROM WATER UNTIL WORK BELOW GROUND LEVEL IS SUFFICIENTLY SET OR PROTECTED



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DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE

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DATUM: A.H.D.

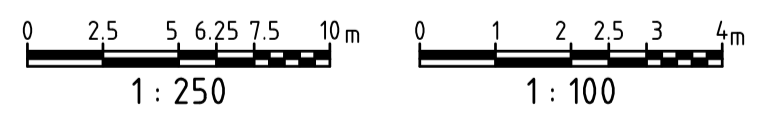
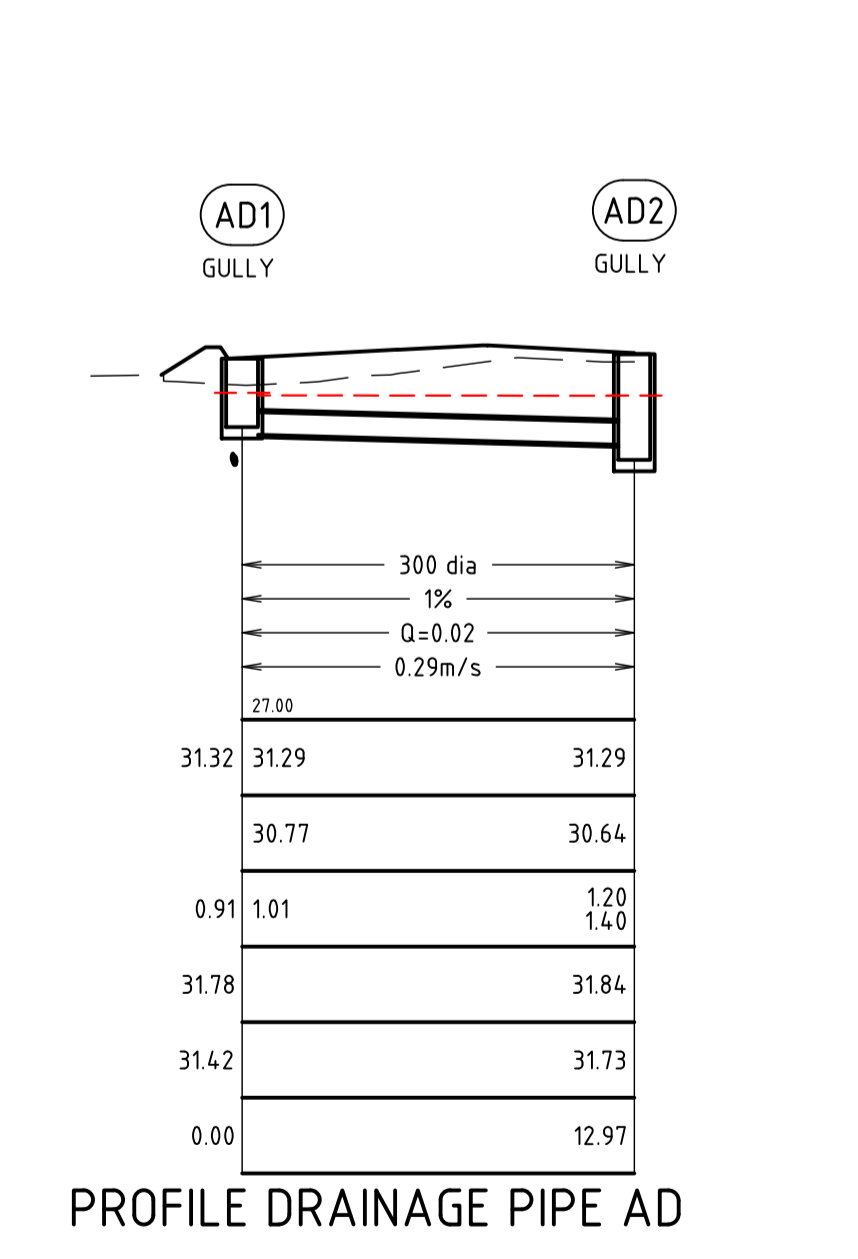
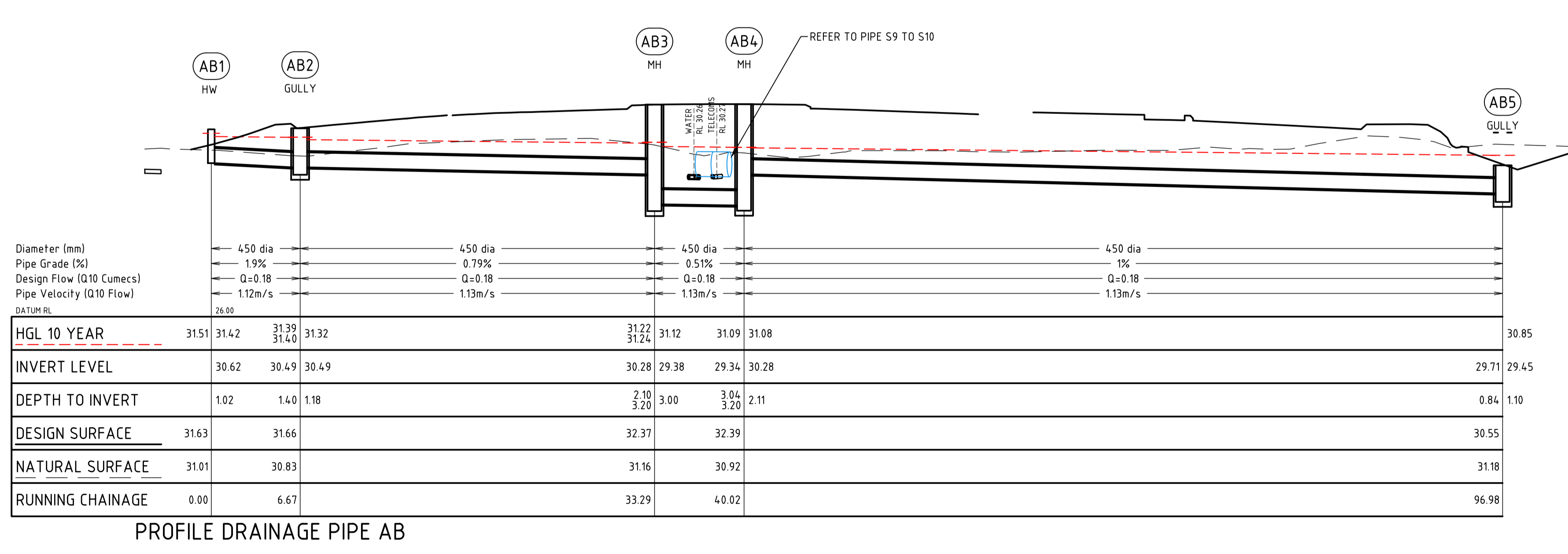
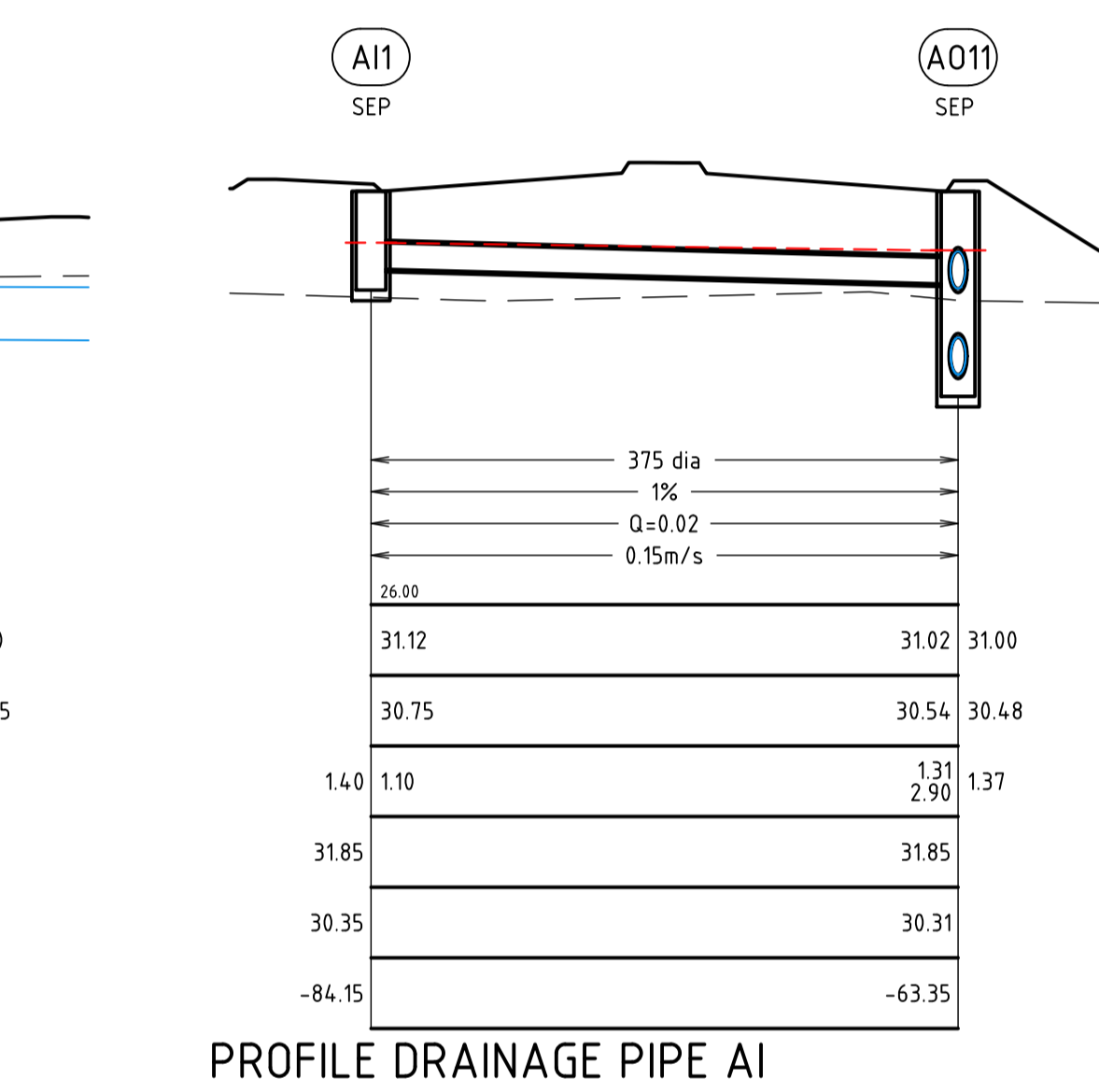
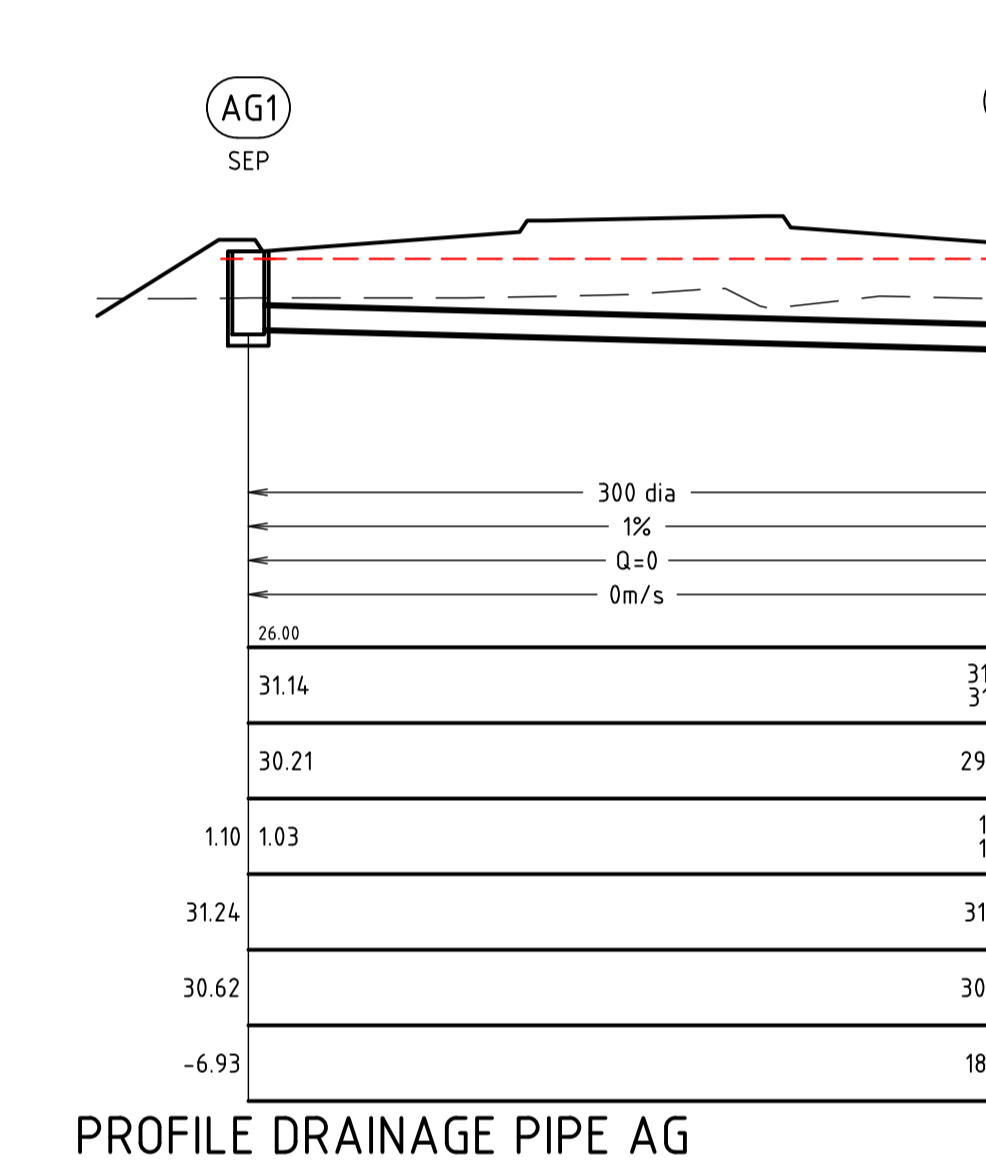
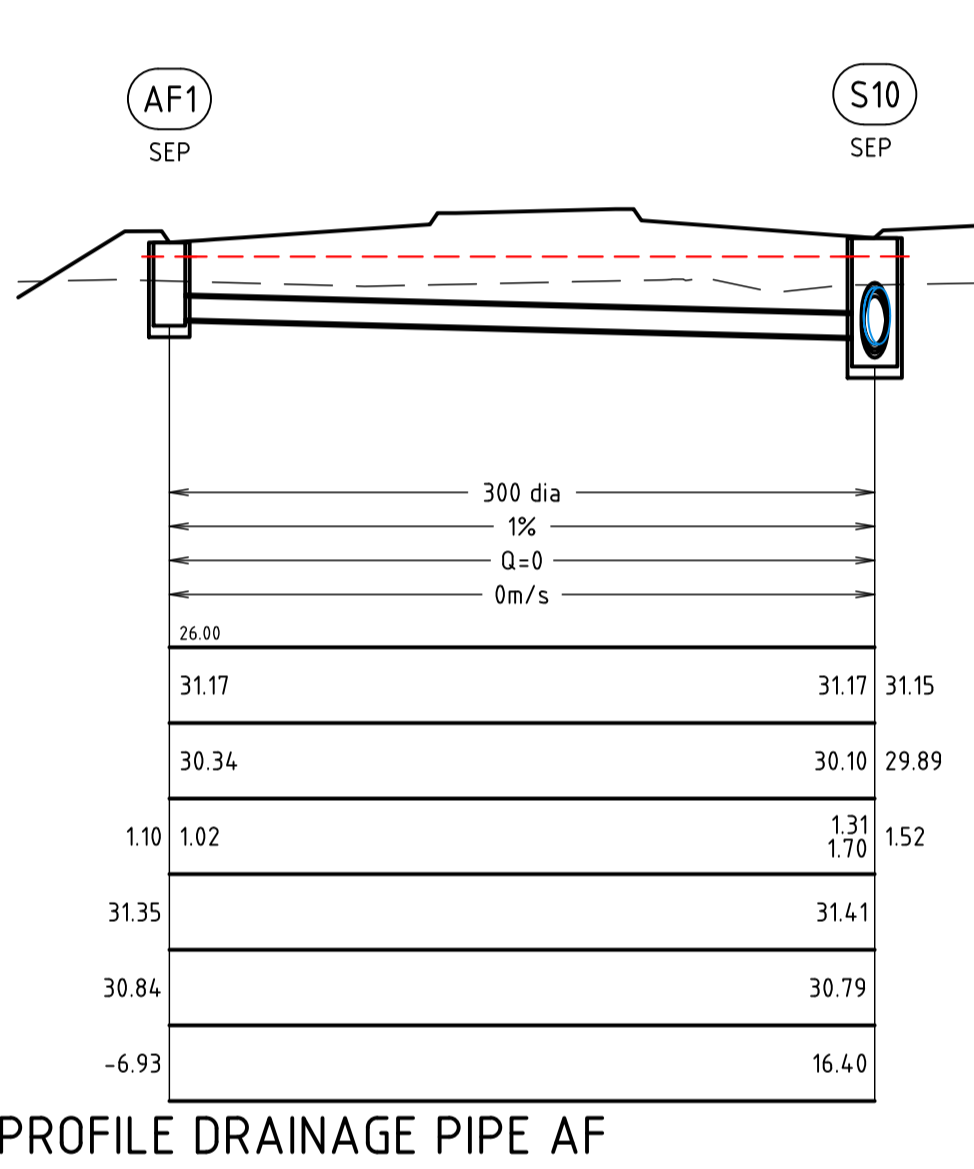
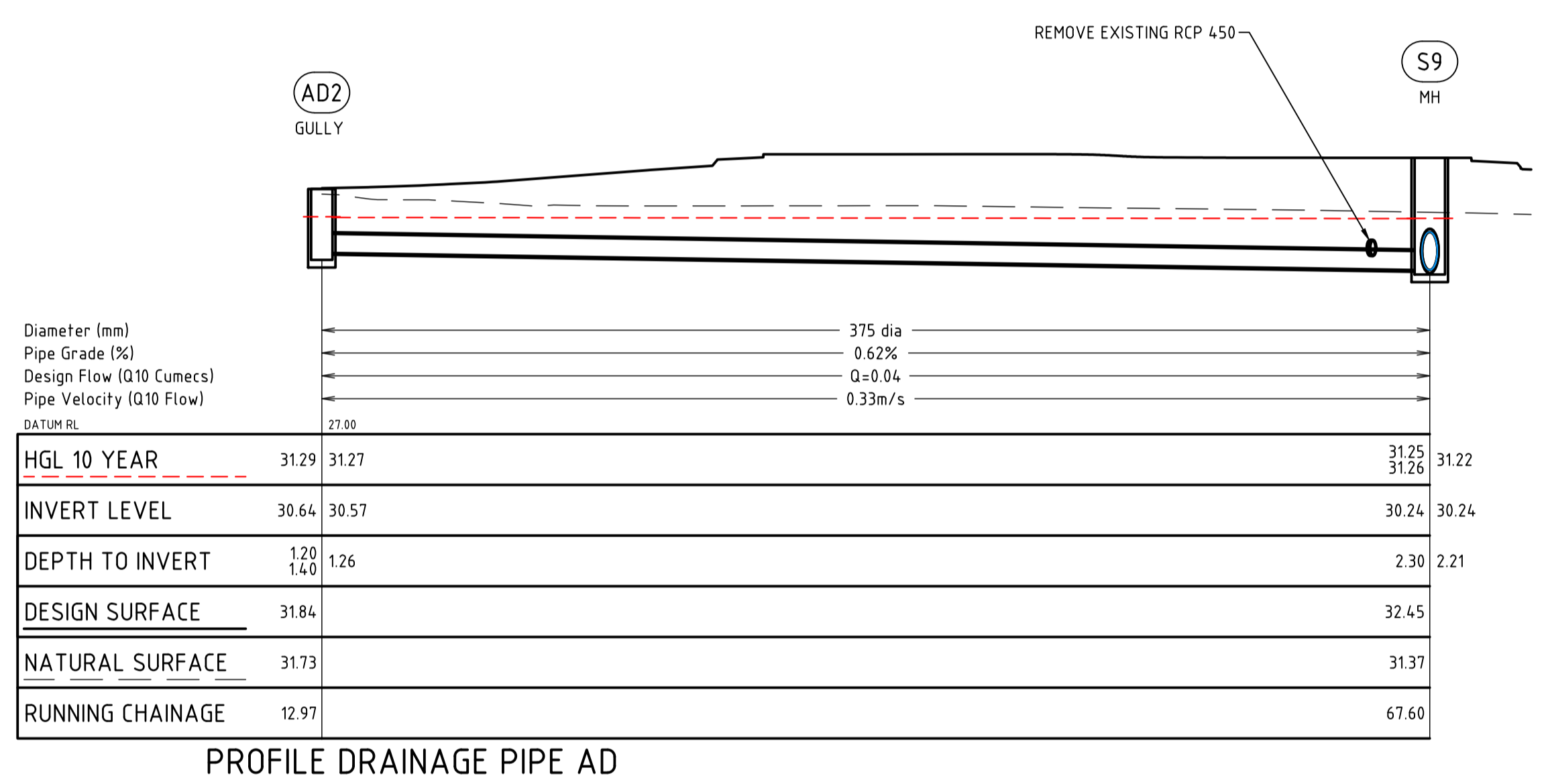
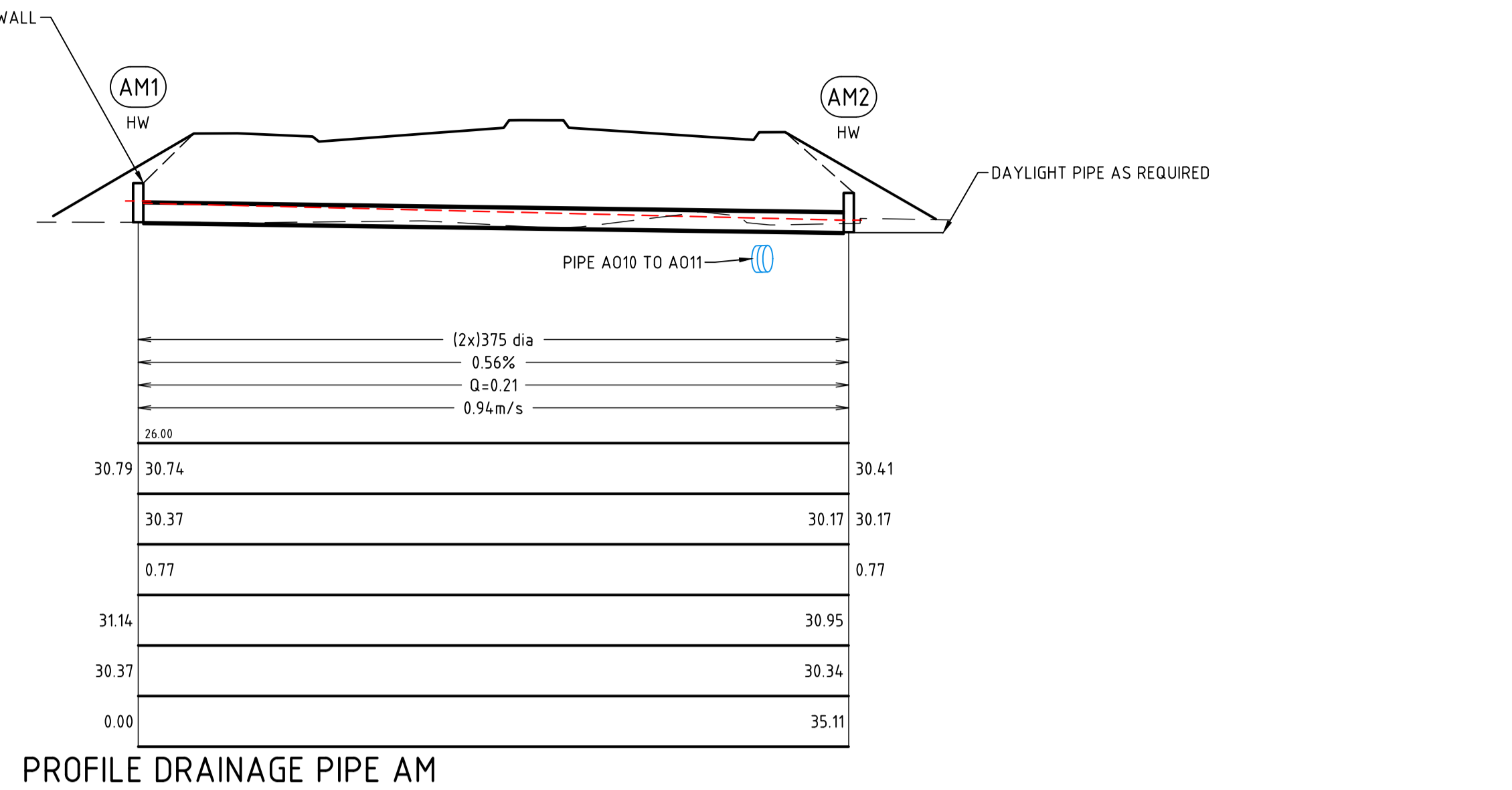
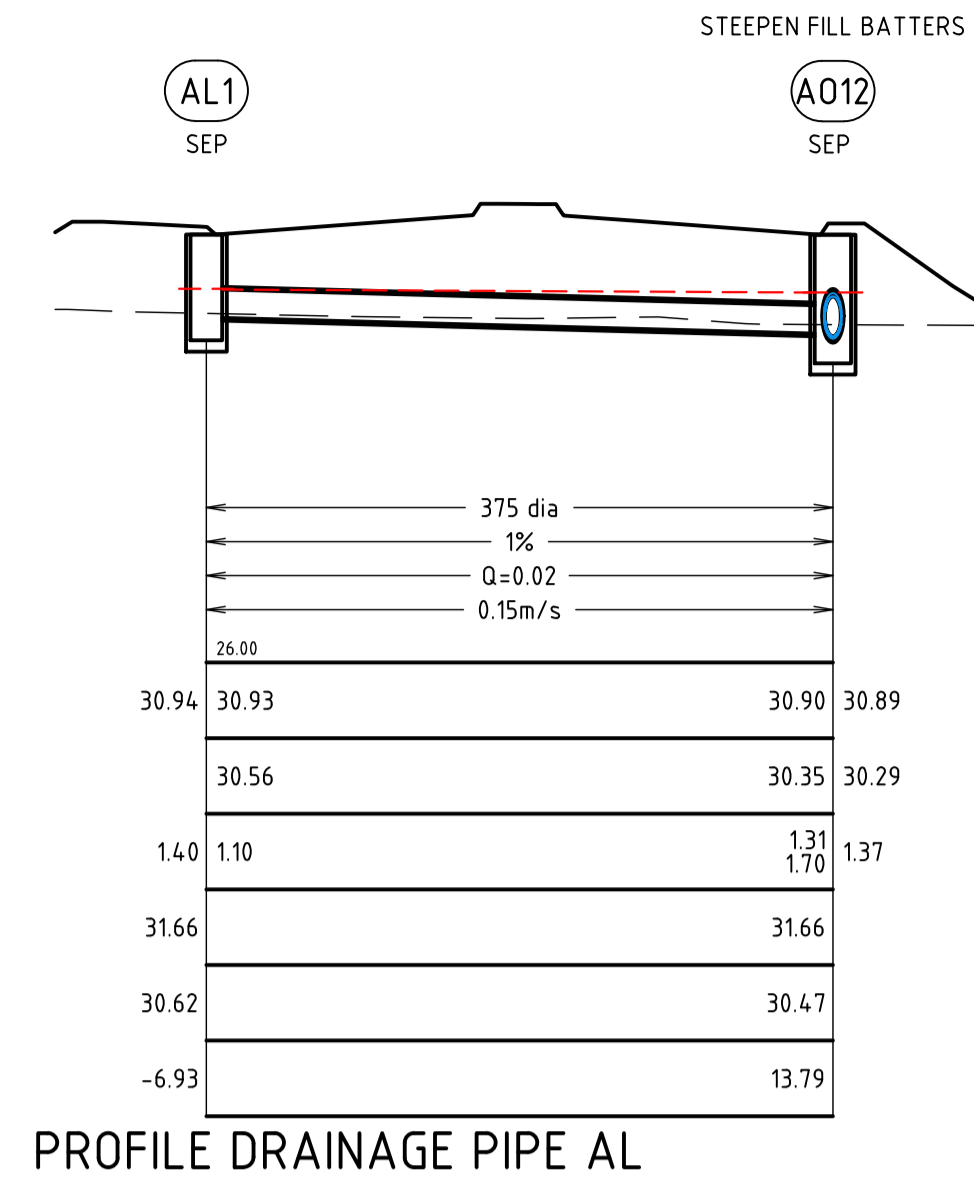
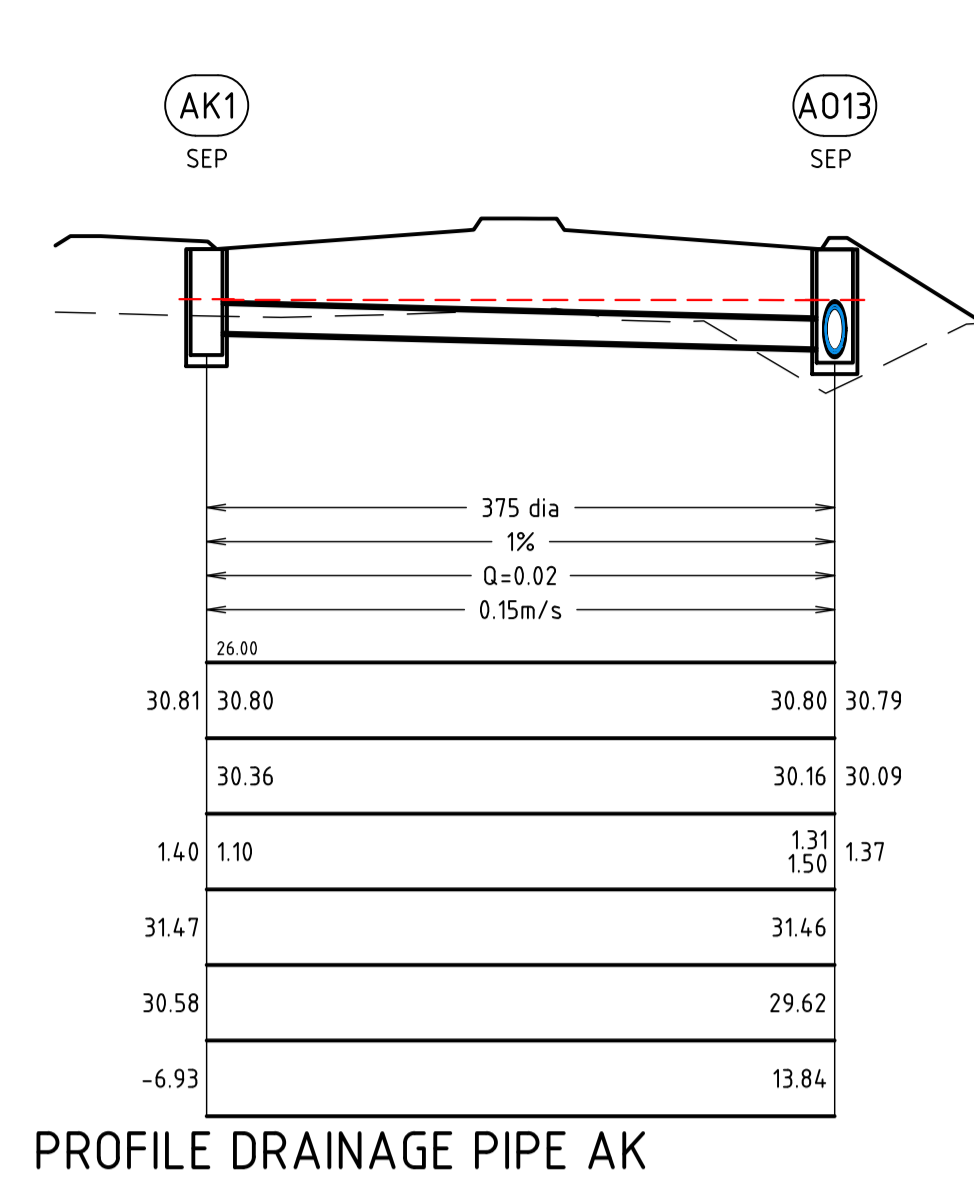
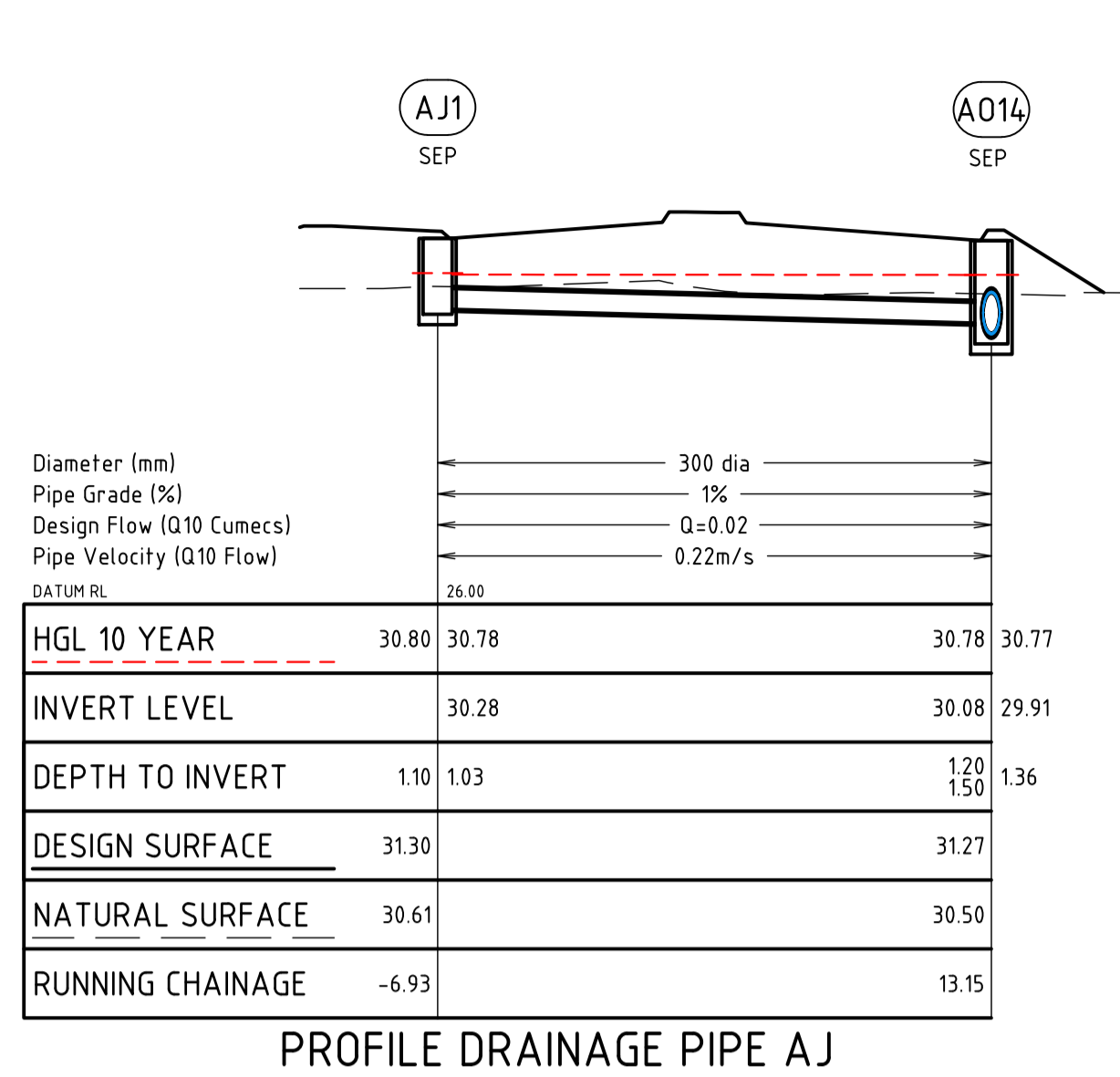
**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 1 OF 7



