INFRASTRUCTURE REPORT - FAST TRACK PROJECT

SUBSTANTIVE APPLICATION

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

MAVEN ASSOCIATES	Job Number 135041		Rev A
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1.0 Statement of Qualifications and Experience

Ryan Hattle - Senior Engineer, Maven Associates Limited

I am a Senior Engineer at Maven Associates Limited. Maven Associates is a multi-disciplinary consultancy specialising in civil engineering, surveying and land development. I have been employed at Maven Associates since October 2021.
I hold the qualifications of Diploma in Civil Engineering from Manukau Institute of Technology. I am a member of Engineering New Zealand.
I have 10 years of professional experience in the Civil Engineering field, including roles such as Civil Engineer at Dodd Civil Consultants prior to employment at Maven Associates. My experience includes design, construction supervision of land development projects. Projects I have worked on include Adison Development Takanini, earthworks, servicing and subdivision of land, and four stages of the Bellfield Estate Development in Papakura which included more than 400 new lots on stages 2 – 5, earthworks, services, stream works design, drafting and compliance documentation.
I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Barry Beaurain – Civil Engineer, Maven Associates Limited

I am a Principal / Manager at Maven Associates Limited. Maven Associates is a multi-disciplinary consultancy specialising in civil engineering, surveying and land development. I have been employed at Maven Associates since March 2017.
I hold the qualifications of Bachelor of Engineering Technology in Civil Engineering from Unitec. I am a chartered member Engineering Technologist, of Engineering New Zealand.
I have 15 years of professional experience in the Civil Engineering field in New Zealand, including roles such as Senior Civil Engineer, Team Leader and Associate at Maven Associates. My experience includes design, construction observation of land development projects, contract management. Projects I have worked on include all stages of the Bellfield Estate Development which consisted of more than 500 new dwellings, all infrastructure (earthworks, roading (pavement design), stormwater conveyance, treatment and attenuation, and wastewater drainage including pumpstation, water supply including offsite augmentation in the wider network, power and telecommunications network coordination and street lighting, landscaping and stream works). I was engineer to the contract for 4 out of 5 stages on this development.
I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

2.0 INTRODUCTION

2.1 PROJECT AND PURPOSE

Vermont Street Partners No. 4 Limited (VSP) has engaged Maven Associates to provide Civil Engineering services for the master planning, consenting and design of Brookvale Green. The site is located at 174 & 176 Brookvale Road approximately 3.5km to the west of Havelock North's village centre in the Hawkes Bay. It comprises of a total area of 24 hectares on the eastern edge of Havelock North's urban residential boundary. Brookvale Green provides a unique opportunity to deliver a comprehensive residential community comprising of 203 new residential lots within a well-connected, high-quality and distinctive living environment.

The proposal is designed to create a defined rural/urban boundary while enhancing the site's natural ecological features. A defining characteristic of the site is the two watercourses, one meandering through the centre and the other forming the northern boundary. These features are central to the design approach, providing a strong landscape framework that has shaped the layout of streets, lots, and open spaces. The watercourses contribute significantly to the site's visual amenity, support ecological values, and provide opportunities for walking, cycling, and passive recreation. Their integration into the development ensures a strong connection to the site's natural character, while the northern watercourse establishes a soft green edge that reinforces the relationship with the wider rural landscape.

The residential community of Brookvale Green is guided by a series of design principles focused on delivering a liveable, connected and green environment, with enhanced public spaces and diverse housing options. The development is structured around a central loop road that extends from Brookvale Road and runs through the heart of the site. This loop is supported by local streets and pedestrian and cycle connections to enable a legible grid structure. A variety of housing typologies and densities are proposed to meet the evolving and growing needs of the housing market, ensuring choice and flexibility for future residents. Together, these elements will support the creation of a diverse, visually interesting neighbourhood with a strong sense of place.

The report provides a detailed summary of civil infrastructure associated with the Fast Track substantive application.

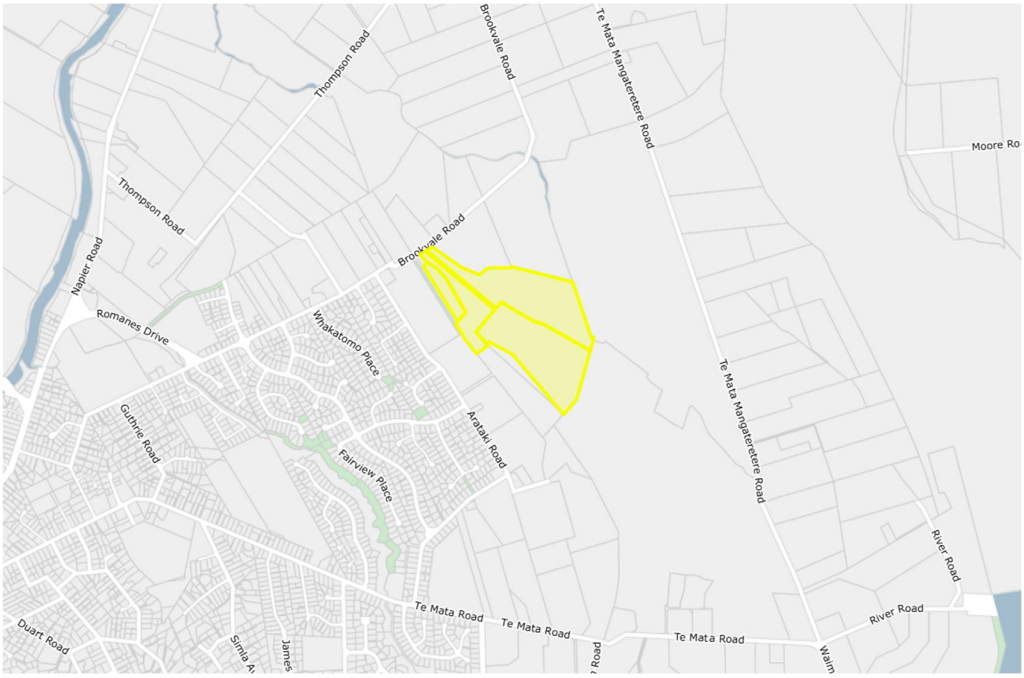

Figure 1 Locality Plan (Source: GRIP).

For further details regarding any information not contained within this report, and not related to infrastructure, refer to the Substantive Application for Fast Track Approval by Barker & Associates Limited and attached appendices.

The information in this report was prepared in accordance with the proposed masterplan prepared by VSP. The Masterplan delivers a yield of 203 lots.

Consultation and confirmation of capacity form key parts of any substantiative Fast Track application. The infrastructure capacity discussed in this report has been co-ordinated with Hastings District Council (HDC) and Hawkes Bay Regional Council (HBRC). Correspondence with both councils and information supplied by other consultants confirm that this site is suitable for development.

Further consultation with councils, external consultants and neighbouring landowners were undertaken and their feedback was considered as part of this substantiative application.

2.2 SITE DESCRIPTION

The site is located on the southern side of Brookvale Road, to the east of Arataki Road. The site adjoins the CDL land to the west which received Fast Track approval for residential development in February 2026.

The site currently houses buildings, sheds, packhouse, warehouse and carparking areas associated with the current businesses located onsite.

Access to the site is gained via a private road from Brookvale Road. Several gravelled roads provide access throughout the site.

The site topography falls inwards from the western and southern boundaries towards the northern boundary of the site.

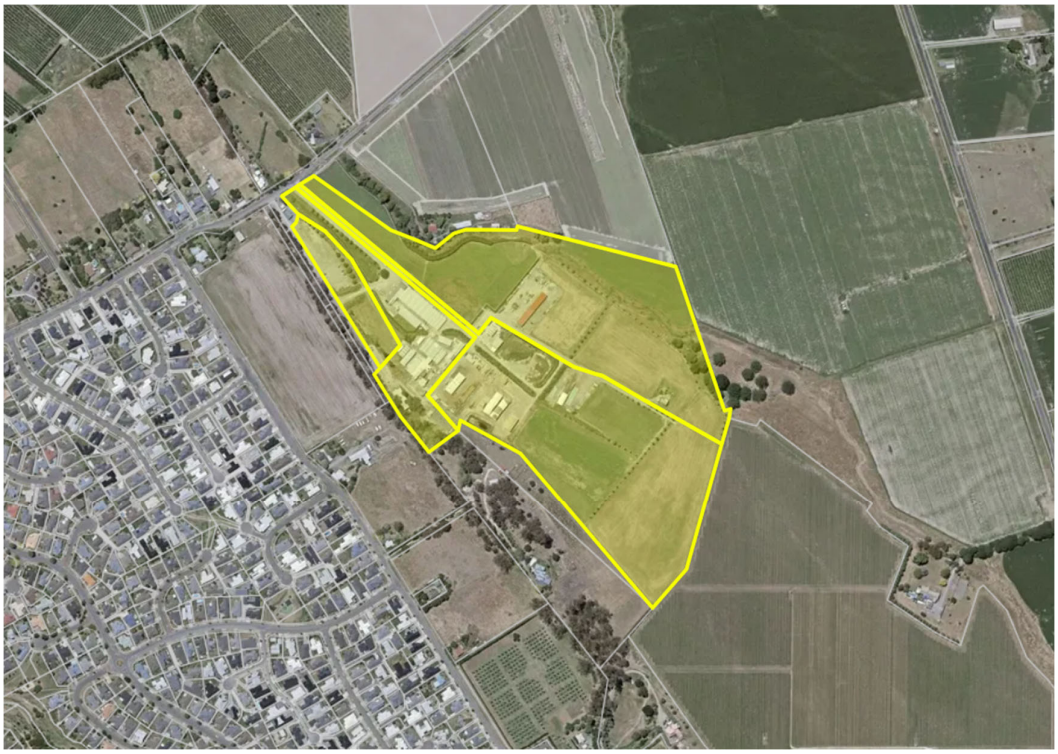

Figure 2 Site coverage and extent information (Aerial overview GIS)

3.0 EARTHWORKS

3.1 GENERAL

The area of proposed earthworks is 24 Ha. The goal of earthworks on this site is to create a landform which will allow rainwater runoff in a controlled manner to the downstream discharge location. Earthworks will include the construction of stormwater management devices, improvement of overland flow channels and filling to create suitable building platforms. The earthwork design also allows for the conveyance of concentrated sheet flows during large rainfall events around the development area, within the eastern channel (Watercourse 1) with secondary stormwater flows overland along new road corridors. This ensures the developable areas are separated from any overland flow and flooding. Refer to Plan C200 series plans for further information on earthworks.

3.2 ESTIMATED VOLUME

The proposed volume of earthworks is 95,000m^3, consisting of 69,000m^3 cut to fill and the import of approximately 26,000m^3 of fill material to be placed on site. The volume of earthworks required for import will be balanced as much as possible to minimise the import of material to site with the target to import mostly pavement construction materials and re-using as much of the existing roading materials on site. Any topsoil currently on site will be retained and re-used in landscaping areas. The roading materials to be imported consist of granular fill material and bitumen for the sealed roads and concrete for footpaths and shared paths. The volume of roading materials is approximately 14,500m^3. This means that the balance of material to import is 11,000m^3. The earthworks design model is a work in progress which includes amendment of cut and fill volumes across the site.

3.3 SEDIMENT CONTROL

The potential effects of earthworks on the surrounding environment will be mitigated in accordance with the HBRC adopted Part 2 of NZS4404:2010. Section 2.3.7 provides guidance on erosion, sediment, and dust control. Refer to Plan C230 for sediment controls to be constructed before any earthworks commences. There are no sensitive environments such as permanent streams or aquatic environment within the site. Silt fencing is proposed adjacent to Watercourse 1 and Watercourse 2 on site, and up to 5 sediment control ponds will be constructed to ensure the effects of sediment runoff is mitigated during earthworks. Dust will be controlled by spraying water on the surface during earthworks (drawn from water stored on site in tanks) by using a water cart or sprinkler system to suppress dust as required. The details of the size, location and height of each sediment retention pond (SRP) will be approved before construction. The chemically treated SRP's must be in place before earthworks occurs in each catchment. Each SRP will service a catchment of no more than 5Ha. An example of the sediment control pond calculation is in Appendix B. Refer to the earthworks management plan for an overview of the proposed controls for this activity. Further recommendations on earthworks staging proposed by the Geotechnical report have been considered within the earthworks management plan.

3.4 RETAINING WALLS

Level change across the site is minimal apart from the western boundary. In most areas the formation of batter slopes can be used with a maximum 1v in 3h slope to prevent the construction of retaining walls. However, Retaining Wall 1, 2m – 2.5m in height is proposed near the western boundary of the site to provide an acceptable road grade of Road 2, and adjacent building platforms (adjacent to Road 3 and Lot 177 – 180). A second retaining wall (Retaining Wall 3) up to 2.9m high at the corner of Road 3 and Brookvale Road is required. To clarify, there was a retaining wall called Retaining Wall 2 which has been removed from the design to use a batter

slope instead. The geotechnical report confirms that batter slopes and retaining walls will be acceptable on the site. Refer to Plan C240-0 to C240-11 for information on the general proposed topography and proposed retaining walls. A staircase with a structural retaining foundation will be constructed between the end of Road 3 and Road 1. No retaining walls are proposed for the staircase.

3.5 GEOTECHNICAL MATTERS

A site investigation was undertaken by Hawkes Bay Geotech – Geotechnical Assessment Report (25030A Rev 3 21/07/2026). The conclusion was that the ground conditions on this site are geotechnically suitable for residential land use. The general findings of the report are summarised below. The report recommends additional investigation and analysis during detailed design and construction phases, however, it is noted that the geotechnical risks can be adequately defined and mitigated. The Geotechnical investigation report is appended to the substantive application.

Slope stability:

Existing relatively steep slopes were identified on site. Adequate measures have been proposed in the earthworks plans to lower the height of banks, add fill to toe slopes to provide a suitable factor of safety. A specific analysis of the batter on the western boundary of the site has been undertaken. The recommendation in the Geotechnical report can be adhered to and will be considered during detailed design.

Retaining walls:

The soils on the site are suitable for the construction of retaining walls. Location specific geotechnical analysis was undertaken to confirm the site is suitable for retaining walls. Further design work will be required as part of retaining wall structural design as required during the building consent application phase.

Ground water:

Groundwater levels varied between 2m and 4m deep (increasing in depth from north to south) below ground level during the investigation. The ground water levels within the overland flow channel base are between 1m and 2m deep. Groundwater level will have seasonal variation, and it is recommended to use subsoil drains in the base of any amended overland flow areas as agreed with the Geotechnical Engineer during construction.

Liquefaction:

The groundwater levels were modelled together with soil testing data to discover the liquefaction susceptibility of material at the site, during a seismic event. Analysis indicated that under Serviceability Limit State, the material is unlikely to liquefy. Under Ultimate Limit State conditions (500-year return period) only thin lenses of material may be liquefiable. It is noted that ejecta is unlikely, vertical settlement are likely to be only minor, and differential settlement is not expected to exceed 1 in 500. It is acknowledged that a portion of the site have silty sands and sandy silts. Lab testing of the soils and field testing by the Geotechnical engineer resulted in the adoption of Technical Categories (TC1-low risk and TC2-moderat risk) for foundations.

Settlement:

Low risk of settlement and differential settlement. Mitigation options are presented in the report.

Consolidation settlement due to soil loading (fill placed during earthworks) is unlikely to exceed 25mm in the worst-case scenario, and more than 90% of settlement is expected to occur within 6 – 8 months. This is considered a low risk. Settlement monitoring is recommended in the areas which exceed 1.5m of fill height. The location of proposed settlement monitoring pins is shown in

the geotechnical report. This will likely be a condition of consent.

Watercourse Bank Stability:

Aerial photography post Cyclone Gabrielle was reviewed, and some areas of possibly minor bank instability was identified within Watercourse 1. The channel bank is currently vegetated with grass and some plants. The overall risk of bank instability is considered low. Bank scouring and bank erosion can be mitigated by using shallow slope angles (1v:3h or less) where channel works are undertaken. Erosion protection materials and planting details to enhance stream bank stability can be finalised during engineering approval and before construction is undertaken.

Bearing Capacity:

The natural soils at the site typically comprise of very stiff to hard sandy silt and silty clay with very dense gravels underlying. A geotechnical ultimate bearing capacity of at least 300kPa can be expected. A CBR of 4% can be assumed for natural ground.

3.6 HYDROGEOLOGICAL ASSESSMENT

Watercourse 1 is proposed to be relocated further towards the eastern boundary within a 280m section. Refer to Figure 3 below. The rest of this channel will be modified to increase conveyance capacity and will be enhanced by landscape planting. The downstream section of this channel immediately south of Brookvale Road will be widened and re-aligned to allow for discharge to occur to the culvert more efficiently as it is currently misaligned with the culvert under Brookvale Road. Earthworks were undertaken historically within a short section of this channel by previous landowners / tenants. In 2017 a report was provided to HBRC with the assessment of the earthworks undertaken for the purpose of a retrospective earthworks and channel diversion resource consent. On council's request, the hydrogeological engineer's assessment included an investigation of potential alteration of the channel base in relation to the underlying aquifer, and the risk that this may pose to ground water contamination. The assessment concluded that:

- The base of the channel was modified during earthworks within the short length that was straightened. The base was not lowered to the point where underlying gravel was exposed
- Soakage occurs within the base of the channel both in the area where earthworks was undertaken and further downstream where no earthworks were undertaken.
- It is unlikely that the earthworks increased the risk of groundwater contamination.

With the proposal now to do further work within the bed of the Watercourse 1 (cutting a new channel adjacent to the boundary and filling in an existing portion of the channel) and to divert the channel flow within the site boundary; it is proposed to provide earthworks monitoring by a hydrogeologist in addition to the monitoring undertaken by the Geotechnical Engineering team. The hydrogeologist will provide advice during site observations and undertake any required testing in the base of the re-aligned channel to determine if it is necessary to provide an impermeable layer to mitigate any risk of enhancing the infiltration capability of the channel in that location. The infiltration rate during and after construction should be no more than the existing infiltration rate of the site in all the areas which are subject to earthworks, trenching for drainage and services and excavation and construction of infrastructure like the pumpstation.

Deep excavations within the proposed development consist of drainage trenches for wastewater and stormwater pipes and manholes, stormwater basins, the wastewater pumpstation. Bulk earthworks proposed to cut and fill material across the full extent of the site. The above deep excavations have the potential to expose gravels which need protection during construction to minimise risk of unwanted ingress. The main risk is for contaminated discharges to flow into the gravel layers and potentially enter the groundwater layer. The contractor responsible for civil works on site will mitigate these risks by identifying exposed gravels, communicating with the

relevant persons in control and preventing possible contamination as necessary. When it is required to reinstate an impermeable layer which had to be excavated, it shall be done with advice from the engineer, hydrogeologist and or geotechnical engineer using the guidance as agreed within the final management plans agreed with council prior to construction.

Refer to the appended Hydrogeological Assessment and Source Water Protection Plan. Refer to the management plans which will be updated to reflect the necessary mitigation requirements and construction methodology throughout the engineering approval process and before construction starts.

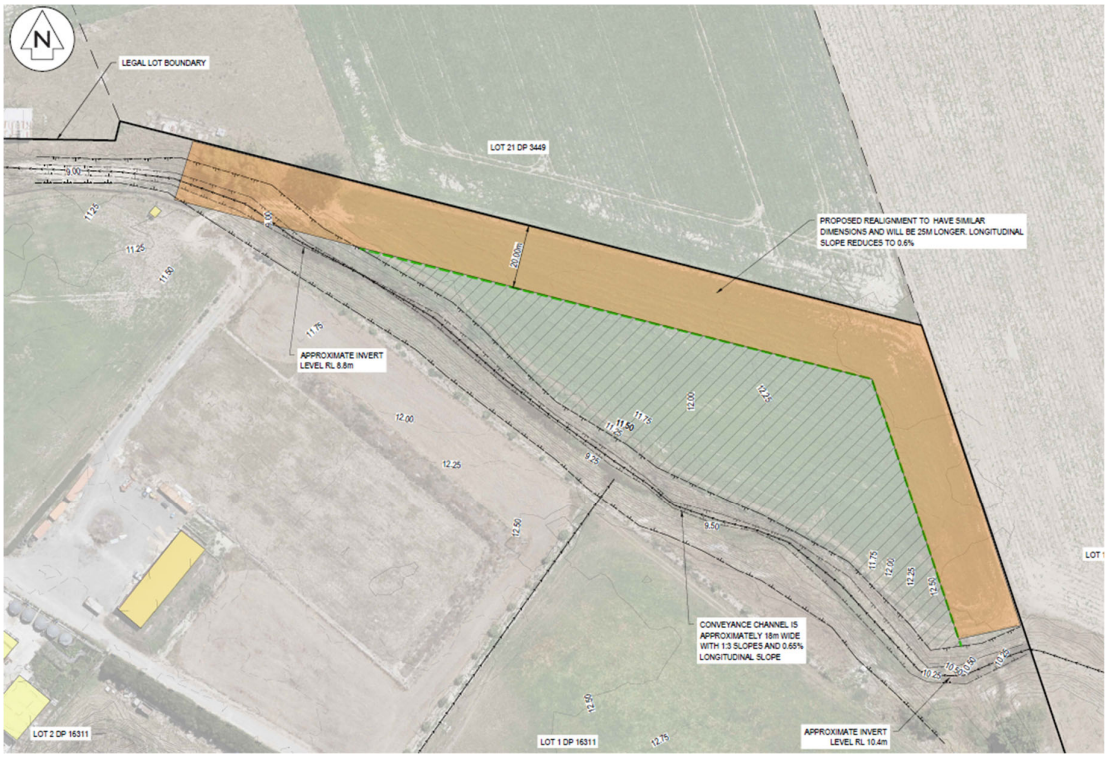

Figure 3 Refer to Plan C063 Rev A and C070 Rev A for more details.

Figure 4 Refer to Plan C220 Rev A for more details on the proposed cut / fill operation.

3.7 STAGING OF EARTHWORKS

Bulk Earthworks shall be undertaken as a single phased period of works (one establishment) over all development stages of the site after the removal of all existing buildings and infrastructure. This is necessary to ensure that the material which is excavated on site can be managed efficiently before it is placed where filling is required. The Geotechnical Report shows the proposed locations of stockpiled materials overlaid on the cut / fill plan in Figure 24 which shows the main areas of excavation and filling. A summary of the earthworks stages are as follows:

1. Watercourse 1 re-alignment works.
2. Western Boundary / Arataki reserve batter slopes cut and fill
3. Stormwater wetland and detention basins cut to South-Eastern central fill (pre-loading that area)
4. The rest of the site-wide cut to fill operation

4.0 ROADING

Brookvale Road will be upgraded to resemble a Collector Road layout with kerb and channel, front and back berm with footpath and services in the southern berm. The footpath will be extended to the west and connected to Arataki Road on the southern side of Brookvale Road as shown on Plan C300 series. The developer of this site will be responsible for co-ordination of the required infrastructure and any upgrade of the existing infrastructure within the road frontage adjacent to the site.

There is an existing HDC owned lot on the western boundary of the site (Lot 1 DP 529421). The site owner currently has an access easement over that lot as agreed with HDC. It is proposed to construct a new local road and services within that lot and vest the infrastructure to council as a public road with footpath and infrastructure. This proposal was discussed with HDC, this proposal will provide benefit in terms of access and use of vacant land without interfering with any other intended purpose of that lot.

There is also a Local Purpose Amenity Reserve on the western boundary of the site (Lot 3 and Lot 4 DP481968). It is proposed to clear the large trees from that area, re-contour the batter and replant that reserve as part of the western access road upgrade (Road 3). Road 3 will be connected to Brookvale Road as shown in the engineering drawings. Refer to Plan C301-1 to 4 for details.

Refer to Plan C300-0 to 10 for the proposed road layout. The location of access to the site and the internal intersections have been engineered to suit the level of traffic required for this development.
The road corridor widths are 21m wide for Road 1, the main access road, and 15m wide for all other urban roads.

Refer to the Integrated Traffic Assessment appended to the substantive application for further information on transport.

4.1 ROAD TYPOLOGIES AND PARKING

15m and 21m wide Road Corridors are proposed in accordance with Table C4 of HDC ECoP. The proposed road cross sections are shown on Plan C330 series and appended in the substantive application. Parking bays for parallel parking are proposed on all roads and wherever practical and safe.

4.2 ROAD PAVEMENT DESIGN

The roads have been designed and sufficient information provided with this substantive application to demonstrate that access, manoeuvring and space for services can be provided. The roading long section plan set C320 show that the proposed roads all have a longitudinal grade of more than the minimum 0.4% grade as suggested by the HDC ECoP. Steeper batters will be fully planted to prevent the need for mowing wherever berm batters are shown as steeper slopes than a typical road reserve berm. This is only encountered adjacent to the western boundary and Road 3. Visibility at intersections for vehicles and pedestrians are confirmed to be safe with the necessary checks done on vegetation and streetlight locations. A complying streetlight design have been provided which have been reviewed by HDC. Detailed design will form part of the Engineering Plan Approval (EPA) application process. Approval of the design of the pavement structure will form part of the EPA process, however, the suggested CBR of 5% is available on the site as reported by the Geotechnical Engineer. The proposed pavement design is to comply with Austroads and NZTA guidelines. A design life of 25 years will be targeted. The traffic volume of 3000 vpd has been considered as the likely level of traffic loading on the new pavement. A 450mm granular pavement over a lime / cement stabilised subgrade will provide sufficient strength to support the 35mm AC10 seal. A curvature function of 0.15mm is targeted in the pavement design to ensure a likely seal life of more than 10 years. A maximum deflection of 1.2mm with the Benkelman Beam test will be targeted on the finished basecourse.

4.3 WASTE MANAGEMENT

The Havelock North area requires collection of a wheelie bins for rubbish once a week. In addition to this but on another time of the week there is also a requirement to collect recycling and, in some cases, green waste. The collection is generally by way of mechanised hydraulic arm lifting

to side load bin to truck. The recycling is collected in a truck, but it is sorted by the driver into separate compartments by hand. During correspondence with HDC it was decided to provide tracking curves for a 10.3m Rubbish / Recycling truck and a passing car on tight bends, and for the kerbs to be widened in those locations. This is what dictates the design location of the widened kerb layout at tight bends on 15m road corridors where the lane width is only 2.75m wide each direction. The location where new homeowners may place rubbish or recycling for collection is shown on the C700 series plans to confirm that the layout of the site and the berm space available is sufficient and allows for a practical waste management system.

5.0 STORMWATER

Stormwater drainage is designed in accordance with the requirements in Section 2 NZS 4404:2010 Stormwater design and construction standards of the HDC Code of Practice 2020, which requires all land development projects to be provided with a means of stormwater disposal.

5.1 STORMWATER RETICULATION

The HDC IntraMaps identifies that the site is currently not connected to a public stormwater network, however, there are culverts under Brookvale Road adjacent to the site which are public assets and convey stormwater from the site to the north. Shallow open channels across the site discharge stormwater into two large channels on site (Watercourse 1 and Watercourse 2), which then flow north through the culverts under Brookvale Road towards the Karamu Stream. There are existing private culverts within the shallow channels and within Watercourse 2 at road crossings.

The subject site is proposed to be serviced by a new stormwater network. The primary drainage network is designed to contain up to a 1 in 5-year ARI rain event within the pipes. The general concept of stormwater runoff on site to the piped reticulation network is as follows:

- Roof water is collected in the gutters of dwellings and downpipes are connected to a single outlet along the kerb adjacent to the lot frontage of each new dwelling.
- Stormwater collected from the driveway and hard surfaces on each lot will also be directed to the kerb discharge point.
- The kerb outlet discharges all flow to the kerb and channel in the road. From here the stormwater flows overland to the surface entry of either the rain gardens, or the wetland, and some areas flow into catchpits first, and then in a pipe to the forebay of the wetland.
- The site is divided into 5 catchments, which all flow to a stormwater management device before being discharged.
- Lots 181 – 188 will discharge directly to Watercourse 2 via sheet flow, however, the roof water will be directed to a kerb discharge. This is due to the roof height being sufficient for a free draining solution, but the rest of the lot levels will be lower than Road 3.
- All other lots will generally shed rainwater runoff towards the road from which it gains access from.
- Once the stormwater is managed within each device for its respective catchment, it will discharge to either of the two watercourses on site.
- All stormwaters will flow to the same location downstream as for the existing site runoff through one of the culverts under Brookvale Road.