DRAWING No: R771-114  
REV No: 0

**OPERATIONS**

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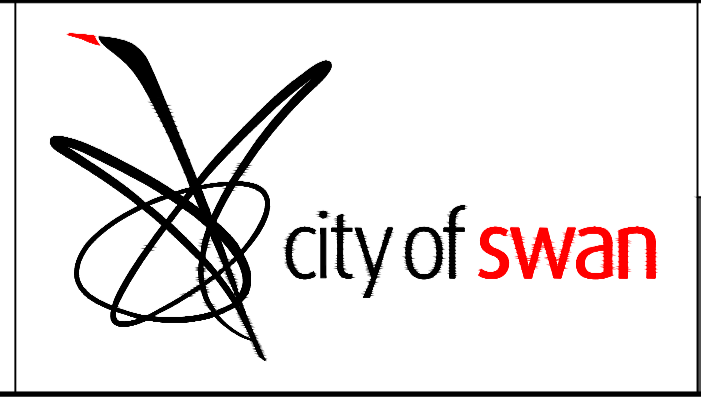
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REV	DATE	BY	DESCRIPTION
0	04.23	DW	ISSUED FOR CONSTRUCTION

AUTHORISATION	APPROVED
PROJECT MANAGER	DESIGN CO-ORDINATOR
DESIGNED	CHECKED
DATE	DATE
DRAWN	CAYATTE

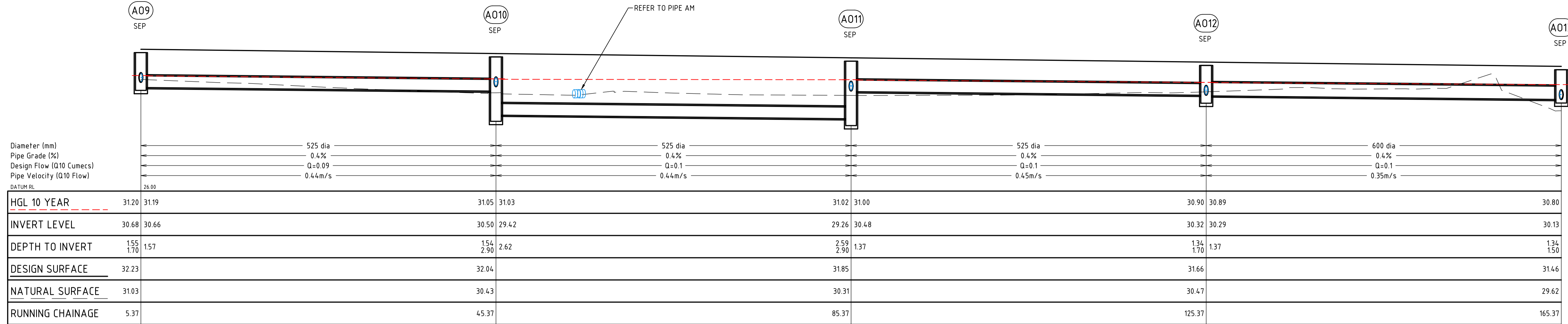
SCALE: H - 1:250 V - 1:100 (A1)  
DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 2 OF 7

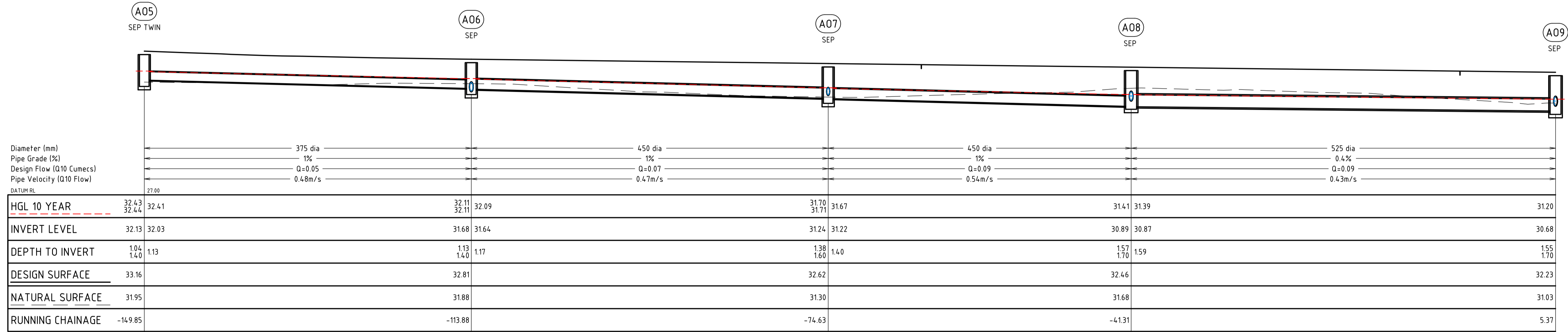


DRAWING No: R771-115  
REV No: 0  
**OPERATIONS**

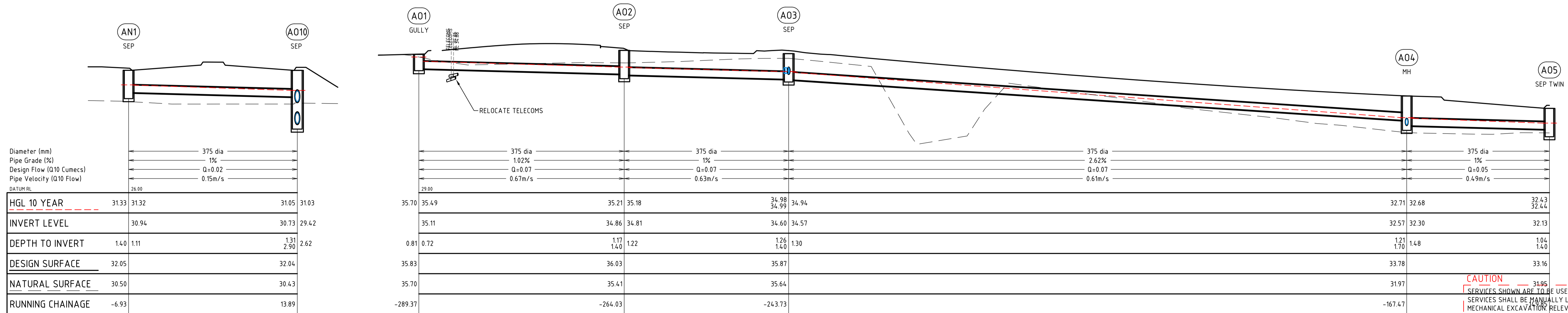




PROFILE DRAINAGE PIPE AO



PROFILE DRAINAGE PIPE AO



PROFILE DRAINAGE PIPE AN

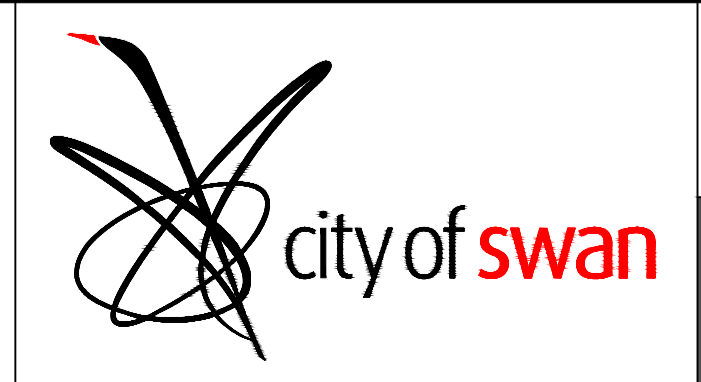
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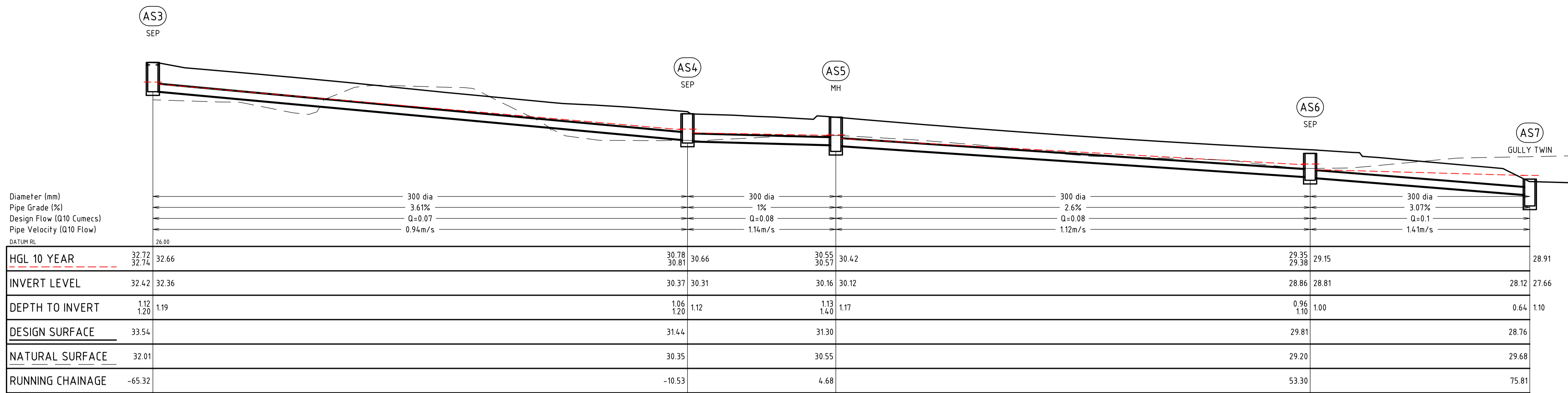
REV	DATE	BY	DESCRIPTION
0	04.23	DW	ISSUED FOR CONSTRUCTION