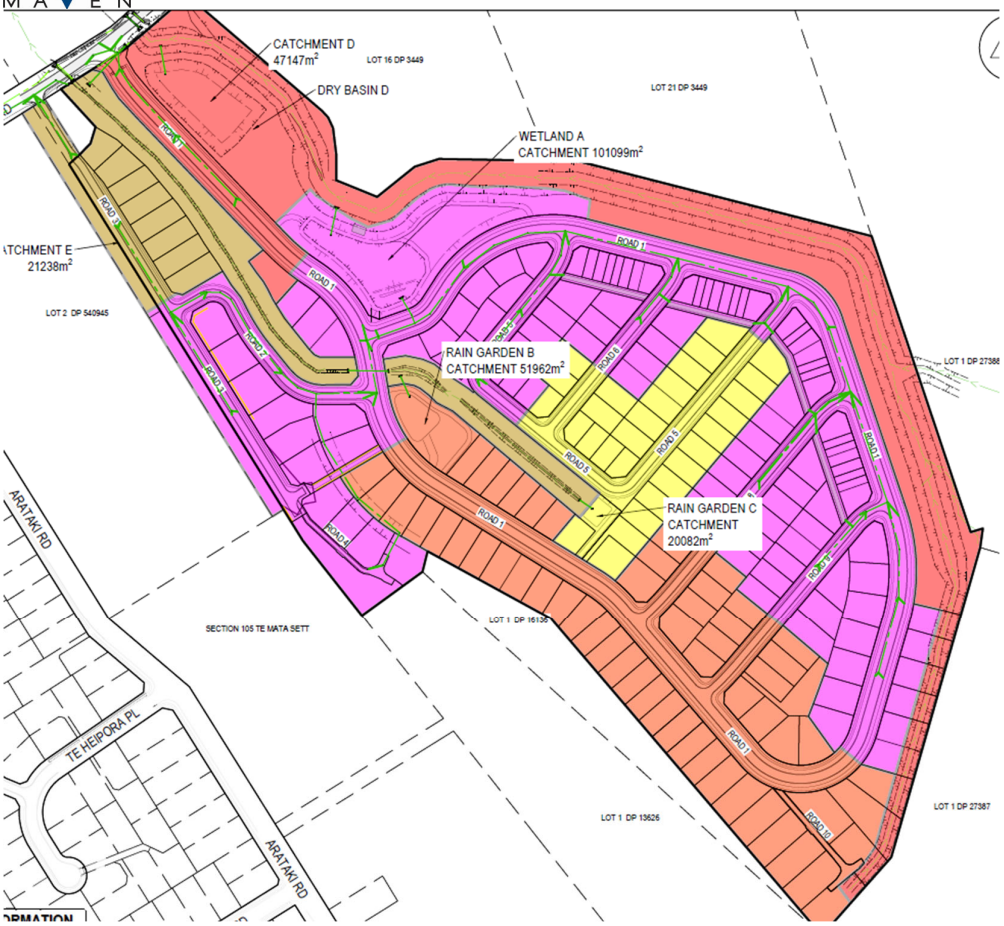

Figure 5. Catchment Plan

Where public drainage is shown in private lots there is a proposed easement shown in favour of council. Refer to the scheme plan set C151 – C159 in Appendix A.

5.2 STORMWATER CAPACITY

There is a 1.4m x 1.1m box culvert under Brookvale Road at the head of Watercourse 1.

There is a 400mm and 800mm culvert at the head of the watercourse 2. Flow in Watercourse 2 also discharges to the northern side of Brookvale Road and are connected to the roadside open drain which flows to the same box culvert mentioned above, with an existing 300mm culvert under the entry to the site (Road 1).

The capacity of the culverts is proposed to be increased in accordance with the stormwater flood model. The primary network and stormwater management devices on site have been designed to limit the discharge from the site as required by the HDC Engineering Code of Practice (HDC ECoP).

5.3 STORMWATER ATTENUATION

The HBRC Plan Change 9 contains rules for the diversion and discharge of stormwater into water, or onto land where it may enter water. HDC ECoP 2020 Section 4 provides guidance on the mitigation of stormwater discharges.

The Brookvale Structure Plan - Stormwater Management Plan December 2020 and HBRC Karamu Catchment Management Plan provides outcomes for attenuation within the catchment plan area. Whilst this site is not within the Brookvale Structure Plan area, the attenuation requirements from the structure plan catchment have been included in the design as to ensure consistent attenuation requirements are applied to this proposal. The attenuation requirements are for the post development discharge to be no greater than the pre-development flow in the 2 and 10-yr ARI event and up to 80% of the predevelopment flow in a 100yr event is also required.

In accordance with a best practice solution using the HDC ECoP 2020 as a guideline, the stormwater attenuation will be combined with stormwater treatment via a wetland and extended detention within the same structure.

One dry basin, four raingardens, one wetland basin with extended detention area and two enlarged conveyance channels will provide the attenuation of stormwater runoff to pre-development levels as required.

Stormwater soakage within the Havelock North area is not permitted. The wetland design detail is subject to the engineering plan approval application process. The wetland design is functional and meets the requirements for this development. An impervious liner is proposed to be installed in the base of the wetland to ensure soakage does not occur. The controlled outlet structure and the outfall structure with riprap into Watercourse 1 have been designed in accordance with the hydraulic requirements of the site. Details of the wetland basin can be found in Plan C400 series.

Figure 6 Proposed Road Layout with location of stormwater management devices. Plan C400

5.4 STORMWATER QUALITY

The rainwater runoff from the new public roads will be directed to the stormwater wetland and raingardens from the on-site upstream catchments respectively, before it is discharged to either Watercourse 1 or Watercourse 2. The design principles for treatment within wetlands which are set out in the HBRC Water Design Guidelines 2009 suggests a low impact design approach and lists five principles in section 4.2. Water quality improvement with the use of a wetland and raingarden provides treatment as close as possible to the source and relies on the natural soil and plant processes within the wetland device at the same time as providing attenuation of rainwater runoff, thereby achieving multiple objectives.

The controlled outlet of the stormwater wetland management structure will discharge to Watercourse 1 via a concrete outfall structure and riprap protected outfall. The wetland basin will be sealed in its base with an impervious layer to prevent infiltration and protect source water within the aquifer below. The wetland will have a forebay which will flow over a level spreader to permanent water level within the planted bathymetry to provide a high level of water quality improvement. The forebay will be drained down with a bypass pipe via a GPT to ensure that the two inlet pipes to the forebay only temporarily holds water during the rainfall event. No up-flow chambers or bubble up chambers will be used as this was a preference of HDC. The drain down of the forebay will occur within 24 hours after rain stops. The outfall structure and riprap are designed to mitigate erosion within the channel base of Watercourse 1. All design details are in Appendix A.
The raingardens (will also have impervious liners in their base) B, C and G will discharge to Watercourse 2 via subsoil drains at low flow through a catchpit sump. Overflow points will be provided via roadside catchpits which will drain to Watercourse 2 and the roadside drain on Brookvale via the culvert under Road 1. The smaller narrower road-side raingardens proposed near the intersection of Brookvale Road are designed to provide water quality improvement for the smaller catchments which can not gravity flow to the larger devices elsewhere on the site. HDC have provided feedback concerning the use of raingardens which relate to sloped surface and maintenance requirements of raingardens. The final design layout and details of the raingardens can be amended during engineering approval in agreement with HDC. If raingardens are not acceptable in the location near the intersections with Brookvale Road, then these devices can be exchanged with Gross Pollutant Traps (GPT) which typically achieve removal of 50-70% of Total Suspended Solids (TSS).

Dry Basin D is planted with vegetation and will normally be dry. It will only have water in it when Watercourse 1 overflows into it temporarily, thereby buffering the amount of water which is discharged to the culverts under Brookvale Road. The dry basin does not have any water treatment functionality. Details of the stormwater quality management devices are on Plan set C450 in Appendix A.

5.5 STORMWATER DEVICE MANAGEMENT

Access to all the stormwater management devices will be provided. There is sufficient setback from the edges of the devices to other structures to provide long term access for maintenance. The engineering plans show access for parking and driving / walking to the proposed stormwater management. The Maintenance manual provides the likely requirements for maintenance. The side slope of the wetland is designed at 1:5 as per HBRC guidelines. The dry attenuation basins, rain gardens and watercourses are designed with a slope of 1:3. It is proposed to fully plant all slopes to avoid the need for extensive mowing.

For more information on the proposed stormwater device operation and maintenance please refer to the Stormwater Management Plan in Appendix E.

5.6 OVERLAND FLOW

The Brookvale SMP states that the 1 in 50 yr ARI rainfall event must be considered for overland flow.
The proposed topography of the site and the roading corridors will be shaped to allow for overland flow generated on site, to be controlled through the site to the discharge point without affecting new building floor levels. Flow depth and velocity will be minimised to provide safe passage for pedestrians and vehicles.

It is proposed to retain and enhance the open stormwater channels (Watercourse 1 and Watercourse 2 in figure 6 above. The historical overland flow from the upstream catchment traversed the site. However, over many years, shallow open channels and culverts have been formed on site to divert the overland flow into the two main watercourses. The extent of Watercourse 2 is shorter than it was 20 years ago for example.

It is proposed to cut off the upstream sheet flow and to divert it around the site to avoid substantial overland flow from the upper catchment entering the road network on site. There is currently an existing cutoff drain along the southern most boundary of the site which already acts in this way. It is proposed to widen the drain along the southern boundary by up to 3m to manage stormwater as a planted swale. This enhanced planted swale will be merged with Watercourse 1 which will also be improved to increase conveyance and storage capacity.

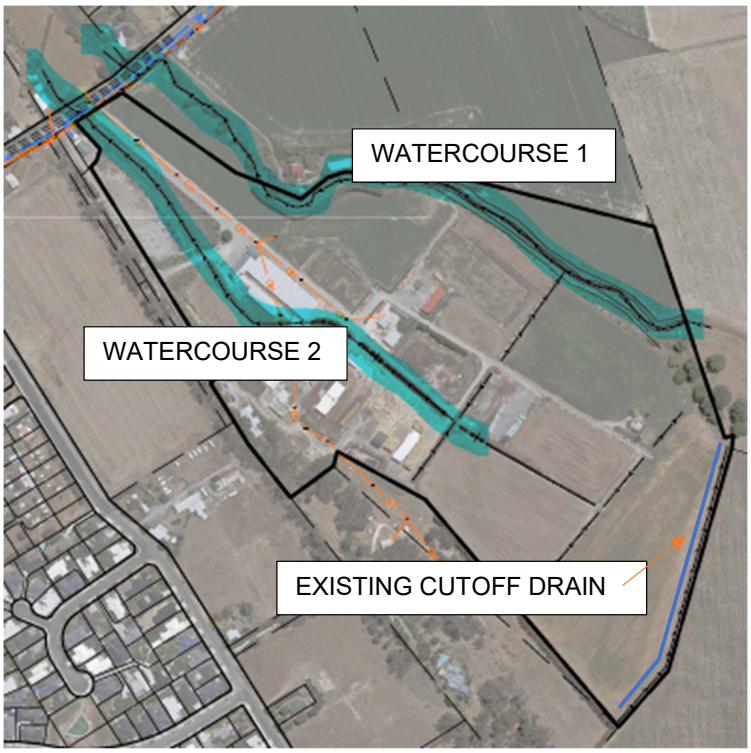

Figure 7 GIS Aerial with Topo survey overlay. Existing OLFP

There is a large catchment upstream of the site. The site is at the head of the Karamu Stream catchment which is 3,560 Ha in size. Watercourse 1 within the site (dry at the time of inspection) acts as a major overland flow path during the 100yr ARI storm event. The flow in this channel will bypass the site and continue under Brookvale Road to an open watercourse / reserve from which flow continues towards the west in open drain and a culvert under Davidson Road into the Crombie Drainage Reserve, and again under Romanes Drive to the Karituwhenua Stream and then discharges to the Karamu Stream.

This conveyance channel has sufficient capacity to direct the 100yr ARI storm event flow past the site however the capacity of the culvert under Brookvale Road is not sufficiently large and therefore ponding occurs on site.

The two watercourses will be enhanced by using the following methods along both channels:

- Removal of weeds and pest plants and large trees.
- Widening of the base and increasing the width of the channel with a side slope of 1 in 3 by excavating material.
- Watercourse 1 will be partially re-directed as discussed above in the earthworks section and shown on Plan C63 and C70
- The base of the channels will be inspected by Geotechnical and or Hydrogeological engineering professionals to advise on potentially adding impervious layers in the areas they deem necessary.
- The surface of the excavated channels will receive a layer of topsoil and coconut matting before landscape planting occurs.
- Erosion protection in the form of green outfall structures, rip-rip rock on Geocloth, wingwall outlet structures and gabion rock will be used to mitigate erosion in critical locations as shown in the plans.

Refer to the Ecological Mitigation and landscaping reports appended to the substantive application for more information on the watercourses.

Figure 8 Proposed overland flow path re-direction

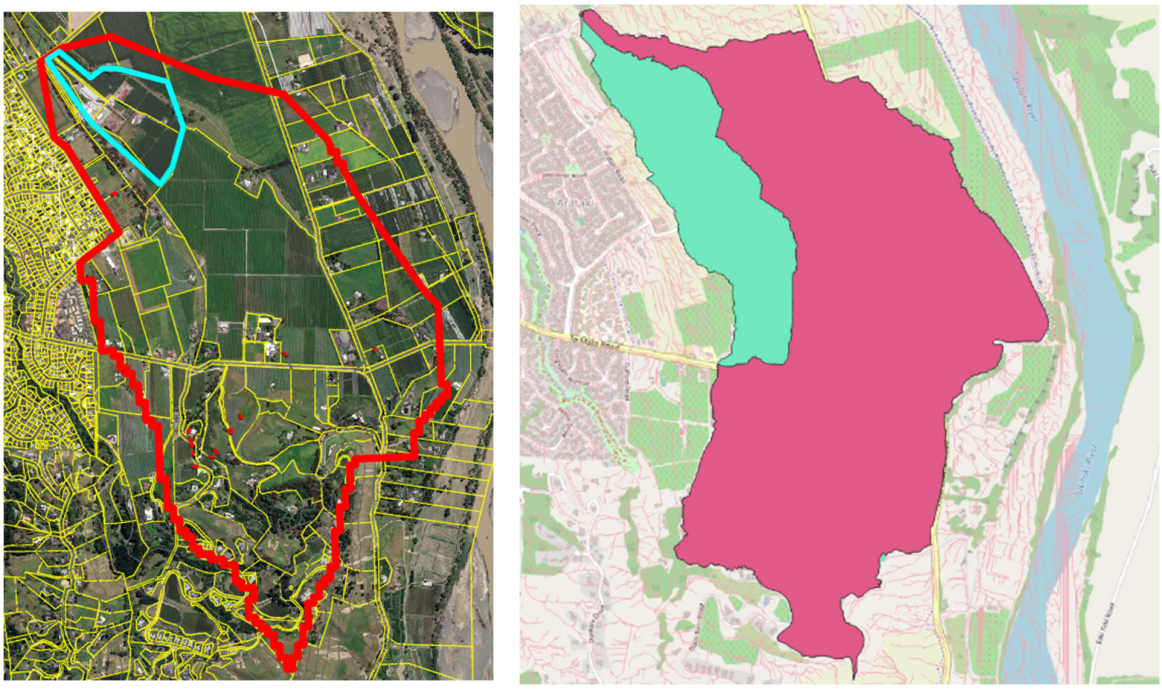

Figure 9 GIS OLFP Catchment Plans for Watercourse 1 and 2

5.7 FLOODING

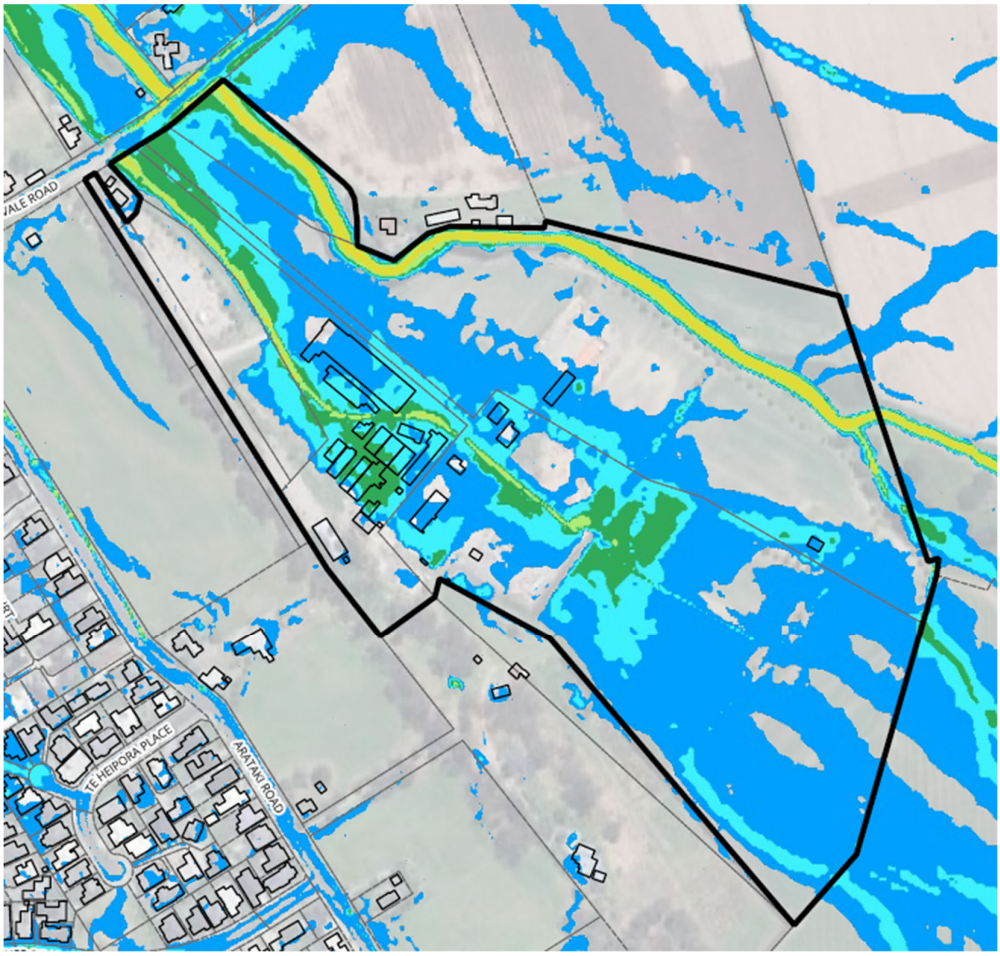

Figure 10 100yr ARI Pre-development Flood Extents (Maven Associates flood model 2026)

The site is within the Plains Production Zone under the HDC Operative District Plan. The site is not within the Brookvale Structure Plan area, however, the design outcomes for mitigation of stormwater discharge from the site to prevent flooding upstream and downstream are considered relevant in terms of the Brookvale Structure Plan – Stormwater Management Plan.

Due to the size of the upstream catchment as shown in figures 9 and 10 above, a predictive stormwater model has been developed by Maven Associates. The stormwater model focuses on the likely overland flow which may occur on the site because of severe inclement weather. A 100yr ARI event including climate change factor of 3.8 degrees temperature increase was considered with a maximum probable development in the upstream catchment.

The engineering design (as indicated within the provided Maven civil drawings and masterplan appended to the substantive application) provides for the required civil engineering solution, of which is summarised below:

- Avoid blocking of overland flow paths.
- Provide a finished topography of the site to allow for a complying stormwater network to act as primary drainage and secondary drainage to flow overland and mainly contained within road corridors between kerbs.
- Provide a cut-off drain (along south-eastern boundary), which intercepts sheet flows and directs this into Watercourse 1 and around the development area.

- Provide adequate overland flow channels to convey stormwater runoff from the upstream catchment and sufficient capacity within the roading network to convey rainwater runoff from the site as secondary drainage.
- Ensure the design of flood flows mimics that of the pre-existing conditions as it tops over Brookvale Road.
- Ensure that there are no effects on any downstream properties which are currently impacted by flooding as detailed in the flood modelling.
- Freeboard above the 100yr design flood level to future floor levels will be as per the building code requirements. For secondary flow this means:

    - *500mm freeboard where surface water has a depth of 100 mm or more and extends from the building directly to a road or car park, other than a car park for a single dwelling.*
    - *150 mm for all other cases.*

- Upgrade the culverts under Brookvale Road to allow for sufficient conveyance of the 100yr ARI storm event and therefore provide adequate freeboard to new building platforms.
- Enhance to storage capacity of channels and basins on site to prevent displacement of flood water which may affect upsream or downstream properties.
- Consider the unlikely event of blocked culverts at Brookvale Road to ensure this does not have an impact on freeboard levels upstream. (Brookvale Road currently receives overflow from the upstream Watercourse 1 in a 100yr event. Watercourse 1 upgraded and with Dry Basin D added, the post - development flood model must show the overflow scenario is no worse and safe for vehicle traffic)

The stormwater modelling concluded that the proposal meets the above target criteria.

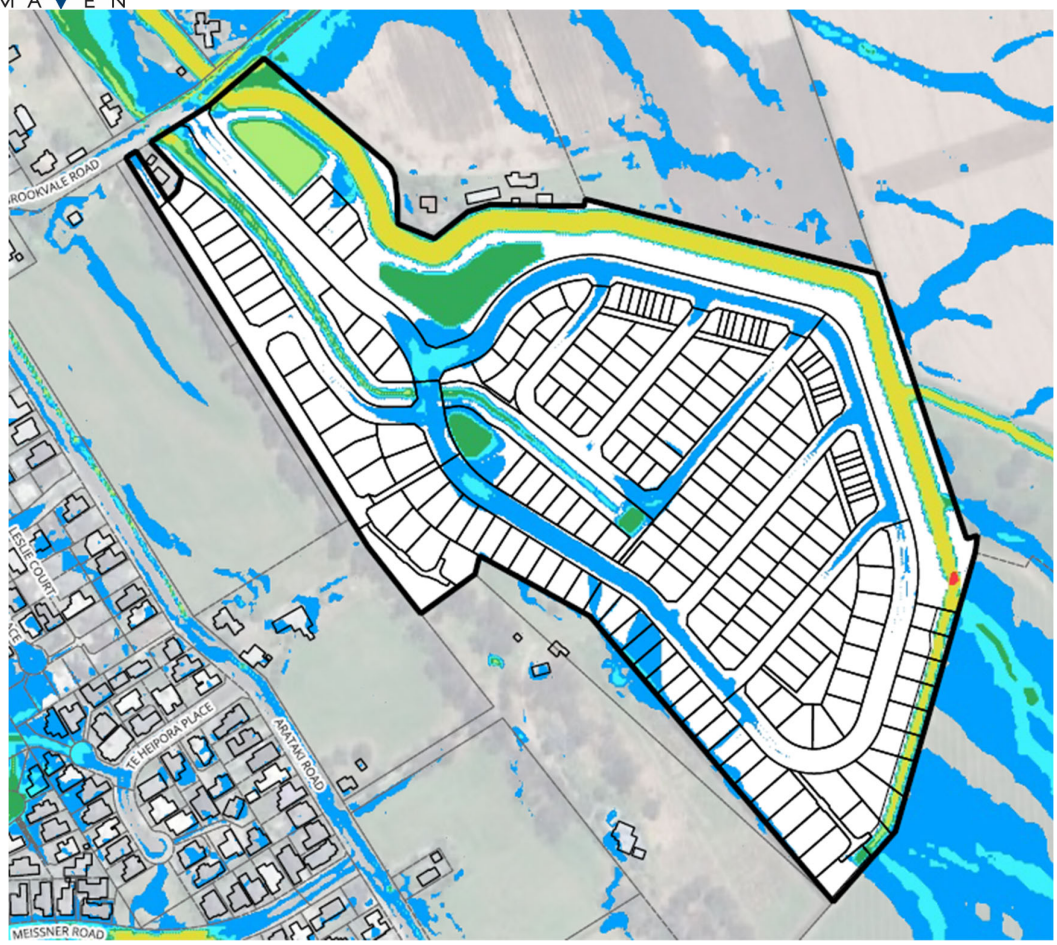

Figure 11 100yr ARI Post-development Flood Extent (Maven Associates flood model 2026)

A flood hazard risk assessment was undertaken as part of the flood model work.
For more information on the flood model results please refer to the flood model report and plans appended to the substantive application.

The general outcome of the flood hazard risk assessment was that the level of risk over the majority of the site will reduce from what it is currently, when the proposed development is completed. The hazards can be summarised as the no or very low hazard near any proposed dwellings and Hazard Class 4 and 5 within the major overland flow paths as expected. Appropriate emergency egress is provided for within the proposed development.

The severity of any theoretical 100yr ARI flooding event is not exacerbated by the proposed development, and no overland flow is blocked by the development. The flood model plans show the extent of flooding within the site and both up and downstream of the site both in existing form and post-development form. The change of the flood extent is negligible due to the proposed mitigation provide for within the proposed development.

Flooding and overland flow on upstream and downstream properties is therefore not made any worse by the proposed development.

6.0 WASTEWATER

The HDC ECoP 2020 (Section 5: Wastewater) sets out the design principles for wastewater and requires any development project to be provided with a means of wastewater disposal.

6.1 WASTEWATER RETICULATION

HDC IntraMaps identifies the subject site is not currently serviced by a public wastewater connection.

Figure 12 Council IntraMaps – Public Wastewater Drainage Network nearby

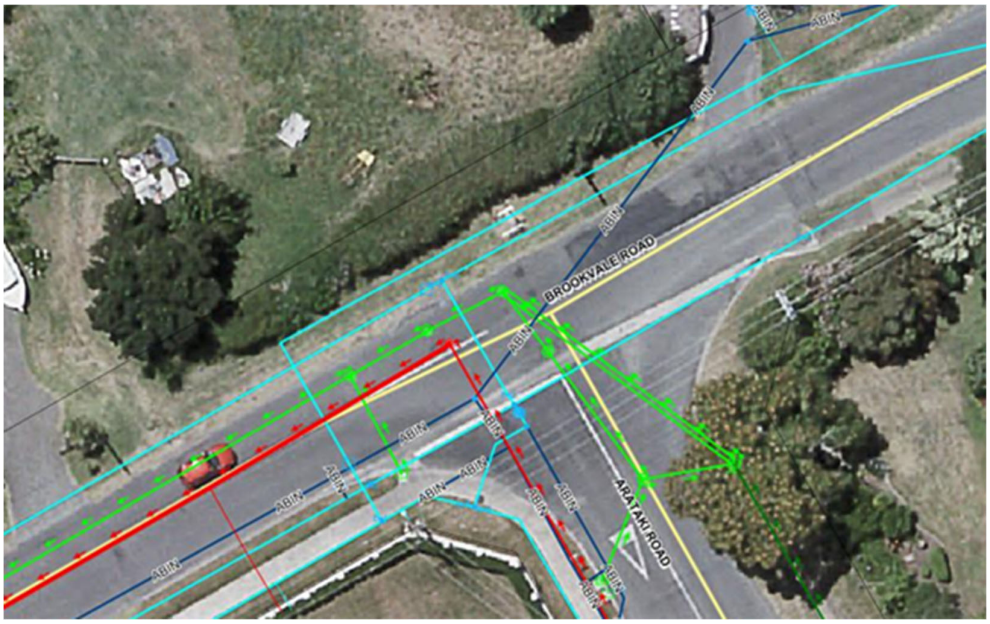

Figure 13 Council IntraMaps – Public Wastewater Services within Arataki Road

The subject site is proposed to be serviced by a new wastewater gravity network, which will be pumped from the site via a new public rising main and connect into the exiting public wastewater infrastructure. A new rising main will be installed and connected to a new stilling manhole to be

located near the intersection of Brookvale Road/Arataki Road. It is possible to extend the gravity main within the Brookvale Road / Arataki Road intersection to the east. The proposed wastewater drainage layout was designed to follow road corridors to service each new dwelling with a private connection. The wastewater drainage layout is shown in Plan C501 – C505 for reference. There is no known development upstream of this site and therefore no additional capacity for upstream connections have been provided.

Where public drainage is shown in private lots there is a proposed easement shown in favour of council. Refer to the scheme plan set C151 – C159 in Appendix A.

6.3 WASTEWATER PUMPSTATION

An alternative proposal to use a packaged pumpstation instead of an on-site constructed pumpstation is available and will be subject to Engineering Approval before construction. Information gathered to date as well as the design and calculations provided in the substantive application show that a wastewater pumpstation can be installed in the proposed location and it will be a feasible and robust method of providing the site with a suitable means of wastewater discharge. The pumpstation will include emergency underground storage with no emergency overflow discharge point from the pumpstation site.

Overview of the pumpstation:

Rising main indicative size:	125mm – 150mm
Rising main length	580m
Flygt Pump Series:	3085 – 3102
Storage Tank Size:	44 – 50m^3 (including storage in wet well) 6hr ADWF
Pump Chamber:	2.4 – 2.5m diameter wet well
Head:	15 – 20m Total

The pumpstation design is shown on plans C550-1 to C550-6.

6.3 WASTEWATER CAPACITY

The proposed wastewater network is designed to have sufficient capacity to cater for the design wet weather flow generated from the proposed development and will be subject to Engineering Plan Approval before construction.

Calculations in accordance with the HDC ECoP show that a 203 - lot subdivision would create peak wet weather flow of 7.71 L/s (Peak Wet Weather Flow of 667m^3/day). It is noted that the trigger value for the wastewater treatment plant was reported as 16,000 m^3/day below available capacity in 2022.

The pipe sizes within this network are suitably sized for the maximum probable development scenario and is considered to have sufficient capacity for wastewater conveyance.

The 9-year review report documented no capacity issues at the wastewater treatment plant up to December 2022. Correspondence with HDC regarding the modelled wastewater flow to the treatment plant (checked by a third-party contractor on behalf of HDC) and including the theoretical discharge from this site indicated only minor considerations from an operational point of view with no capacity constraints.

6.4 WASTEWATER CAPACITY CONSULTATION

A meeting was held with HDC to discuss wastewater capacity and the ability for this site to be serviced in the future. Demand calculations and the general concept of the site development were provided. HDC has confirmed that there are no capacity issues in the Wastewater Network.

7.0 WATER SUPPLY

The HDC ECoP 2020, for development and subdivision, sets out the design principles for water supply and requires assessment against Section 6, Water Supply NZS 4404:2010. SNZPAS 4509:2008 NZ Fire Service Fire Fighting Water Supply Code of Practice.

7.1 WATER RETICULATION

The HDC IntraMaps indicate existing 300mm and 375mm public water pipes run to the north-west of the subject site in the road reserve of Brookvale Road, as indicated in Figure 14 below. It is proposed to connect to the existing water main network and extend a public water main into the site. A 180mm water main is to be constructed within the main road and 125mm mains in all local roads with fire hydrants, and rider mains on the opposite side of each road.

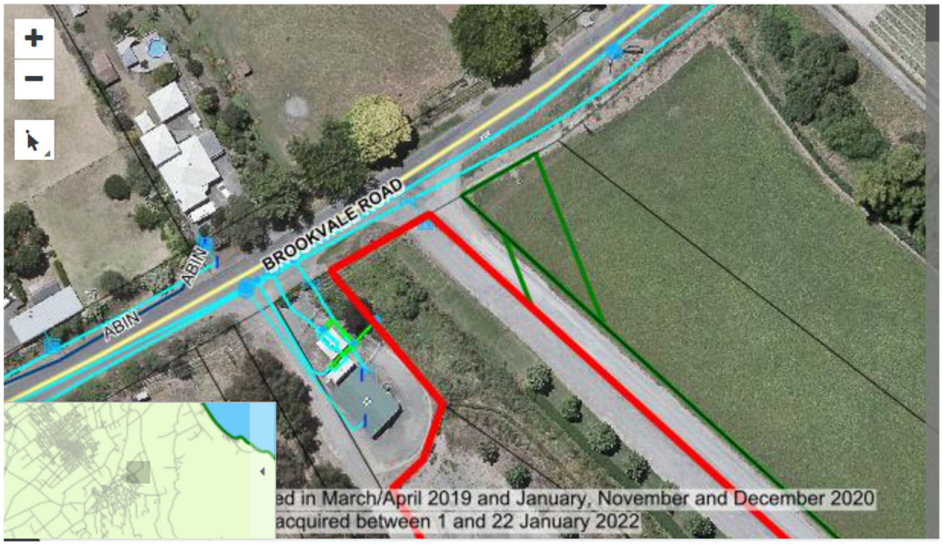

Figure 14 Council IntraMaps – Public Water Supply Networks

7.2 POTABLE WATER AND FIRE FIGHTING SUPPLY

The potable water demand has been calculated in accordance with the HDC ECoP. For a 203 - lot subdivision, an average daily water demand of 2.82 L/s (5.64 L/s peak demand) will be required. This figure was calculated using the conservative measure of 400 Litres per person per day with and occupancy rate of 3 people per dwelling.
The minimum firefighting water supply classification for development in urban areas is FW2. Therefore, any future residential development must meet the following water supply requirements:

- A primary water flow of 12.5 litres/sec within a radial distance of 135m
- An additional secondary flow of 12.5 litres/sec within a radial distance of 270m
- The required flow must be achieved from a maximum of one or two hydrants operating simultaneously.
- A minimum running pressure of 100kPa

The proximity of new fire hydrants to dwelling have been checked and the design confirms that the distances mentioned above are complied with.

From correspondence with HDC it is expected that the above demand can be supplied by connecting to the west of the water supply pump station on Brookvale Road. A new water main can be extended to the intersection of Brookvale Road and the entry to the site. HDC have engaged with a third-party contractor to model the proposed increase in demand from this development, and they confirmed that there are no capacity constraints. Refer to Plan C600 which shows the proposed connection of the new 180mm main to the existing 300mm PVC water main.

7.3 WATER SUPPLY CAPACITY CONSULTATION

A meeting was held with HDC to discuss water supply capacity and the ability for this site to be serviced in the future. Demand calculations and the general concept of the site development were provided. HDC has confirmed that there are no capacity issues in the Water Supply Network. In June of 2026 further correspondence from HBRC suggested that the global water take consent held by HDC may be nearing over-allocation. A solution of transferring existing bore water allocation held by the site in return for residential water supply was agreed with HBRC and HDC.

7.4 EXISTING WATER BORES

There are currently at least five water bores on the site. The water bores will be protected during construction, and the boreholes will be decommissioned as development progresses. It is envisaged that the existing bores will be encountered during the bulk earthworks stage, and therefore the proposed management of the existing bores form part of the earthworks management plan. For more information on the existing bores refer to Appendix F.

7.5 PROPOSED EFFICIENT WATER DESIGN APPROACH

It is widely acknowledged that water resources are subject to increasing demand and that New Zealand's management of its source water supply must be improved to cater for this additional demand as the population grows. An efficient water supply network for all new subdivisions is therefore part of good engineering design. The new water supply network is therefore proposed to be:

- Designed in accordance with the HDC ECoP and subject to engineering approval. The new network will be constructed using the relevant engineering standards and best practice by qualified and experienced contractors.
- Designed to allow for operational requirements such as flushing via fire hydrants. Water quality issues will be minimised by eliminating dead-ends and looping the network to allow for multiple connection points and valves to shut off parts of the network for future maintenance.
- Monitored for total use by way of a bulk water meter to capture the water use in this specific zone. Details are to be confirmed however it is envisaged that a Mag flow meter at each connection to the existing watermain in Brookvale Road would be necessary reconciliate the actual consumption by the site.
- Pressure controlled by way of pressure reducing valves in future design locations to optimise the performance of the site's water take.
- Vested to HDC as a public water reticulation network. The new water mains will be subject to the usual pressure testing, disinfection and laboratory sample testing before connection to the existing network can be made.
- Servicing domestic supply only. No irrigation systems to public road reserves or stormwater reserves are proposed. Any water required for tree maintenance will be carted to site.

8.0 OTHER SERVICES

Telecommunications in the area are managed by Chorus. Details of any network extension and alterations required to service the development will be agreed with this Private Utility Operator during the detailed design phase. A preliminary design has been included in the Maven Civil plans. Chorus have confirmed that there is capacity in the fibre network to service this development. A letter from Chorus with the design and supply quotation is appended in the substantive application.

Power supply in the area is managed by Unison Networks Limited. Details of any network extension or alteration will be agreed with this Private Utility Operator during the detailed design phase. Unison have confirmed that they are able to underground the overhead powerlines within the site and that there is sufficient capacity in the wider network to service this development. A letter from Unison is appended to the substantive application.

Gas supply in the area is managed by Powerco. Details of any network extension or alteration will be agreed with this Private Utility Operator. A notification email has been sent to this company for their response on possible construction near their assets and they have been advised that a connection to the gas network is not required for the new development. Any connections which may exist to the gas network will be removed from the site by this utility operator.

9.0 CONCLUSIONS

This report outlines the civil servicing strategy for the substantive application for resource consent of the proposed development. The developed design plans demonstrate that the development will deliver 203 residential lots to Havelock North with a supporting road network, services infrastructure and reserves.

Earthworks and sediment control design plans allow for the construction of building platforms, accessways and services. The proposed landform is supported by the Geotechnical report, the contents of which include a suitable strategy on staging of earthworks to mitigate risks.

The development has suitable access from Brookvale Road. The road network will be formed to provide safe access to all areas. The developed design complies with development standards and includes some input from HDC who have been very helpful during correspondence.

A new stormwater network will be constructed, and this will provide a means of stormwater disposal for the public roads and all future lots and houses. The network is designed using Section 2 NZS 4404:2010 Stormwater design and construction standards of the HDC ECoP 2020. Stormwater management of water quality and attenuation is included in the developed design and are in accordance with the ECoP and the HBRC Water Guidelines.

Maven Associates have built a flood model for the catchment, and this has been used in development of the overall masterplan and civil engineering developed design. The civil design allows for sheet flows from the upstream catchment, before directing this flow around the site along Watercourse 1 and away from the development building platforms. The flood model report shows that upstream and downstream properties are not affected by an increase in extent because of the proposed development. All dwellings will be designed with freeboard in accordance with the New Zealand Building Code and developable areas are removed from flood hazards.

Suitable wastewater disposal can be provided for the development. The new gravity wastewater network on site will drain to a pumpstation. The new pumpstation will pump to a public manhole within Brookvale Road via a rising main. There are no known network capacity issues.
Water supply for the development will be provided by way of a new watermain network within the site, connected to the public supply within Brookvale Road. There are no known network capacity issues.

Chorus have confirmed that the proposed site can be serviced with a telecommunications network. They have provided a quote to the applicant for this service.

Unison have confirmed that electricity is available for the site. The existing overhead power within the site can be relocated underground with the provision of additional transformers to provide capacity for the proposed subdivision.

Overall, the information, assessment and design completed for the proposed Brookvale Green project confirm that the site can be appropriately serviced and is suitable for the proposed residential development from a civil and infrastructure perspective.

APPENDIX A – ENGINEERING PLANS

(Appended to the substantive application)

APPENDIX B – ENGINEERING CALCULATIONS

MAVEN ASSOCIATES	Job Number	Sheet	Rev
	135041	1	A
Job Title: Brookvale Green	Author	Date	Checked
Calc Title: 100yr Overland Flow Path	RH	22/06/2026	BB

Rainfall Depth	ARI 100YR (mm)	
TP108 rainfall data	169	From Hastings Rainfall charts
Climate change Increase	197.392	(assuming 2.1C increase in temperature 16.8%)

Catchment Section	Catchment	Catchment Area *m2*	CN	Peak Flow rate - 100YR ARI *l/s*	Cum. Flow *l/s*	Cum. Flow *m³/s*
D-D	ROAD	3592	90.8	112.3	112.3	
	LOTS	6837	89.6	211.1	323.3	
	RESERVE	0	74.0	0.0	**323.3**	**0.323**
C-C	D-D			323.3	323.3	
	ROAD	7161	90.8	223.8	547.1	
	LOTS	10967	89.6	338.5	885.7	
	RESERVE	0	74.0	0.0	**885.7**	**0.886**
B-B	C-C			885.7	885.7	
	ROAD	6532	90.8	204.2	1089.8	
	LOTS	5450	89.6	168.2	1258.1	
	RESERVE	0	74.0	0.0	**1258.1**	**1.258**
A-A	B-B			1258.1	1258.1	
	ROAD	6424	90.8	200.8	1458.9	
	LOTS	12437	89.6	383.9	1842.8	
	RESERVE	0	74.0	0.0	**1842.8**	**1.843**
G-G	OLFP 1			290.0	290.0	
	ROAD	5390	90.8	168.5	458.5	
	LOTS	18572	89.6	573.3	1031.8	
	RESERVE	0	74.0	0.0	**1031.8**	**1.032**
F-F	OLFP 2			1120.0	1120.0	
	P-P to RG			-450.00	670.0	
	G-G			1031.8	1701.8	
	ROAD	5538	90.8	173.1	1874.9	
	LOTS	11191	89.6	345.5	2220.3	
	RESERVE	0	74.0	0.0	**2220.3**	**2.220**
M-M Spillway RG B	F-F			2220.3	2220.3	
	ROAD	1741	90.8	54.4	2274.7	
	LOTS	5365	89.6	165.6	2440.4	
	RESERVE	2014	74.0	47.8	**2488.1**	**2.488**
L-L	ROAD	1977	90.8	61.8	61.8	
	LOTS	1827	89.6	56.4	118.2	
	RESERVE	0	74.0	0.0	**118.2**	**0.118**

MAVEN ASSOCIATES	Job Number 135041	Sheet 2	Rev A
Job Title: Brookvale Green Calc Title: 100yr Overland Flow Path	Author: RH	Date: 22/06/2026	Checked: BB

Rainfall Depth	ARI 100YR (mm)	
TP108 rainfall data	169	From Hastings Rainfall charts
Climate change Increase	197.392	(assuming 2.1C increase in temperature 16.8%)

Catchment Section	Catchment	Catchment Area *m2*	CN	Peak Flow rate - 100YR ARI *l/s*	Cum. Flow *l/s*	Cum. Flow *m³/s*
I-I	ROAD	2371	90.8	74.1	74.1	
	LOTS	0	89.6	0.0	74.1	
	RESERVE	1457	74.0	34.6	**108.7**	**0.109**
J-J	I-I (59.1%)			64.2	64.2	
	ROAD	2647	90.8	82.7	146.9	
	LOTS	0	89.6	0.0	146.9	
	RESERVE	1748	74.0	41.5	**188.4**	**0.188**
H-H	I-I (40.8%)			44.3	44.3	
	ROAD	2823	90.8	88.2	132.6	
	LOTS	4385	89.6	135.4	267.9	
	RESERVE	0	74.0	0.0	**267.9**	**0.268**
E-E	H-H			267.9	267.9	
	ROAD	2036	90.8	63.6	331.6	
	LOTS	2320	89.6	71.6	403.2	
	RESERVE	0	74.0	0.0	**403.2**	**0.403**
K-K	ROAD	4173	90.8	130.4	130.4	
	LOTS	2042	89.6	63.0	193.5	
	RESERVE	0	74.0	0.0	**193.5**	**0.193**
O-O Wetland spillway	A-A			1842.8	1842.8	
	E-E			403.2	2246.0	
	ROAD	2608	90.8	81.5	2327.5	
	LOTS	524	89.6	16.2	2343.7	
	RESERVE	0	74.0	0.0	**2343.7**	**2.344**
N-N Spillway RG C	ROAD	5124	90.8	160.2	160.2	
	LOTS	11662	89.6	360.0	520.2	
	RESERVE	0	74.0	0.0	**520.2**	**0.520**
Lot 172 Swale	ROAD	493	90.8	15.4	15.4	
	LOTS	0	89.6	0.0	15.4	
	RESERVE	2014	74.0	47.8	**63.2**	**0.063**

MAVEN ASSOCIATES	Job Number 135041	Sheet 3	Rev A
Job Title: Brookvale Green Calc Title: 100yr Overland Flow Path	Author: RH	Date: 22/06/2026	Checked: BB

Rainfall Depth	ARI 100YR (mm)	
TP108 rainfall data	169	From Hastings Rainfall charts
Climate change Increase	197.392	(assuming 2.1C increase in temperature 16.8%)

Catchment Section	Catchment	Catchment Area *m2*	CN	Peak Flow rate - 100YR ARI *l/s*	Cum. Flow *l/s*	Cum. Flow *m³/s*
P-P	From Tuflow model			450.0	450.0	**0.450**

NOTES

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4. ORIGIN OF LEVELS = IT IV SO1837SOURCED FROM THE LINZ DIGITAL GEODETIC DATABASE.

LEGEND

- PR BDY
- EX BDY
- PR MAJOR CONTOUR
- PR MINOR CONTOUR
- PR PUBLIC SW
- OVERLAND FLOW PATH
- PR WETLAND
- RESERVE AREA

Rev	Description	By	Date
A	SUBSTANTIVE APPLICATION	RH	06/2026

	By	Date
Survey	TECH SP	02/2025
Design	RH	06/2026
Drawn	RH	06/2026
Checked	BB	06/2026

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Project

BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED

Title

PROPOSED 100YR OVERLAND FLOW PATH PLAN

Project no.	135041
Scale	1:3000 @ A3
Cad file	135041-C405 OLFP.DWG
Drawing no.	C405-0
Rev	A

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Title

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Project no.	135041		
Scale	1:1000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-1	Rev	A

RESOURCE CONSENT

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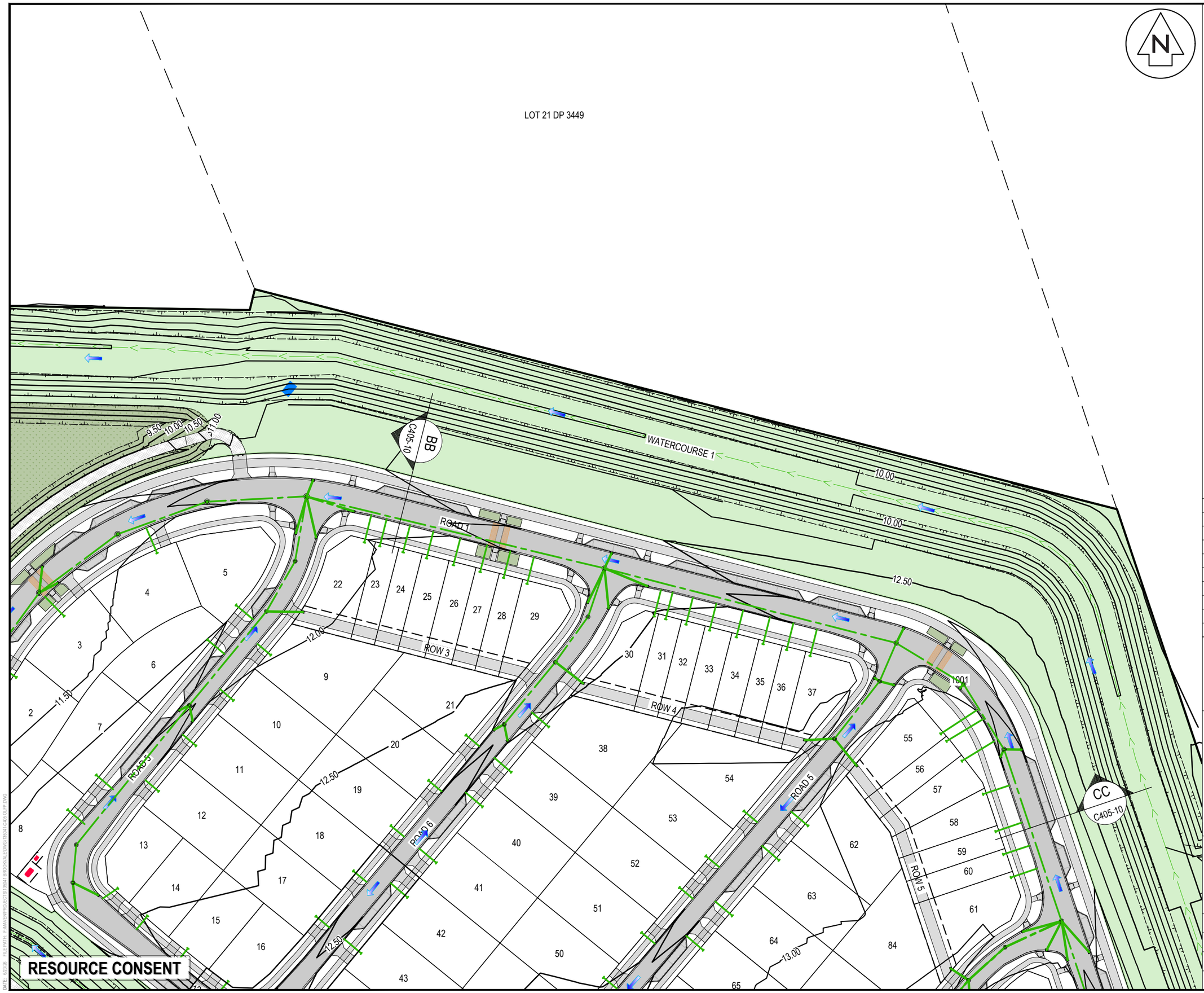

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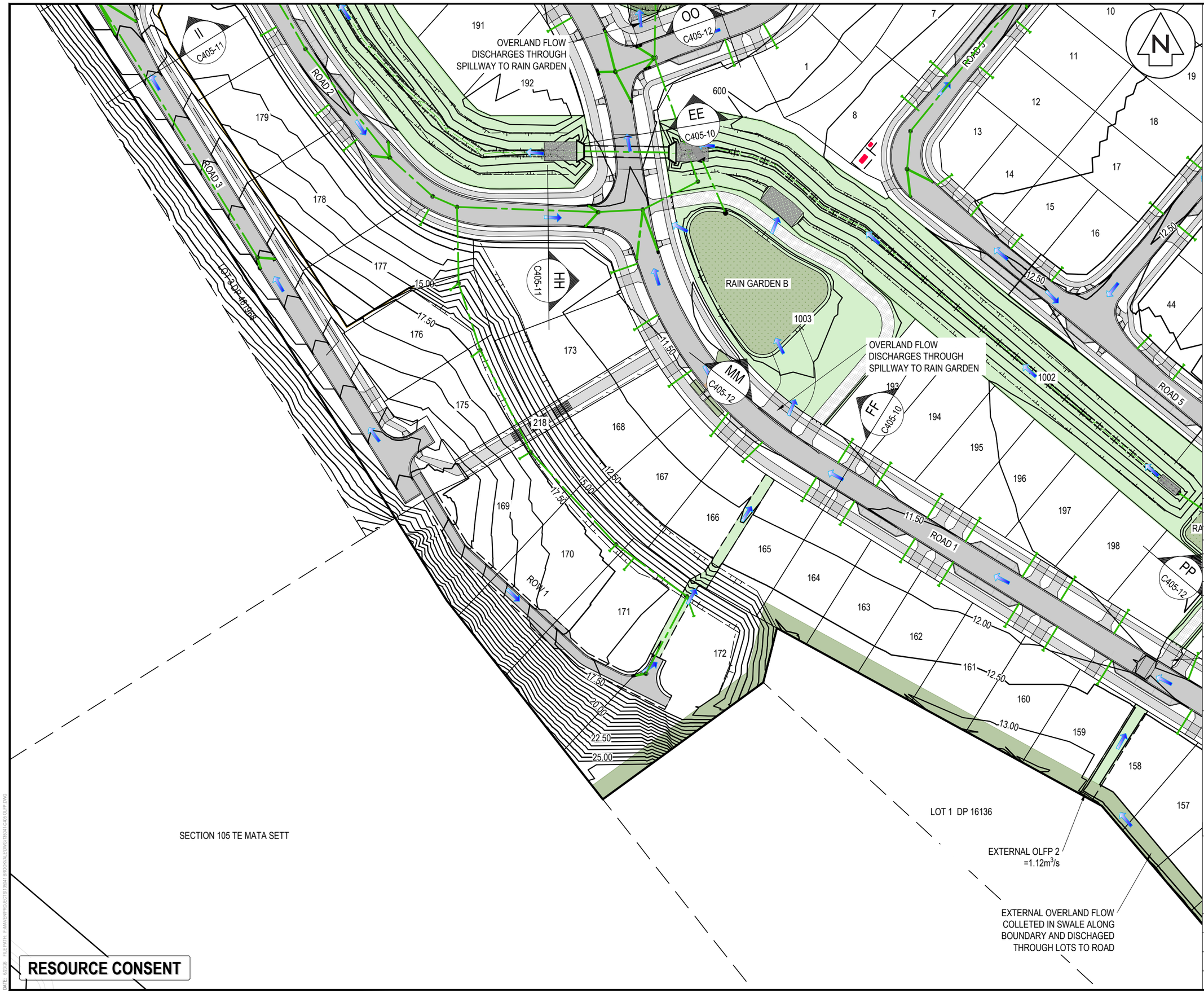
Project no.	135041		
Scale	1:1000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-2	Rev	A



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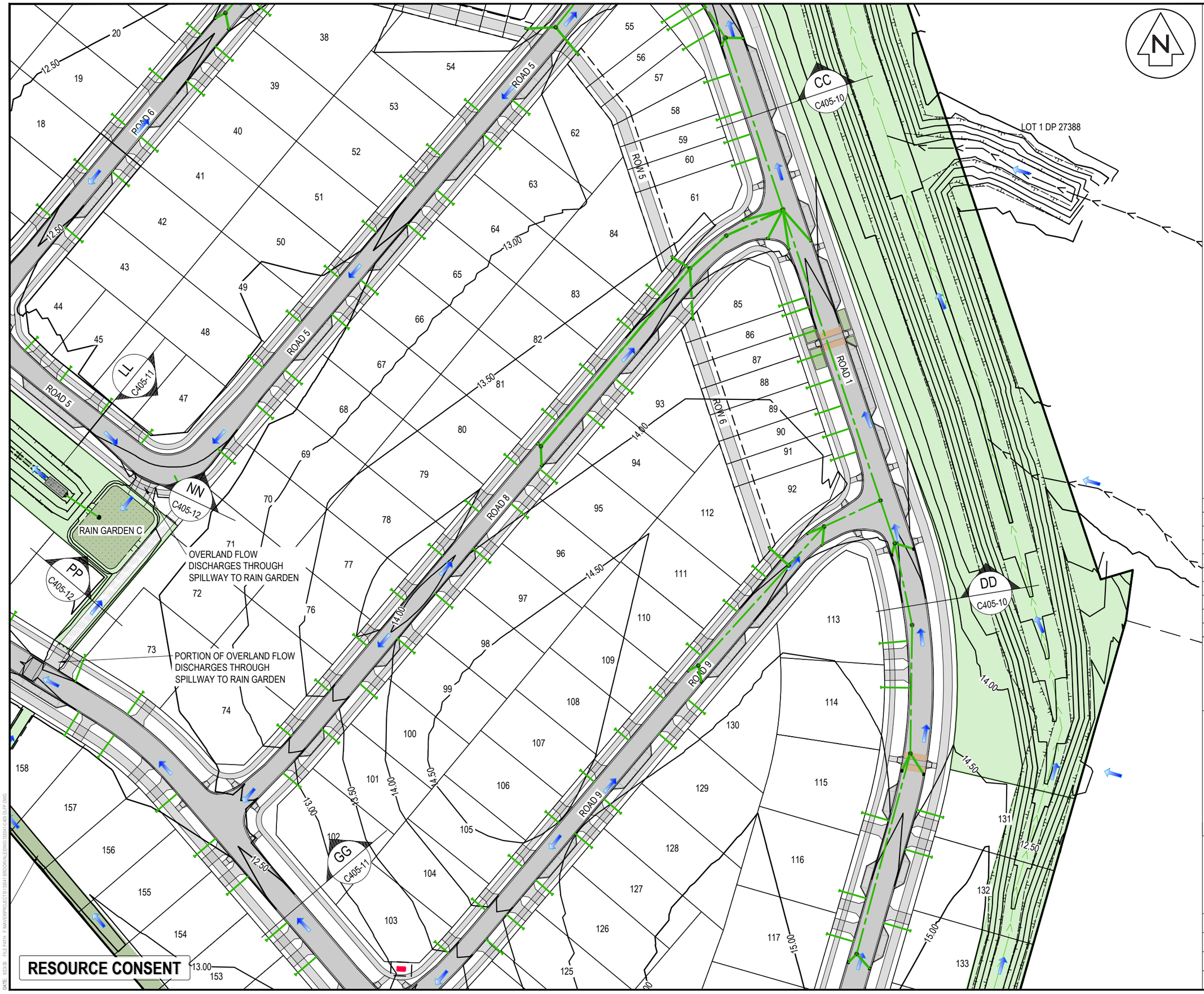
Project no.	135041		
Scale	1:1000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-3	Rev	A