AUTHORISATION	APPROVED	SCALE: (A1)
PROJECT MANAGER _____ DATE _____	DESIGN CO-ORDINATOR _____ DATE _____	DATUM: A.H.D.
DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE	
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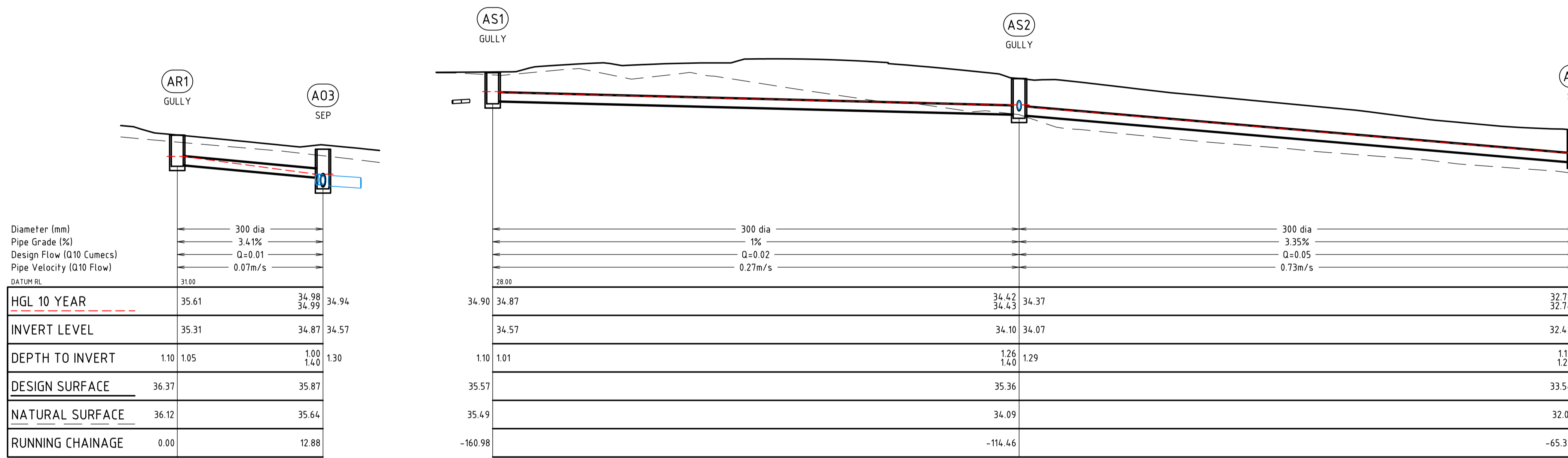
**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 3 OF 7



DRAWING No: <b>R771-116</b>	REV No: <b>0</b>
<b>OPERATIONS</b>	

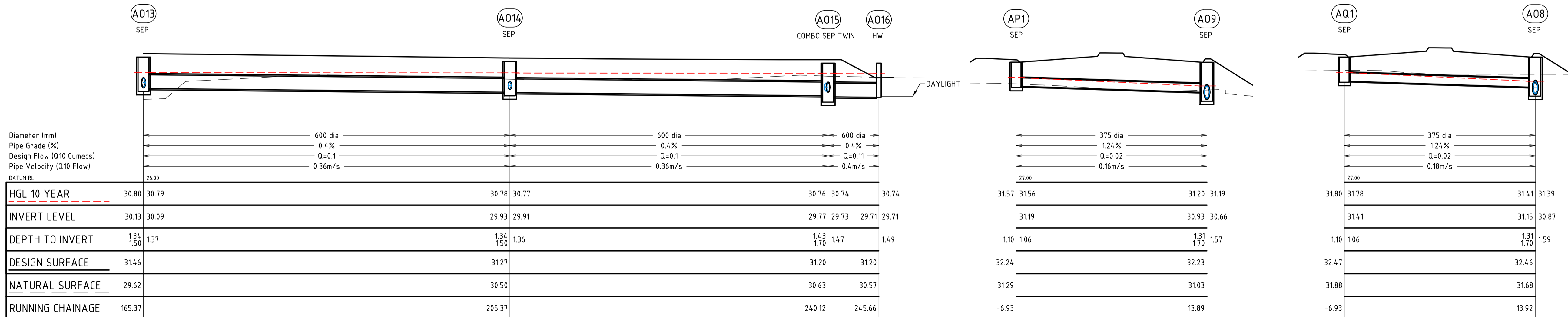


PROFILE DRAINAGE PIPE AS



PROFILE DRAINAGE PIPE AR

PROFILE DRAINAGE PIPE AS



PROFILE DRAINAGE PIPE AO

PROFILE DRAINAGE PIPE AP

PROFILE DRAINAGE PIPE AQ

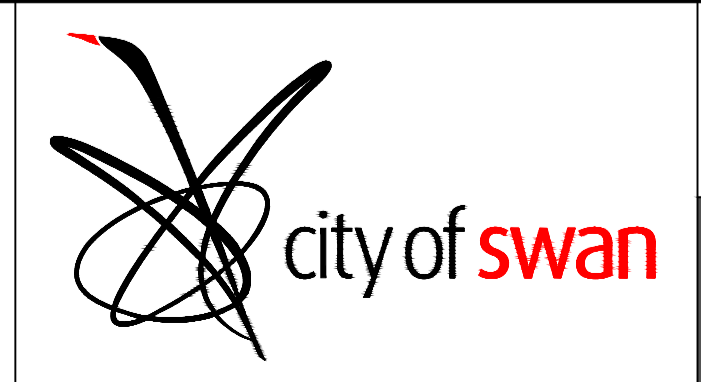
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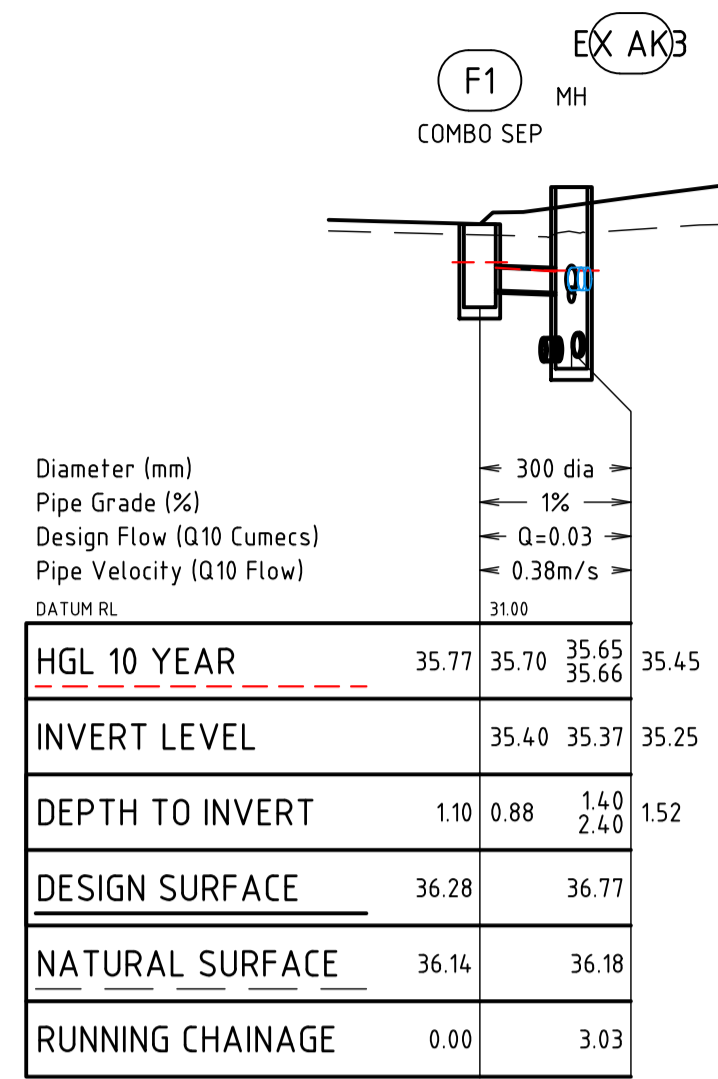
AUTHORISATION	APPROVED
PROJECT MANAGER _____ DATE _____	DESIGN CO-ORDINATOR _____ DATE _____
DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE

SCALE: (A1)  
DATUM: A.H.D.

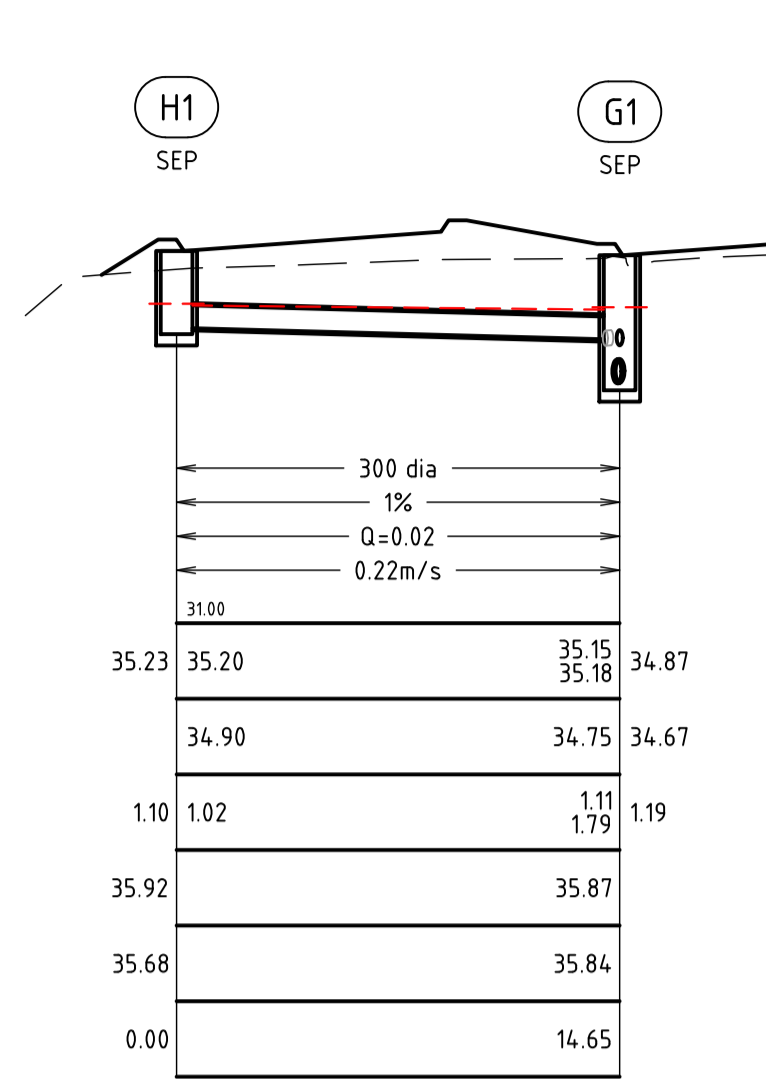
**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 4 OF 7



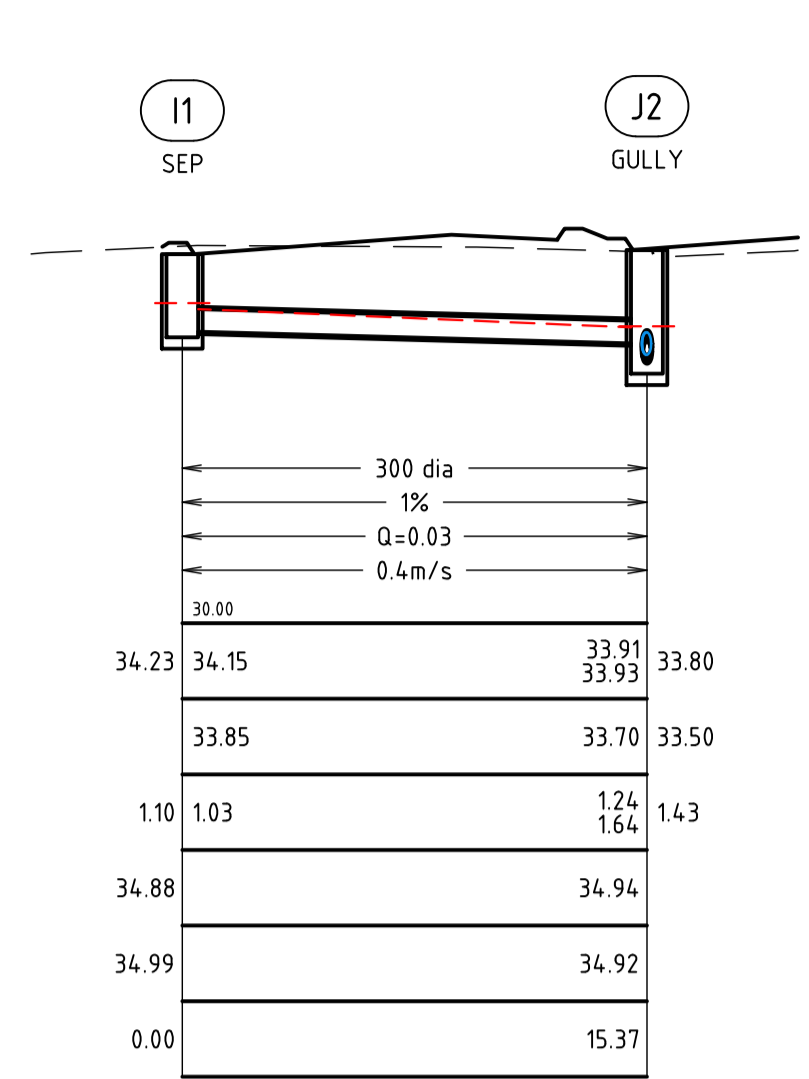
DRAWING No: R771-117  
REV No: 0  
**OPERATIONS**