RESOURCE CONSENT

DATE: 6/03/26 FILE PATH: P:\MAVEN\PROJECTS\135041 BROOKVALE\DWG\135041-C405-OLFP.DWG



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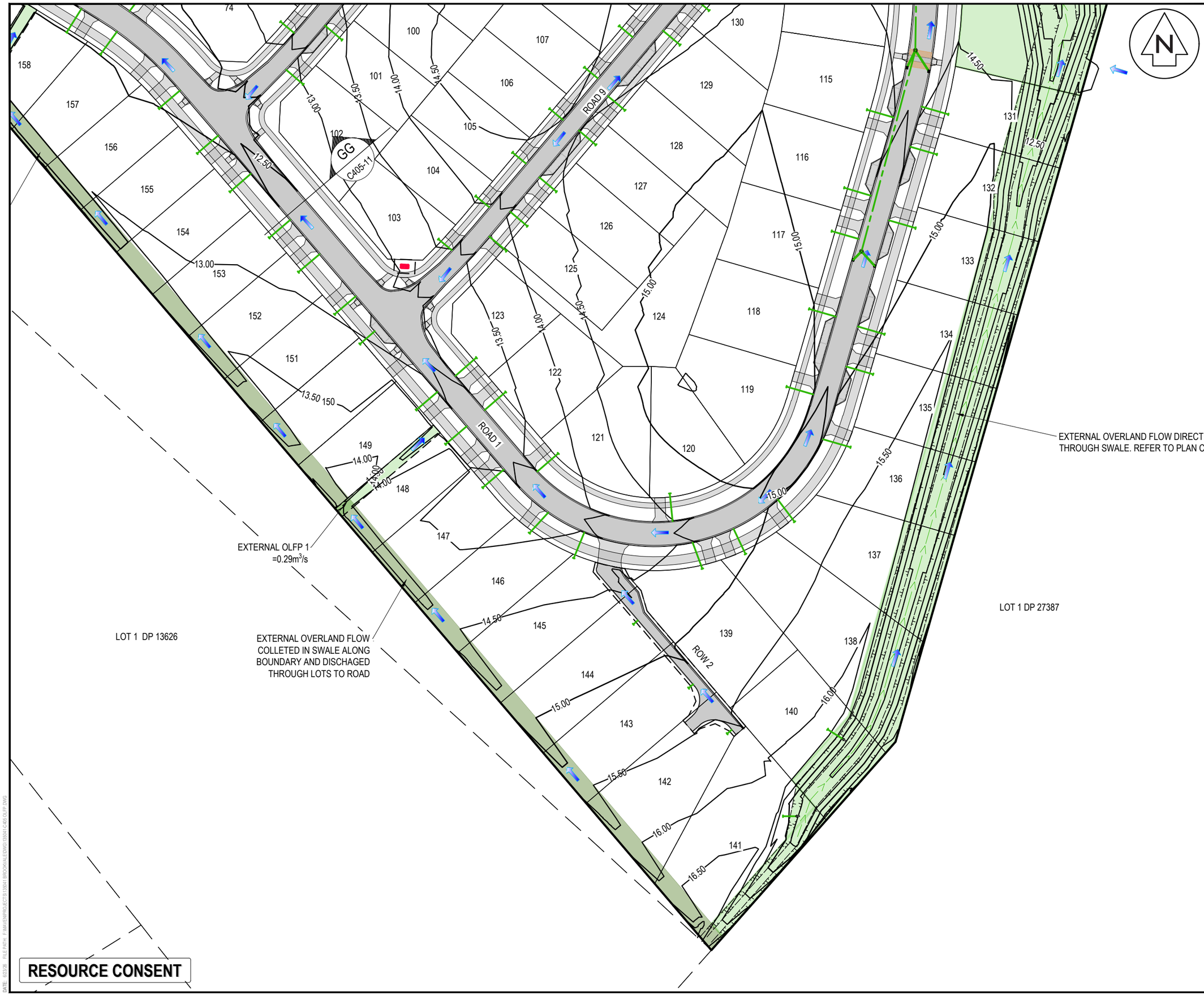
Title

PROPOSED 100YR OVERLAND FLOW PATH PLAN

Project no.	135041		
Scale	1:1000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-4	Rev	A



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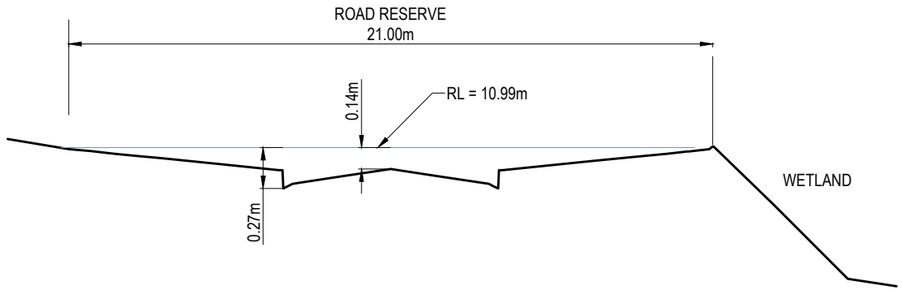
Title

PROPOSED 100YR OVERLAND FLOW PATH PLAN

Project no.	135041		
Scale	1:1000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-5	Rev	A

RESOURCE CONSENT

DATE: 6/02/26 FILE PATH F:\MAVEN\PROJECTS\135041 BROOKVALE\DWG\135041-C405 OLFP.DWG



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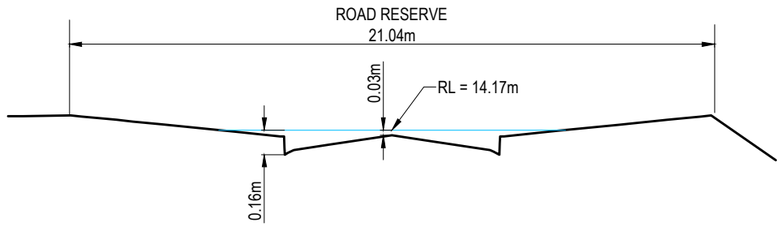
SCALE: HORI 1:200 VERT 1:40



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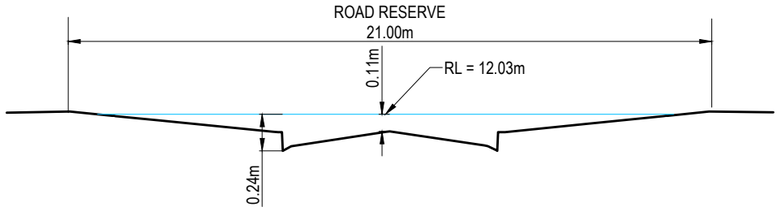

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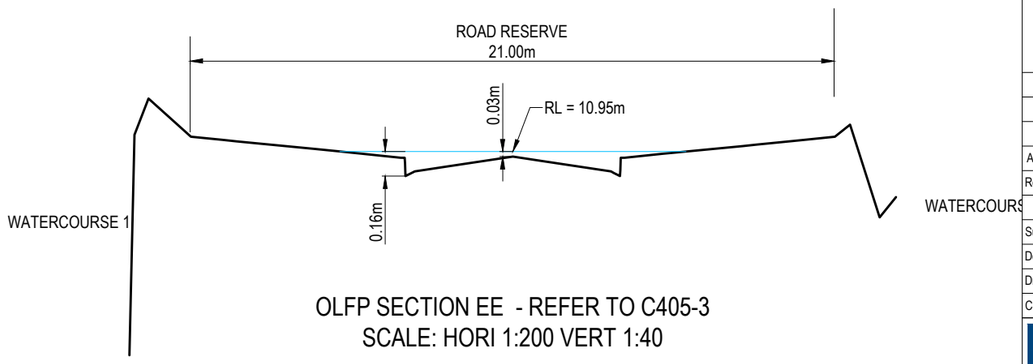

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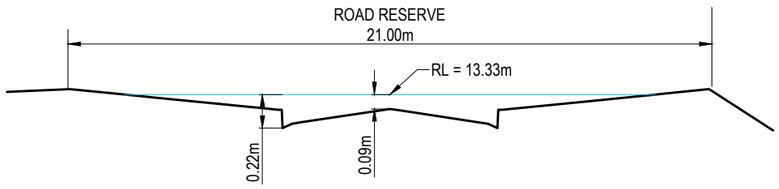

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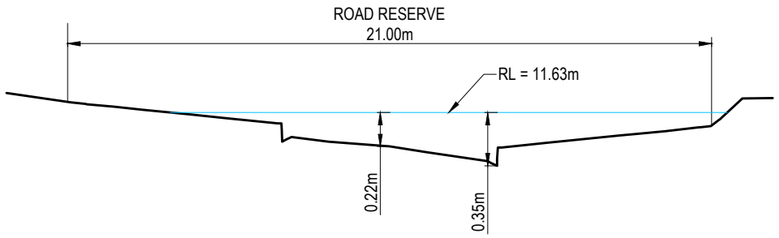

OLFP SECTION FF - REFER TO C405-3
SCALE: HORI 1:200 VERT 1:40

RESOURCE CONSENT

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LEGEND
PGL
WATER LEVEL

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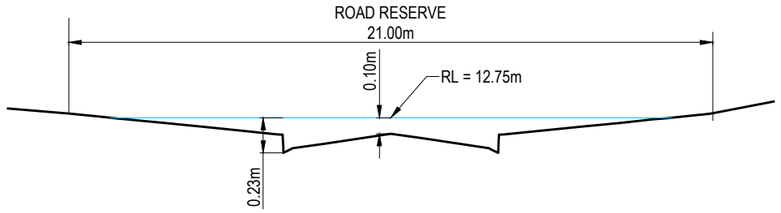
Project
BROOKVALE GREEN
HAVELOCK NORTH
FOR
VERMONT STREET
PARTNERS NO. 4 LIMITED

Title
PROPOSED
OVERLAND FLOW PATH
CROSS SECTIONS

Project no.	135041		
Scale	1:200 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-10	Rev	A

DATE: 6/23/26 FILE PATH: F:\MAVEN\PROJECTS\135041 BROOKVALE\DWG\135041-C405 OLFP.DWG



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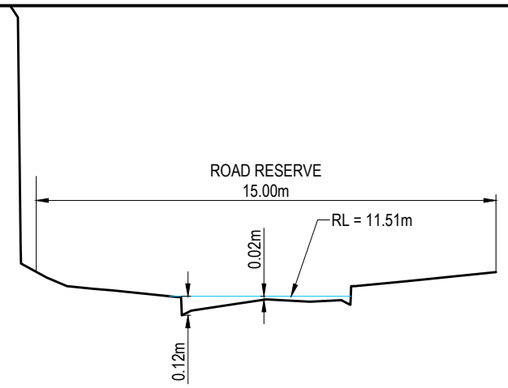

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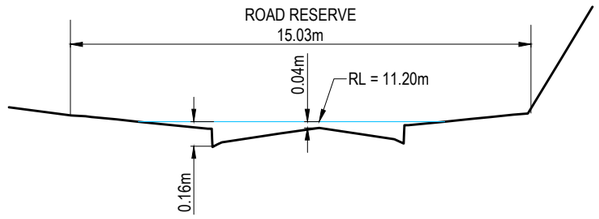

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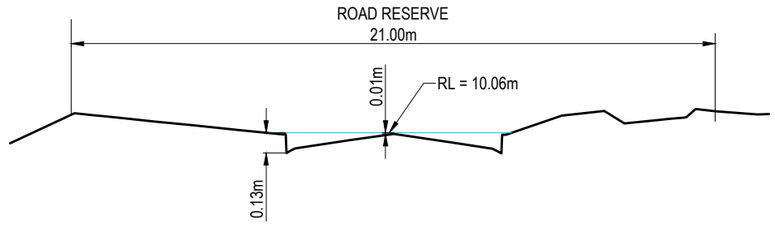

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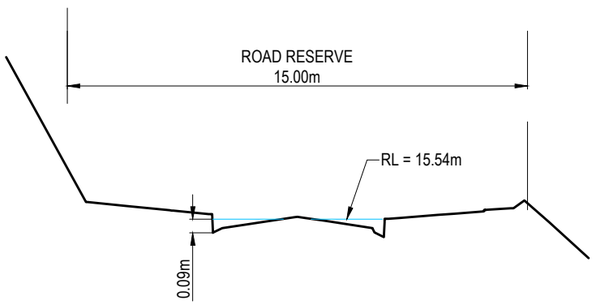

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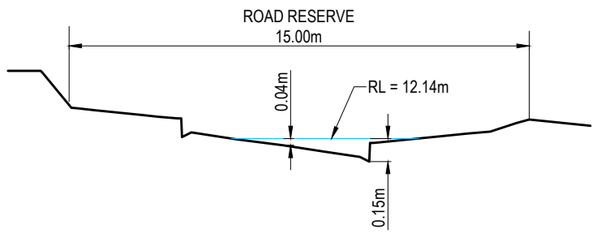

OLFP SECTION LL - REFER TO C405-4
SCALE: HORI 1:200 VERT 1:40

RESOURCE CONSENT

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LEGEND
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WATER LEVEL

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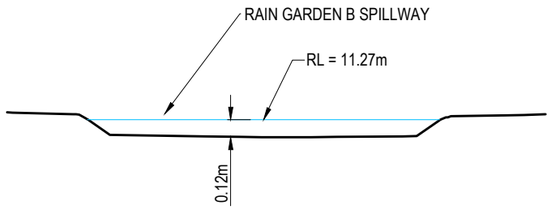
PARTNERS NO. 4 LIMITED

Title
PROPOSED
OVERLAND FLOW PATH
CROSS SECTIONS

Project no.	135041		
Scale	1:200 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-11	Rev	A

DATE: 6/23/26 FILE PATH: P:\MAVEN\PROJECTS\135041 BROOKVALE\DWG\135041-C405 OLFP.DWG



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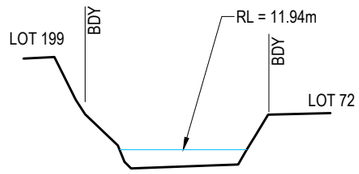
SCALE: HORI 1:200 VERT 1:40



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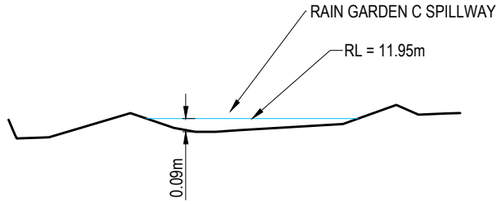

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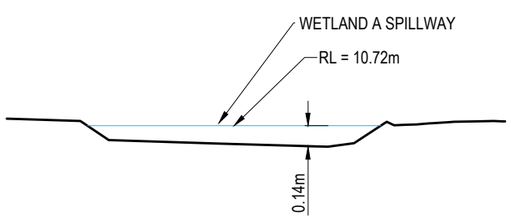

OLFP SPILLWAY SECTION OO - REFER TO C405-1
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Title
PROPOSED
OVERLAND FLOW PATH
CROSS SECTIONS

Project no.	135041		
Scale	1:200 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-12	Rev	A

DATE: 6/23/26 FILE PATH: F:\MAVEN\PROJECTS\135041 BROOKVALE\DWG\135041-C405 OLFP.DWG

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BROOKVALE GREEN HAVELOCK NORTH FOR VERMONT STREET PARTNERS NO. 4 LIMITED

Title

PROPOSED 100YR OVERLAND FLOW PATH CATCHMENT PLAN

Project no.	135041		
Scale	1:3000 @ A3		
Cad file	135041-C405 OLFP.DWG		
Drawing no.	C405-13	Rev	A

MAVEN ASSOCIATES	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Calc Title: OLFP Assessment Outcome	Author: RH	Date: 15/06/2026	Checked: BB

Rainfall event: 100yr ARI

Point	Qp100cc (m3/s)	Depth (m)	Velocity (m/s)	VD (m2/s)	Safe?
A-A	1.843	0.27	0.738	0.20	YES
B-B	1.258	0.24	0.664	0.16	YES
C-C	0.886	0.22	0.606	0.13	YES
D-D	0.323	0.16	0.460	0.07	YES
E-E	0.403	0.16	0.600	0.09	YES
F-F	2.220	0.35	0.779	0.27	YES
G-G	1.032	0.23	0.610	0.14	YES
H-H	0.268	0.16	0.432	0.07	YES
I-I	0.111	0.09	0.740	0.07	YES
J-J	0.188	0.13	0.736	0.09	YES
K-K	0.193	0.19	0.442	0.09	YES
L-L	0.118	0.15	0.448	0.07	YES
Pedestrian Access					
M-M	2.488	0.13	1.950	0.24	YES
N-N	0.520	0.09	1.430	0.12	YES
O-O	2.344	0.16	1.890	0.30	YES

Note: Depth taken from road kerb invert.

TDM - Road Drainage V.1.2

TABLE 3 MAJOR EVENT - ROADWAY FLOW LIMITATIONS

Situation	Requirement
Where floor levels of adjacent buildings are above road level	Total flow contained within road reserve. Freeboard from peak flow level to habitable floors in accord with Building Code and unitary plan.
Where floor levels of adjacent buildings are less than 350mm above the top of the kerb, and the fall on the footpath towards the kerb is..	**Greater than 100mm:** Water depth must be limited to 50mm above top of kerb. **Less than 100mm:** Water depth must be limited to top of kerb in conjunction with a footpath profile that prevents flow from the roadway entering onto the adjacent property. In these cases, compliance with Building Code and unitary plan may require separate approvals.
Where no kerb is provided	Above depths must be measured from the channel lip level plus 100mm.
Pedestrian safety[1]	**No obvious danger:** $d_g \times V_{ave} \leq 0.6m^2/s$. **Obvious danger:** $d_g \times V_{ave} \leq 0.4m^2/s$.
Vehicle safety	Maximum height of energy line300mm above roadway surface for areas subject to transverse flow. The exception is specific floodway design and additional vehicle warning and protection, where $d_g \times V_{ave} \leq 0.3m^2/s$. On-street parking is not to be permitted where overland flow exceeds $0.3m^2/s$.

1 Obvious danger is interpreted as areas where pedestrians are directed to, or most likely to cross water paths, e.g. marked crossings and corners of intersections.

d_g = flow depth in the channel adjacent to the kerb, i.e. at the invert (m).

V_{ave} = average velocity of the flow (m/s).

Source: Adapted from DNRW (2007a)

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Greenvale Calc Title: Outlet Structures Rip rap	Author: RH	Date: 21/05/2026	Checked: BB

SW OUTLET STRUCTURE 10-1 ROCK RIPRAP
Outlet to Dry Detention pond

Pipe diameter = 0.900 m ks= 1.5

Pipe gradient = 0.006 m/m = 0.55 %

Velocity = 2.08 m/s

Froude Number Fo = 0.70

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 160 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 320 mm => Use **320** mm (min 2x D_{50})

Outfall width = 2.7 m => Use **2.7** m

Outfall length = 4.83 m => Use **4.8** m

SW OUTLET STRUCTURE 11-1 ROCK RIPRAP
Outlet to Slippery Creek

Pipe diameter = 0.675 m ks= 1.5

Pipe gradient = 0.009 m/m = 0.85 %

Velocity = 2.16 m/s

Froude Number Fo = 0.84

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 2.025 m => Use **2.1** m

Outfall length = 4.52 m => Use **4.5** m

Maven Associates	Job Number 135041	Sheet 2	Rev A
Job Title: Greenvale Calc Title: Outlet Structures Rip rap	Author: RH	Date: 21/05/2026	Checked: BB

SW OUTLET STRUCTURE 12-1 ROCK RIPRAP
Outlet to Dry Detention pond

Pipe diameter = 0.825 m ks= 1.5

Pipe gradient = 0.012 m/m = 1.2 %

Velocity = 2.91 m/s

Froude Number Fo = 1.02

Flow type= supercritical flow (fast rapid flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 220 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 440 mm => Use **440** mm (min 2x D_{50})

Outfall width = 2.475 m => Use **2.5** m

Outfall length = 6.74 m => Use **6.7** m

SW OUTLET STRUCTURE 17-1 ROCK RIPRAP
Outlet to Slippery Creek

Pipe diameter = 0.450 m ks= 1.5

Pipe gradient = 0.012 m/m = 1.15 %

Velocity = 1.94 m/s

Froude Number Fo = 0.92

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 1.35 m => Use **1.4** m

Outfall length = 3.33 m => Use **3.3** m

Maven Associates	Job Number 135041	Sheet 3	Rev A
Job Title: Greenvale Calc Title: Outlet Structures Rip rap	Author: RH	Date: 21/05/2026	Checked: BB

SW OUTLET STRUCTURE 14-1 ROCK RIPRAP
Outlet to Dry Detention pond

Pipe diameter = 0.225 m ks= 1.5

Pipe gradient = 0.020 m/m = 2 %

Velocity = 1.63 m/s

Froude Number Fo = 1.09

Flow type= supercritical flow (fast rapid flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 0.675 m => Use **0.7** m

Outfall length = 1.95 m => Use **2.0** m

SW OUTLET STRUCTURE 21-1 ROCK RIPRAP
Outlet to Slippery Creek

Pipe diameter = 1.600 m ks= 0.6

Pipe gradient = 0.001 m/m = 0.1 %

Velocity = 1.40 m/s

Froude Number Fo = 0.35

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 4.8 m => Use **4.8** m

Outfall length = 0.53 m => Use **0.5** m

Maven Associates	Job Number 135041	Sheet 4	Rev A
Job Title: Greenvale Calc Title: Outlet Structures Rip rap	Author: RH	Date: 21/05/2026	Checked: BB

SW OUTLET STRUCTURE 22-1 ROCK RIPRAP
Outlet to Dry Detention pond

Pipe diameter =	0.750	m	ks=	1.5	
Pipe gradient =	0.005	m/m	=	0.5	%
Velocity =	1.77	m/s			
Froude Number Fo =	0.65				

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth =	300	mm	=> Use	**300**	mm (min 2x D_{50})
Outfall width =	2.25	m	=> Use	**2.3**	m
Outfall length =	3.63	m	=> Use	**3.6**	m

Maven Associates	Job Number 135041	Sheet 4	Rev A
Job Title: Greenvale Calc Title: Outlet Structures Rip rap	Author: RH	Date: 24/06/2026	Checked: BB

SW OUTLET STRUCTURE 1-1 ROCK RIPRAP
Outlet to Dry Detention pond

Pipe diameter = 0.825 m ks= 1.5

Pipe gradient = 0.005 m/m = 0.5 %

Velocity = 1.88 m/s

Froude Number Fo = 0.66

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 2.475 m => Use **2.5** m

Outfall length = 4.07 m => Use **4.1** m

SW OUTLET STRUCTURE 2-0 ROCK RIPRAP
Outlet to Slippery Creek

Pipe diameter = 0.600 m ks= 1.5

Pipe gradient = 0.006 m/m = 0.55 %

Velocity = 1.61 m/s

Froude Number Fo = 0.66

Flow type= subcritical flow (slow flow)
Requirement= standard headwall & apron or similar

Rock diameter D_{50} = 150 mm (150mm min rock diameter)

Recommended thickness (depth) of rip rap is 1.5 to 2 x D_{50}. Minimum size is 300mm

Outfall depth = 300 mm => Use **300** mm (min 2x D_{50})

Outfall width = 1.8 m => Use **1.8** m

Outfall length = 2.98 m => Use **3.0** m

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Site coverage	Author: RH	Date: 26/05/2026	Checked: BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Site Characteristics:

Pre-development land-use	Coverage	C
Impervious area	90%	0.9
Pervious area	10%	0.3
Runoff coefficient		0.84

Post-development land-use roads	Coverage	C
Impervious area	90%	0.9
Pervious area	10%	0.3
Runoff coefficient		0.84

Post-development land-use lots 500m²	Coverage	C
Impervious area	65%	0.9
Pervious area	35%	0.3
Runoff coefficient		0.69

Post-development land-use lots 1000m²	Coverage	C
Impervious area	38%	0.9
Pervious area	62%	0.3
Runoff coefficient		0.53

Post-development land-use reserves	Coverage	C
Impervious area	0%	0.9
Pervious area	100%	0.3
Runoff coefficient		0.30

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Rain Garden C Design	Author RH	Date 26/05/2026	Checked BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Raingarden catchment:

Catchment C	Impervious Coverage	C	Area m²
Roads	90%	0.84	4828
Lots 500m²	65%	0.69	14721
Lots 1000m²	38%	0.53	0
Reserve Area	0%	0.53	0
Total	71%	0.73	19549

Design Storm

Storm Event	90% rainfall event	
Water Quality Storm (WQS)	17.50	*max 30mm*

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Water Quality Volume (WQV):

Catchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
Catchment C	1.955 ha	71%	13,914m³	0.018m	0,243m³

Rain Garden sizing:

Ponding depth =	0.3	m	*Maximum depth 300mm*
Soil media depth =	0.6	m	*Minimum 400-600mm*
Transition layer =	0.1	m	
Drainage layer =	0.15	m	
Planting soil depth (d_{rg}) =	0.85	m	
Coefficient of permeability (k) =	0.75	m/d	
Average height of water (h) =	0.15	m	*1/2 maximum depth (Maximum depth 300mm)*
Time to pass WQV through soil bed =	1.5	days	
Surface area of rain garden (A_{rg}) =	413.94	m²	$Arg=(WQV)(d_{rg})/k(h+d_{rg})t_{rg}$
Live storage volume needed V_{live} =	97.40	m³	
Live storage avaliable =	124.18	m³	Storage ok
Device length =	20	m	
Device width =	20.70	m	
Device depth =	1.15	m	
Detention volume =	232.84	m³	

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Rain Garden B Design	Author RH	Date 19/03/2026	Checked BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Raingarden catchment:

Catchment B	Impervious Coverage	C	Area m²
Roads	90%	0.84	11785
Lots 500m²	65%	0.69	37639
Lots 1000m²	38%	0.53	0
Reserve Area	0%	0.53	0
Total	71%	0.73	49424

Design Storm

Storm Event	90% rainfall event
Water Quality Storm (WQS)	17.50

max 30mm

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Water Quality Volume (WQV):

Catchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
Catchment B	4.942 ha	71%	35,072m³	0.018m	0,614m³

Rain Garden sizing:

Ponding depth =	0.3	m	*Maximum depth 300mm*
Soil media depth =	0.6	m	*Minimum 400-600mm*
Transition layer =	0.1	m	
Drainage layer =	0.15	m	
Planting soil depth (d_{rg}) =	0.85	m	
Coefficient of permeability (k) =	0.75	m/d	
Average height of water (h) =	0.15	m	*1/2 maximum depth (Maximum depth 300mm)*
Time to pass WQV through soil bed =	1.5	days	
Surface area of rain garden (A_{rg}) =	1043.39	m²	$Arg=(WQV)(d_{rg})/k(h+d_{rg})t_{rg}$
Live storage volume needed V_{live} =	245.50	m³	
Live storage avaliable =	313.02	m³	Storage ok
Device length =	28	m	
Device width =	37.26	m	
Device depth =	1.15	m	
Detention volume =	586.91	m³	

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Rain Garden E Design	Author RH	Date 14/05/2026	Checked BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Raingarden catchment:

Catchment E	Impervious Coverage	C	Area m²
Roads	90%	0.84	2094
Lots 500m²	65%	0.69	668
Lots 1000m²	38%	0.53	0
Reserve Area	0%	0.53	0
Total	84%	0.80	2762

Design Storm

Storm Event	90% rainfall event	
Water Quality Storm (WQS)	17.50	*max 30mm*

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Water Quality Volume (WQV):

Catchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
Catchment E	0.276 ha	84%	2,319m³	0.018m	0,041m³

Rain Garden sizing:

Ponding depth =	0.3	m	*Maximum depth 300mm*
Soil media depth =	0.6	m	*Minimum 400-600mm*
Transition layer =	0.1	m	
Drainage layer =	0.15	m	
Planting soil depth (d_{rg}) =	0.85	m	
Coefficient of permeability (k) =	0.75	m/d	
Average height of water (h) =	0.15	m	*1/2 maximum depth (Maximum depth 300mm)*
Time to pass WQV through soil bed =	1.5	days	
Surface area of rain garden (A_{rg}) =	68.98	m²	$Arg=(WQV)(d_{rg})/k(h+d_{rg})t_{rg}$
Live storage volume needed V_{live} =	16.23	m³	
Live storage avaliable =	20.70	m³	Storage ok
Device length =	24.2	m	
Device width =	2.85	m	
Device depth =	1.15	m	
Detention volume =	38.80	m³	

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Rain Garden F Design	Author: RH	Date: 14/05/2026	Checked: BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Raingarden catchment:

Catchment F	Impervious Coverage	C	Area m²
Roads	90%	0.84	2022
Lots 500m²	65%	0.69	2346
Lots 1000m²	38%	0.53	0
Reserve Area	0%	0.53	0
Total	77%	0.76	4368

Design Storm

Storm Event	90% rainfall event	
Water Quality Storm (WQS)	17.50	*max 30mm*

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Water Quality Volume (WQV):

Catchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
Catchment F	0.437 ha	77%	3,345m³	0.018m	0,059m³

Rain Garden sizing:

Ponding depth =	0.3	m	*Maximum depth 300mm*
Soil media depth =	0.6	m	*Minimum 400-600mm*
Transition layer =	0.1	m	
Drainage layer =	0.15	m	
Planting soil depth (d_{rg}) =	0.85	m	
Coefficient of permeability (k) =	0.75	m/d	
Average height of water (h) =	0.15	m	*1/2 maximum depth (Maximum depth 300mm)*
Time to pass WQV through soil bed =	1.5	days	
Surface area of rain garden (A_{rg}) =	99.50	m²	$Arg=(WQV)(d_{rg})/k(h+d_{rg})t_{rg}$
Live storage volume needed V_{live} =	23.41	m³	
Live storage avaliable =	29.85	m³	Storage ok
Device length =	25.9	m	
Device width =	3.84	m	
Device depth =	1.15	m	
Detention volume =	55.97	m³	

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Rain Garden G Design	Author RH	Date 14/05/2026	Checked BB

Site coverage coefficients based on Hawkes Bay Waterway Guidelines - Table 6-1a

Raingarden catchment:

Catchment G	Impervious Coverage	C	Area m²
Roads	90%	0.84	1099
Lots 500m²	65%	0.69	2340
Lots 1000m²	38%	0.53	0
Reserve Area	0%	0.53	856
Total	58%	0.70	4295

Design Storm

Storm Event	90% rainfall event	
Water Quality Storm (WQS)	17.50	*max 30mm*

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Water Quality Volume (WQV):

Catchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
Catchment G	0.430 ha	58%	2,510m³	0.018m	0,044m³

Rain Garden sizing:

Ponding depth =	0.3	m	*Maximum depth 300mm*
Soil media depth =	0.6	m	*Minimum 400-600mm*
Transition layer =	0.1	m	
Drainage layer =	0.15	m	
Planting soil depth (d_{rg}) =	0.85	m	
Coefficient of permeability (k) =	0.75	m/d	
Average height of water (h) =	0.15	m	*1/2 maximum depth (Maximum depth 300mm)*
Time to pass WQV through soil bed =	1.5	days	
Surface area of rain garden (A_{rg}) =	74.68	m²	$Arg=(WQV)(d_{rg})/k(h+d_{rg})t_{rg}$
Live storage volume needed V_{live} =	17.57	m³	
Live storage avaliable =	22.40	m³	Storage ok
Device length =	35.5	m	
Device width =	2.10	m	
Device depth =	1.15	m	
Detention volume =	42.00	m³	

Maven Associates	Job Number	Sheets	Rev
	135041	1	A

Job Title	Brookvale Green USLE	Author	Date	Checked
Calc Title	TP108 - SEDIMENT YIELD - SRP Typical	BB	30.4.2026	BB

Design Spreadsheet for USLE

Calc 1: Estimate of Sediment Generation (A), tonnes/ha/yr

A= R x K x LS x C x P

Where
- A = Sediment Generation (tonnes/ha/ya)
- R = Rainfall Erosion Index (J/hectare)
- K = Soil Erodibility Factor (tonnes/unit of R)
- LS = Slope Lenth and steepness Factor
- C= Ground Cover Factor
- P= Roughness Factor

Rainfall Erosion Index

R = 0.00828*P^2.2*1.7

P = 47.1

P is the 2yr 24 hour rainfall from ARC TP108 Figure A.1 for a 6 hour duration period

TP108 2yr = 75 mm/24hr

Therefore **R** = **71.94** **J/ha**

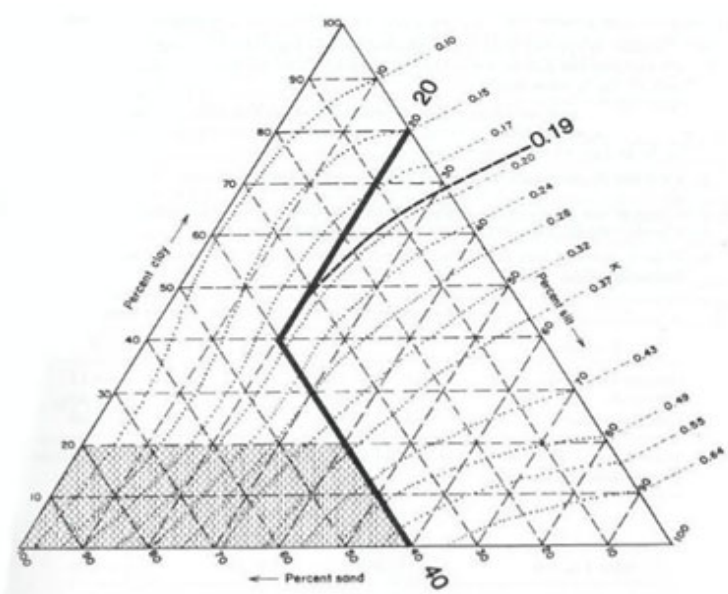


Figure 1: USLE Nomograph for Estimating k value

Soil Erodibility Factor

K = k x Organic % Factor x M-I Factor

The K factor can be determined by using the nomograph method, which requires that a particle size analysis be done to determine the percentages of sand, very fine sand, silt and clay. Use the figure above to determine appropriate K value.

Site Geology

sand	%	0
silt	%	70
clay	%	30

Therefore from Figure 1 of USLE, k value unfactored =

k = 0.43

Organic % = 4

Therefore from Table 1 of USLE, Organic % Factor =

O%F = -0.14

Metric To Imperial Factor

M-I Factor = 1.32

Therefore **K** = **0.3828** **tonnes/unit of R**

Correct for organic content using Table 1 (the nomograph assumes 2% organic matter).

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Multiply the corrected K value by 1.32 to convert from imperial to metric
i.e. K = 0.33 (tonnes/unit of R)

Table 1: USLE Organic % Correction Factor

Slope Length and Steepness Factor

LS = From Appendix 1 equation

Slope Length =	300	m
Maximum Elevation =	12	m
Minimum Elevation =	11	m
Slope As a %	0.33	
Therefore m =	0.2	

Therefore **LS** = **0.11**

Ground Cover Factor

C	=	**1**	Assumed site as **Bare Soil** and taking value from Table 2

Roughness Factor

P	=	**1.32**	Assumed site as **Bare Soil** and taking value from Table 2

Ground Cover Factor

This is the ratio of soil loss from an actual site (or parts of a site) with specific ground cover (e.g. clay, topsoil, grass) compared to a bare site (i.e. no vegetation or topsoil). The bare site is given a value of 1.0.

Roughness Factor

The P factor provides adjustment for the degree to which surface roughness affects the erosion of sediment from a site (or part of a site).

As a standard practice, it is appropriate to use the range of C and P values given in Table 2 below.

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass[1]	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

Table 2: USLE Organic % Correction Factor

Therefore **A** = **3.91** **tonnes/ha/yr**

Estimate of Sediment yield

S (Yeild) = **A x Area x SD x SCE x Duration**

where	A	=	3.91	tonnes/ha/yr
	Area	=	5	ha
	SDR	=	0.7	
	SCM	=	90	%
	Duration	=	0.5	yrs

SDR Sediment Deilvery Ratio, 0.5 for slopes < 10°(17.6%), 0.7 for slopes > 10°(17.6%)

SCM Sediment Contro Measures (%) 50% is considered conservative

Therefore **S** (Yeild) = **0.684** **tonnes / per** **6 months**

Maven Associates	Job Number 135041	Sheets 1	Rev A
Job Title: BROOKVALE GREEN SRP S1, S3, S5 Calc Title: Earthworks Pond	Author BB	Date 30.4.2026	Checked BB

Catchment Area	**50000**	**m^2**
Pond Volume 3% of Area	1500	m^3
Dead Storage 30% of volume	450	m^3
Live Storage 70% of volume	1050	m^3
Decant Dewatering (3l/s/ha)	15	l/s

Size Decant

Standard decant	4.5	l/s	=	200	holes
Therefore	15.00	l/s	=	667	holes
Use	**3**	**decants**			

Pond Dimensions

v = **1500** **m^3**

d = **1.5** **m**

x = width of pond base

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

Calc 2: Calculate width and length of base, Quadratic Equation

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 3x^2d+8.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	4.5	x^2+	19.125	x+	-1466.25
x	=	16.05	width of pond base			
or	=	-20.30				

Check = 1500 m^3

5:1 ratio

$v = (((5x^2)+((x+4d)(5x+5d)))/2)d$

=> $v = 5x^2d+12.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	7.5	x^2+	28.125	x+	-1466.25
x	=	12.23	width of pond base			
or	=	-15.98				

Check = 1500 m^3

Base width =	**16.05**	**m**		**Top width =**	**24.45**	**m**
Base length =	**48.15**	**m**		**Top length =**	**57.75**	**m**
Forebay width base =	**16.05**	**m**		**Forebay depth =**	**1**	**m**
Forebay length base =	**2**	**m**		**Forebay sideslope =**	**1 in 1**	**m**
Forebay length top =	**4**	**m**		**Forebay width top =**	**18.05**	**m**

Dead Storage Depth

Pond Dimensions

x = 16.05 m

v = 450.0 m^3

d = Dead storage depth

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 10d^3+8.5xd^2+3x^2d$ cubic equation to find "d"

			a		b		c
0	=	d^3+	13.6429287	d^2+	77.28561	+d	-45

e	=	5.08	
f	=	104.18	
g	=	5.93	
h	=	-0.86	
d	**=**	**0.531**	depth of dead storage

Check v = 450.00 m^3

Spillway Dimensions

Side Slope	horizontal	3	vertical	1
Gradient		**1**	**%**	
Base Width		4.00	m	

Calc 3: Calculate spillway flow (Q) Rational Formula

Q=CIA 1% AEP

where	C	=	0.85		
	I	=	0.000038889	mm/s	140 r (HIRDS Historical data 100yr/10min)
	A	=	50000	m2	
Therefore	**Q**	**=**	**1.65**	**m3/sec**	

Calc 4: Calculate spillway depth (H) Mannings Formula

$V=(1/n)R^{2/3}S^{1/2}$ R=A/P Q=AV

n = 0.018 Flow path is firm earth

Where: H = depth of channel P = wetted parameter

A = Sectional Area S = slope of channel

H	P	A	S	R	V	Q
0.21	5.328157	0.9723	0.01	0.182483	1.78735	1.737841

Therefore **H** = **0.21** **m** Min 300mm

Therefore = **300** mm

Maven Associates	Job Number	Sheets	Rev
	135041	1	A

Job Title	Brookvale Green USLE	Author	Date	Checked
Calc Title	TP108 - SEDIMENT YIELD - SRP S2	BB	30.4.2026	BB

Design Spreadsheet for USLE

Calc 1: Estimate of Sediment Generation (A), tonnes/ha/yr

A= R x K x LS x C x P

Where
- A = Sediment Generation (tonnes/ha/ya)
- R = Rainfall Erosion Index (J/hectare)
- K = Soil Erodibility Factor (tonnes/unit of R)
- LS = Slope Lenth and steepness Factor
- C= Ground Cover Factor
- P= Roughness Factor

Rainfall Erosion Index

R	**=**	0.00828*P^2.2*1.7
P	=	47.1
P	is the 2yr 24 hour rainfall from ARC TP108 Figure A.1 for a 6 hour duration period	
TP108 2yr	=	75 mm/24hr

Therefore **R** **=** **71.94** **J/ha**

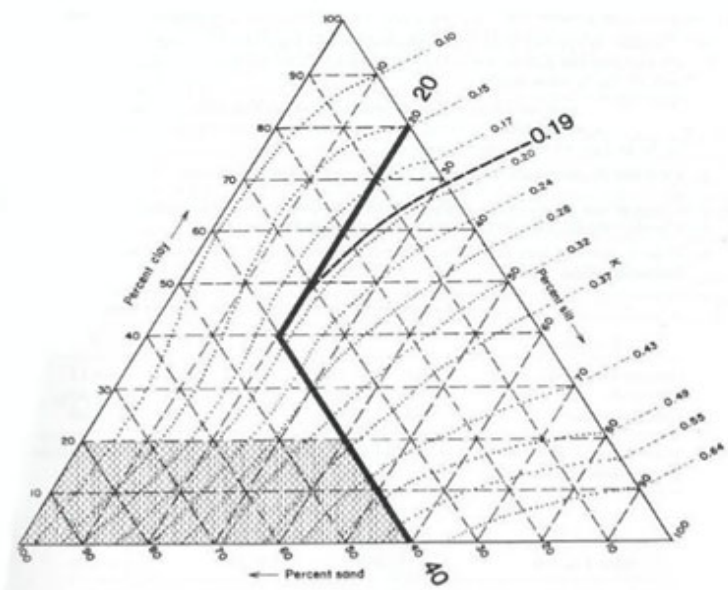


Figure 1: USLE Nomograph for Estimating k value

Soil Erodibility Factor

K = k x Organic % Factor x M-I Factor

The K factor can be determined by using the nomograph method, which requires that a particle size analysis be done to determine the percentages of sand, very fine sand, silt and clay. Use the figure above to determine appropriate K value.

Site Geology

sand	%	0
silt	%	70
clay	%	30

Therefore from Figure 1 of USLE, k value unfactored =

k = 0.43

Organic % = 4

Therefore from Table 1 of USLE, Organic % Factor =

O%F = -0.14

Metric To Imperial Factor

M-I Factor = 1.32

Therefore **K** = **0.3828** **tonnes/unit of R**

Correct for organic content using Table 1 (the nomograph assumes 2% organic matter).

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Multiply the corrected K value by 1.32 to convert from imperial to metric
i.e. K = 0.33 (tonnes/unit of R)

Table 1: USLE Organic % Correction Factor

Slope Length and Steepness Factor

LS = From Appendix 1 equation

Slope Length =	300	m
Maximum Elevation =	12	m
Minimum Elevation =	11	m
Slope As a %	0.33	
Therefore m =	0.2	

Therefore **LS** = **0.11**

Ground Cover Factor

C	=	**1**	Assumed site as **Bare Soil** and taking value from Table 2

Roughness Factor

P	=	**1.32**	Assumed site as **Bare Soil** and taking value from Table 2

Ground Cover Factor

This is the ratio of soil loss from an actual site (or parts of a site) with specific ground cover (e.g. clay, topsoil, grass) compared to a bare site (i.e. no vegetation or topsoil). The bare site is given a value of 1.0.

Roughness Factor

The P factor provides adjustment for the degree to which surface roughness affects the erosion of sediment from a site (or part of a site).

As a standard practice, it is appropriate to use the range of C and P values given in Table 2 below.

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass[1]	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

Table 2: USLE Organic % Correction Factor

Therefore **A** = **3.91** **tonnes/ha/yr**

Estimate of Sediment yield

S (Yeild) = **A x Area x SD x SCE x Duration**

where	A	=	3.91	tonnes/ha/yr
	Area	=	5	ha
	SDR	=	0.7	
	SCM	=	90	%
	Duration	=	0.5	yrs

SDR Sediment Deilvery Ratio, 0.5 for slopes < 10°(17.6%), 0.7 for slopes > 10°(17.6%)

SCM Sediment Contro Measures (%) 50% is considered conservative

Therefore **S** (Yeild) = **0.684** **tonnes / per** **6 months**

Maven Associates	Job Number 135041	Sheets 1	Rev A
Job Title: BROOKVALE GREEN SRP S2 Calc Title: Earthworks Pond	Author BB	Date 30.4.2026	Checked BB

Catchment Area	**47000**	**m^2**
Pond Volume 3% of Area	1410	m^3
Dead Storage 30% of volume	423	m^3
Live Storage 70% of volume	987	m^3
Decant Dewatering (3l/s/ha)	14.1	l/s

Size Decant

Standard decant	4.5	l/s	=	200	holes
Therefore	14.10	l/s	=	627	holes
Use	**3**	**decants**			

Pond Dimensions

v =	**1410**	**m^3**
d =	**1.5**	**m**
x =	width of pond base	

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

Calc 2: Calculate width and length of base, Quadratic Equation

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 3x^2d+8.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	4.5	x^2+	19.125	x+	-1376.25
x	=	15.49	width of pond base			
or	=	-19.74				

Check = 1410 m^3

5:1 ratio

$v = (((5x^2)+((x+4d)(5x+5d)))/2)d$

=> $v = 5x^2d+12.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	7.5	x^2+	28.125	x+	-1376.25
x	=	11.80	width of pond base			
or	=	-15.55				

Check = 1410 m^3

Base width =	**15.49**	**m**		**Top width =**		**23.89**	**m**
Base length =	**46.48**	**m**		**Top length =**		**56.08**	**m**
Forebay width base =	**15.49**	**m**		**Forebay depth =**		**1**	**m**
Forebay length base =	**2**	**m**		**Forebay sideslope =**		**1 in 1**	**m**
Forebay length top =	**4**	**m**		**Forebay width top =**		**17.49**	**m**

Dead Storage Depth

Pond Dimensions

x = 15.49 m

v = 423.0 m^3

d = Dead storage depth

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 10d^3+8.5xd^2+3x^2d$ cubic equation to find "d"

			a		b		c
0	=	d^3+	13.16796525	d^2+	71.99805	+d	-42.3

e	=	4.73	
f	=	94.60	
g	=	5.75	
h	=	-0.82	
d	**=**	**0.533**	depth of dead storage

Check v = 423.00 m^3

Spillway Dimensions

Side Slope	horizontal	3	vertical	1
Gradient		**1**	**%**	
Base Width		4.00	m	

Calc 3: Calculate spillway flow (Q) Rational Formula

Q=CIA 1% AEP

where	C	=	0.85		
	I	=	0.000038611	m/s	139 r (HIRDS Historical data 100yr/10min)
	A	=	47000	m2	
Therefore	**Q**	**=**	**1.54**	**m3/sec**	

Calc 4: Calculate spillway depth (H) Mannings Formula

$V=(1/n)R^{2/3}S^{1/2}$ R=A/P Q=AV

n = 0.018 Flow path is firm earth

Where: H = depth of channel P = wetted parameter

A = Sectional Area S = slope of channel

H	P	A	S	R	V	Q
0.2	5.264911	0.92	0.01	0.174742	1.736436	1.597521

Therefore **H** = **0.2 m** Min 300mm

Therefore = **300** mm

Maven Associates	Job Number	Sheets	Rev
	135041	1	A

Job Title	Brookvale Green USLE	Author	Date	Checked
Calc Title	TP108 - SEDIMENT YIELD - SRP Typical	BB	30.4.2026	BB

Design Spreadsheet for USLE

Calc 1: Estimate of Sediment Generation (A), tonnes/ha/yr

A= R x K x LS x C x P

Where
- A = Sediment Generation (tonnes/ha/ya)
- R = Rainfall Erosion Index (J/hectare)
- K = Soil Erodibility Factor (tonnes/unit of R)
- LS = Slope Lenth and steepness Factor
- C= Ground Cover Factor
- P= Roughness Factor

Rainfall Erosion Index

R = 0.00828*P^2.2*1.7

P = 47.1

P is the 2yr 24 hour rainfall from ARC TP108 Figure A.1 for a 6 hour duration period

TP108 2yr = 75 mm/24hr

Therefore **R** = **71.94** **J/ha**

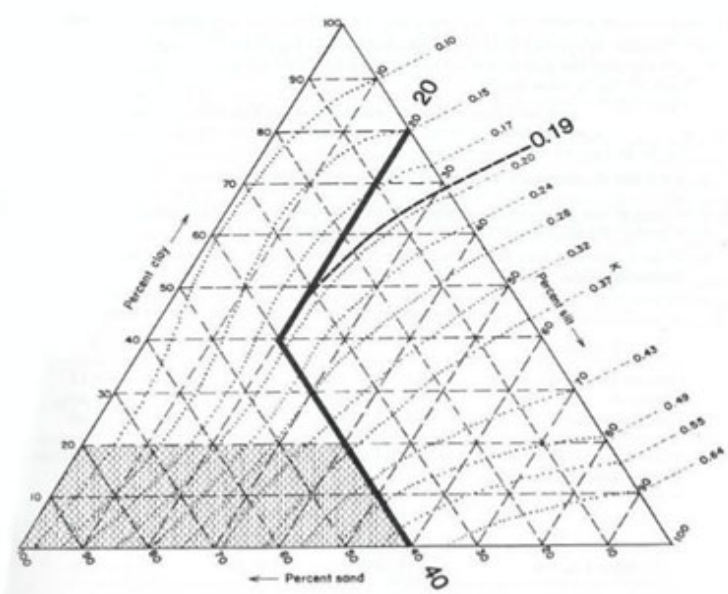


Figure 1: USLE Nomograph for Estimating k value

Soil Erodibility Factor

K = k x Organic % Factor x M-I Factor

The K factor can be determined by using the nomograph method, which requires that a particle size analysis be done to determine the percentages of sand, very fine sand, silt and clay. Use the figure above to determine appropriate K value.

Site Geology

sand	%	0
silt	%	70
clay	%	30

Therefore from Figure 1 of USLE, k value unfactored =

k = 0.43

Organic % = 4

Therefore from Table 1 of USLE, Organic % Factor =

O%F = -0.14

Metric To Imperial Factor

M-I Factor = 1.32

Therefore **K** = **0.3828** **tonnes/unit of R**

Correct for organic content using Table 1 (the nomograph assumes 2% organic matter).

Table 1

K Value	Correction factor when percent organic matter is				
	0% (clay)	1%	2%	3%	4% (topsoil)
Greater than 0.40	+ 0.14	+ 0.07	0	- 0.07	- 0.14
0.20 – 0.40	+ 0.10	+ 0.05	0	- 0.05	- 0.10
Less than 0.20	+ 0.06	+ 0.03	0	- 0.03	- 0.06

In this table, exposed clay is considered 0% organic; topsoil 4% organic. In our example, if the surface is clay, the value would be corrected by adding 0.06 to the K value of 0.19 i.e. K = 0.25

Multiply the corrected K value by 1.32 to convert from imperial to metric
i.e. K = 0.33 (tonnes/unit of R)

Table 1: USLE Organic % Correction Factor

Slope Length and Steepness Factor

LS = From Appendix 1 equation

Slope Length =	300	m
Maximum Elevation =	12	m
Minimum Elevation =	11	m
Slope As a %	0.33	
Therefore m =	0.2	

Therefore **LS** = **0.11**

Ground Cover Factor

C	=	**1**	Assumed site as **Bare Soil** and taking value from Table 2

Roughness Factor

P	=	**1.32**	Assumed site as **Bare Soil** and taking value from Table 2

Ground Cover Factor

This is the ratio of soil loss from an actual site (or parts of a site) with specific ground cover (e.g. clay, topsoil, grass) compared to a bare site (i.e. no vegetation or topsoil). The bare site is given a value of 1.0.

Roughness Factor

The P factor provides adjustment for the degree to which surface roughness affects the erosion of sediment from a site (or part of a site).

As a standard practice, it is appropriate to use the range of C and P values given in Table 2 below.

Table 2

Treatment	C factor	P factor
Bare Soil		
- compacted and smooth	1.0	1.32
- track walked on contour	1.0	1.2
- rough irregular surface	1.0	0.9
- disked to 250 mm depth	1.0	0.8
Native vegetation (undisturbed)	0.01	1.0
Pasture (undisturbed)	0.02	1.0
Establishing grass[1]	0.1	1.0
Mulch – on subsoil[2]	0.15 (3 month period only)	1.0
Mulch – on topsoil[3]	0.05 (3 month period only)	1.0

Table 2: USLE Organic % Correction Factor

Therefore **A** = **3.91** **tonnes/ha/yr**

Estimate of Sediment yield

S (Yeild) = **A x Area x SD x SCE x Duration**

where	A	=	3.91	tonnes/ha/yr
	Area	=	5	ha
	SDR	=	0.7	
	SCM	=	90	%
	Duration	=	0.5	yrs

SDR Sediment Deilvery Ratio, 0.5 for slopes < 10°(17.6%), 0.7 for slopes > 10°(17.6%)

SCM Sediment Contro Measures (%) 50% is considered conservative

Therefore **S** (Yeild) = **0.684** **tonnes / per** **6 months**

Maven Associates	Job Number 135041	Sheets 1	Rev A
Job Title: BROOKVALE GREEN SRP S4 Calc Title: Earthworks Pond	Author BB	Date 30.4.2026	Checked BB

Catchment Area	**43000**	**m^2**
Pond Volume 3% of Area	1290	m^3
Dead Storage 30% of volume	387	m^3
Live Storage 70% of volume	903	m^3
Decant Dewatering (3l/s/ha)	12.9	l/s

Size Decant

Standard decant	4.5	l/s	=	200	holes
Therefore	12.90	l/s	=	573	holes
Use	**3**	**decants**			

Pond Dimensions

v = **1290** **m^3**

d = **1.5** **m**

x = width of pond base

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

Calc 2: Calculate width and length of base, Quadratic Equation

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 3x^2d+8.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	4.5	x^2+	19.125	x+	-1256.25
x	=	14.72	width of pond base			
or	=	-18.97				

Check = 1290 m^3

5:1 ratio

$v = (((5x^2)+((x+4d)(5x+5d)))/2)d$

=> $v = 5x^2d+12.5xd^2+10d^3$ quadratic equation to find "x"

		a		b		c
0	=	7.5	x^2+	28.125	x+	-1256.25
x	=	11.20	width of pond base			
or	=	-14.95				

Check = 1290 m^3

Base width =	**14.72**	**m**	**Top width =**	**23.12**	**m**
Base length =	**44.15**	**m**	**Top length =**	**53.75**	**m**
Forebay width base =	**14.72**	**m**	**Forebay depth =**	**1**	**m**
Forebay length base =	**2**	**m**	**Forebay sideslope =**	**1 in 1**	**m**
Forebay length top =	**4**	**m**	**Forebay width top =**	**16.72**	**m**

Dead Storage Depth

Pond Dimensions

x = 14.72 m

v = 387.0 m^3

d = Dead storage depth

Pond calculations allow for the sides and outlet of the pond to be at a 2:1 batter slope and for the inlet of the pond to be at a 3:1 batter slope.