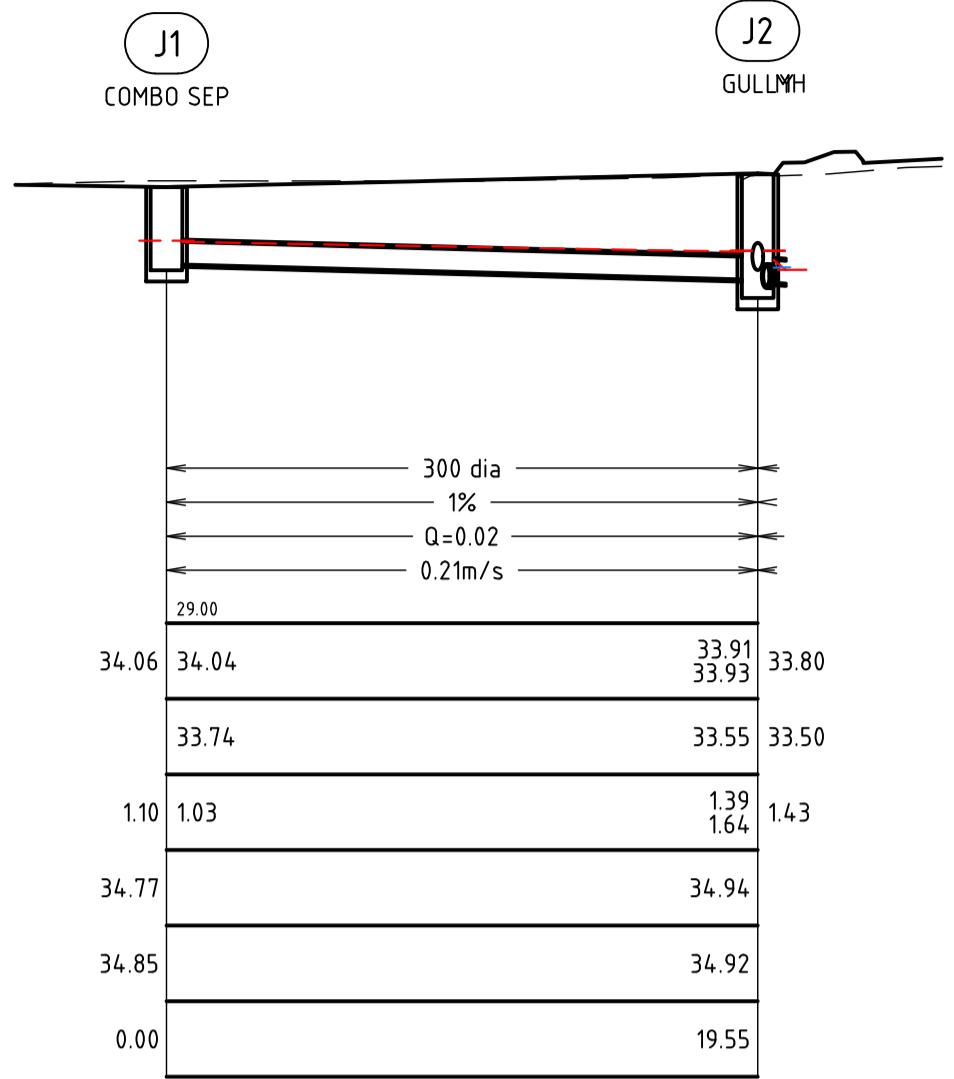
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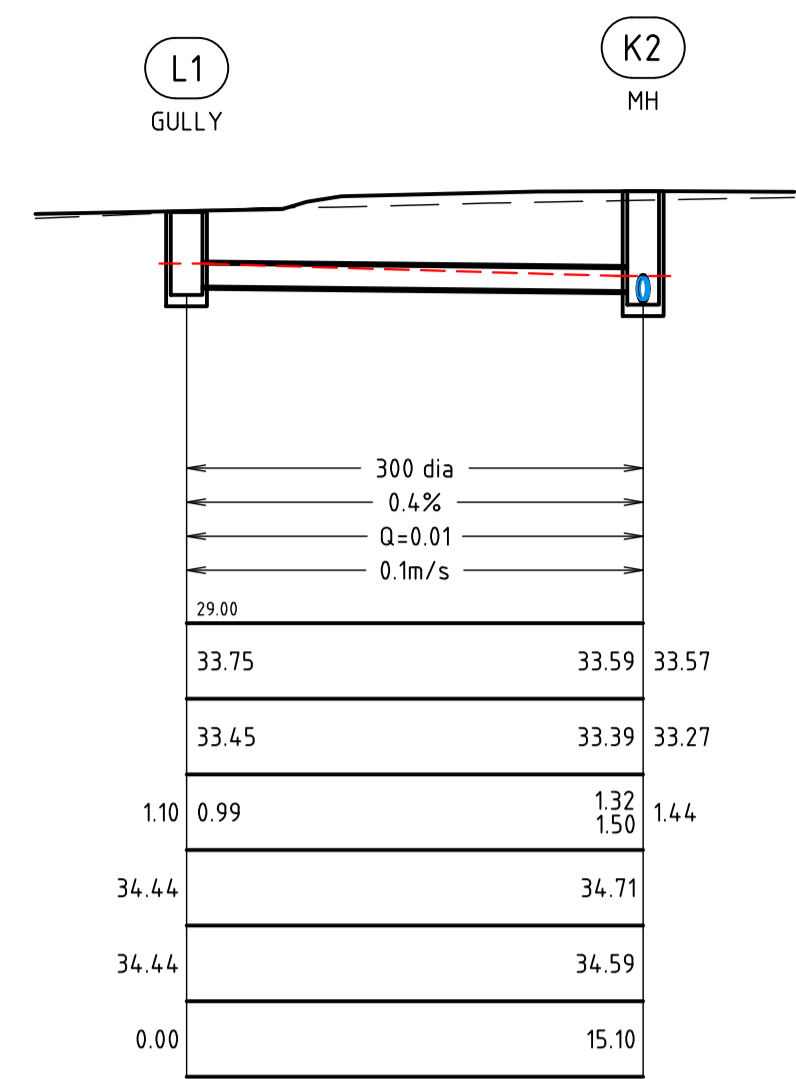
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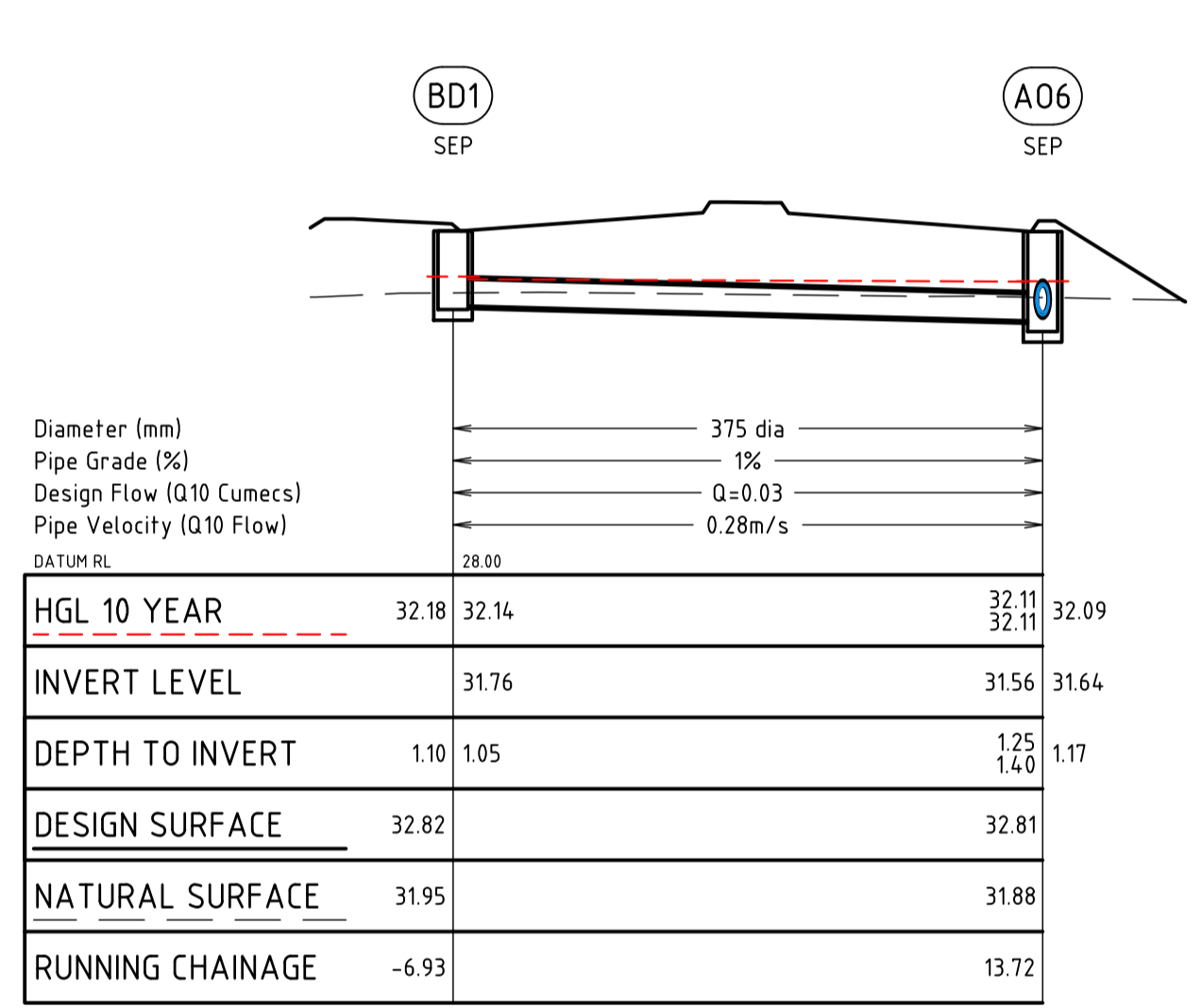
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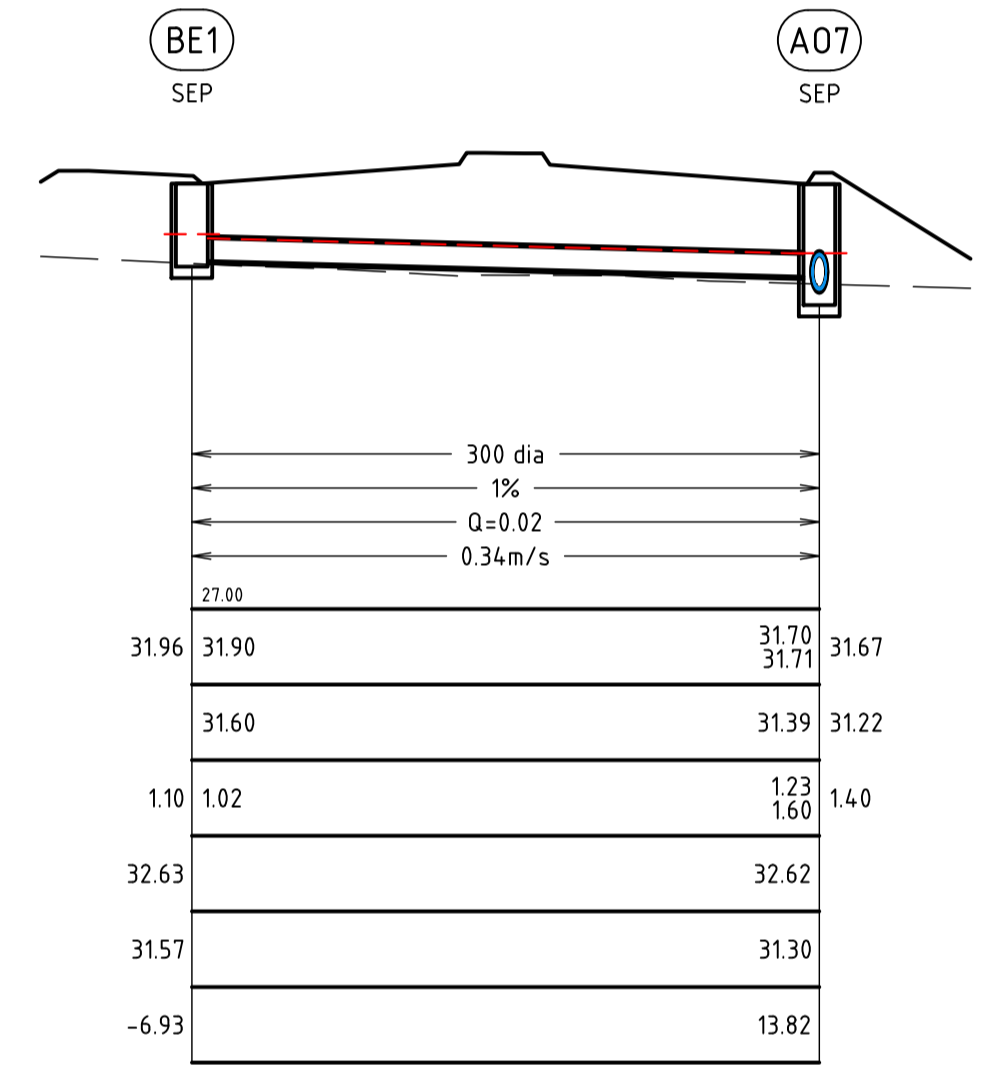
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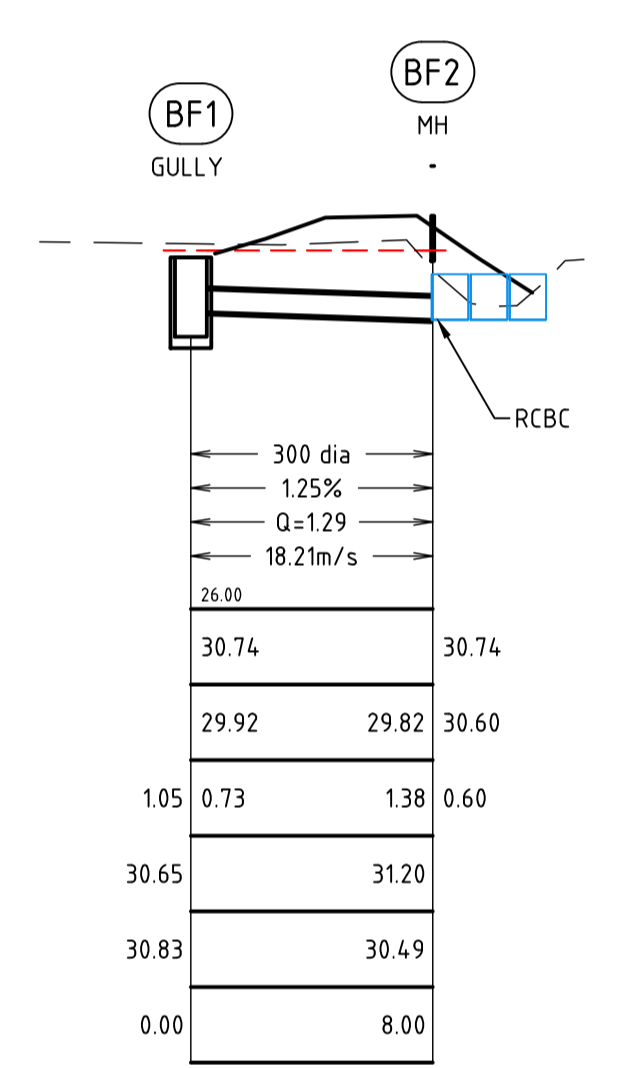
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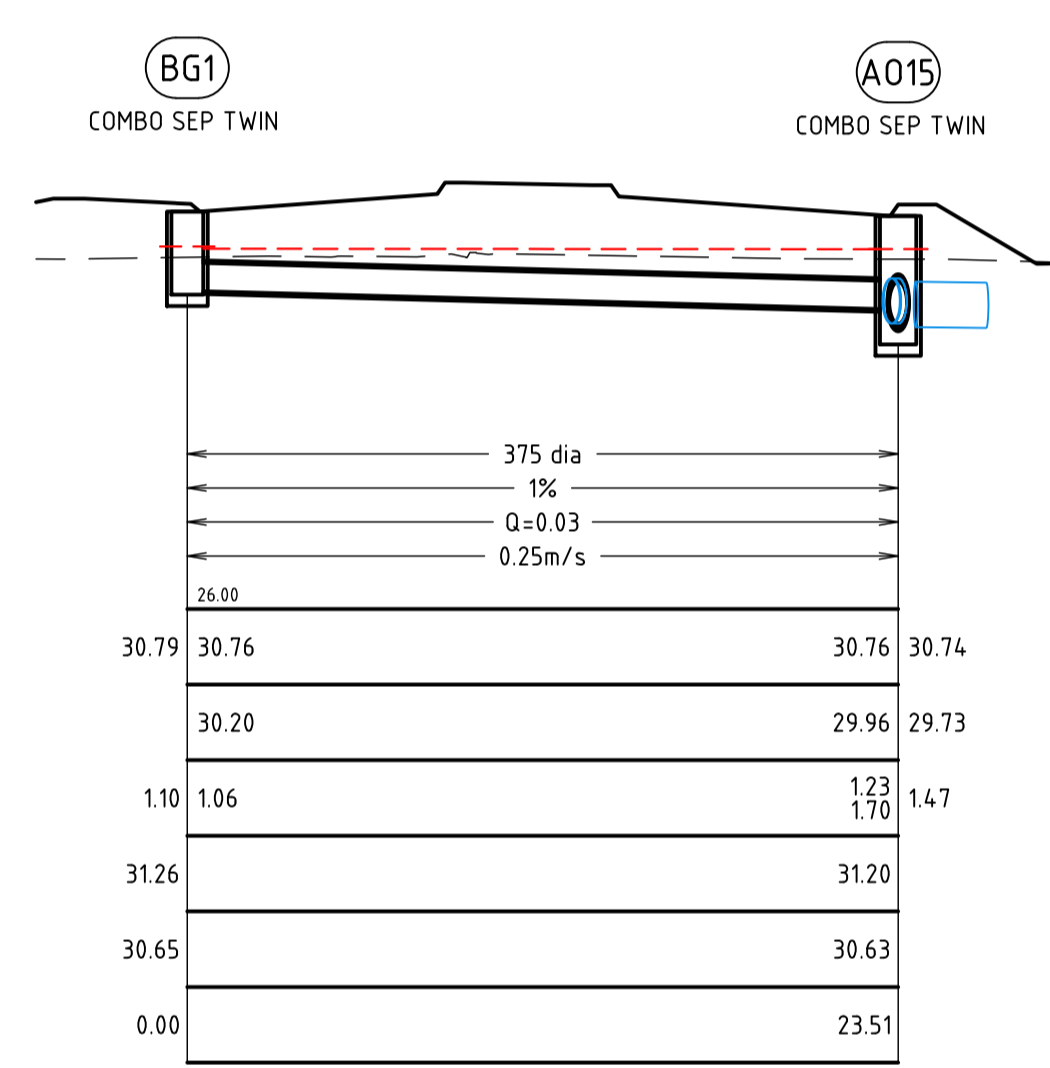
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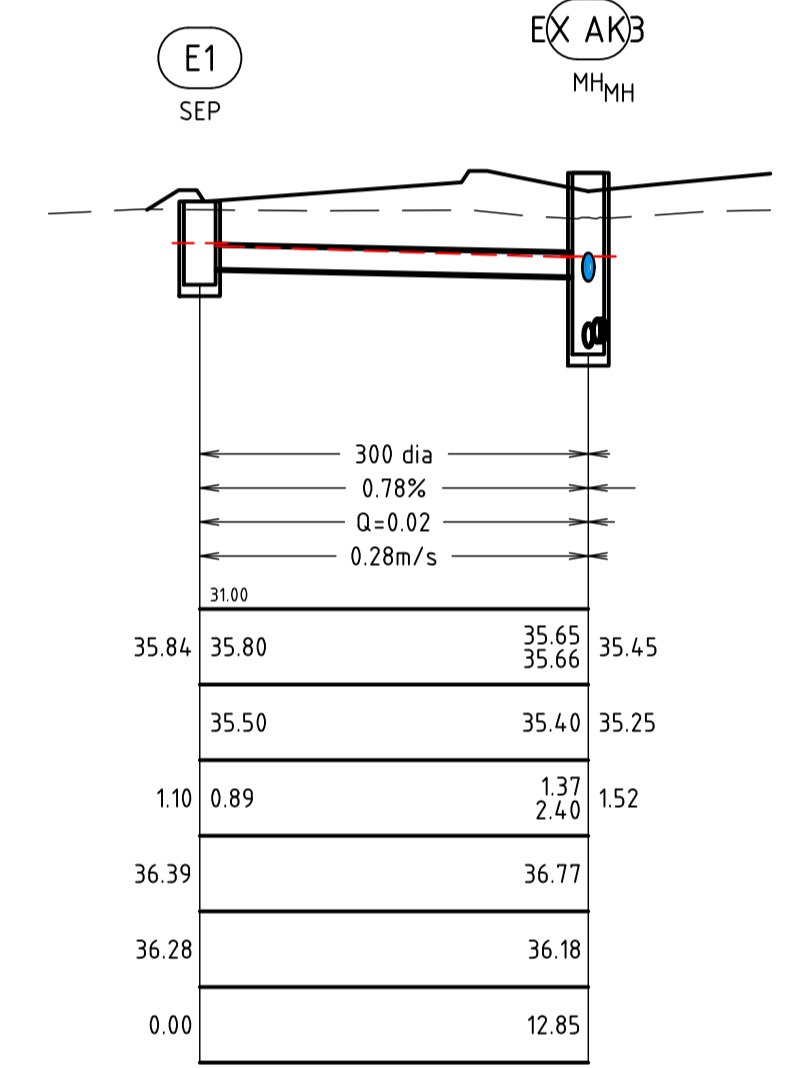
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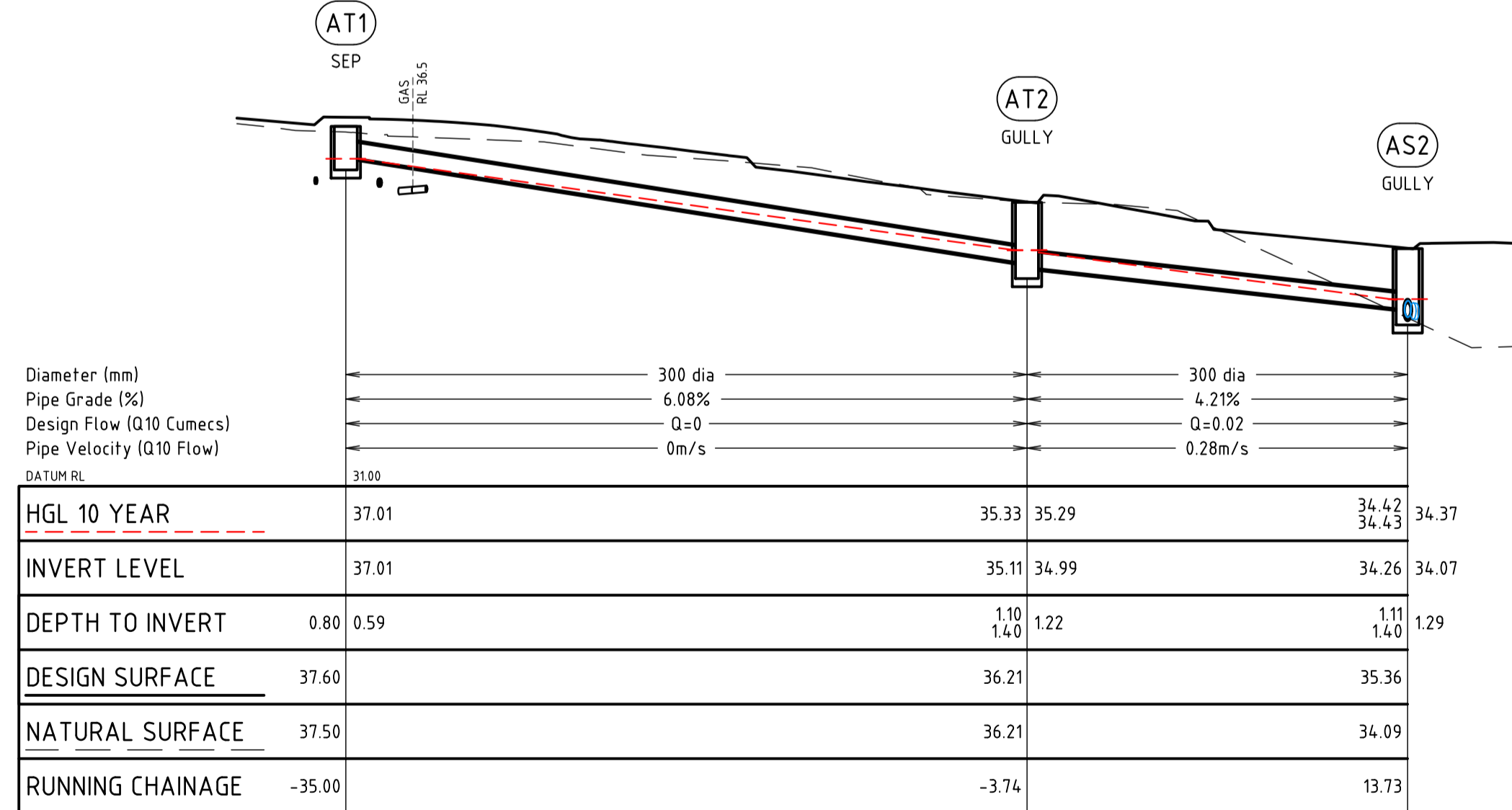
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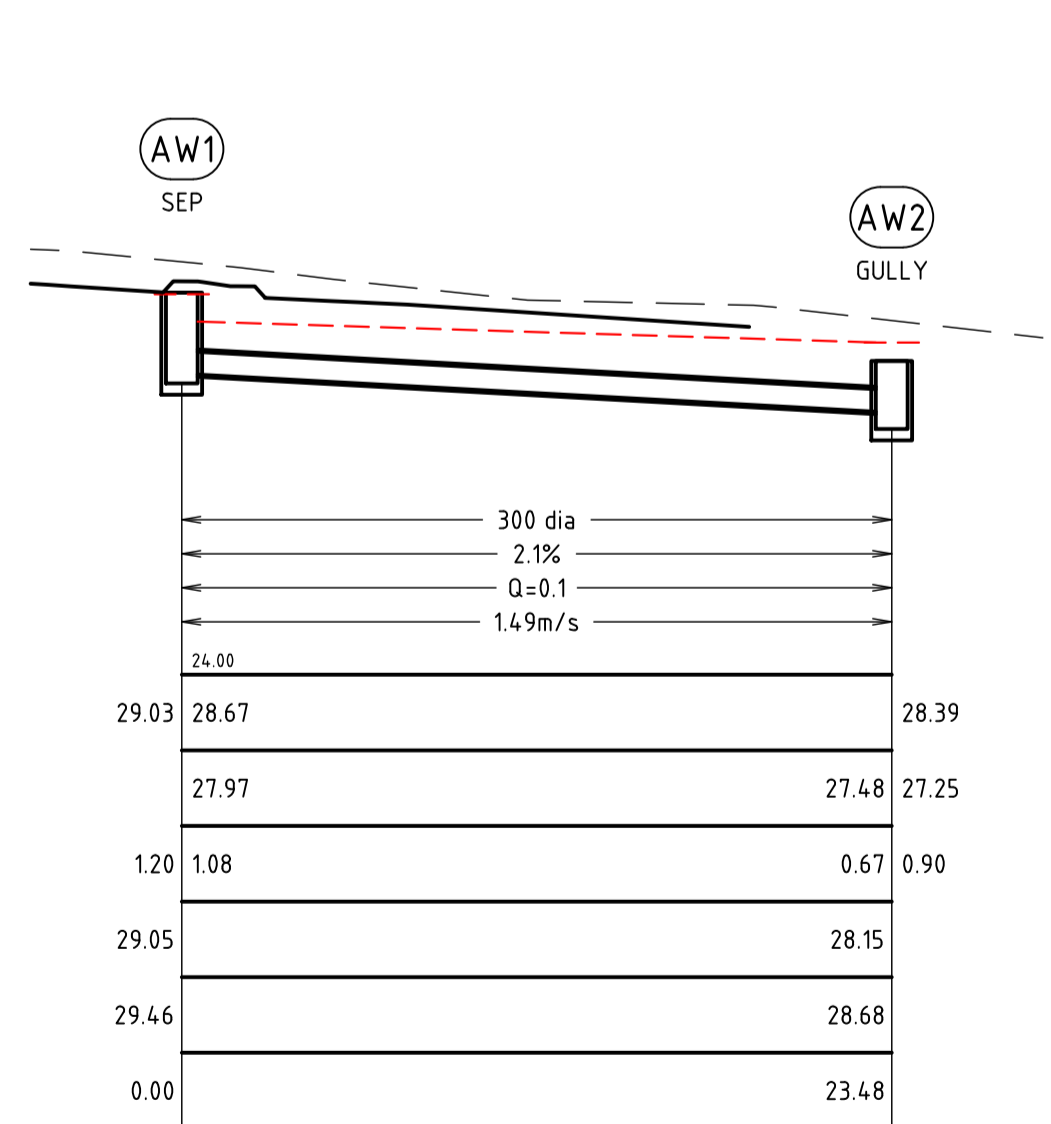
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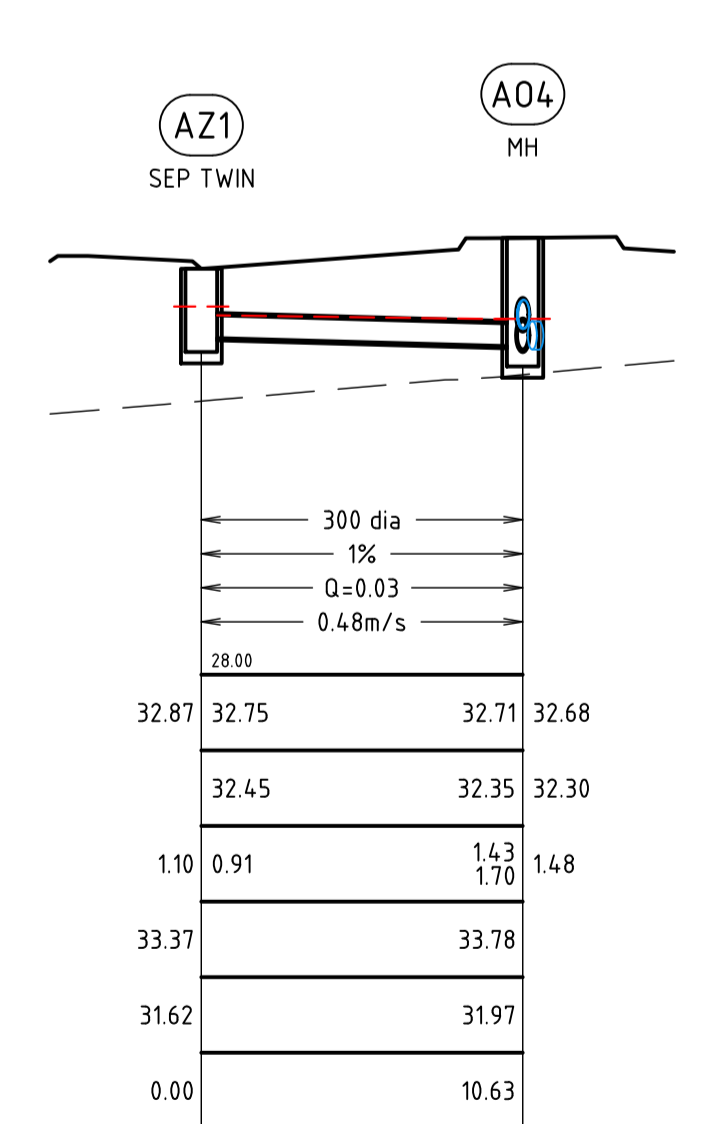
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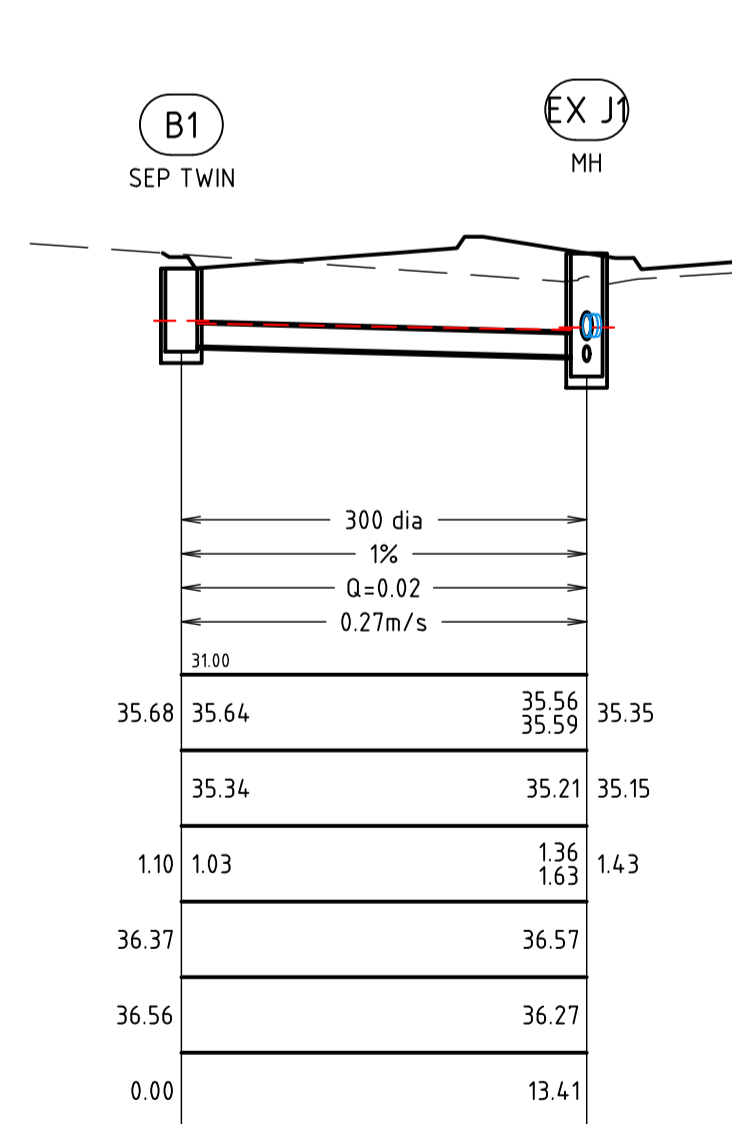
PROFILE DRAINAGE PIPE AT



PROFILE DRAINAGE PIPE AW



PROFILE DRAINAGE PIPE AZ



PROFILE DRAINAGE PIPE B

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0	04.23	DW	ISSUED FOR CONSTRUCTION

AUTHORISATION	APPROVED
PROJECT MANAGER _____ DATE _____	DESIGN CO-ORDINATOR _____ DATE _____
DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE

SCALE: A.H.D. (A1)  
DATUM: A.H.D.