3:1 ratio

$v = (((3x^2)+((x+4d)(3x+5d)))/2)d$

=> $v = 10d^3+8.5xd^2+3x^2d$ cubic equation to find "d"

			a		b		c
0	=	d^3+	12.51019005	d^2+	64.98471	+d	-38.7

e	=	4.27	
f	=	82.33	
g	=	5.49	
h	=	-0.78	
d	**=**	**0.538**	depth of dead storage

Check v = 387.00 m^3

Spillway Dimensions

Side Slope	horizontal	3	vertical	1
Gradient		**1**	**%**	
Base Width		5.00	m	

Calc 3: Calculate spillway flow (Q) Rational Formula

Q=CIA 1% AEP

where	C	=	0.85		
	I	=	0.000038611	m/s	139 r (HIRDS Historical data 100yr/10min)
	A	=	43000	m2	
Therefore	**Q**	**=**	**1.41**	**m3/sec**	

Calc 4: Calculate spillway depth (H) Mannings Formula

$V=(1/n)R^{2/3}S^{1/2}$ R=A/P Q=AV

n = 0.018 Flow path is firm earth

Where: H = depth of channel P = wetted parameter

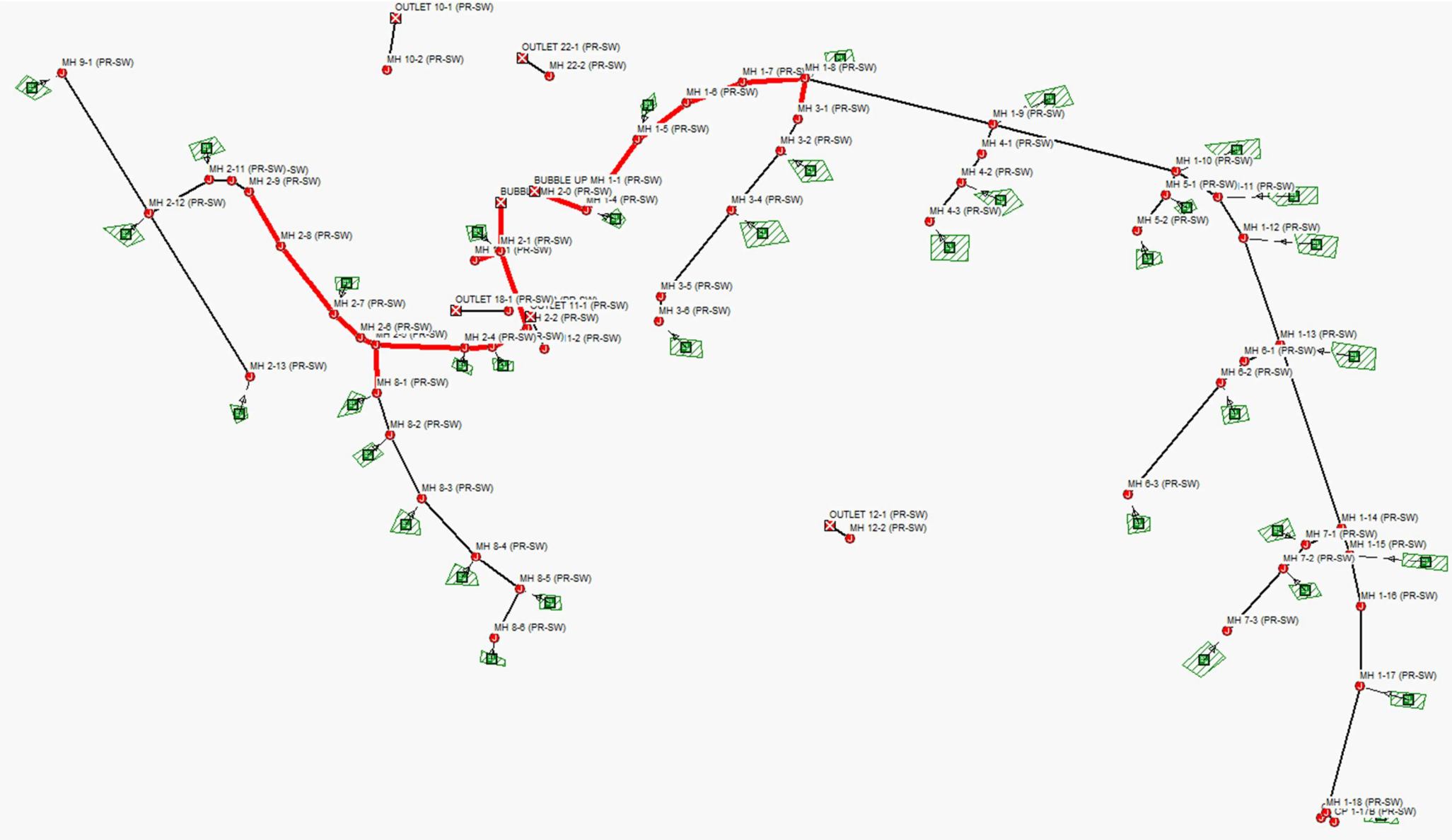
A = Sectional Area S = slope of channel

H	P	A	S	R	V	Q
0.17	6.075174	0.9367	0.01	0.154185	1.597431	1.496313

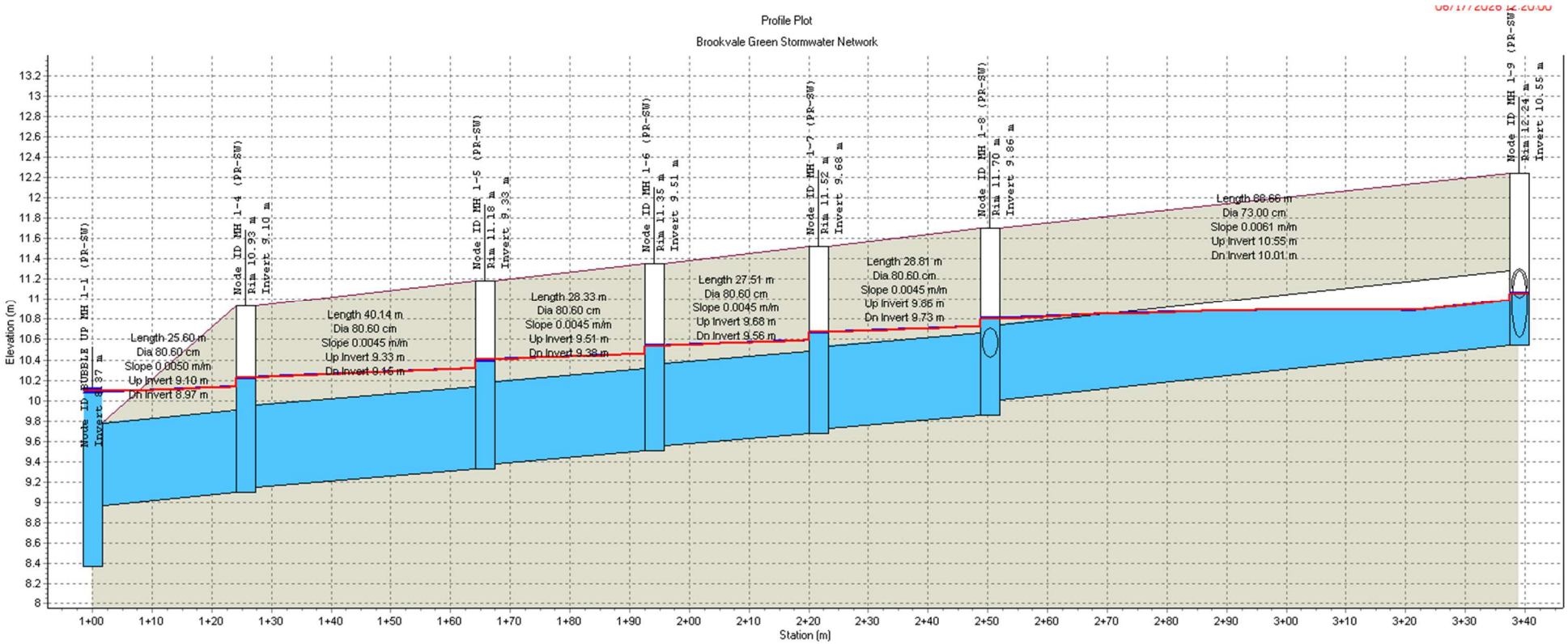
Therefore **H** = **0.17** **m** Min 300mm

Therefore = **300** mm

Stormwater network hydraulic grade line check for 5 year rain event with Climate Change.



Line 1



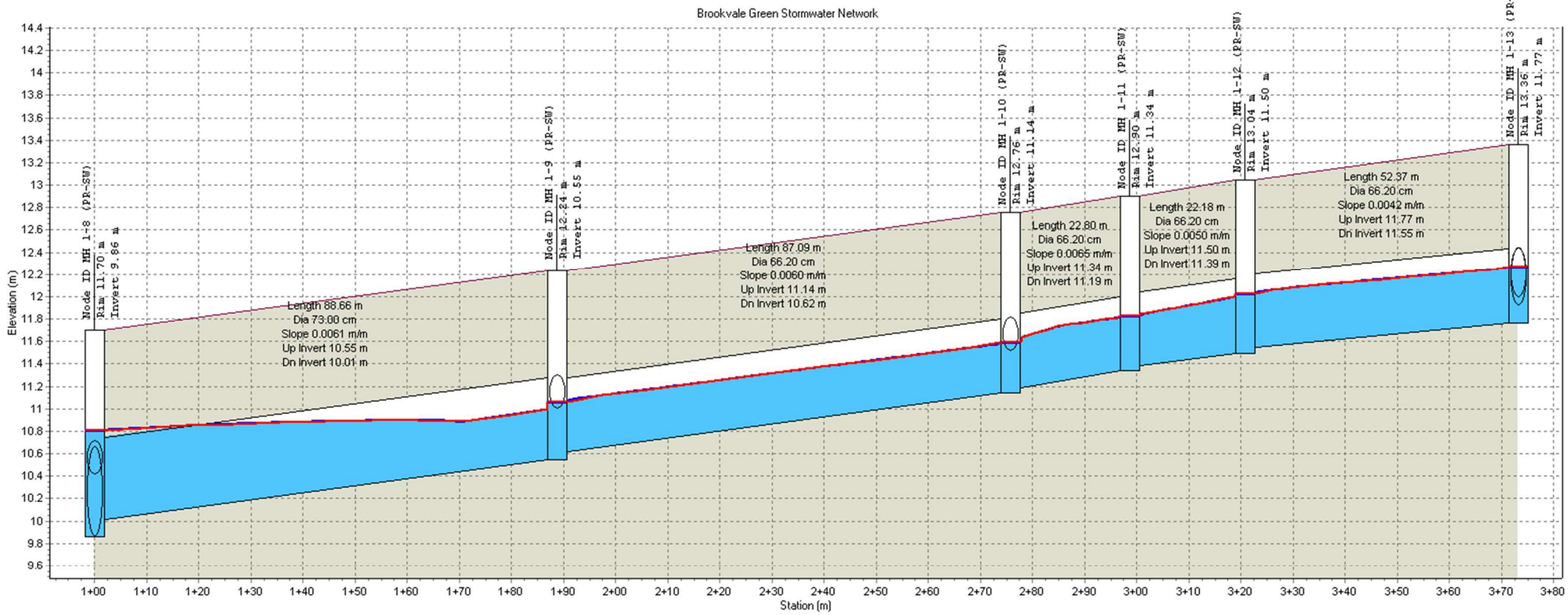
Node ID:		MH 1-4 (PR-SW)	MH 1-5 (PR-SW)	MH 1-6 (PR-SW)	MH 1-7 (PR-SW)	MH 1-8 (PR-SW)	MH 1-9 (PR-SW)
Rim (m):		10.93	11.18	11.35	11.52	11.70	12.24
Invert (m):	8.37	9.10	9.33	9.51	9.68	9.86	10.55
Min Pipe Cover (m):		0.98	0.99	0.99	0.99	0.96	0.93
Max HGL (m):	10.12	10.23	10.40	10.54	10.67	10.81	11.06

Link ID:	{PR-SW}.Pipe - (18) (PR-SW)	{PR-SW}.Pipe - (17) (PR-SW)	{PR-SW}.Pipe - (16) (PR-SW)	{PR-SW}.Pipe - (15) (PR-SW)	{PR-SW}.Pipe - (14) (PR-SW)	{PR-SW}.Pipe - (13) (PR-SW)
Length (m):	25.60	40.14	28.33	27.51	28.81	88.66
Dia (cm):	80.60	80.60	80.60	80.60	80.60	73.00
Slope (m/m):	0.0050	0.0045	0.0045	0.0045	0.0045	0.0061
Up Invert (m):	9.10	9.33	9.51	9.68	9.86	10.55
Dn Invert (m):	8.97	9.15	9.38	9.56	9.73	10.01
Max Q (lps):	663.96	648.07	621.05	620.98	620.89	516.33
Max Vel (m/s):	1.30	1.27	1.22	1.22	1.22	1.64
Max Depth (m):	0.81	0.81	0.81	0.81	0.81	0.62

06/17/2026 12:20:00

Profile Plot

Brookvale Green Stormwater Network



Node ID:	MH 1-8 (PR-SW)	MH 1-9 (PR-SW)	MH 1-10 (PR-SW)	MH 1-11 (PR-SW)	MH 1-12 (PR-SW)	MH 1-13 (PR-SW)
Rim (m):	11.70	12.24	12.76	12.90	13.04	13.36
Invert (m):	9.86	10.55	11.14	11.34	11.50	11.77
Min Pipe Cover (m):	0.96	0.93	0.91	0.86	0.83	0.91
Max HGL (m):	10.81	11.06	11.59	11.83	12.03	12.27

Link ID:	{PR-SW}.Pipe - (13) (PR-SW)	{PR-SW}.Pipe - (11) (PR-SW)	{PR-SW}.Pipe - (10) (PR-SW)	{PR-SW}.Pipe - (9) (1) (PR-SW)	{PR-SW}.Pipe - (9) (PR-SW)
Length (m):	88.66	87.09	22.80	22.18	52.37
Dia (cm):	73.00	66.20	66.20	66.20	66.20
Slope (m/m):	0.0061	0.0060	0.0065	0.0050	0.0042
Up Invert (m):	10.55	11.14	11.34	11.50	11.77
Dn Invert (m):	10.01	10.62	11.19	11.39	11.55
Max Q (lps):	516.33	427.03	408.96	398.41	377.23
Max Vel (m/s):	1.64	1.80	1.69	1.49	1.39
Max Depth (m):	0.62	0.45	0.45	0.48	0.49

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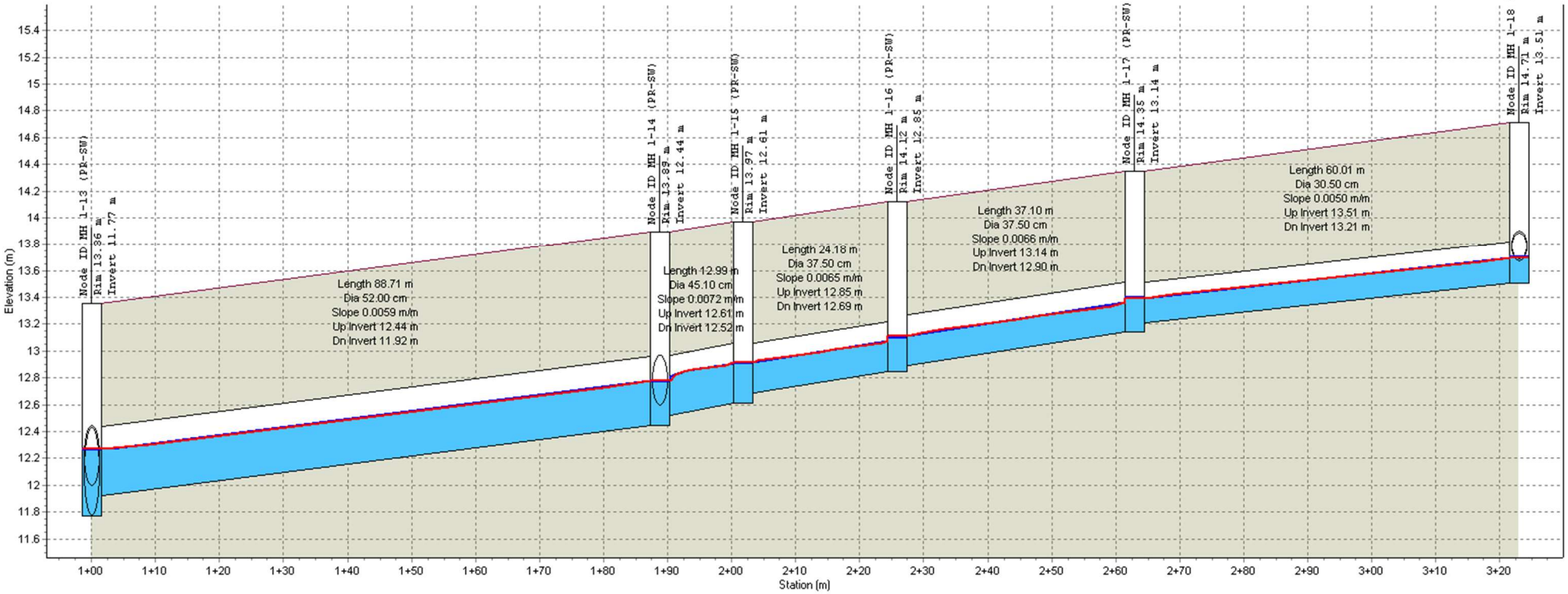
Profile Plot

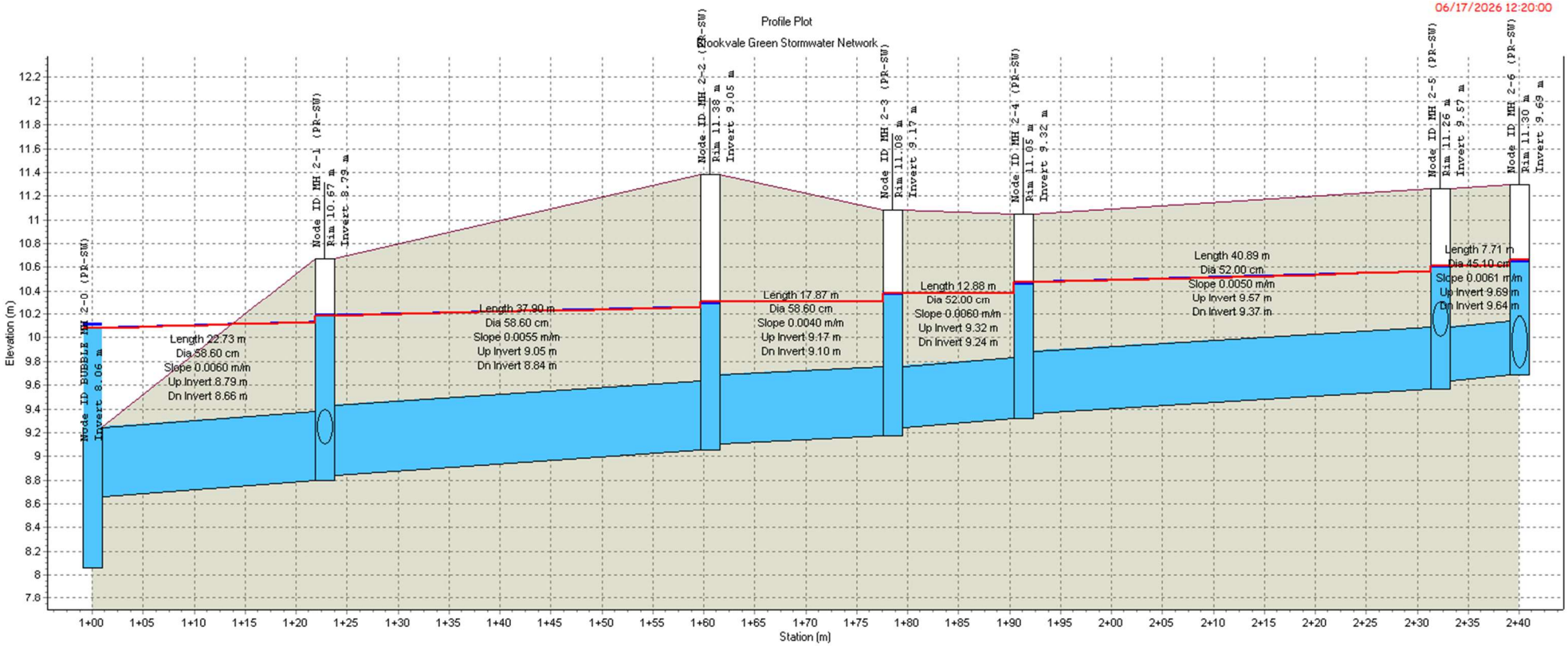
Brookvale Green Stormwater Network



Node ID:	MH 1-13 (PR-SW)	MH 1-14 (PR-SW)	MH 1-15 (PR-SW)	MH 1-16 (PR-SW)	MH 1-17 (PR-SW)	MH 1-18 (PR-SW)
Rim (m):	13.36	13.89	13.97	14.12	14.35	14.71
Invert (m):	11.77	12.44	12.61	12.85	13.14	13.51
Min Pipe Cover (m):	0.91	0.93	0.91	0.85	0.83	0.81
Max HGL (m):	12.27	12.79	12.92	13.12	13.40	13.71

Link ID:	{PR-SW}.Pipe - (8) (PR-SW)	{PR-SW}.Pipe - (75) (1) (PR-SW)	{PR-SW}.Pipe - (75) (PR-SW)	{PR-SW}.Pipe - (74) (PR-SW)	{PR-SW}.Pipe - (73) (PR-SW)
Length (m):	88.71	12.99	24.18	37.10	60.01
Dia (cm):	52.00	45.10	37.50	37.50	30.50
Slope (m/m):	0.0059	0.0072	0.0065	0.0066	0.0050
Up Invert (m):	12.44	12.61	12.85	13.14	13.51
Dn Invert (m):	11.92	12.52	12.69	12.90	13.21
Max Q (lps):	224.44	134.70	100.58	100.59	48.83
Max Vel (m/s):	1.49	1.28	1.26	1.30	0.99
Max Depth (m):	0.34	0.28	0.25	0.24	0.19

Line 2



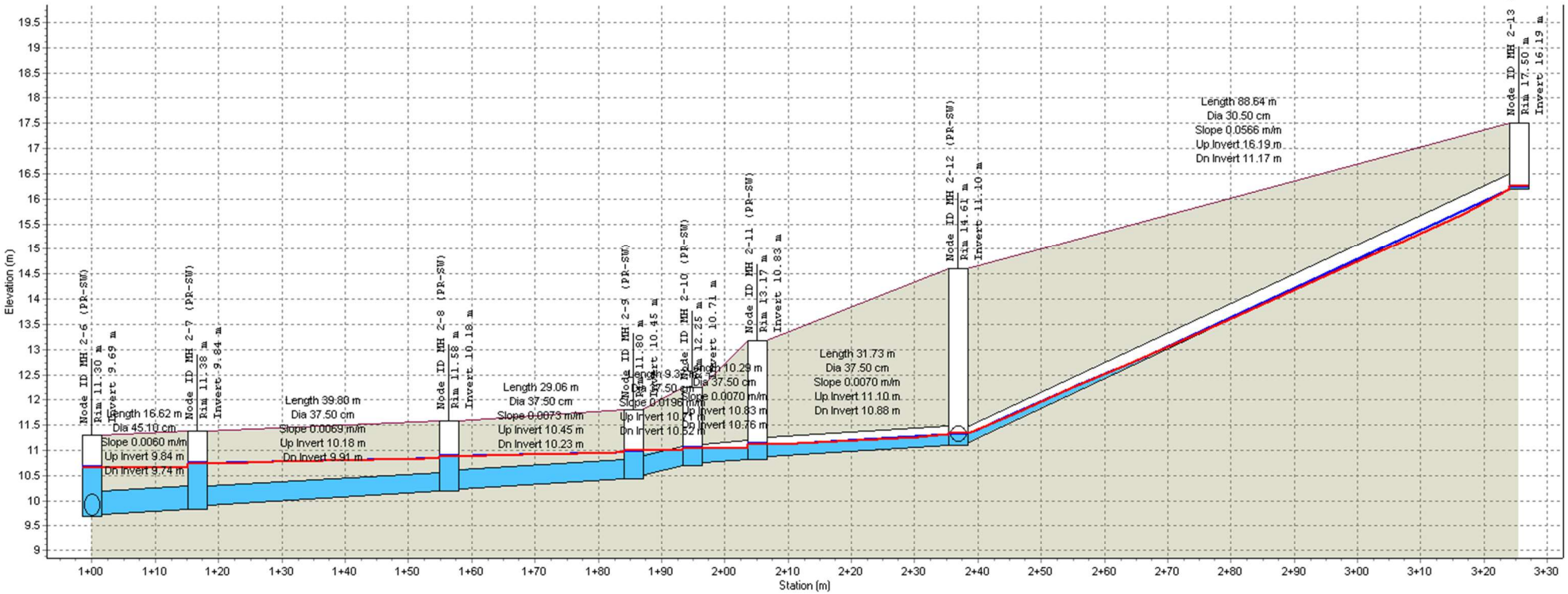
Node ID:		MH 2-1 (PR-SW)	MH 2-2 (PR-SW)	MH 2-3 (PR-SW)	MH 2-4 (PR-SW)	MH 2-5 (PR-SW)	MH 2-6 (PR-SW)
Rim (m):		10.67	11.38	11.08	11.05	11.26	11.30
Invert (m):	8.06	8.79	9.05	9.17	9.32	9.57	9.69
Min Pipe Cover (m):		1.24	1.69	1.32	1.16	0.95	1.11
Max HGL (m):	10.12	10.19	10.30	10.38	10.47	10.61	10.66

Link ID:	{PR-SW}.Pipe - (79) (PR-SW)	{PR-SW}.Pipe - (102) (PR-SW)	{PR-SW}.Pipe - (101) (PR-SW)	{PR-SW}.Pipe - (39) (2) (1) (PR-SW)	{PR-SW}.Pipe - (39) (PR-SW)	{PR-SW}.Pipe - (38) (PR-SW)
Length (m):	22.73	37.90	17.87	12.88	40.89	7.71
Dia (cm):	58.60	58.60	58.60	52.00	52.00	45.10
Slope (m/m):	0.0060	0.0055	0.0040	0.0060	0.0050	0.0061
Up Invert (m):	8.79	9.05	9.17	9.32	9.57	9.69
Dn Invert (m):	8.66	8.84	9.10	9.24	9.37	9.64
Max Q (lps):	420.85	254.60	254.59	223.00	202.04	134.12
Max Vel (m/s):	1.67	1.09	0.94	1.05	0.95	0.84
Max Depth (m):	0.59	0.59	0.59	0.52	0.52	0.45