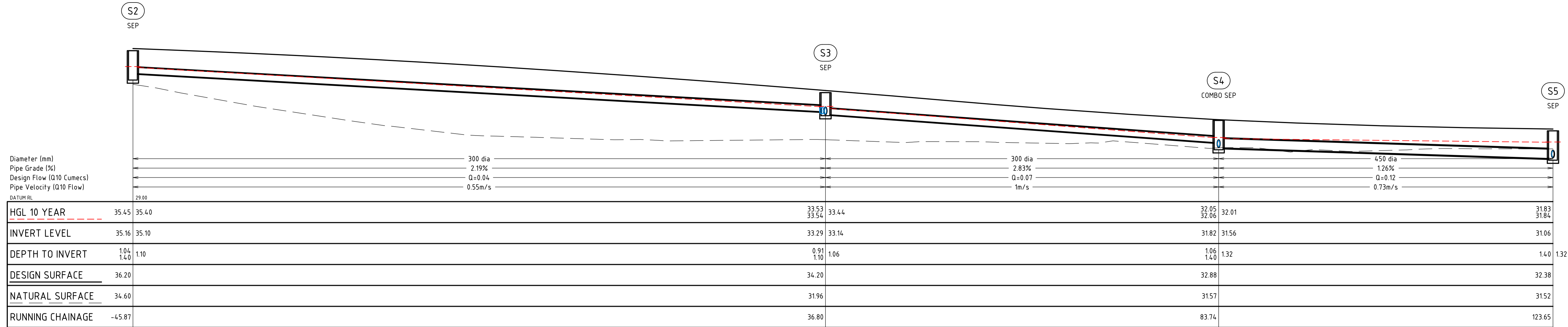
**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 5 OF 7

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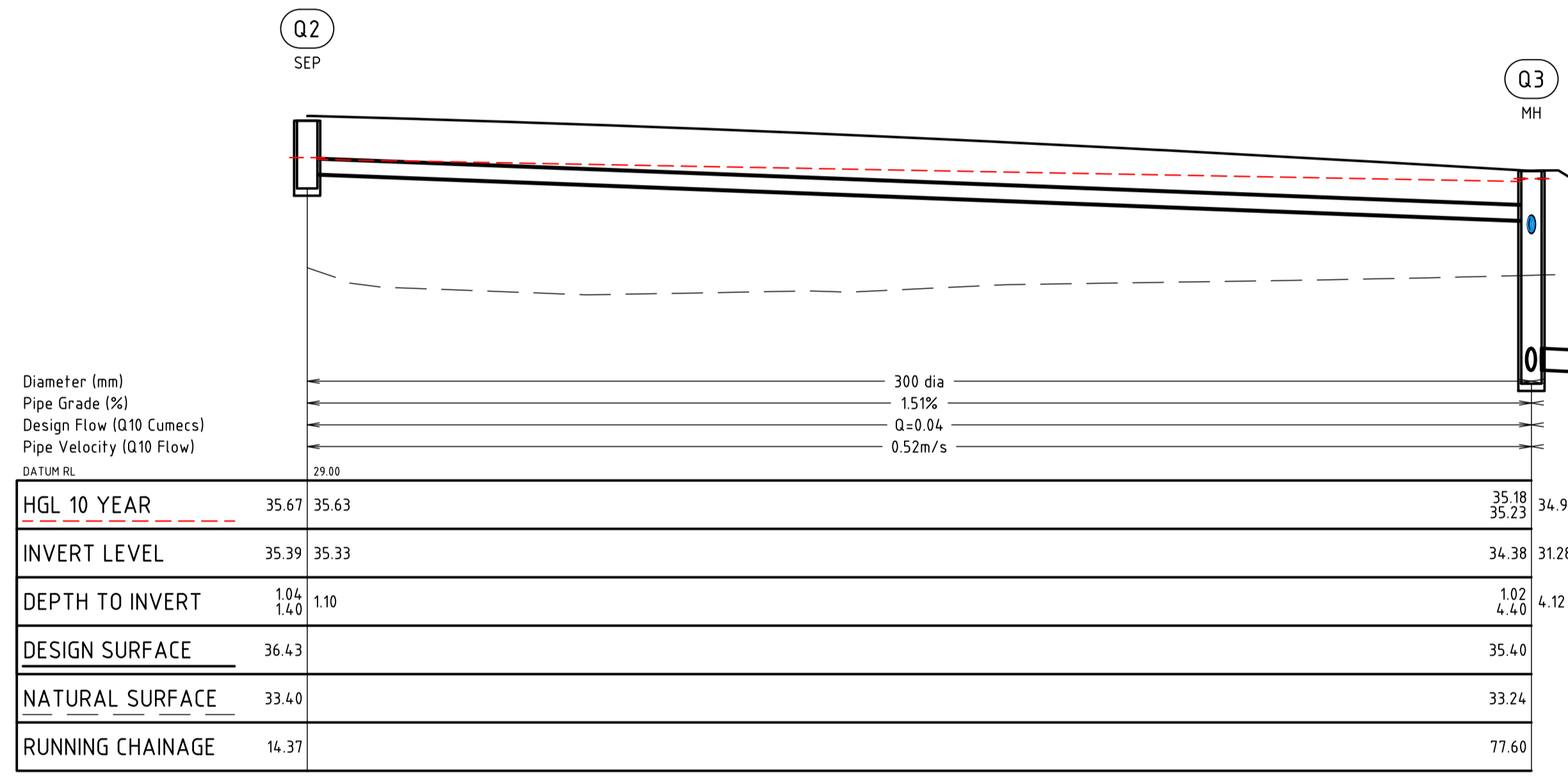


DRAWING No: R771-118  
REV No: 0

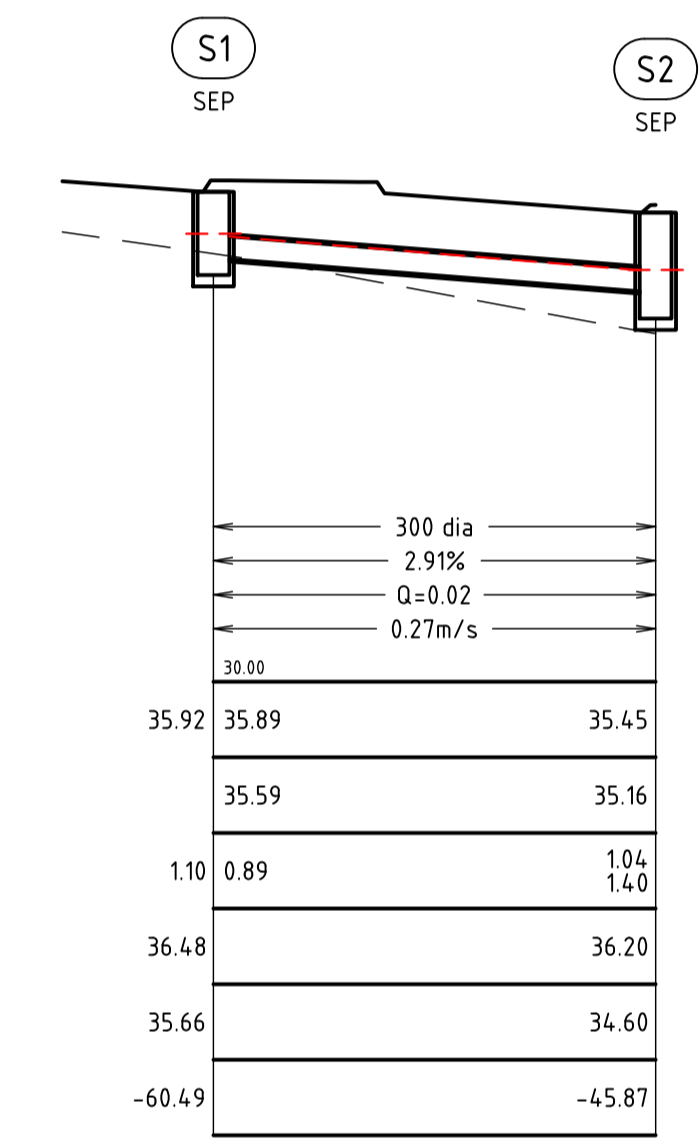
**OPERATIONS**



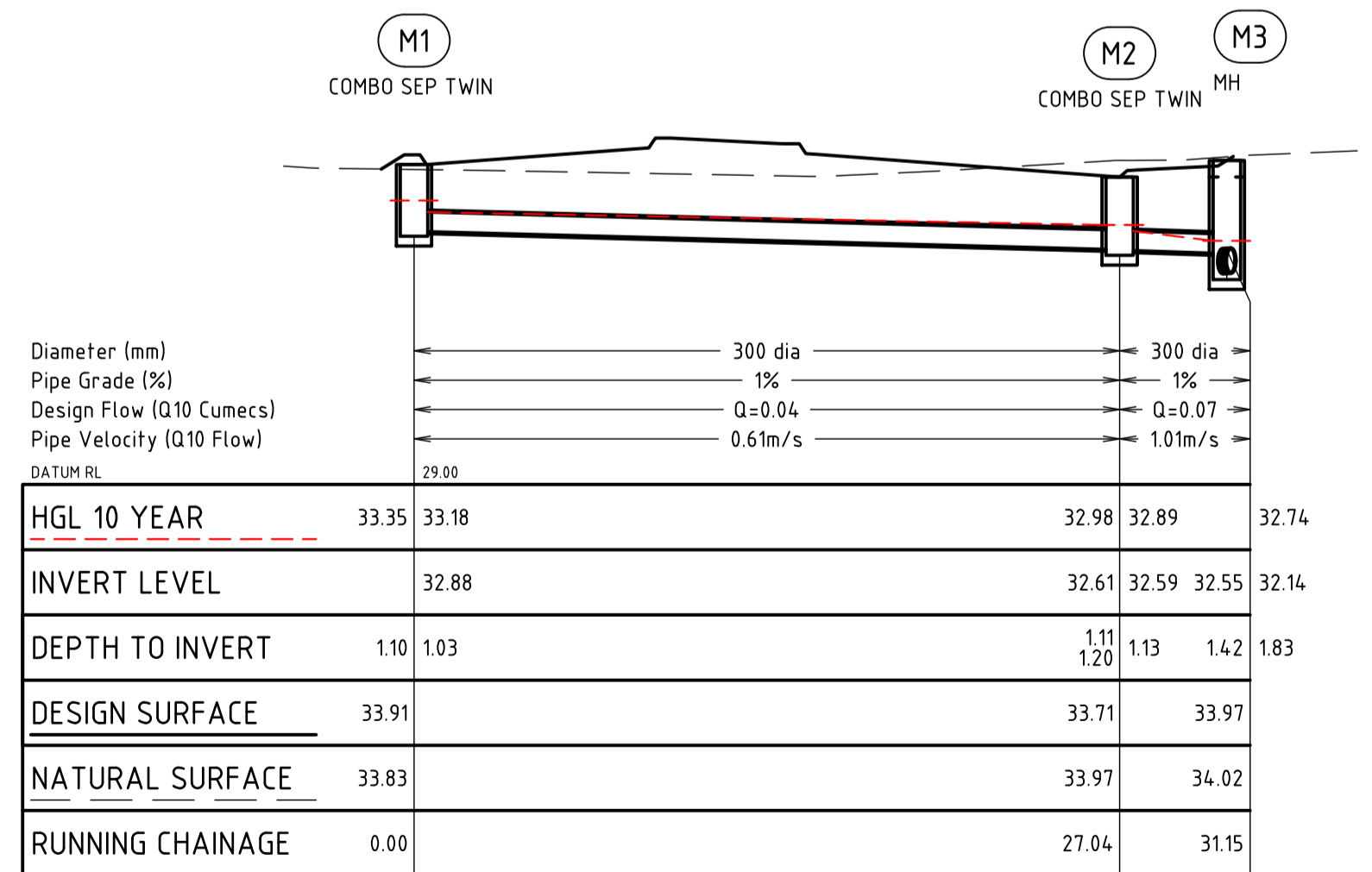
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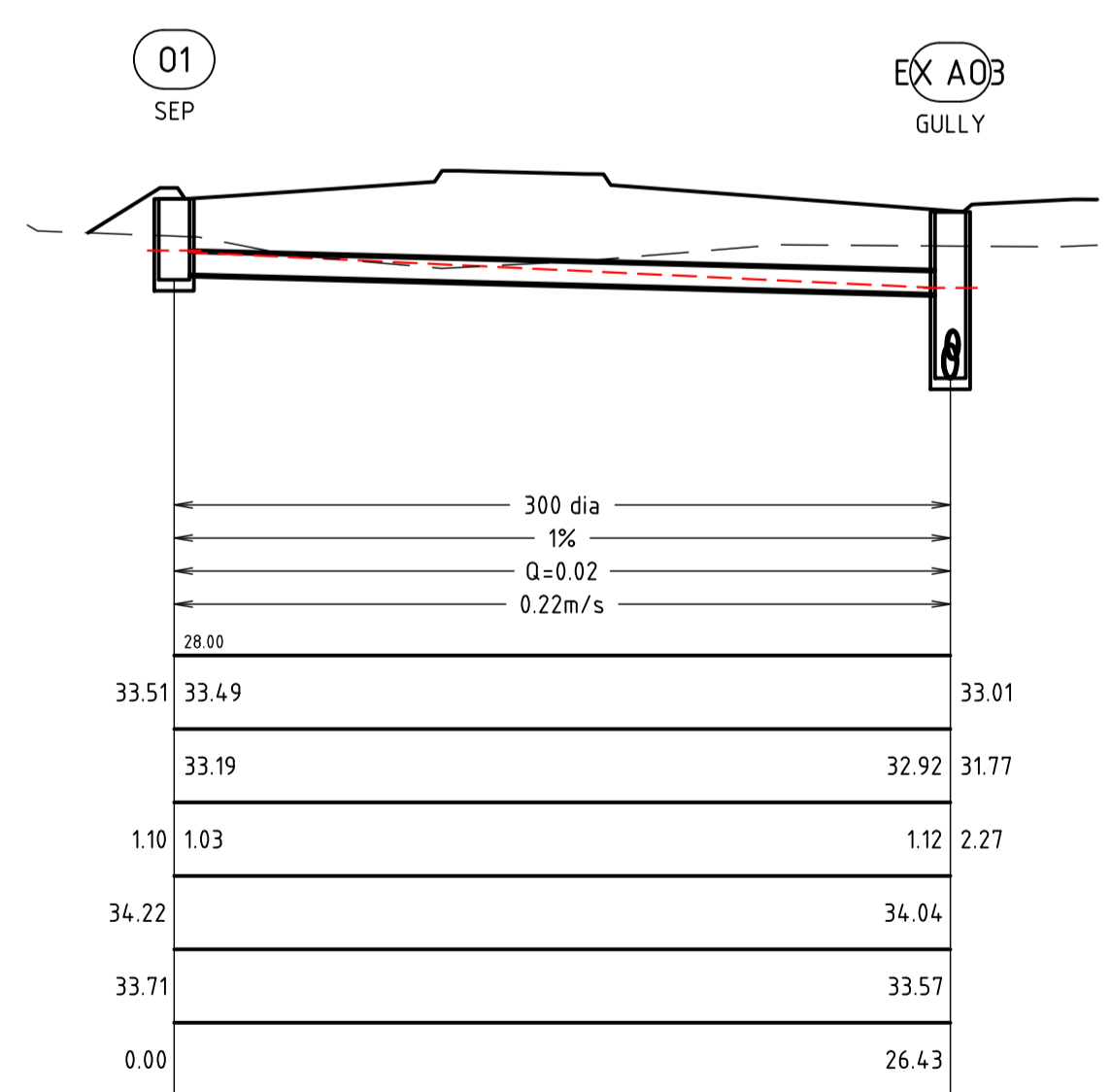
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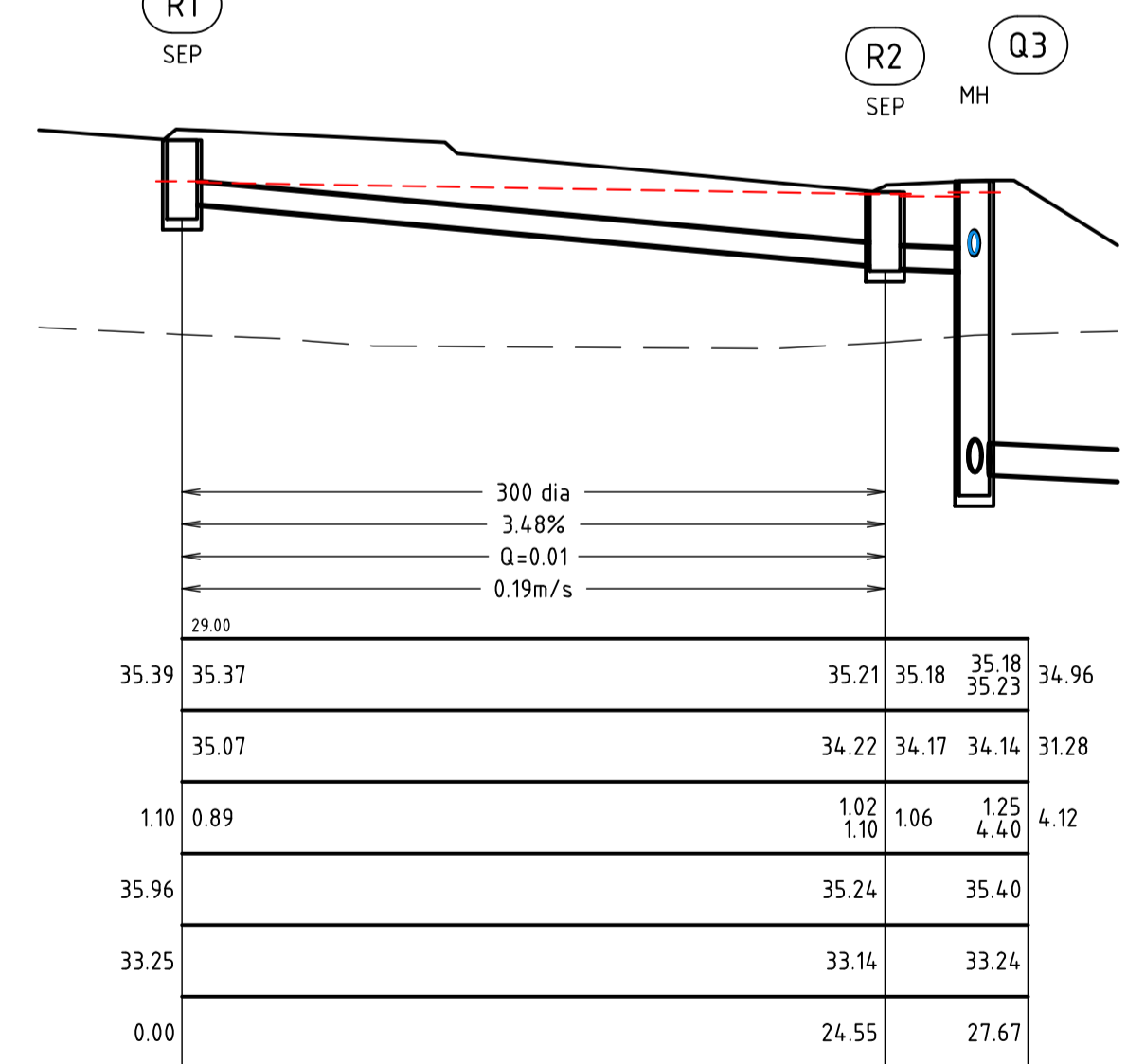
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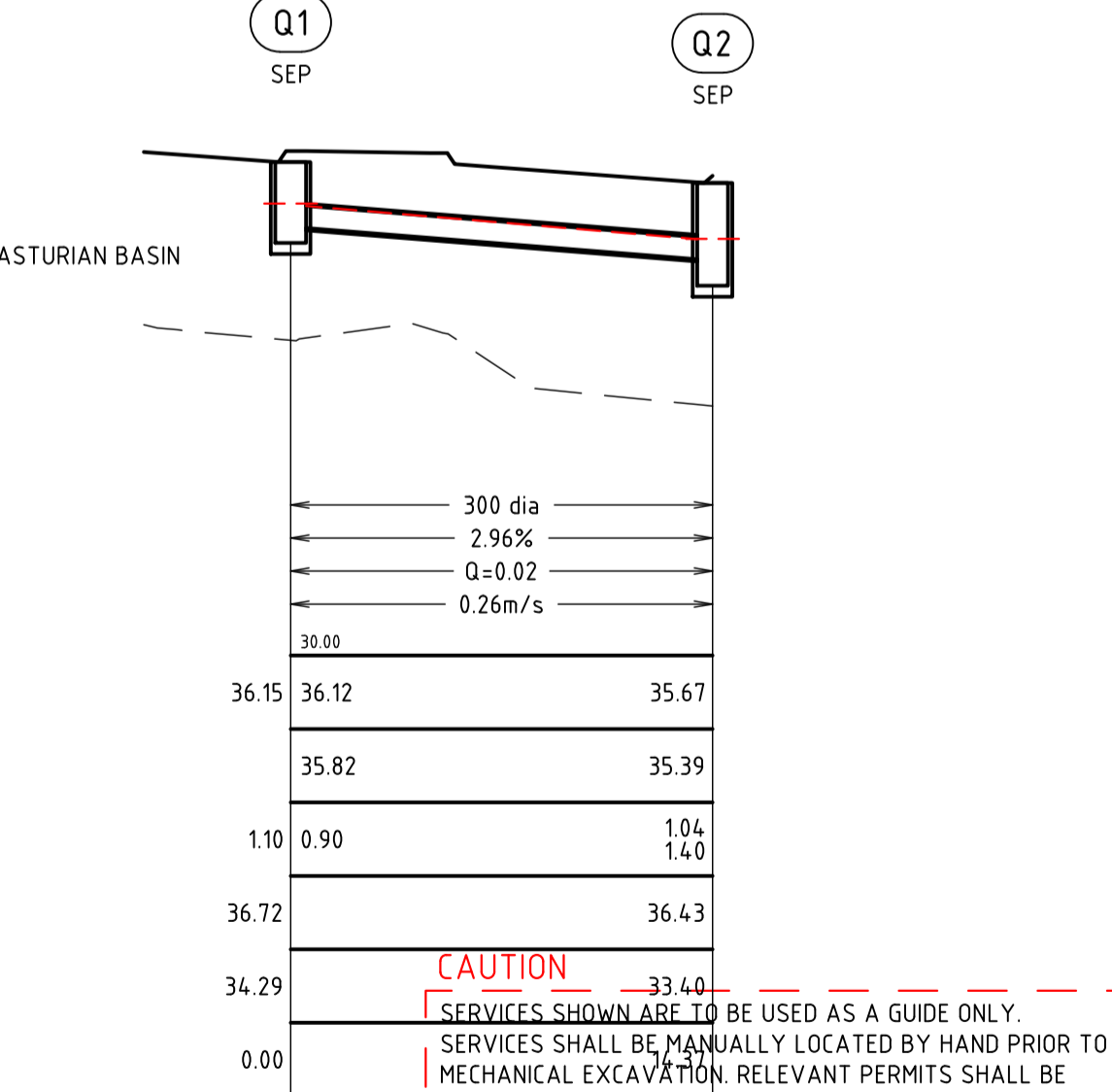
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PROFILE DRAINAGE PIPE O



PROFILE DRAINAGE PIPE P



PROFILE DRAINAGE PIPE N

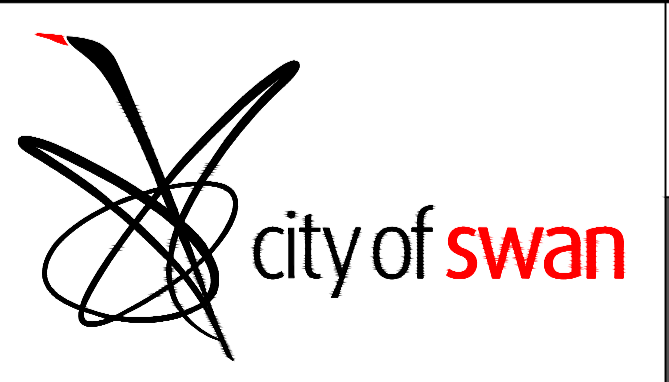
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AMENDMENTS	REV	DATE	BY	DESCRIPTION
	0	04.23	DW	ISSUED FOR CONSTRUCTION

AUTHORISATION	APPROVED
PROJECT MANAGER _____ DATE _____	DESIGN CO-ORDINATOR _____ DATE _____
DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE

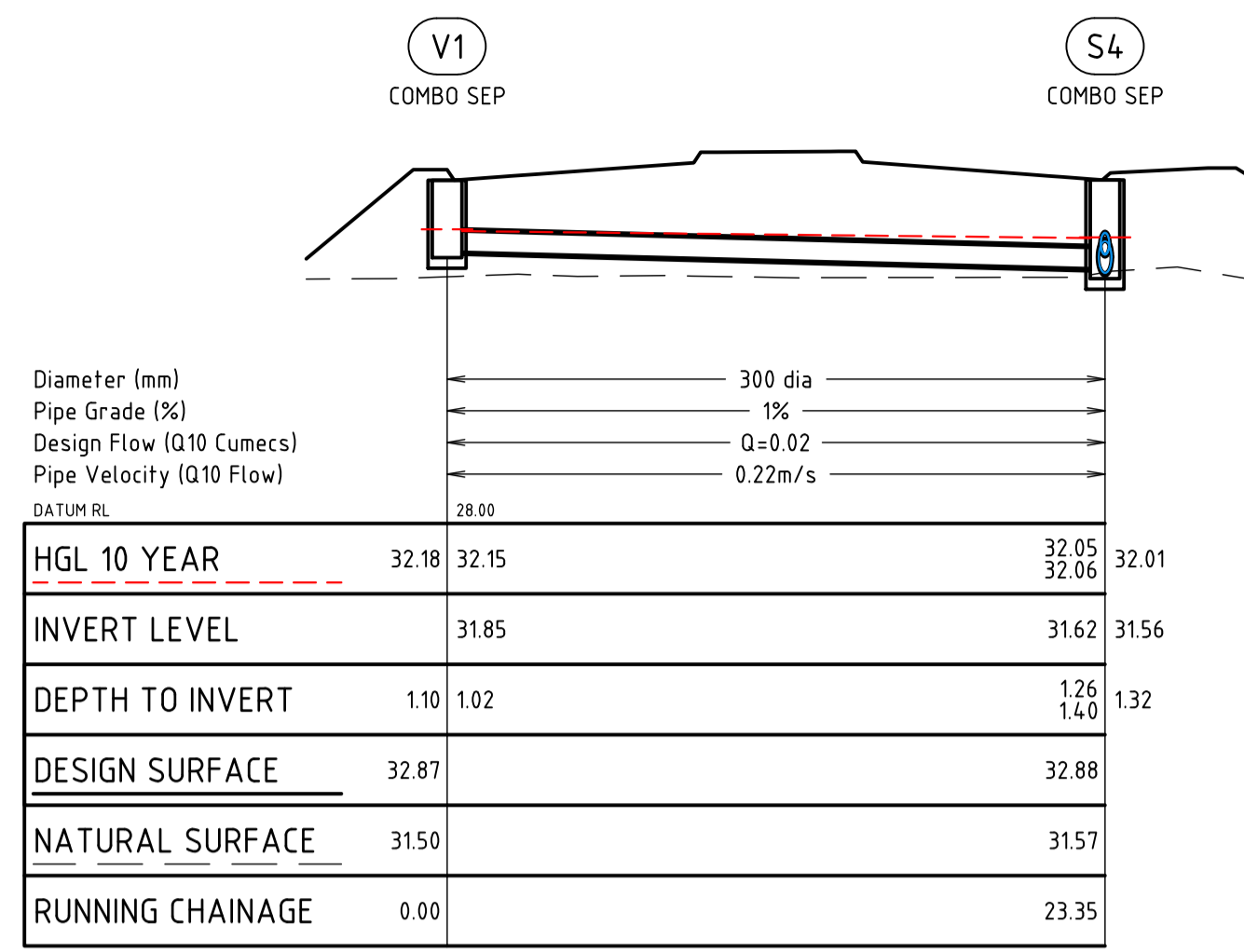
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DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 6 OF 7

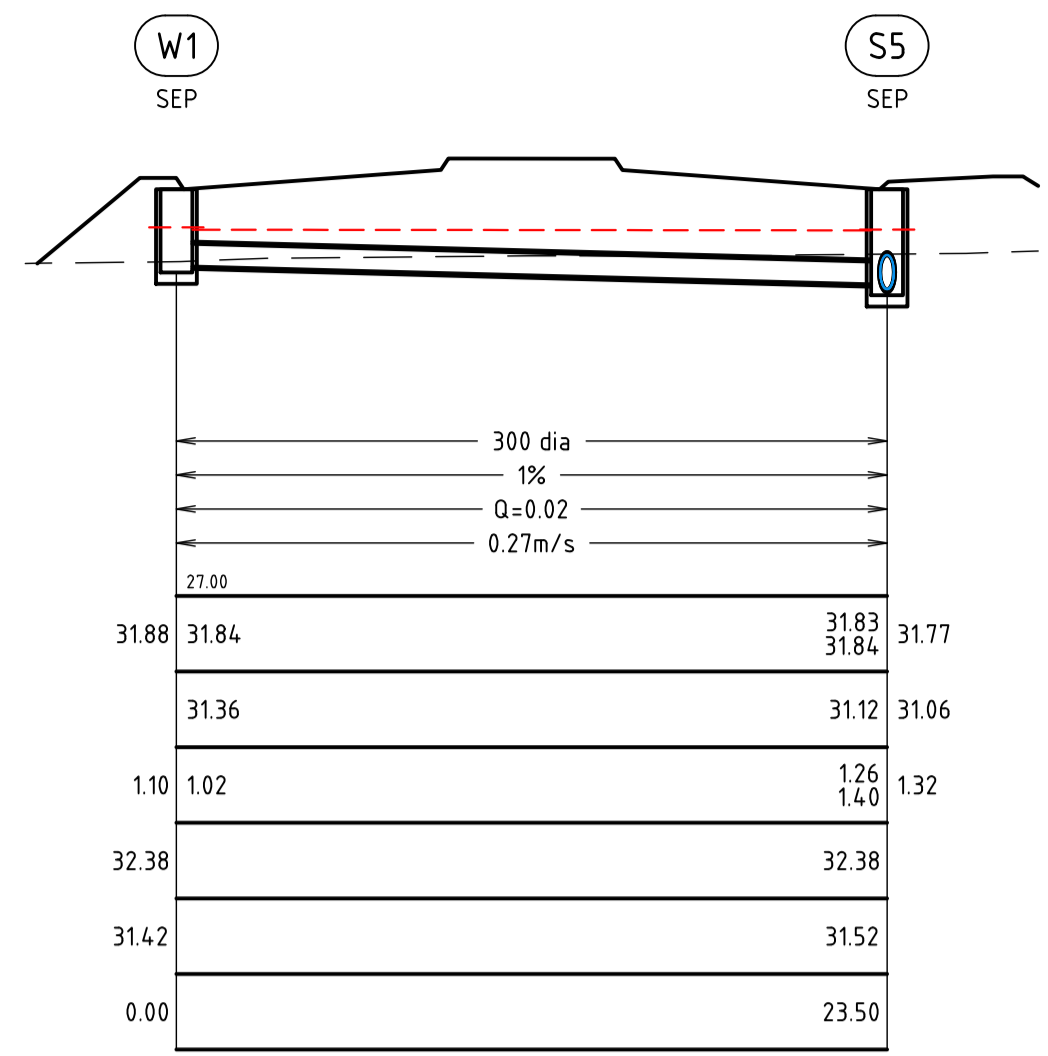


DRAWING No: R771-119  
REV No: 0  
**OPERATIONS**

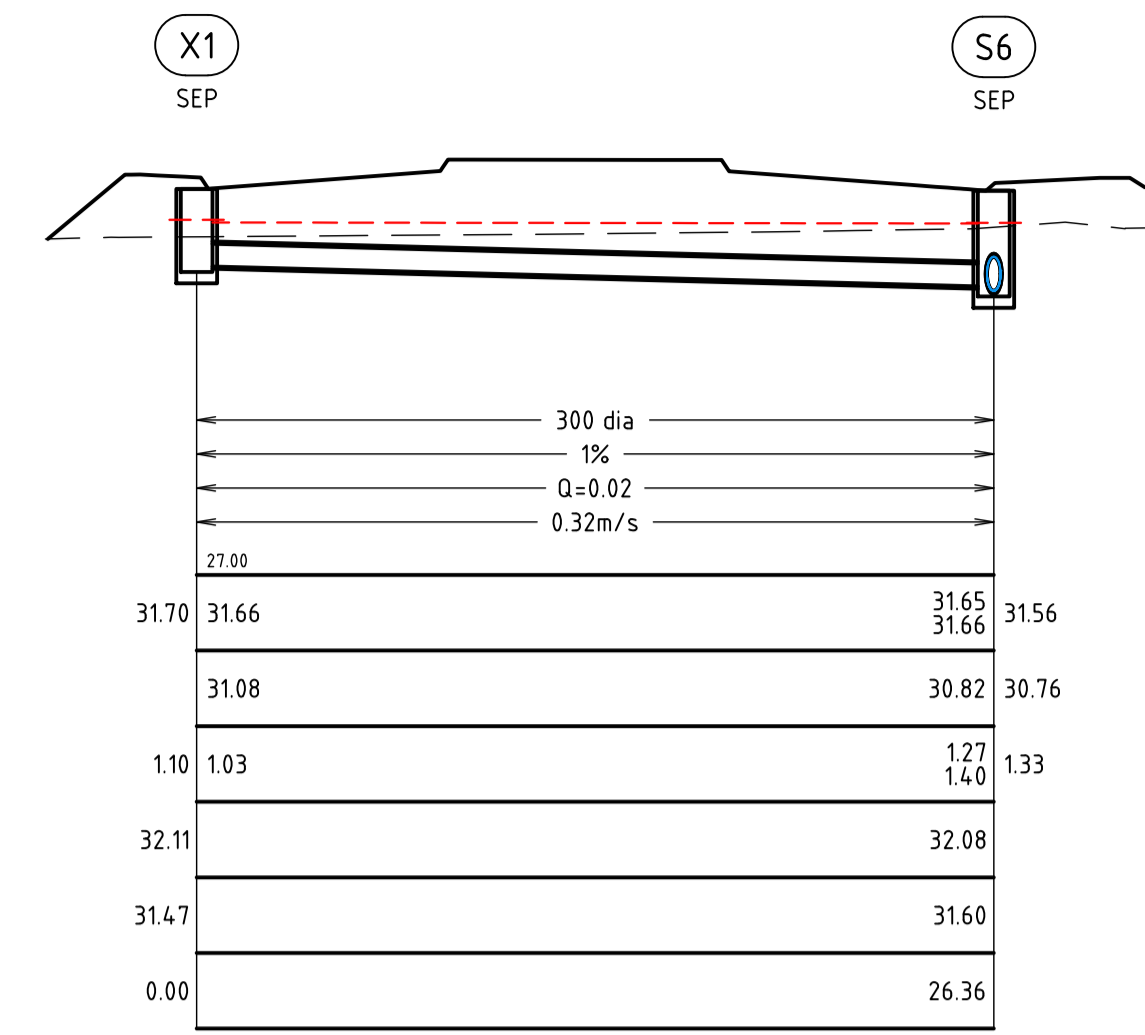
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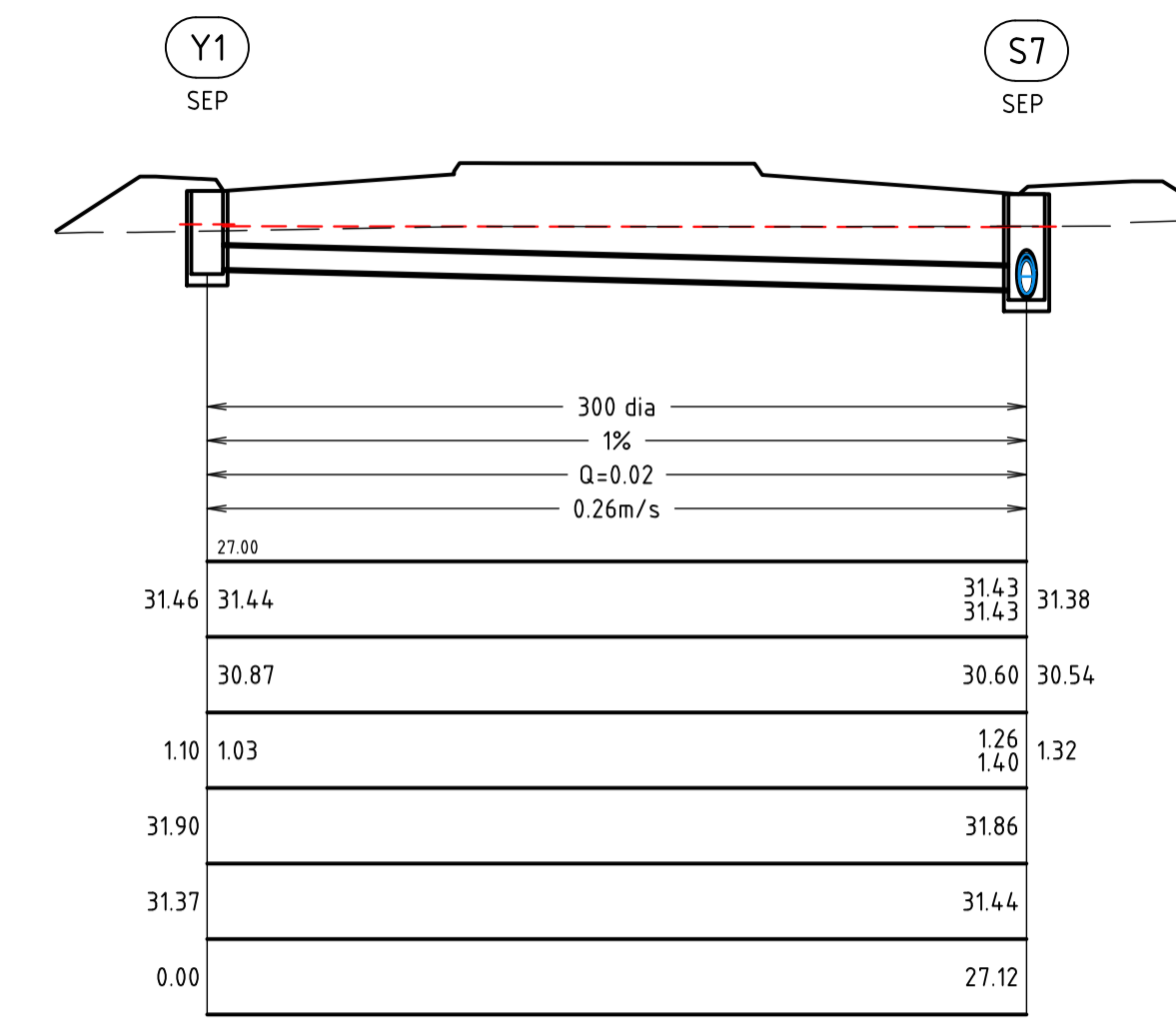
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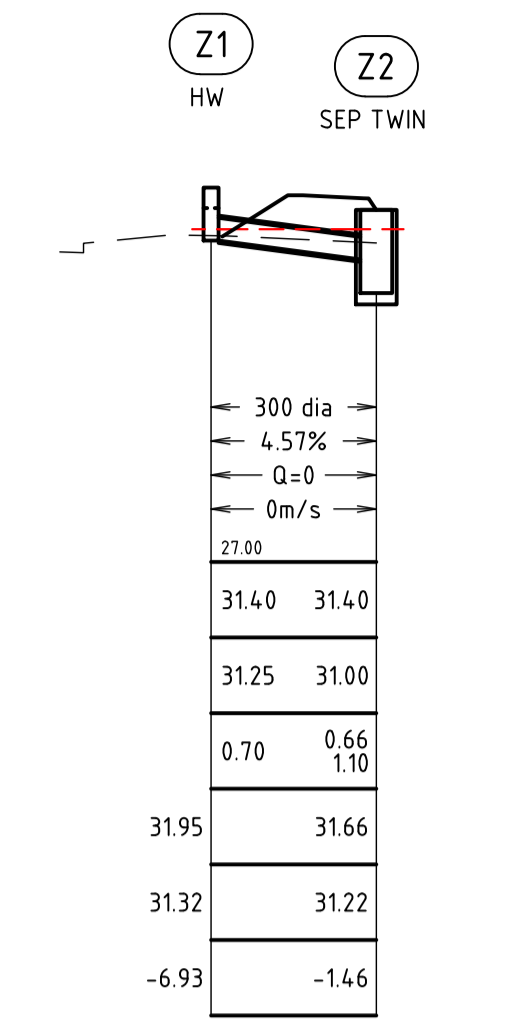
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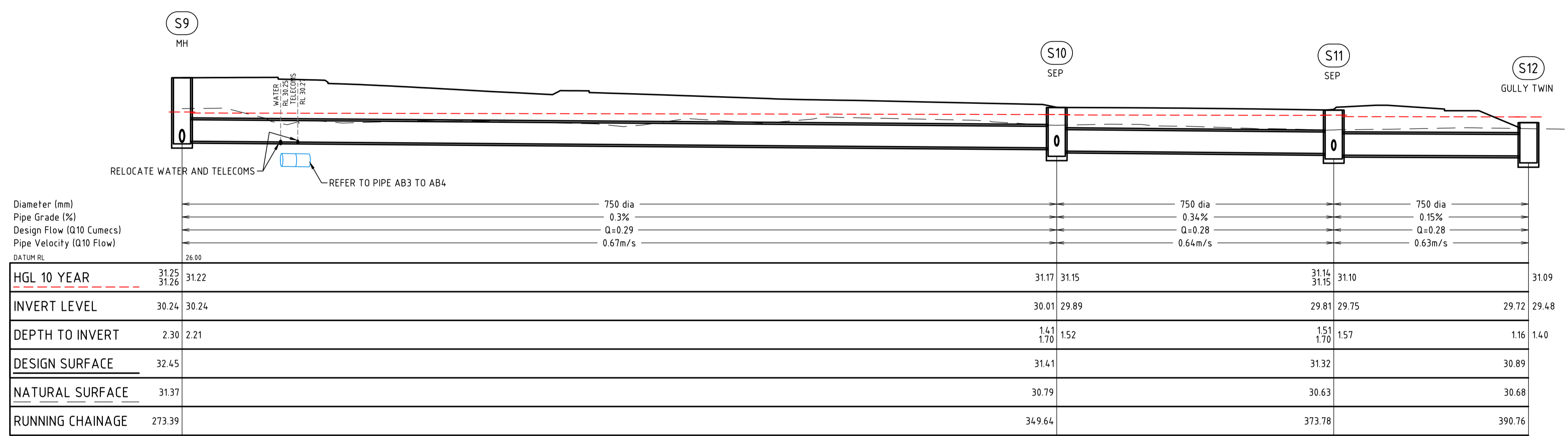
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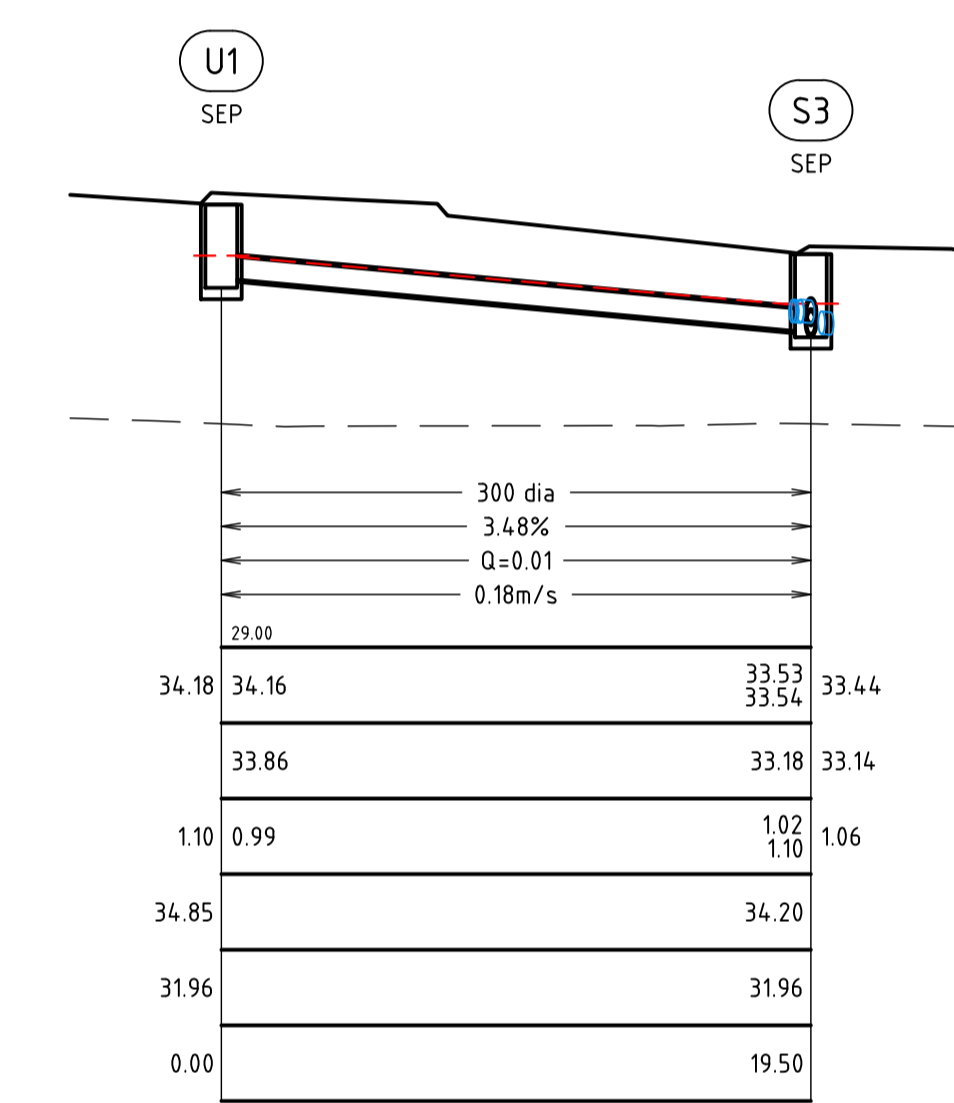
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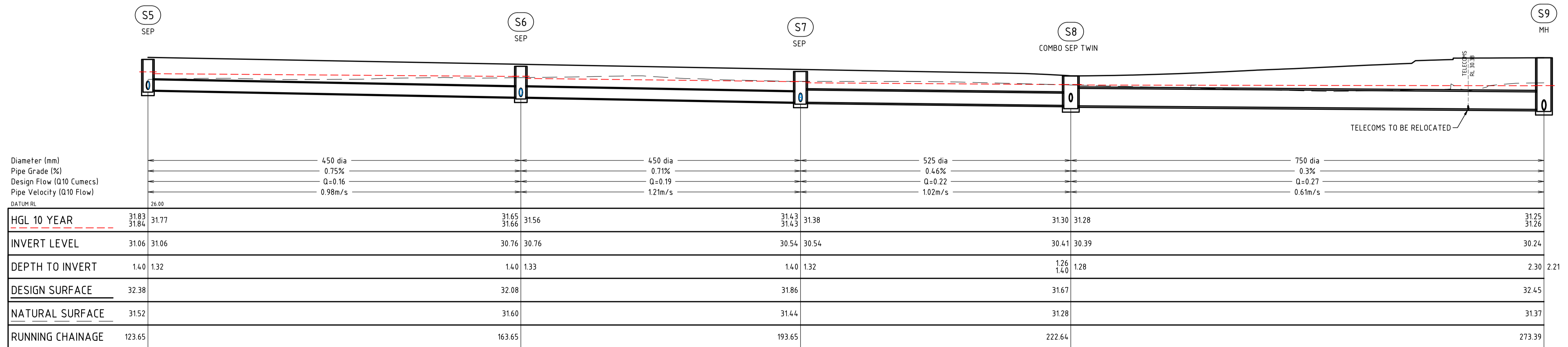
PROFILE DRAINAGE PIPE Z