06/17/2026 [illegible]:20:00

Profile Plot

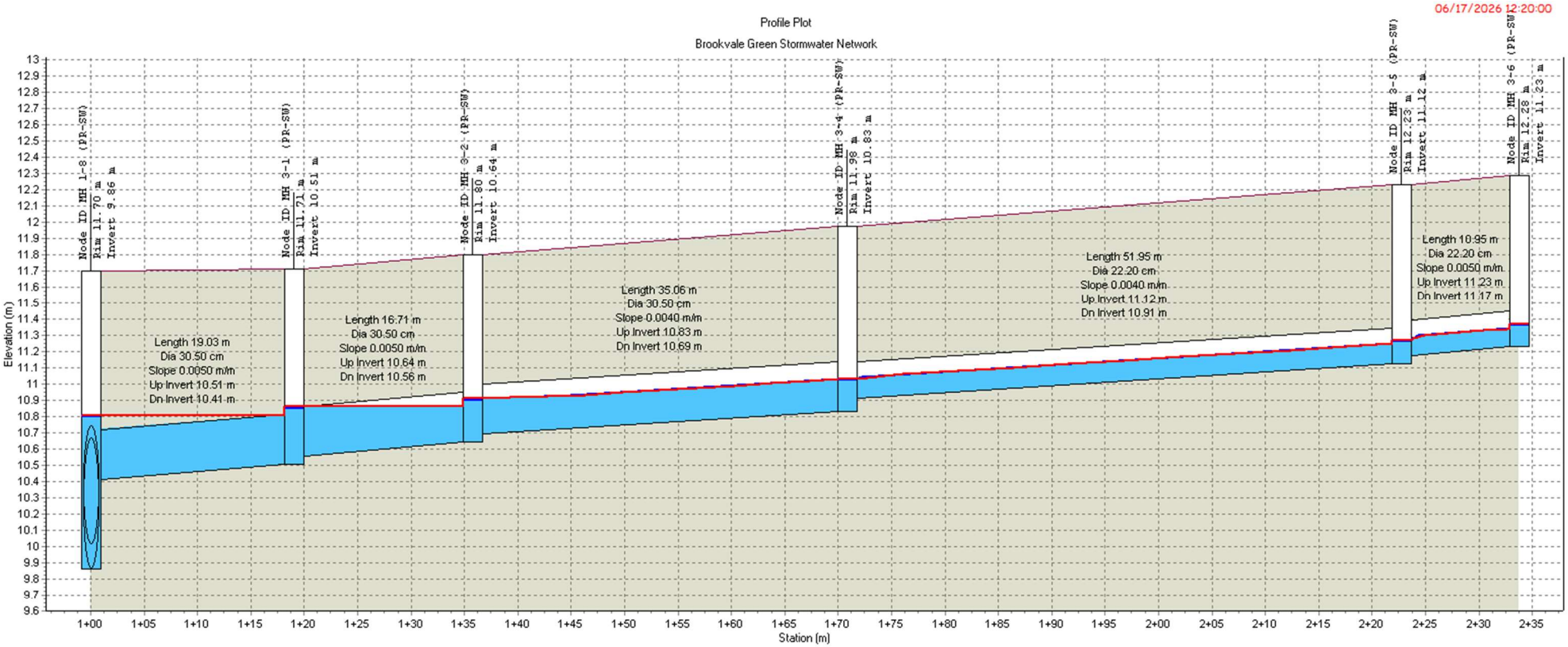
Brookvale Green Stormwater Network



Node ID:	MH 2-6 (PR-SW)	MH 2-7 (PR-SW)	MH 2-8 (PR-SW)	MH 2-9 (PR-SW)	MH 2-10 (PR-SW)	MH 2-11 (PR-SW)	MH 2-12 (PR-SW)	MH 2-13 (PR-SW)
Rim (m):	11.30	11.38	11.58	11.80	12.25	13.17	14.61	17.50
Invert (m):	9.69	9.84	10.18	10.45	10.71	10.83	11.10	16.19
Min Pipe Cover (m):	1.11	1.09	0.97	0.91	1.12	1.91	3.13	1.00
Max HGL (m):	10.66	10.74	10.88	10.99	11.05	11.13	11.34	16.25

Link ID:	{PR-SW}.Pipe - (37) [PR-SW]	{PR-SW}.Pipe - (36) [PR-SW]	{PR-SW}.Pipe - (35) [PR-SW]	{PR-SW}.Pipe - (34) [PR-SW]	{PR-SW}.Pipe - (33) [1]	{PR-SW}.Pipe - (33) [PR-SW]	{PR-SW}.Pipe - (32) [PR-SW]
Length (m):	16.62	39.80	29.06	9.37	10.29	31.73	88.64
Dia (cm):	45.10	37.50	37.50	37.50	37.50	37.50	30.50
Slope (m/m):	0.0060	0.0069	0.0073	0.0196	0.0070	0.0070	0.0566
Up Invert (m):	9.84	10.18	10.45	10.71	10.83	11.10	16.19
Dn Invert (m):	9.74	9.91	10.23	10.52	10.76	10.88	11.17
Max Q (lps):	134.12	93.83	93.72	93.13	91.41	87.25	21.27
Max Vel (m/s):	0.84	0.85	1.19	1.68	1.21	1.25	1.30
Max Depth (m):	0.45	0.38	0.38	0.36	0.30	0.24	0.11

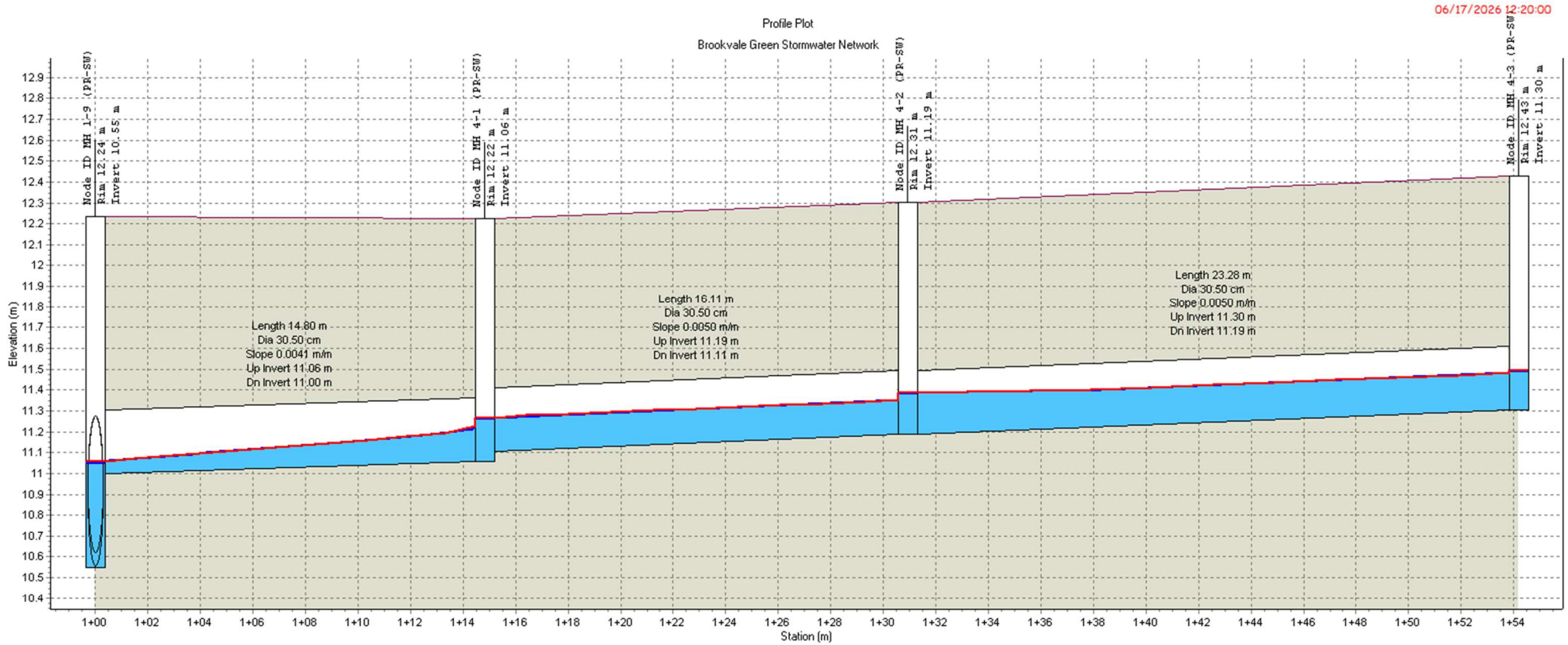
Line 3



Node ID:	MH 1-8 (PR-SW)	MH 3-1 (PR-SW)	MH 3-2 (PR-SW)	MH 3-4 (PR-SW)	MH 3-5 (PR-SW)	MH 3-6 (PR-SW)
Rim (m):	11.70	11.71	11.80	11.98	12.23	12.28
Invert (m):	9.86	10.51	10.64	10.83	11.12	11.23
Min Pipe Cover (m):	0.96	0.85	0.80	0.84	0.84	0.83
Max HGL (m):	10.81	10.87	10.92	11.03	11.27	11.37

Link ID:	{PR-SW}.Pipe - (12) (PR-SW)	{PR-SW}.Pipe - (51) (PR-SW)	{PR-SW}.Pipe - (50) (1) (PR-SW)	{PR-SW}.Pipe - (50) (PR-SW)	{PR-SW}.Pipe - (49) (PR-SW)
Length (m):	19.03	16.71	35.06	51.95	10.95
Dia (cm):	30.50	30.50	30.50	22.20	22.20
Slope (m/m):	0.0050	0.0050	0.0040	0.0040	0.0050
Up Invert (m):	10.51	10.64	10.83	11.12	11.23
Dn Invert (m):	10.41	10.56	10.69	10.91	11.17
Max Q (lps):	46.10	47.62	43.65	19.07	19.14
Max Vel (m/s):	0.98	1.00	0.95	0.78	0.81
Max Depth (m):	0.31	0.29	0.21	0.13	0.13

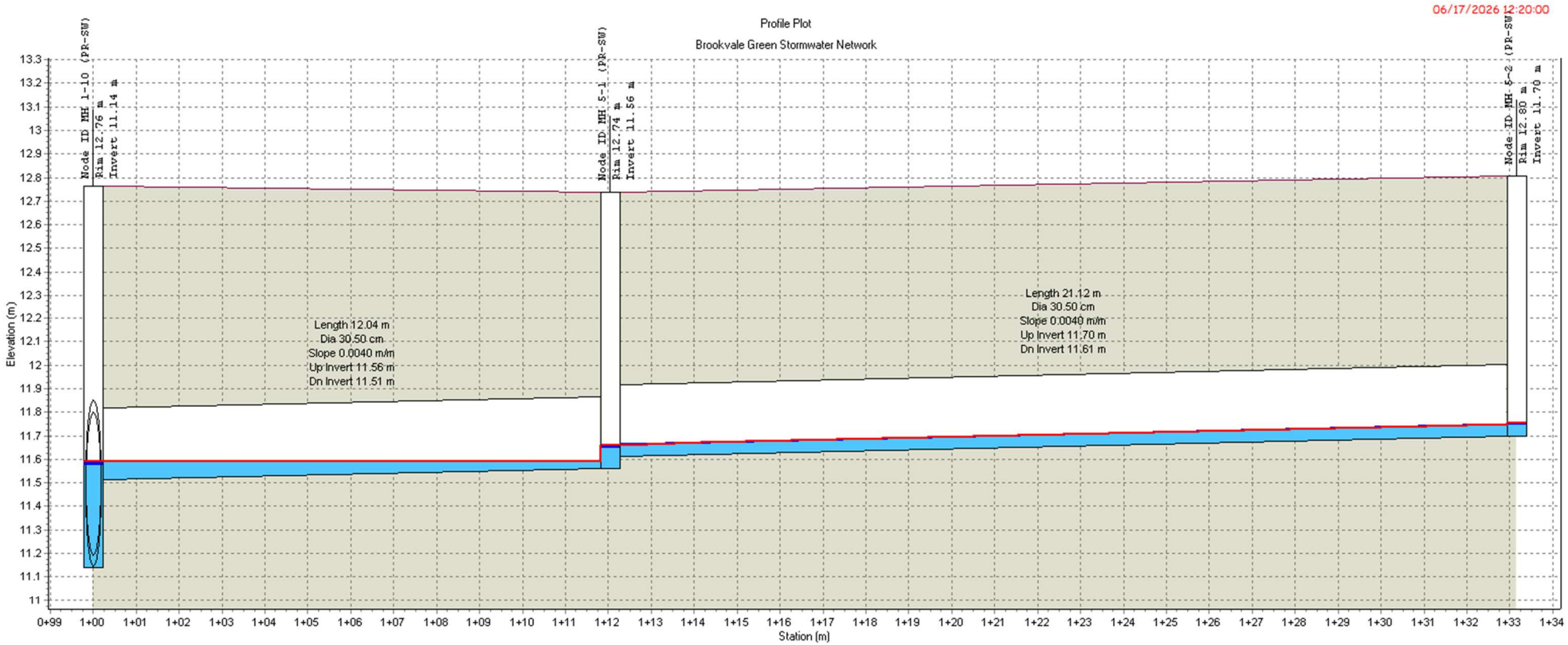
Line 4



Node ID:	MH 1-9 (PR-SW)	MH 4-1 (PR-SW)	MH 4-2 (PR-SW)	MH 4-3 (PR-SW)
Rim (m):	12.24	12.22	12.31	12.43
Invert (m):	10.55	11.06	11.19	11.30
Min Pipe Cover (m):	0.93	0.81	0.81	0.82
Max HGL (m):	11.06	11.27	11.39	11.50

Link ID:	{PR-SW}.Pipe - (55) (PR-SW)	{PR-SW}.Pipe - (54) (1) (PR-SW)	{PR-SW}.Pipe - (54) (PR-SW)
Length (m):	14.80	16.11	23.28
Dia (cm):	30.50	30.50	30.50
Slope (m/m):	0.0041	0.0050	0.0050
Up Invert (m):	11.06	11.19	11.30
Dn Invert (m):	11.00	11.11	11.19
Max Q (lps):	45.34	45.43	43.57
Max Vel (m/s):	0.95	0.99	0.86
Max Depth (m):	0.18	0.18	0.20

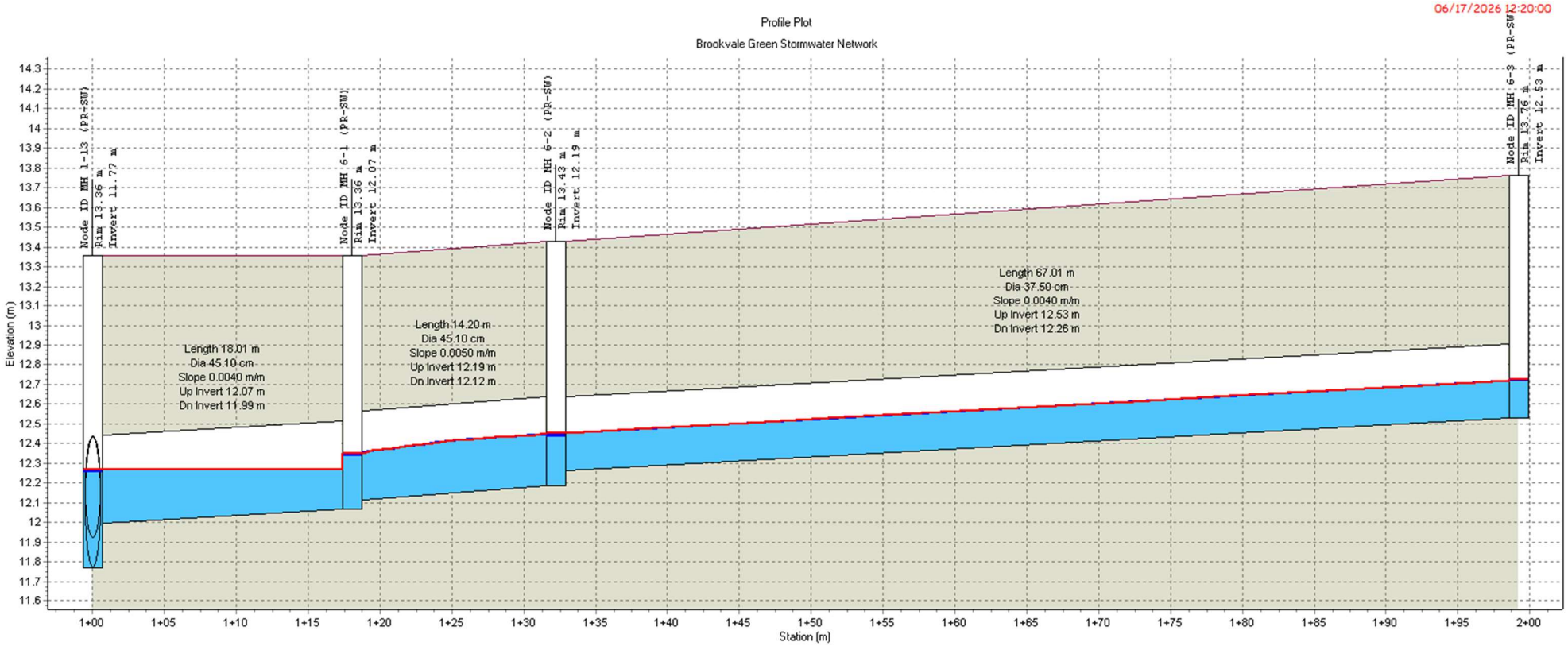
Line 5



Node ID:	MH 1-10 (PR-SW)	MH 5-1 (PR-SW)	MH 5-2 (PR-SW)
Rim (m):	12.76	12.74	12.80
Invert (m):	11.14	11.56	11.70
Min Pipe Cover (m):	0.91	0.82	0.80
Max HGL (m):	11.59	11.66	11.76

Link ID:	{PR-SW}.Pipe - (61) (PR-SW)	{PR-SW}.Pipe - (60) (PR-SW)
Length (m):	12.04	21.12
Dia (cm):	30.50	30.50
Slope (m/m):	0.0040	0.0040
Up Invert (m):	11.56	11.70
Dn Invert (m):	11.51	11.61
Max Q (lps):	12.00	4.81
Max Vel (m/s):	0.66	0.53
Max Depth (m):	0.09	0.05

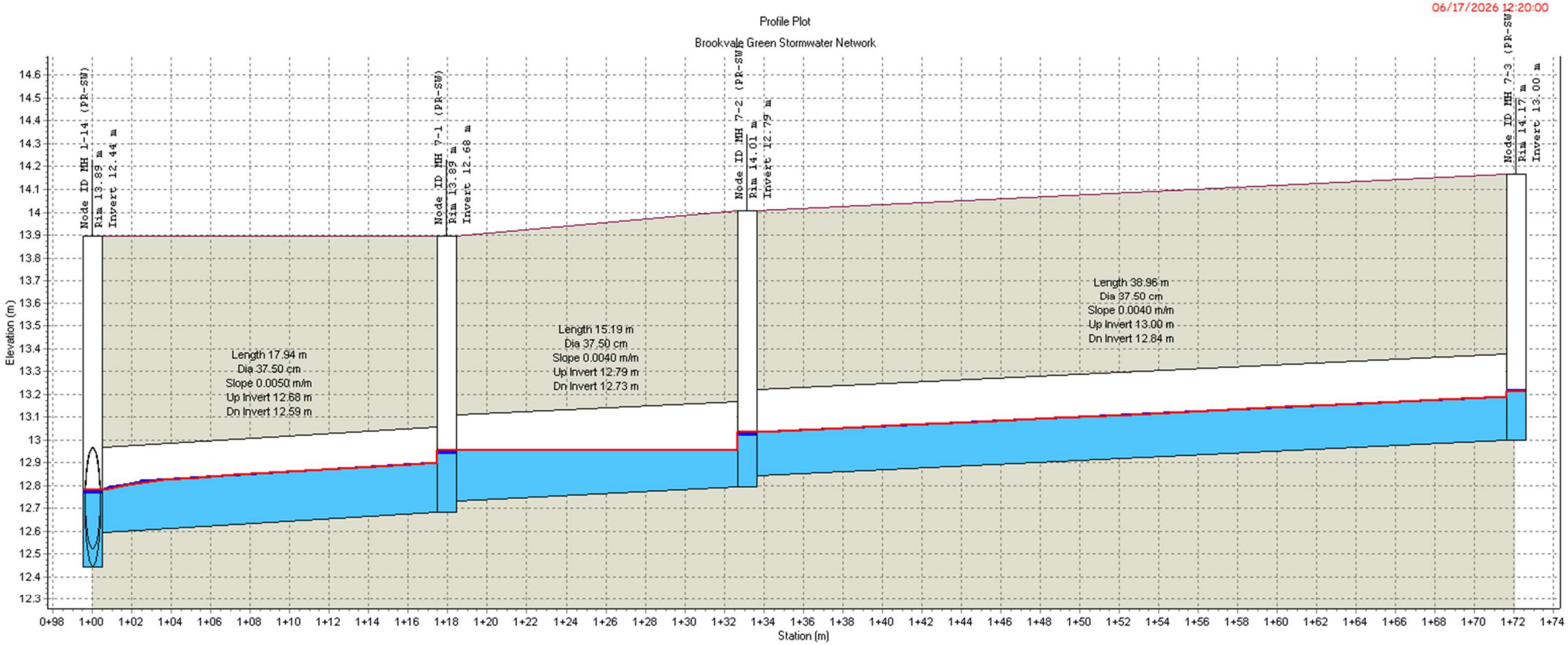
Line 6



Node ID:	MH 1-13 (PR-SW)	MH 6-1 (PR-SW)	MH 6-2 (PR-SW)	MH 6-3 (PR-SW)
Rim (m):	13.36	13.36	13.43	13.76
Invert (m):	11.77	12.07	12.19	12.53
Min Pipe Cover (m):	0.91	0.79	0.79	0.85
Max HGL (m):	12.27	12.35	12.46	12.73

Link ID:	{PR-SW}.Pipe - (72) (PR-SW)	{PR-SW}.Pipe - (71) (PR-SW)	{PR-SW}.Pipe - (70) (PR-SW)
Length (m):	18.01	14.20	67.01
Dia (cm):	45.10	45.10	37.50
Slope (m/m):	0.0040	0.0050	0.0040
Up Invert (m):	12.07	12.19	12.53
Dn Invert (m):	11.99	12.12	12.26
Max Q (lps):	95.92	96.51	55.94
Max Vel (m/s):	1.03	1.09	0.96
Max Depth (m):	0.28	0.25	0.19

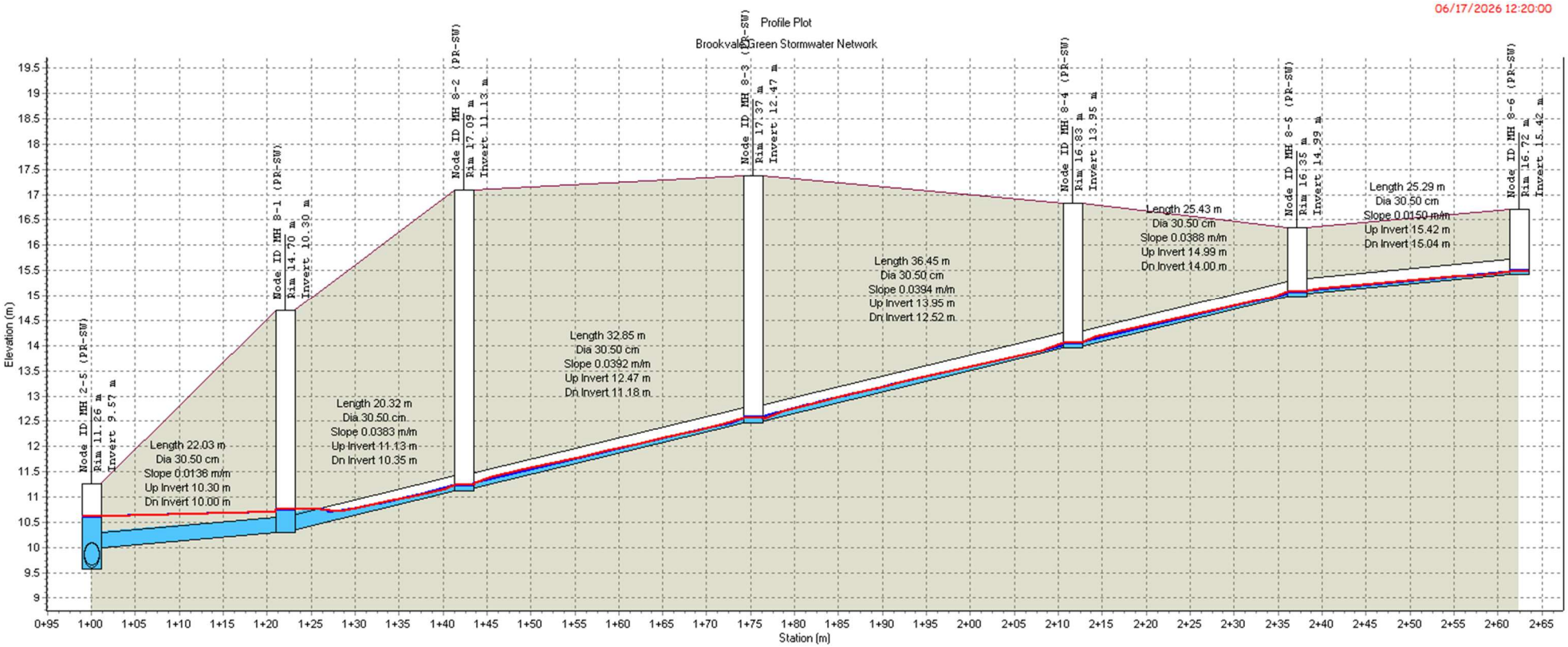
Line 7



Node ID:	MH 1-14 (PR-SW)	MH 7-1 (PR-SW)	MH 7-2 (PR-SW)	MH 7-3 (PR-SW)
Rim (m):	13.89	13.89	14.01	14.17
Invert (m):	12.44	12.68	12.79	13.00
Min Pipe Cover (m):	0.93	0.79	0.79	0.79
Max HGL (m):	12.79	12.96	13.04	13.22

Link ID:	{PR-SW}.Pipe - (6) (PR-SW)	{PR-SW}.Pipe - (22) (2) (1) (PR-SW)	{PR-SW}.Pipe - (22) (PR-SW)
Length (m):	17.94	15.19	38.96
Dia (cm):	37.50	37.50	37.50
Slope (m/m):	0.0050	0.0040	0.0040
Up Invert (m):	12.68	12.79	13.00
Dn Invert (m):	12.59	12.73	12.84
Max Q (lps):	89.84	63.43	61.17
Max Vel (m/s):	1.15	0.86	0.98
Max Depth (m):	0.24	0.23	0.20

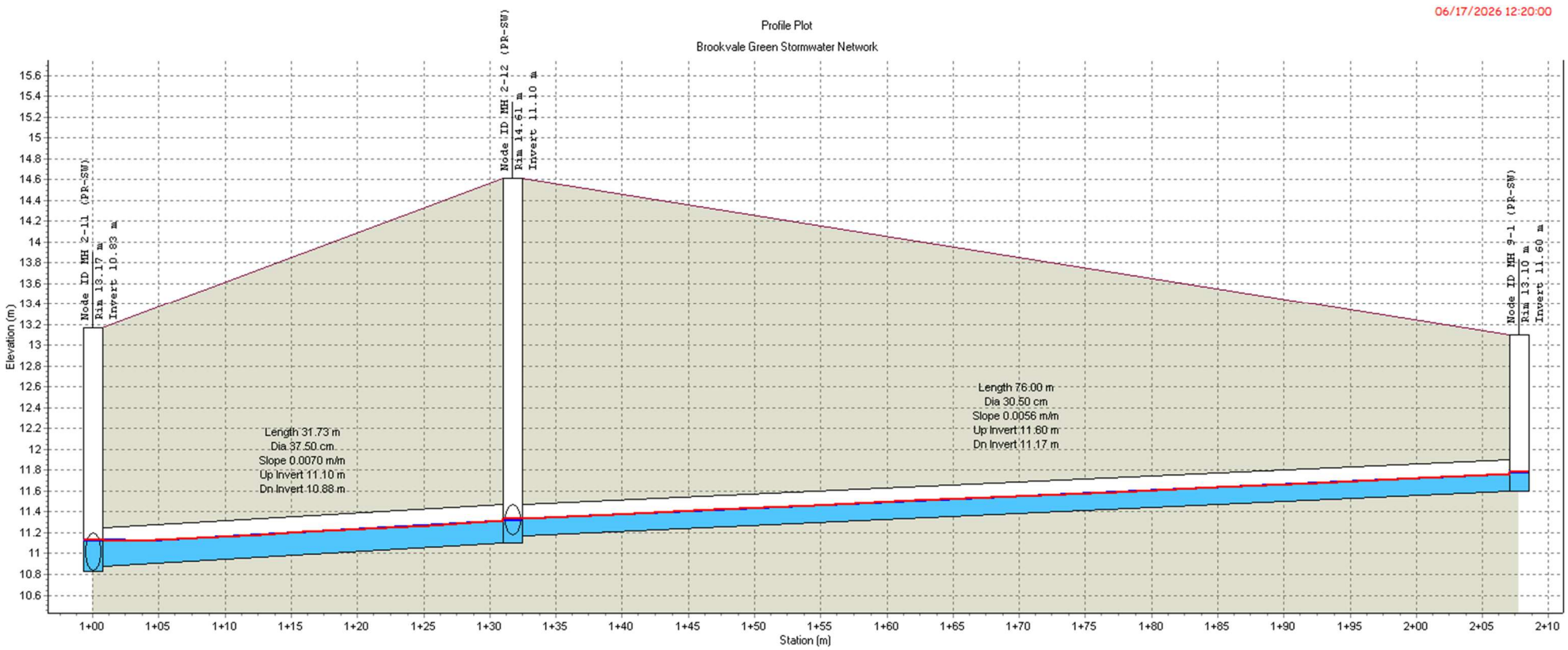
Line 8



Node ID:	MH 2-5 (PR-SW)	MH 8-1 (PR-SW)	MH 8-2 (PR-SW)	MH 8-3 (PR-SW)	MH 8-4 (PR-SW)	MH 8-5 (PR-SW)	MH 8-6 (PR-SW)
Rim (m):	11.26	14.70	17.09	17.37	16.83	16.35	16.72
Invert (m):	9.57	10.30	11.13	12.47	13.95	14.99	15.42
Min Pipe Cover (m):	0.95	4.04	5.60	4.55	2.52	1.01	1.00
Max HGL (m):	10.61	10.77	11.24	12.58	14.05	15.08	15.49