PROFILE DRAINAGE PIPE S



PROFILE DRAINAGE PIPE U



PROFILE DRAINAGE PIPE S

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DESIGNED D.WEERTS CHECKED _____ DATE _____	DRAWN C.CAYATTE

SCALE: (A1)  
DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE PROFILES SHEET 7 OF 7



DRAWING No: R771-120  
REV No: 0

**OPERATIONS**

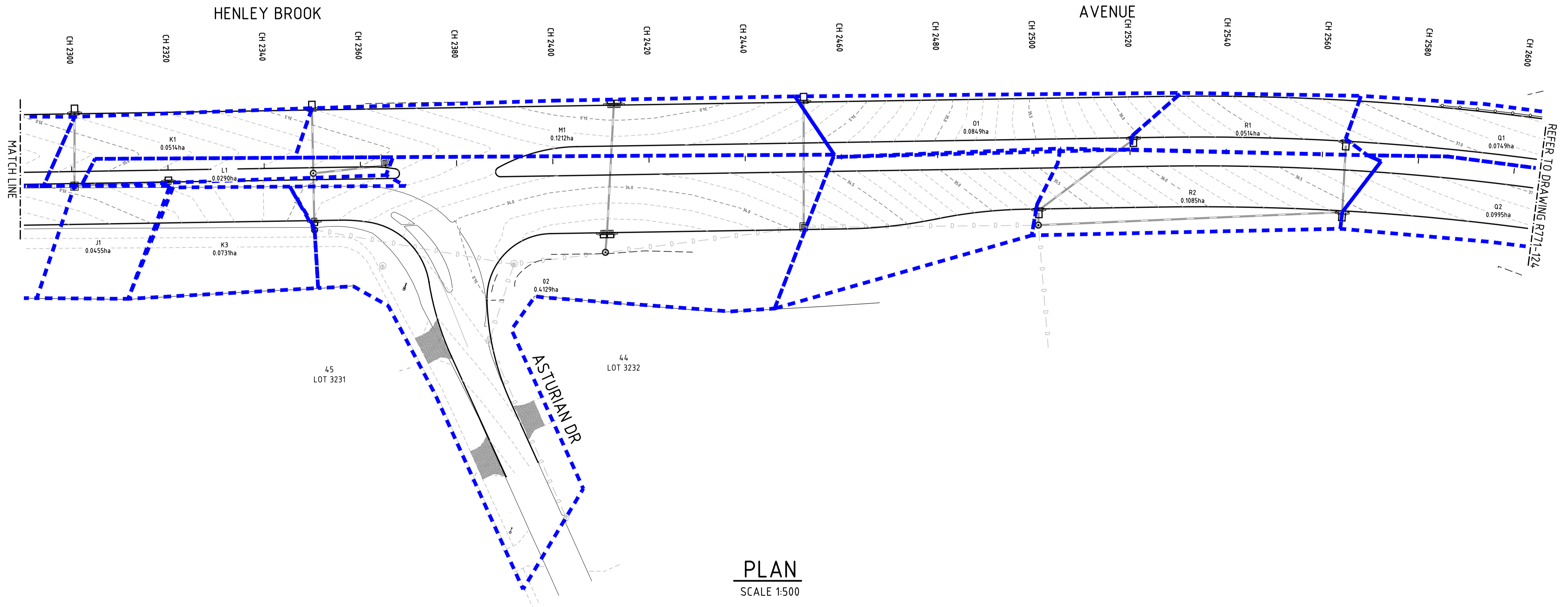
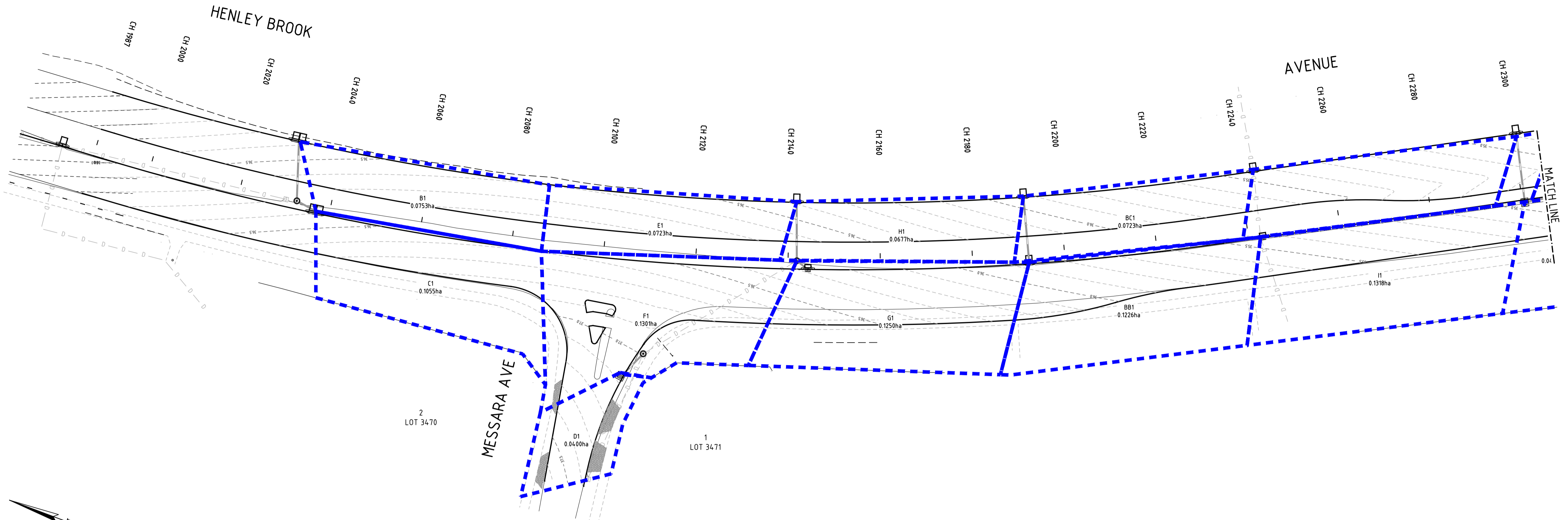
**PIT SCHEDULE**

NAME	TYPE	EASTING	NORTHING	SETOUT RL	DIAMETER	DEPTH	REMARKS
A1	SEP	65368.86	280499.416	36.156	1.05	1.75	CONVERT SEP
AB1	HW	65486.156	279492.43	30.616	0.5	1.02	
AB2	GULLY	65492.203	279489.748	31.665	1.05	1.4	
AB3	MH	65514.087	279474.464	32.374	1.05	3.2	
AB4	MH	65517.332	279468.574	32.387	1.05	3.2	
AB5	GULLY	65544.371	279418.431	31.535	1.05	1.1	
A01	GULLY	65571.331	279487.817	31.777	1.05	0.91	
A02	GULLY	65570.945	279473.871	31.836	1.05	1.4	
AF1	SEP	65537.14	279398.803	31.353	1.05	1.1	
AG1	SEP	65535.727	279378.529	31.238	1.05	1.1	
AH1	HW	65472.953	279356.434	29.88	0.1	1	
AH2	HW	65538.748	279361.724	29.68	0.1	1	
AI1	SEP	65502.901	279200.582	31.853	1.05	1.4	
AJ1	SEP	65512.361	279319.993	31.305	1.05	1.1	
AK1	SEP	65508.831	279280.224	31.468	1.05	1.4	
AL1	SEP	65506.051	279240.309	31.661	1.05	1.4	
AM1	HW	65493.629	279181.576	30.368	0.5	0.77	
AM2	HW	65525.346	279166.526	30.173	0.5	0.77	
AN1	SEP	65500.487	279160.431	32.047	1.05	1.4	
A03	GULLY	65467.156	278839.28	35.834	1.05	0.81	
A010	SEP	65520.44	279159.061	32.042	1.2	2.9	
A011	SEP	65523.22	279198.964	31.85	1.2	2.9	
A012	SEP	65525.999	279238.867	31.658	1.2	1.7	
A013	SEP	65529.22	279278.74	31.465	1.2	1.5	
A014	SEP	65531.558	279318.674	31.274	1.2	1.5	
A015	COMBO SEP TWIN	65533.973	279353.344	31.98	1.2	1.7	
A016	HW	65539.103	279355.932	29.705	0.5	1.49	
A02	SEP	65482.526	278859.155	36.031	1.05	1.4	
A03	SEP	65495.393	278874.71	35.869	1.05	1.4	
A04	MH	65496.554	278950.969	33.778	1.05	1.7	
A05	SEP TWIN	65507.659	278964.223	33.164	1.05	1.4	
A06	SEP	65509.374	279000.196	32.808	1.05	1.4	
A07	SEP	65512.511	279039.322	32.619	1.05	1.6	
A08	GULLY	65514.417	279072.594	32.459	1.2	1.7	
A09	SEP	65517.661	279119.157	32.235	1.2	1.7	
AP1	SEP	65497.699	279120.401	32.241	1.05	1.1	
AQ1	SEP	65494.469	279074.033	32.465	1.05	1.1	
AR1	GULLY	65497.64	278862.009	36.365	1.05	1.1	
AS1	GULLY	65468.096	278821.876	35.573	1.05	1.1	
AS2	GULLY	65502.028	278789.94	35.361	1.05	1.4	
AS3	SEP	65515.674	278742.792	33.444	1.05	1.2	
AS4	SEP	65541.558	278694.494	31.438	1.05	1.2	
AS5	MH	65555.895	278689.43	31.296	1.05	1.4	
AS6	SEP	65579.517	278646.888	29.812	1.05	1.1	
AS7	GULLY TWIN	65602.366	278644.397	28.76	1.05	1.1	
AT1	SEP	65534.277	278827.304	37.604	1.05	0.8	
AT2	GULLY	65514.312	278802.333	36.211	1.05	1.4	
AW1	SEP	65615.778	278597.47	29.053	1.05	1.2	
AW2	GULLY	65639.587	278596.699	28.15	1.05	0.9	
AZ1	SEP TWIN	65485.949	278951.692	33.368	1.05	1.1	
B1	SEP TWIN	65381.444	280449.664	36.373	1.05	1.1	
BB1	COMBO SEP	65408.878	280240.858	35.427	1.05	1.1	ADJUST LID
BC1	SEP	65422.383	280246.134	35.434	1.05	1.46	CONVERT LID TO SEP
BD1	SEP	65489.423	279001.586	32.816	1.05	1.1	
BE1	SEP	65492.154	279040.805	32.626	1.05	1.1	
BF1	GULLY	65490.552	279367.734	30.65	1.05	1.05	
BG1	COMBO SEP TWIN	65511.878	279347.43	31.256	1.05	1.1	
CI	SEP TWIN	65367.048	280442.526	36.397	1.05	1.1	
D1	GULLY	65347.561	280369.402	37.078	1.05	1.1	

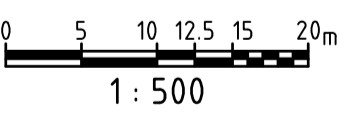
**PIPE SCHEDULE**

NAME	TYPE	EASTING	NORTHING	SETOUT RL	DIAMETER	DEPTH	REMARKS
D2	MH	65353.572	280366.232	37.081	1.05	2.19	ADJUST LID
E1	SEP	65393.199	280341.258	36.388	1.05	1.1	
Ex A01	MH	65438.188	280137.283	34.527	1.05	1.57	Convert to MH Raise Lid
Ex Ak3	MH	65380.845	280338.337	36.768	1.05	2.4	adjust lid
Ex A03	GULLY	65473.827	280042.043	34.04	1.05	2.27	CONVERT MH TO GULLY
Ex J1	MH	65368.753	280447.074	36.773	1.05	1.63	CONVERT TO MH AND RAISE LID
F1	COMBO SEP	65379.584	280335.578	36.277	1.05	1.1	
G1	SEP	65391.734	280289.009	35.865	1.05	1.79	ADJUST LID
H1	SEP	65405.513	280293.536	35.923	1.05	1.1	
I1	SEP	65443.397	280192.46	34.88	1.05	1.1	
J1	COMBO SEP	65436.923	280169.222	34.768	1.05	1.1	
J2	GULLY	65429.797	280187.425	34.936	1.05	1.64	ADJUST LID
K1	SEP	65461.387	280146.51	34.406	1.05	1.1	
K2	MH	65449.142	28014.652	34.712	1.05	1.5	
K3	COMBO SEP	65440.007	280138.03	34.394	1.05	1.4	
L1	GULLY	65455.385	280128.003	34.44	1.05	1.1	
M1	COMBO SEP TWIN	65484.273	280088.052	33.906	1.05	1.1	
M2	COMBO SEP TWIN	65458.917	280080.128	33.714	1.05	1.2	
M3	MH	65454.961	280079.02	33.714	1.05	1.83	
N1	HW	65521.811	279075.98	31.005	0.5	0.85	
N2	HW outlet	65522.523	279088.075	30.935	0.5	0.85	
O1	SEP	65498.65	280051.329	34.215	1.05	1.1	
Q1	SEP	65530.456	279942.856	36.717	1.05	1.1	
Q2	SEP	65516.349	279938.444	36.434	1.05	1.4	
Q3	MH	65491.73	279996.688	35.235	1.05	4.4	Raise MH
R1	SEP	65515.669	279984.542	35.964	1.05	1.1	
R2	SEP	65494.914	279997.782	35.238	1.05	1.1	
S1	SEP	65554.075	279799.171	36.479	1.05	1.1	
S10	SEP	65514.471	279404.233	31.413	1.5	1.7	
S11	SEP	65510.63	279380.403	31.322	1.5	1.7	
S12	GULLY TWIN	65493.616	279381.346	31.369	1.5	1.4	
S2	SEP	65539.117	279798.784	36.203	1.05	1.4	
S3	SEP	65536.189	279716.156	34.201	1.05	1.1	
S4	COMBO SEP	65532.83	279669.341	32.876	1.05	1.4	
S5	SEP	65530.155	279629.523	32.378	1.05	1.4	
S6	SEP	65527.375	279589.62	32.083	1.05	1.4	
S7	SEP	65525.041	279559.709	31.861	1.2	1.4	
S8	COMBO SEP TWIN	65523.014	279530.786	31.669	1.5	1.4	
S9	MH	65516.49	279480.453	32.448	1.5	2.3	
U1	SEP	65551.573	279128.336	34.855	1.05	1.1	
V1	COMBO SEP	65555.879	279667.828	32.873	1.05	1.1	
W1	SEP	65553.101	279627.923	32.378	1.05	1.1	
X1	SEP	65553.039	279587.829	32.106	1.05	1.1	
Y1	SEP	65551.566	279557.928	31.904	1.05	1.1	
Z1	HW	65552.062	279528.036	31.25	0.5	0.7	
Z2	SEP TWIN	65546.599	279528.119	31.656	1.05	1.1	

NAME	DIAMETER	LENGTH	U/S IL	D/S IL	SLOPE(lin)	SLOPE(%)	CLASS
BF1 to BF2	300	8	29.924	29.824	-80	1.25	HDPE SN8
AD1 to AD2	300	12.97	30.768	30.638	-100	1	RCP 4
AF1 to S10	300	23.33	30.337	30.104	-100	1	RCP 4
AG1 to S11	300	25.71	30.209	29.952	-100	1	RCP 4
AJ1 to A15	300	20.08	30.277	30.077	-100	1	RCP 4
AR1 to A03	300	12.88	35.312	34.873	-29.3	3.41	RCP 4
AS1 to AS2	300	4.653	34.567	34.102	-100	1	RCP 4
AS2 to AS3	300	4.913	34.067	32.422	-29.9	3.35	RCP 4
AS3 to AS4	300	54.8	32.355	30.375	-27.7	3.61	RCP 4
AS4 to AS5	300	15.21	30.314	30.162	-100	1	RCP 4
AS5 to AS6	300	4.862	30.122	28.857	-38.4	2.6	RCP 4
AS6 to AS7	300	22.51	28.812	28.121	-32.6	3.07	RCP 4
AT1 to AT2	300	31.26	37.01	35.109	-16.4	6.08	RCP 4
AT2 to AS1	300	17.47	34.991	34.256	-23.8	4.21	RCP 4
AW1 to AW2	300	23.48	27.97	27.478	-47.7	2.1	RCP 4
AZ1 to A04	300	10.63	32.453	32.347	-100	1	RCP 4
B1 to C2	300	13.41	35.345	35.211	-100	1	RCP 4
BE1 to A07	300	20.75	31.601	31.394	-100	1	RCP 4
CI to Ex J1	300	4.71	35.512	35.465	-100	1	RCP 4
D1 to D2	300	6.91	36.042	35.973	-100	1	RCP 4
E1 to E2	300	12.85	35.5	35.4	-128.5	0.78	RCP 4
F1 to E2	300	3.03	35.4	35.37	-100	1	RCP 4
H1 to G1	300	14.65	34.901	34.755	-100	1	RCP 4
I1 to J2	300	15.37	33.854	33.7	-100	1	RCP 4
J1 to J2	300	19.55	33.742	33.547	-100	1	RCP 4
K1 to K2	300	13.55	33.409	33.274	-100	1	RCP 4
K2 to K3	300	9.83	33.274	33.176	-100	1	RCP 4
K3 to Ex A01	300	1.97	33.176	33.156	-100	1	RCP 4
L1 to K2	300	15.1	33.453	33.393	-250.2	0.4	RCP 4
M1 to M2	300	27.04	32.877	32.606	-100	1	RCP 4
M2 to M3	300	4.11	32.586	32.545	-100	1	RCP 4
O1 to Ex A03	300	26.43	33.189	32.925	-100	1	RCP 4
Q1 to Q2	300	14.37	35.82	35.395	-33.8	2.96	RCP 4
Q2 to Ex A04	300	63.23	35.335	34.378	-66.1	1.51	RCP 4
R1 to R2	300	24.55	35.074	34.22	-28.7	3.48	RCP 4
R2 to Q3	300	3.12	34.175	34.143	-100	1	RCP 4
S1 to S2	300	14.62	35.588	35.163	-34.4	2.91	RCP 4
S2 to S3	300	82.67	35.103	33.289	-45.6	2.19	RCP 4
S3 to S4	300	46.94	33.144	31.815	-35.3	2.83	RCP 4
U1 to S3	300	19.5	33.863	33.184	-28.7	3.48	RCP 4
V1 to S4	300	23.35	31.851	31.617	-100	1	RCP 4
W1 to S5	300	23.5	31.356	31.121	-100	1	RCP 4
X1 to S6	300	26.36	31.08	30.816	-100	1	RCP 4
Y1 to S7	300	27.12	30.873	30.602	-100	1	RCP 4
Z1 to Z2	300	5.47	31.25	31	-21.9	4.57	RCP 4
Z2 to S8	300						



**PLAN**  
SCALE 1:500



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REV	DATE	BY	DESCRIPTION
0	04.23	DW	ISSUED FOR CONSTRUCTION

AUTHORISATION		APPROVED	
PROJECT MANAGER	DATE	DESIGN CO-ORDINATOR	DATE
DESIGNED D.WEERTS	CHECKED	DATE	DRAWN C.CAYATTE

SCALE: 1:500 (A1)  
DATUM: A.H.D.

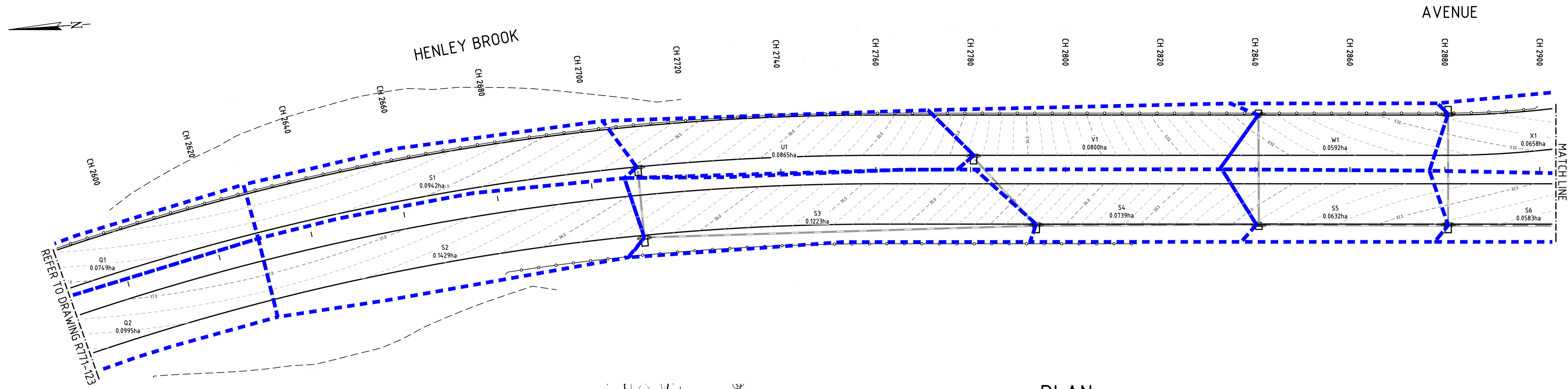
**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE CATCHMENT PLAN SHEET 1 OF 4



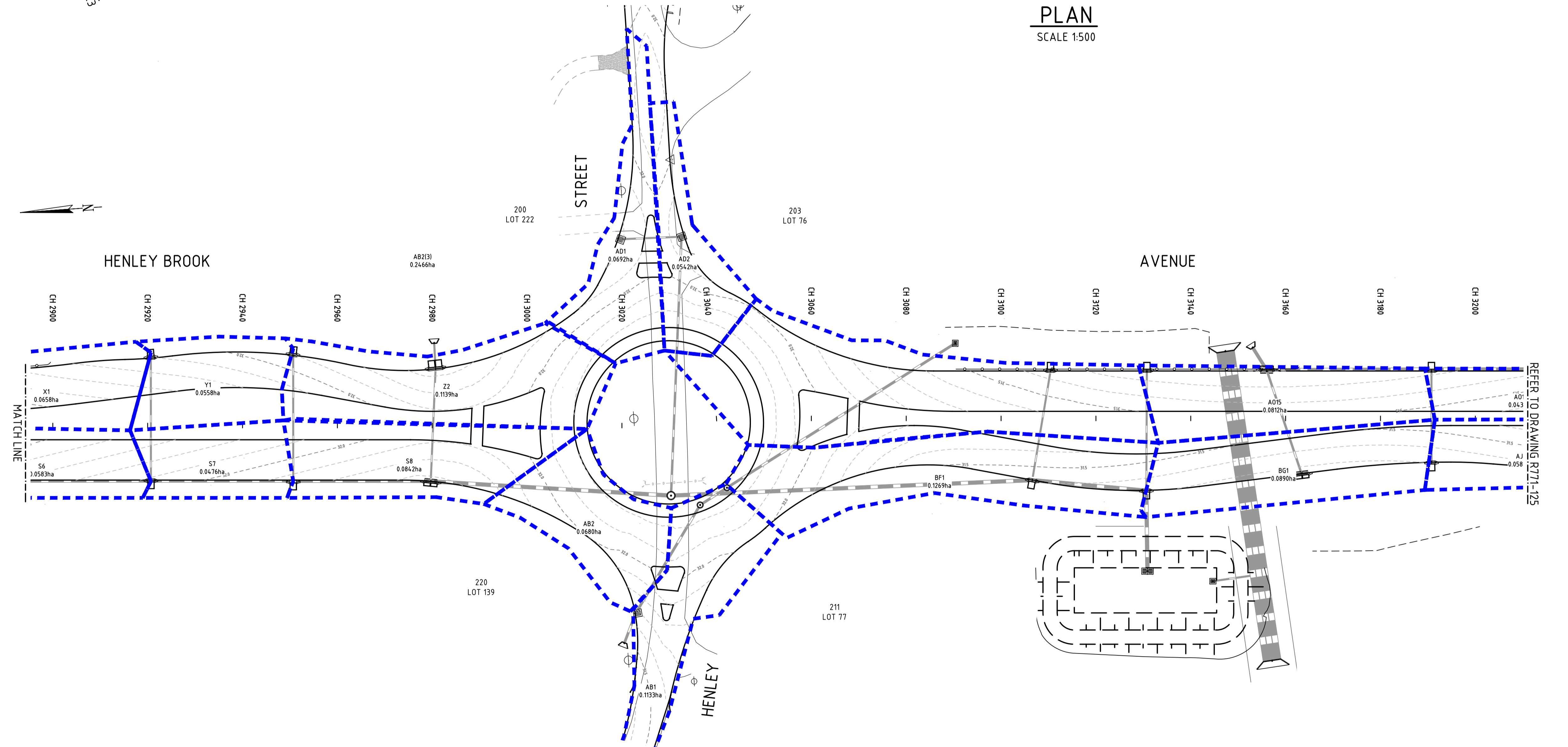
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**OPERATIONS**

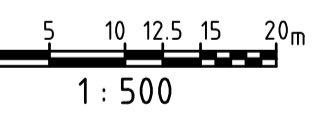
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DESIGNED D.WEERTS	CHECKED	DATE	DRAWN C.CAYATTE

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DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE CATCHMENT PLAN SHEET 2 OF 4



DRAWING No: R771-123  
REV No: 0

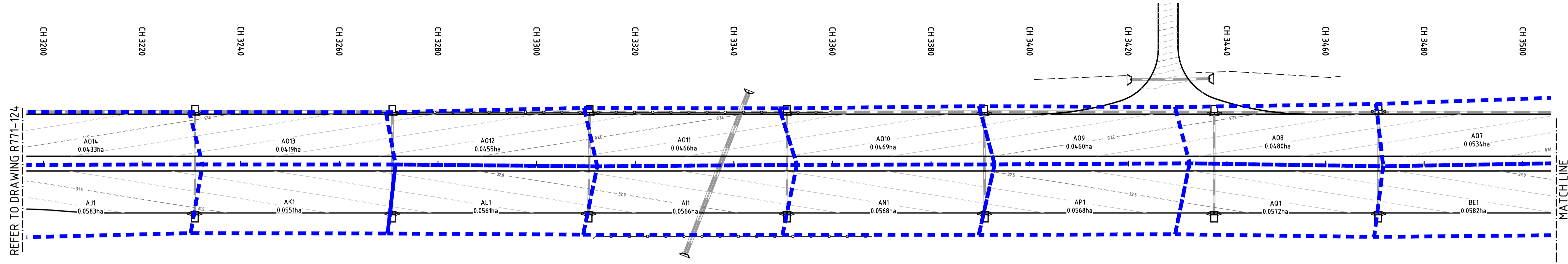
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HENLEY BROOK

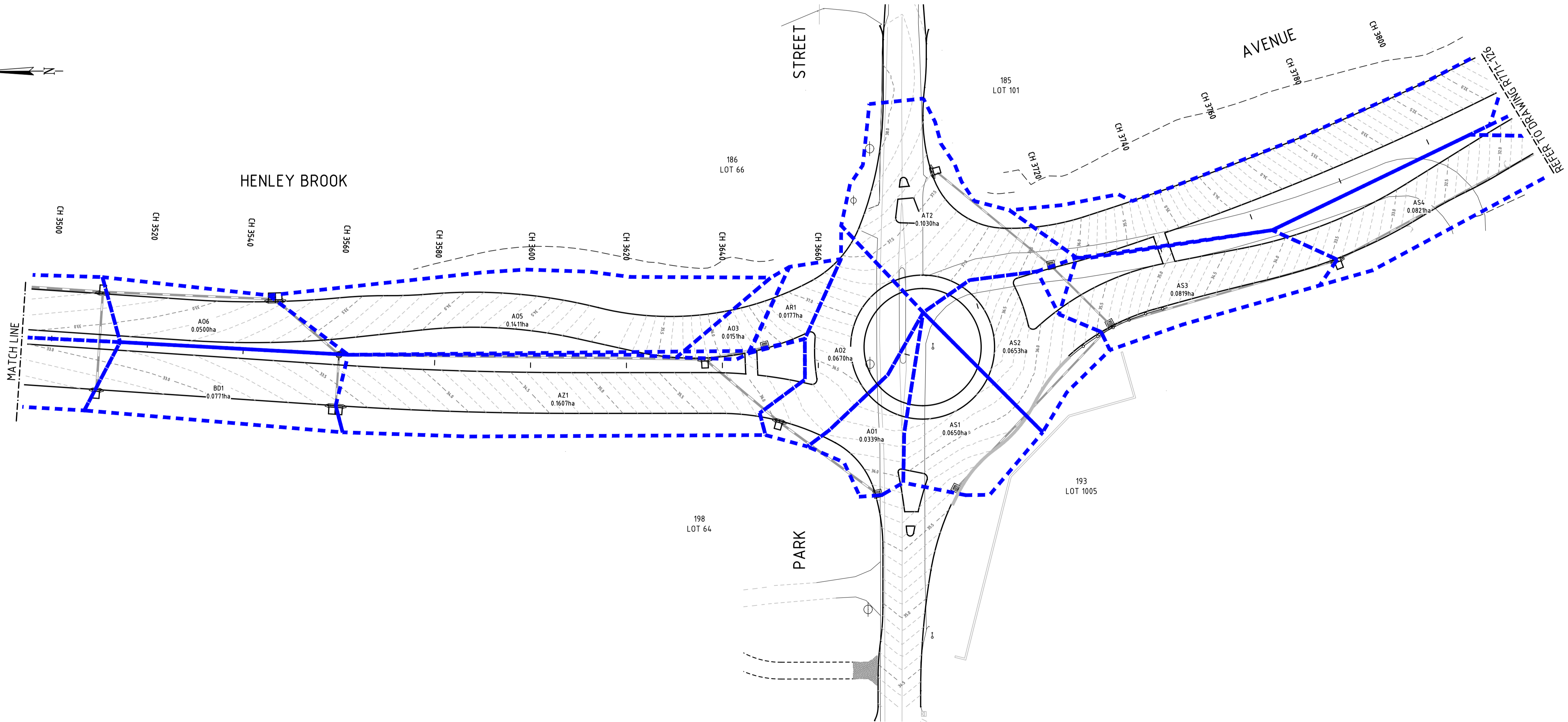
AVENUE



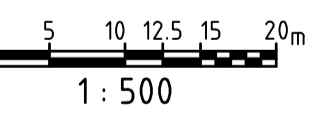
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HENLEY BROOK

AVENUE



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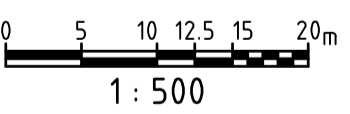
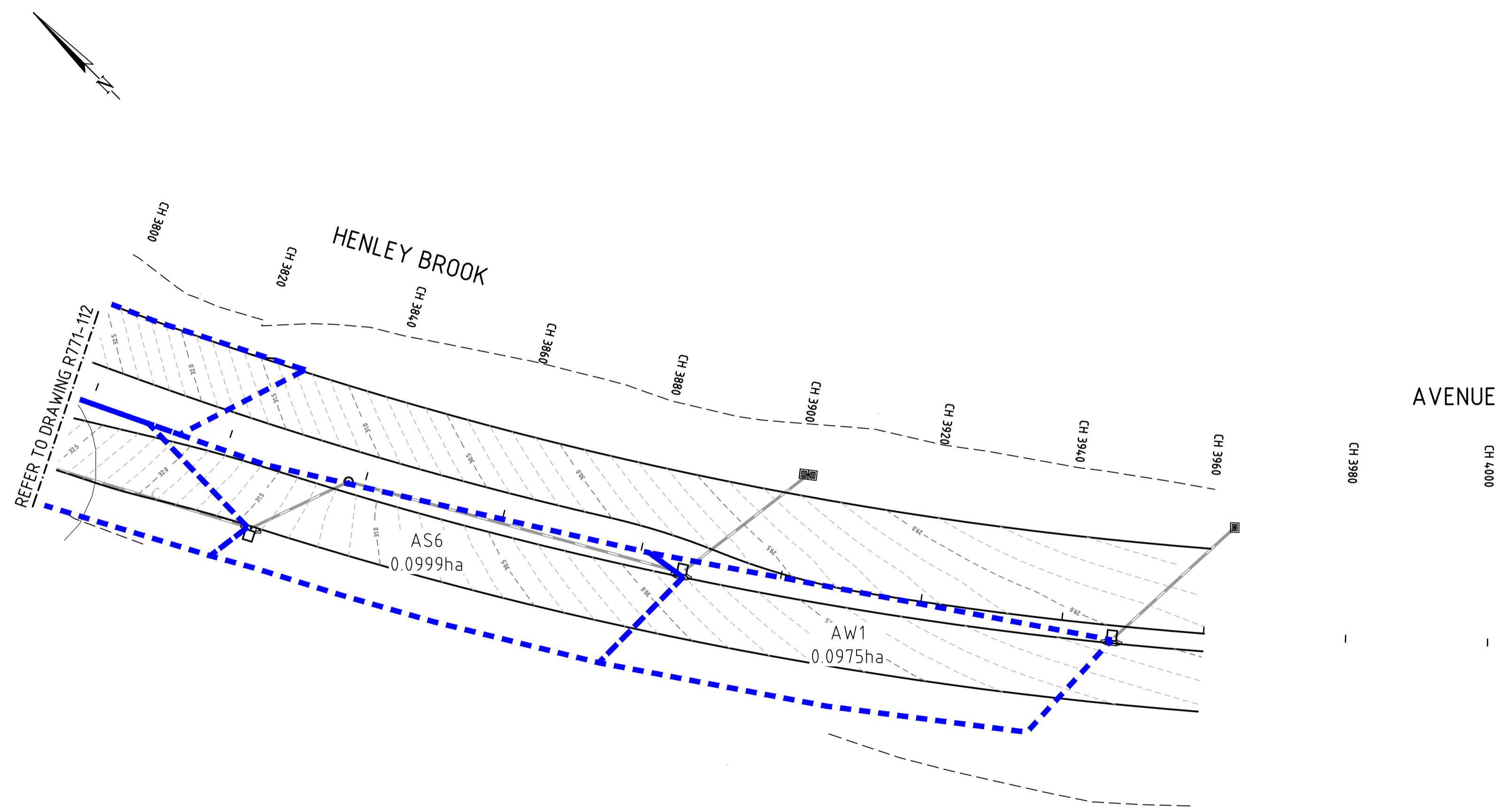
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PROJECT MANAGER	DATE	DESIGN CO-ORDINATOR	DATE
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**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE CATCHMENT PLAN SHEET 3 OF 4



DRAWING No: R771-124  
REV No: 0  
**OPERATIONS**



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**PLAN**  
SCALE 1:500

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AUTHORISATION		APPROVED	
PROJECT MANAGER	DATE	DESIGN CO-ORDINATOR	DATE
DESIGNED D.WEERTS	CHECKED	DATE	DRAWN C.CAYATTE

SCALE: 1:500 (A1)  
DATUM: A.H.D.

**HENLEY BROOK AVE - STAGE 3**  
MESSARA AVENUE TO PARK STREET  
DUAL CARRIAGEWAY  
DRAINAGE CATCHMENT PLAN SHEET 4 OF 4



DRAWING No: R771-125  
REV No: 0

**OPERATIONS**







HYDRAULICS Q100 (1% AEP)

Table with 40 columns: Pipe ID, Pipe Type, Length, Size, Area, Grade, Full-area, Part-area, Direct Node, Peak, Net Bypass, Excess Pipe, Capacity, Q/Cap, Full Pipe, Norm Depth, Crif Depth, Capacity Vel, US Node, Pipe, DS Node, Cover, Pipe, US Node, Pipe, US Node, Phead Loss, WSE Loss, Pipe, US Node, Pipe, DS Node, HGL, Fboard, US. Contains detailed hydraulic data for various pipe segments.

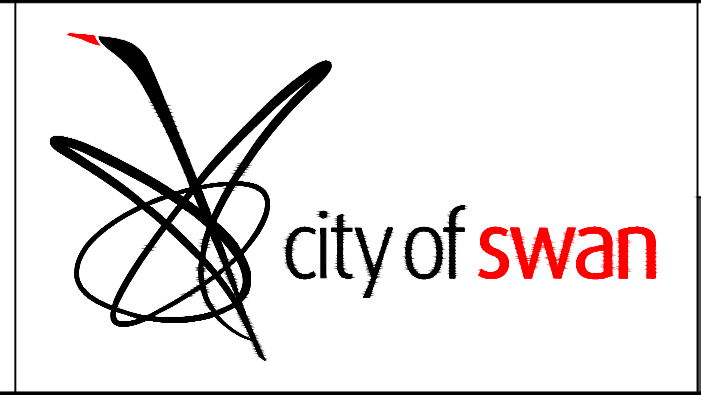
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Table with 2 columns: REV, DATE, DW, ISSUED FOR CONSTRUCTION. Row 0: 04.23 DW ISSUED FOR CONSTRUCTION.

AUTHORISATION, APPROVED, PROJECT MANAGER, DATE, DESIGN CO-ORDINATOR, DATE, DESIGNED, D.WEERTS, CHECKED, DATE, DRAWN, C.CAYATTE, DATE.

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HENLEY BROOK AVE - STAGE 3 MESSARA AVENUE TO PARK STREET DUAL CARRIAGEWAY DRAINAGE HYDRAULICS Q100



DRAWING No: R771-128 REV No: 0 OPERATIONS

**HYDROLOGY Q100 (1% AEP)**



Node Name	Node Type	Setout Easting (m)	Setout Northing (m)	Setout RL (m)	Grate RL (m)	Cover RL (m)	Catch ID	Tc Method	Catch Length (m)	Catch Slope (%)	Catch Retardance (-)	Time (min)	Intensity I (mm/hr)	Runoff C (-)	Area A (ha)	Full CA (ha)	Full Sum CA (ha)	Full Occ-CIA (L/s)	Partial CA (ha)	Partial Sum CA (ha)	Partial Occ-CIA (L/s)	Catchment Flow Qc (L/s)	Direct Flow Qdg (L/s)	Approach Flow Qa (L/s)	Road Capacity (L/s)	Flooded Depth (m)	Flooded Width (m)	Flooded Vel. Dep (sqm/s)	Road Grade (%)	Road Xfall (%)	Max Pond Depth (m)	Choke Factor (-)	Inlet Curve Name	Inlet Flow Qg (L/s)	Bypass Flow Qb (L/s)	Bypass Node (-)		
A1	SEP	65368.86	280499.42	36.16	36.16	36.16																																
A2	MH	65371.15	280502.61	36.16	36.06	36.06																																
AB1	HW	65486.16	279492.43	30.62	31.63	31.63	11	Direct				5	214.27	0.9	0.1133	0.102	7.7083	3815	0.102	0.2517	149.8	3815																
AB2	GULLY	65492.2	279489.75	31.66	31.66	31.66	3P	Kinematic Wave	790.59	0.5	0.25	253.93	17.82	0.45	16.9029	7.6063																						
AB3	MH	65514.09	279474.46	32.37	32.37	32.37																																
AB4	MH	65517.33	279468.57	32.39	32.39	32.39																																
AB5	GULLY	65544.37	279418.43	31.54	31.54	30.55																																
AD1	GULLY	65571.33	279487.82	31.78	31.78	31.78	11	Direct				5	214.27	0.9	0.0692	0.0623	0.0623	37.1	0.0623	0.0623	37.1	37.1																
AD2	GULLY	65570.94	279473.87	31.84	31.84	31.84	11	Direct				5	214.27	0.9	0.0542	0.0487	0.0487	29	0.0487	0.0487	29	29																
AF1	SEP	65537.14	279398.8	31.35	31.35	31.35																																
AG1	SEP	65535.73	279378.53	31.24	31.24	31.24																																
AH1	HW Triple	65472.95	279356.43	29.88	33	30.88																																
AH2	HW outlet Triple	65538.75	279361.72	29.68	31.2	30.68																																
AJ1	SEP	65502.9	279200.58	31.85	31.85	31.85	11	Direct				5	214.27	0.9	0.0566	0.0509	0.0509	30.3	0.0509	0.0509	30.3	30.3																
AJ1	SEP	65512.36	279199.99	31.3	31.3	31.3	11	Direct				5	214.27	0.9	0.0583	0.0524	0.0524	31.2	0.0524	0.0524	31.2	31.2																
AK1	SEP	65508.83	279280.22	31.47	31.47	31.47	11	Direct				5	214.27	0.9	0.0551	0.0496	0.0496	29.5	0.0496	0.0496	29.5	29.5																
AL1	SEP	65506.05	279240.31	31.66	31.66	31.66	11	Direct				5	214.27	0.9	0.0561	0.0505	0.0505	30	0.0505	0.0505	30	30																
AM1	HW Double	65493.63	279181.58	30.37	31.14	31.14	3P	Kinematic Wave	597.18	0.4	0.25	229.3	19.1	0.45	18.6082	8.3737	8.3737	444.2	8.3737	8.3737	444.2	444.2																
AM2	HW outlet Double	65525.35	279166.53	30.17	30.95	30.95																																
AN1	SEP	65500.49	279160.43	32.05	32.05	32.05	11	Direct				5	214.27	0.9	0.0568	0.0511	0.0511	30.4	0.0511	0.0511	30.4	30.4																
AO1	GULLY	65467.16	278839.28	35.83	35.83	35.83	3P	Kinematic Wave	100	2.5	0.25	24	89.36	0.45	29.6648	13.3492																						
AO2	SEP	65482.53	278859.15	36.03	36.03	36.03	11	Direct				5	214.27	0.9	0.067	0.0603	0.0603	35.9	0.0603	0.0603	35.9	35.9																
AO3	SEP	65495.39	278874.71	35.87	35.87	35.87	11	Direct				5	214.27	0.9	0.051	0.0136	0.0136	8.1	0.0136	0.0136	8.1	8.1																
AO4	MH	65496.55	278950.97	33.78	33.78	33.78																																
AO5	SEP TWIN	65507.66	278964.22	33.16	33.16	33.16	11	Direct				5	214.27	0.9	0.1411	0.127	0.127	75.6	0.127	0.127	75.6	75.6																
AO6	SEP	65509.37	279000.2	32.81	32.81	32.81	11	Direct				5	214.27	0.9	0.05	0.045	0.045	26.8	0.045	0.045	26.8	26.8																
AO7	SEP	65512.51	279039.32	32.62	32.62	32.62	11	Direct				5	214.27	0.9	0.0534	0.0481	0.0481	28.6	0.0481	0.0481	28.6	28.6																
AO8	SEP	65514.42	279072.59	32.46	32.46	32.46	11	Direct				5	214.27	0.9	0.048	0.0432	0.0432	25.7	0.0432	0.0432	25.7	25.7																
AO9	SEP	65517.66	279119.16	32.23	32.23	32.23	11	Direct				5	214.27	0.9	0.046	0.0414	0.0414	24.6	0.0414	0.0414	24.6	24.6																
AO10	SEP	65520.44	279159.06	32.04	32.04	32.04	11	Direct				5	214.27	0.9	0.0469	0.0422	0.0422	25.1	0.0422	0.0422	25.1	25.1																
AO11	SEP	65523.22	279198.96	31.85	31.85	31.85	11	Direct				5	214.27	0.9	0.0466	0.042	0.042	25	0.042	0.042	25	25																
AO12	SEP	65526	279238.87	31.66	31.66	31.66	11	Direct				5	214.27	0.9	0.0455	0.041	0.041	24.4	0.041	0.041	24.4	24.4																
AO13	SEP	65529.22	279278.74	31.46	31.46	31.46	11	Direct				5	214.27	0.9	0.0419	0.0377	0.0377	22.4	0.0377	0.0377	22.4	22.4																
AO14	SEP	65531.56	279318.67	31.27	31.27	31.27	11	Direct				5	214.27	0.9	0.0439	0.039	0.039	23.2	0.039	0.039	23.2	23.2																
AO15	COMBO SEP TWIN	65533.97	279353.34	31.2	31.2	31.2	11	Direct				5	214.27	0.9	0.0812	0.0731	0.0731	43.5	0.0731	0.0731	43.5	43.5																
AO16	HW outlet	65539.1	279355.93	29.7	31.2	31.2																																
AP1	SEP	65497.7	279120.4	32.24	32.24	32.24	11	Direct				5	214.27	0.9	0.0568	0.0511	0.0511	30.4	0.0511	0.0511	30.4	30.4																
AQ1	SEP	65494.47	279074.03	32.47	32.47	32.47	11	Direct				5	214.27	0.9	0.0572	0.0515	0.0515	30.7	0.0515	0.0515	30.7	30.7																
AR1	GULLY	65497.64	278862.01	36.37	36.37	36.37	11	Direct				5	214.27	0.9	0.0177	0.0159	0.0159	9.5	0.0159	0.0159	9.5	9.5																
AS1	GULLY	65468.1	278821.88	35.57	35.57	35.57	11	Direct				5	214.27	0.9	0.065	0.0585	0.0585	34.8	0.0585	0.0585	34.8	34.8																
AS2	GULLY	65502.03	278789.94	35.36	35.36	35.36	11	Direct				5	214.27	0.9	0.0653	0.0588	0.0588	35	0.0588	0.0588	35	35																
AS3	SEP	65515.67																																				