Link ID:	{PR-SW}.Pipe - (48) (PR-SW)	{PR-SW}.Pipe - (47) (PR-SW)	{PR-SW}.Pipe - (46) (2) (1) (PR-SW)	{PR-SW}.Pipe - (46) (PR-SW)	{PR-SW}.Pipe - (45) (PR-SW)	{PR-SW}.Pipe - (44) (PR-SW)
Length (m):	22.03	20.32	32.85	36.45	25.43	25.29
Dia (cm):	30.50	30.50	30.50	30.50	30.50	30.50
Slope (m/m):	0.0136	0.0383	0.0392	0.0394	0.0388	0.0150
Up Invert (m):	10.30	11.13	12.47	13.95	14.99	15.42
Dn Invert (m):	10.00	10.35	11.18	12.52	14.00	15.04
Max Q (lps):	69.71	59.88	50.39	40.89	32.52	14.56
Max Vel (m/s):	1.21	2.07	2.18	2.08	1.92	1.10
Max Depth (m):	0.31	0.21	0.11	0.09	0.09	0.07

Line 9



Node ID:	MH 2-11 (PR-SW)	MH 2-12 (PR-SW)	MH 9-1 (PR-SW)
Rim (m):	13.17	14.61	13.10
Invert (m):	10.83	11.10	11.60
Min Pipe Cover (m):	1.91	3.13	1.20
Max HGL (m):	11.13	11.34	11.78

Link ID:	{PR-SW}.Pipe - (33) (PR-SW)	{PR-SW}.Pipe - (43) (PR-SW)
Length (m):	31.73	76.00
Dia (cm):	37.50	30.50
Slope (m/m):	0.0070	0.0056
Up Invert (m):	11.10	11.60
Dn Invert (m):	10.88	11.17
Max Q (lps):	87.25	48.67
Max Vel (m/s):	1.25	1.09
Max Depth (m):	0.24	0.18

MAVEN ASSOCIATES	Job Number	Sheet	Rev	Job Title: Brookvale Green	Author		Date	Checked
	135041	1	A	Calc Title: Pipe Capacity Check	RH		20/05/2026	BB

Rainfall Depth	ARI 5YR (mm)	ARI 100YR (mm)	
TP108 rainfall data	86	169	From Hastings Rainfall charts
Climate change Increase	100.45	197.39	(assuming 2.1C increase in temperature 16.8%)

Pipe ks factor = 1.5 mm (pipes up to 1.0m dia)
0.6 mm (pipes over 1.0m dia)

	CN Number	
Impervious area	98	
Pervious	74	
Residential Lots 500m²	89.6	Equivalent CN - (65% impervious coverage, 35% pervious coverage)
Residential Lots 1000m²	83.1	Equivalent CN - (38% impervious coverage, 62% pervious coverage)
Proposed Roads	90.8	Equivalent CN - (74% impervious coverage, 26% pervious coverage)

Line number	MH to MH number	Flow From description	Catchment letter	Catchment Area m2	CN	Peak Flow rate - 10YR ARI l/s	Cum. Flow l/s	Pipe dia m	Ks mm	Gradient %	Capacity l/s	Percent Capacity %	Remaining l/s	Velocity m/s	Check OK
LINE 1	1-18 to 1-17	ROAD		1316	90.8	19.0	19.0								
		LOTS		2992	89.6	41.9	60.9								
		RESERVE		0	74.0	0.0	60.9	0.300	1.5	0.50	69.5	87.6%	8.6	0.98	OK
	1-17 to 1-16	ROAD		1206	90.8	17.4	78.4								
		LOTS		3445	89.6	48.2	126.6								
		RESERVE		0	74.0	0.0	126.6	0.375	1.5	0.66	144.3	87.7%	17.7	1.31	OK
	1-16 to 1-15	ROAD		0	90.8	0.0	126.6								
		LOTS		0	89.6	0.0	126.6								
		RESERVE		0	74.0	0.0	126.6	0.375	1.5	0.65	143.2	88.4%	16.6	1.30	OK
	1-15 to 1-14	ROAD		1616	90.8	23.4	150.0								
		LOTS		1421	89.6	19.9	169.9								
		RESERVE		0	74.0	0.0	169.9	0.450	1.5	0.50	203.4	83.5%	33.5	1.28	OK
	1-14 to 1-13	ROAD		0	90.8	0.0	169.9								
		LOTS		0	89.6	0.0	169.9								
		RESERVE		0	74.0	0.0	169.9								
		LINE 7				112.9	282.8	0.525	1.5	0.59	332.0	85.2%	49.2	1.53	OK
	1-13 to 1-12	ROAD		3558	90.8	51.5	334.3								
		LOTS		1717	89.6	24.0	358.3								
		RESERVE		0	74.0	0.0	358.3								
		LINE 6				121.7	480.1	0.675	1.5	0.42	543.5	88.3%	63.4	1.52	OK
	1-12 to 1-11	ROAD		1048	90.8	15.2	495.2								
		LOTS		955	89.6	13.4	508.6								
		RESERVE		0	74.0	0.0	508.6	0.675	1.5	0.50	593.0	85.8%	84.4	1.66	OK
	1-11 to 1-10	ROAD		329	90.8	4.8	513.4								
		LOTS		672	89.6	9.4	522.8								
		RESERVE		0	74.0	0.0	522.8	0.675	1.5	0.65	676.1	77.3%	153.4	1.89	OK
	1-10 to 1-9	ROAD		591	90.8	8.5	531.3								
		LOTS		0	89.6	0.0	531.3								
		RESERVE		0	74.0	0.0	531.3								
		LINE 5				15.0	546.3	0.675	1.5	0.60	649.6	84.1%	103.3	1.82	OK
	1-9 to 1-8	ROAD		2662	90.8	38.5	584.8								
		LOTS		2291	89.6	32.1	616.9								
		RESERVE		0	74.0	0.0	616.9								
		LINE 4				57.2	674.1	0.750	1.5	0.61	864.5	78.0%	190.4	1.96	OK
	1-8 to 1-7	ROAD		2124	90.8	30.7	704.8								
		LOTS		3801	89.6	53.2	758.0								
		RESERVE		0	74.0	0.0	758.0								

Line number	MH to MH number	Flow From description	Catchment letter	Catchment Area m2	CN	Peak Flow rate - 10YR ARI l/s	Cum. Flow l/s	Pipe dia m	Ks mm	Gradient %	Capacity l/s	Percent Capacity %	Remaining l/s	Velocity m/s	Check OK
		LINE 3		0	74.0	61.0	819.0	0.825	1.5	0.45	954.2	85.8%	135.2	1.79	OK
	1-7 to 1-6	ROAD		0	90.8	0.0	819.0								
		LOTS		0	89.6	0.0	819.0								
		RESERVE		0	74.0	0.0	819.0	0.825	1.5	0.45	954.2	85.8%	135.2	1.79	OK
	1-6 to 1-5	ROAD		0	90.8	0.0	819.0								
		LOTS		0	89.6	0.0	819.0								
		RESERVE		0	74.0	0.0	819.0	0.825	1.5	0.45	954.2	85.8%	135.2	1.79	OK
	1-5 to 1-4	ROAD		1643	90.8	23.8	842.8								
		LOTS		1020	89.6	14.3	857.1								
		RESERVE		0	74.0	0.0	857.1	0.825	1.5	0.45	954.2	89.8%	97.1	1.79	OK
	1-4 to 1-3	ROAD		1007	90.8	14.6	871.6								
		LOTS		502	89.6	7.0	878.7								
		RESERVE		0	74.0	0.0	878.7	0.825	1.5	0.50	1005.8	87.4%	127.2	1.88	OK
	1-3 to 1-2	ROAD		0	90.8	0.0	878.7								
		LOTS		0	89.6	0.0	878.7								
		RESERVE		0	74.0	0.0	878.7	0.825	1.5	0.50	1005.8	87.4%	127.2	1.88	OK
	1-2 to 1-1	ROAD		0	90.8	0.0	878.7								
		LOTS		0	89.6	0.0	878.7								
		RESERVE		0	74.0	0.0	878.7	0.825	1.5	0.50	1005.8	87.4%	127.2	1.88	OK
LINE 2	2-13 to 2-12	ROAD		1416	90.8	20.5	20.5								
		LOTS		0	89.6	0.0	20.5								
		RESERVE		820	74.0	6.3	26.8	0.300	1.5	5.67	234.3	11.4%	207.5	3.31	OK
	2-12 to 2-11	ROAD		1196	90.8	17.3	44.1								
		LOTS		0	89.6	0.0	44.1								
		RESERVE		793	74.0	6.1	50.2								
		LINE 9				62.9	113.1	0.375	1.5	0.70	148.6	76.1%	35.5	1.35	OK
	2-11 to 2-10	ROAD		446	90.8	6.5	119.5								
		LOTS		0	89.6	0.0	119.5								
		RESERVE		0	74.0	0.0	119.5	0.375	1.5	0.70	148.6	80.4%	29.1	1.35	OK
	2-10 to 2-9	ROAD		0	90.8	0.0	119.5								
		LOTS		0	89.6	0.0	119.5								
		RESERVE		0	74.0	0.0	119.5	0.375	1.5	1.97	249.3	47.9%	129.8	2.26	OK
	2-9 to 2-8	ROAD		0	90.8	0.0	119.5								
		LOTS		0	89.6	0.0	119.5								
		RESERVE		0	74.0	0.0	119.5	0.375	1.5	0.73	151.8	78.8%	32.2	1.37	OK
	2-8 to 2-7	ROAD		0	90.8	0.0	119.5								
		LOTS		0	89.6	0.0	119.5								
		RESERVE		0	74.0	0.0	119.5	0.375	1.5	0.69	147.5	81.0%	28.0	1.34	OK
	2-7 to 2-6	ROAD		1473	90.8	21.3	140.8								
		LOTS		2475	89.6	34.7	175.5								
		RESERVE		0	74.0	0.0	175.5	0.450	1.5	0.60	222.8	78.7%	47.4	1.40	OK
	2-6 to 2-5	ROAD		0	90.8	0.0	175.5								
		LOTS		0	89.6	0.0	175.5								
		RESERVE		0	74.0	0.0	175.5	0.450	1.5	0.60	222.8	78.7%	47.4	1.40	OK
	2-5 to 2-4	ROAD		0	90.8	0.0	175.5								
		LOTS		0	89.6	0.0	175.5								
		RESERVE		0	74.0	0.0	175.5								
		LINE8				88.9	264.4	0.525	1.5	0.50	305.6	86.5%	41.2	1.41	OK
	2-4 to 2-3	ROAD		994	90.8	14.4	278.8								
		LOTS		913	89.6	12.8	291.6								
		RESERVE		0	74.0	0.0	291.6	0.525	1.5	0.60	334.8	87.1%	43.2	1.55	OK
	2-3 to 2-2	ROAD		1209	90.8	17.5	309.1								

Line number	MH to MH number	Flow From description	Catchment letter	Catchment Area m2	CN	Peak Flow rate - 10YR ARI l/s	Cum. Flow l/s	Pipe dia m	Ks mm	Gradient %	Capacity l/s	Percent Capacity %	Remaining l/s	Velocity m/s	Check OK
		LOTS		1672	89.6	23.4	332.5								
		RESERVE		0	74.0	0.0	332.5	0.600	1.5	0.40	388.8	85.5%	56.3	1.38	OK
	2-2 to 2-1	ROAD		0	90.8	0.0	332.5								
		LOTS		0	89.6	0.0	332.5								
		RESERVE		0	74.0	0.0	332.5	0.600	1.5	0.55	455.9	72.9%	123.5	1.61	OK
	2-1 to 2-0	ROAD		1264	90.8	18.3	350.8								
		LOTS		1028	89.6	14.4	365.2								
		RESERVE		0	74.0	0.0	365.2								
		LINE 15			75.0	34.9	400.0	0.600	1.5	0.60	476.2	84.0%	76.2	1.68	OK
LINE 3	3-6 to 3-5	ROAD		602	90.8	8.7	8.7								
		LOTS		1075	89.6	15.1	23.8								
		RESERVE		0	74.0	0.0	23.8	0.225	1.5	0.40	29.0	82.0%	5.2	0.73	OK
	3-5 to 3-4	ROAD		0	90.8	0.0	23.8								
		LOTS		0	89.6	0.0	23.8								
		RESERVE		0	74.0	0.0	23.8	0.225	1.5	0.40	29.0	82.0%	5.2	0.73	OK
	3-4 to 3-3	ROAD		112	90.8	1.6	25.4								
		LOTS		2128	89.6	29.8	55.2								
		RESERVE		0	74.0	0.0	55.2	0.300	1.5	0.40	62.2	88.7%	7.0	0.88	OK
	3-3 to 3-2	ROAD		0	90.8	0.0	55.2								
		LOTS		0	89.6	0.0	55.2								
		RESERVE		0	74.0	0.0	55.2	0.300	1.5	0.40	62.2	88.7%	7.0	0.88	OK
	3-2 to 3-1	ROAD		402	90.8	5.8	61.0								
		LOTS		0	89.6	0.0	61.0								
		RESERVE		0	74.0	0.0	61.0	0.300	1.5	0.50	69.5	87.7%	8.5	0.98	OK
	3-1 to 1-8	ROAD		0	90.8	0.0	61.0								
		LOTS		0	89.6	0.0	61.0								
		RESERVE		0	74.0	0.0	61.0	0.300	1.5	0.50	69.5	87.7%	8.5	0.98	OK
LINE 4	4-3 to 4-2	ROAD		690	90.8	10.0	10.0								
		LOTS		3173	89.6	44.4	54.4								
		RESERVE		0	74.0	0.0	54.4	0.300	1.5	0.40	62.2	87.5%	7.8	0.88	OK
	4-2 to 4-1	ROAD		191	90.8	2.8	57.2								
		LOTS		0	89.6	0.0	57.2								
		RESERVE		0	74.0	0.0	57.2	0.300	1.5	0.50	69.5	82.2%	12.4	0.98	OK
	4-1 to 1-9	ROAD		0	90.8	0.0	57.2								
		LOTS		0	89.6	0.0	57.2								
		RESERVE		0	74.0	0.0	57.2	0.300	1.5	0.50	69.5	82.2%	12.4	0.98	OK
LINE 5	5-2 to 5-1	ROAD		403	90.8	5.8	5.8								
		LOTS		0	89.6	0.0	5.8								
		RESERVE		0	74.0	0.0	5.8	0.300	1.5	0.40	62.2	9.4%	56.4	0.88	OK
	5-1 to 1-10	ROAD		634	90.8	9.2	15.0								
		LOTS		0	89.6	0.0	15.0								
		RESERVE		0	74.0	0.0	15.0	0.300	1.5	0.40	62.2	24.1%	47.2	0.88	OK
LINE 6	6-3 to 6-2	ROAD		869	90.8	12.6	12.6								
		LOTS		4068	89.6	57.0	69.5								
		RESERVE		0	74.0	0.0	69.5	0.375	1.5	0.40	112.3	61.9%	42.8	1.02	OK
	6-2 to 6-1	ROAD		429	90.8	6.2	75.7								
		LOTS		3284	89.6	46.0	121.7								
		RESERVE		0	74.0	0.0	121.7	0.450	1.5	0.50	203.4	59.8%	81.7	1.28	OK
	6-1 to 1-13	ROAD		0	90.8	0.0	121.7								

Line number	MH to MH number	Flow From description	Catchment letter	Catchment Area m2	CN	Peak Flow rate - 10YR ARI l/s	Cum. Flow l/s	Pipe dia m	Ks mm	Gradient %	Capacity l/s	Percent Capacity %	Remaining l/s	Velocity m/s	Check OK
		LOTS		0	89.6	0.0	121.7								
		RESERVE		0	74.0	0.0	121.7	0.450	1.5	0.40	181.9	66.9%	60.2	1.14	OK
LINE 7	7-3 to 7-2	ROAD		901	90.8	13.0	13.0								
		LOTS		4523	89.6	63.3	76.4								
		RESERVE		0	74.0	0.0	76.4	0.375	1.5	0.40	112.3	68.0%	36.0	1.02	OK
	7-2 to 7-1	ROAD		210	90.8	3.0	79.4								
		LOTS		0	89.6	0.0	79.4								
		RESERVE		0	74.0	0.0	79.4	0.375	1.5	0.40	112.3	70.7%	32.9	1.02	OK
	7-1 to 1-14	ROAD		782	90.8	11.3	90.7								
		LOTS		1587	89.6	22.2	112.9								
		RESERVE		0	74.0	0.0	112.9	0.375	1.5	0.50	125.6	89.9%	12.6	1.14	OK
LINE 8	8-6 to 8-5	ROAD		493	90.8	7.1	7.1								
		LOTS		0	89.6	0.0	7.1								
		RESERVE		1829	74.0	14.0	21.2	0.300	1.5	1.99	138.8	15.3%	117.6	1.96	OK
	8-5 to 8-4	ROAD		0	90.8	0.0	21.2								
		LOTS		1602	89.6	22.4	43.6								
		RESERVE		0	74.0	0.0	43.6	0.300	1.5	3.88	193.8	22.5%	150.2	2.74	OK
	8-4 to 8-3	ROAD		0	90.8	0.0	43.6								
		LOTS		739	89.6	10.3	54.0								
		RESERVE		0	74.0	0.0	54.0	0.300	1.5	3.94	195.3	27.6%	141.3	2.76	OK
	8-3 to 8-2	ROAD		0	90.8	0.0	54.0								
		LOTS		854	89.6	12.0	65.9								
		RESERVE		0	74.0	0.0	65.9	0.300	1.5	3.93	195.0	33.8%	129.1	2.76	OK
	8-2 to 8-1	ROAD		0	90.8	0.0	65.9								
		LOTS		768	89.6	10.8	76.7								
		RESERVE		0	74.0	0.0	76.7	0.300	1.5	3.83	192.5	39.8%	115.9	2.72	OK
	8-1 to 2-4	ROAD		0	90.8	0.0	76.7								
		LOTS		876	89.6	12.3	88.9								
		RESERVE		0	74.0	0.0	88.9	0.300	1.5	1.36	114.7	77.5%	25.8	1.62	OK
LINE 9	9-1 to 2-11	ROAD		1256	90.8	18.2	18.2								
		LOTS		2688	89.6	37.6	55.8								
		RESERVE		923	74.0	7.1	62.9	0.300	1.5	0.56	73.6	85.5%	10.7	1.04	OK
LINE 10	10-2 to 10-1	ROAD		100	90.8	1.4	1.4								
		LOTS		0	89.6	0.0	1.4								
		RESERVE		0	74.0	0.0	1.4	0.825	1.5	0.44	943.5	0.2%	942.1	1.77	OK
LINE 11	11-2 to 11-1	ROAD		11785	90.8	170.5	170.5								
		LOTS		37639	89.6	527.1	697.5								
		RESERVE		0	74.0	0.0	697.5	0.675	1.5	0.90	795.6	87.7%	98.1	2.22	OK
LINE 12	12-2 to 12-1	ROAD		4828	90.8	69.8	69.8								
		LOTS		14724	89.6	206.2	276.0								
		RESERVE		0	74.0	0.0	276.0	0.450	1.5	1.20	315.2	87.6%	39.1	1.98	OK
LINE 13	13-3 to 13-2	ROAD		4253	90.8	61.5	61.5								
		LOTS		3021	89.6	42.3	103.8								
		RESERVE		0	74.0	0.0	103.8	0.375	1.5	0.50	125.6	82.7%	21.8	1.14	OK
LINE 14	14-5 to 14-4	ROAD		723	90.8	10.5	10.5								

Line number	MH to MH number	Flow From description	Catchment letter	Catchment Area m2	CN	Peak Flow rate - 10YR ARI l/s	Cum. Flow l/s	Pipe dia m	Ks mm	Gradient %	Capacity l/s	Percent Capacity %	Remaining l/s	Velocity m/s	Check OK
		LOTS		0	89.6	0.0	10.5								
		RESERVE		0	74.0	0.0	10.5	0.225	1.5	2.30	69.5	15.0%	59.0	1.75	OK
	14-4 to 14-3	ROAD		0	90.8	0.0	10.5								
		LOTS		0	89.6	0.0	10.5								
		RESERVE		0	74.0	0.0	10.5	0.225	1.5	3.50	85.7	12.2%	75.3	2.16	OK
	14-3 to 14-2	ROAD		2282	90.8	33.0	43.5								
		LOTS		0	89.6	0.0	43.5								
		RESERVE		1044	74.0	8.0	51.5	0.225	1.5	2.00	64.8	79.4%	13.3	1.63	OK
	14-2 to 14-1	ROAD		0	90.8	0.0	51.5								
		LOTS		0	89.6	0.0	51.5								
		RESERVE		0	74.0	0.0	51.5	0.225	1.5	2.00	64.8	79.4%	13.3	1.63	OK
LINE 15	15-1 to 2-1	ROAD		2410	90.8	34.9	34.9								
		LOTS		0	89.6	0.0	34.9								
		RESERVE		0	74.0	0.0	34.9	0.300	1.5	0.40	62.2	56.1%	27.3	0.88	OK
LINE 16	16-2 to 16-1	ROAD		566	90.8	8.2	8.2								
		LOTS		0	89.6	0.0	8.2								
		RESERVE		0	74.0	0.0	8.2	0.225	1.5	0.50	32.4	25.3%	24.2	0.81	OK
	16-1 to 13-2	ROAD		901	90.8	13.0	21.2								
		LOTS		0	89.6	0.0	21.2								
		RESERVE		0	74.0	0.0	21.2	0.225	1.5	0.50	32.4	65.5%	11.2	0.81	OK
LINE 17	17-2 to 17-1	ROAD		0	90.8	0.0	0.0								
		LOTS		0	89.6	0.0	0.0								
		RESERVE		3972	74.0	30.5	30.5	1.500	0.6	1.15	8151.0	0.4%	8120.5	4.61	OK

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Site coverage	Author: RH	Date: 15/06/2026	Checked: BB

Site coverage coefficients based on AKL TP108

Site Characteristics:

Pre-development land-use	Coverage	CN
Impervious area	0%	98
Pervious area	100%	74
Runoff coefficient		74

Post-development land-use roads	Coverage	CN
Impervious area	74%	98
Pervious area	26%	74
Runoff coefficient		91.76

Post-development land-use lots 500m²	Coverage	CN
Impervious area	65%	98
Pervious area	35%	74
Runoff coefficient		89.6

Post-development land-use lots 1000m²	Coverage	CN
Impervious area	38%	98
Pervious area	62%	74
Runoff coefficient		83.12

Post-development land-use reserves	Coverage	CN
Impervious area	0%	98
Pervious area	100%	74
Runoff coefficient		74.00

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Existing Catchment coverage	Author RH	Date 15/06/2026	Checked BB

Site coverage coefficients based on AKL TP108

Pre Development catchments:

Catchment 1	Impervious Coverage	CN	Area m²
Impervious Area	100%	98	54166
Pervious Area	0%	74.00	112908
Total	32%	81.78	167074

Catchment 2	Impervious Coverage	CN	Area m²
Impervious Area	100%	98	122
Pervious Area	0%	74.00	74334
Total	0.16%	74.04	74456

Pre Development total site coverage:

Full site	Impervious Coverage	CN	Area m²
Impervious Area	100%	98	54288
Pervious Area	0%	74.00	187242
Total	22%	79.39	241530

Maven Associates	Job Number 135041	Sheet 3	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Post Development Catchment coverage	Author RH	Date 15/06/2026	Checked BB

Site coverage coefficients based on AKL TP108

Pond catchments:

Catchment A - Wetland A	Impervious Coverage	CN	Area m²
Roads	74%	91.76	35981
Lots 500m²	65%	89.6	50968
Lots 1000m²	38%	83.12	0
Reserve Area	0%	74.00	14150
Total	59%	88.19	101099

Catchment Raingarden B	Impervious Coverage	CN	Area m²
Roads	74%	91.76	12349
Lots 500m²	65%	89.6	37075
Lots 1000m²	38%	83.12	0
Reserve Area	0%	74.00	2538
Total	64%	89.35	51962

Catchment Raingarden C	Impervious Coverage	CN	Area m²
Roads	74%	91.76	4828
Lots 500m²	65%	89.6	14571
Lots 1000m²	38%	83.12	0
Reserve Area	0%	74.00	683
Total	65%	89.59	20082

Catchment Pond D	Impervious Coverage	CN	Area m²
Roads	74%	91.76	4543
Lots 500m²	65%	89.6	669
Lots 1000m²	38%	83.12	0
Reserve Area	0%	74.00	41935
Total	8%	75.93	47147

Catchment E	Impervious Coverage	CN	Area m²
Roads	74%	91.76	2395
Lots 500m²	65%	89.6	5038
Lots 1000m²	38%	83.12	0
Reserve Area	0%	83.12	13805
Total	24%	85.63	21238

Post development full site coverage:

Full site	Impervious Coverage	CN	Area m²
Roads	74%	91.76	60096
Lots < 500m²	65%	89.6	108321
Lots > 500m²	38%	83.12	0
Reserve Area	0%	83.12	73111
Total	48%	88.18	241528

Maven Associates	Job Number 135041	Sheet 4	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Wetland Preliminary Design - Runoff - Water Quality	Author RH	Date 15/06/2026	Checked BB

Estimated Post Development Residential Land Use (per 1000m²)

Catchment		A (m²)	A (ha)	CN
Land use in Runoff Calculations Sheet "Post Development Catchment Coverage"				
Catchment A	Post development Impervious %	59.1%	10.1099	88.19
Catchment B	Post development Impervious %	64.0%	5.1962	89.35
Catchment C	Post development Impervious %	65.0%	2.0082	89.59
Catchment D	Post development Impervious %	8.1%	4.7147	75.93
Catchment E	Post development Impervious %	23.8%	2.1238	85.63

Design Storm

Storm Event	90% rainfall event
Water Quality Storm (WQS)	17.50

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Subcatchment Info - Pre Development

CN (Catchment 1)	81.78		
CN (Catchment 2)	74.04		
2-yr 24-hr rainfall	72.42	mm	← *Hasting rainfall charts including 2.1C climate change*
10-yr 24-hr rainfall	120.30	mm	← *Hasting rainfall charts including 2.1C climate change*
100-yr 24-hr rainfall	197.39	mm	← *Hasting rainfall charts including 2.1C climate change*

Subcatchment	Area	Q_2	V_2	Q_{10}	V_{10}	Q_{100}	V_{100}
1	16.71 ha	1.03m³/s	7,150m³	2.02m³/s	13,770m³	3.76m³/s	25,370m³
2	7.45 ha	0.31m³/s	2,140m³	0.71m³/s	4,810m³	1.45m³/s	9,720m³
Total	24.15 ha	1.33m³/s	9,290m³	2.73m³/s	18,580m³	5.21m³/s	35,090m³

**Runoff rates and volumes determined using HEC-HMS*

Subcatchment Info - Post Development

C	See above table		
2-yr 24-hr rainfall	72.4	mm	← *Hasting rainfall charts including 2.1C climate change*
10-yr 24-hr rainfall	120.3	mm	← *Hasting rainfall charts including 2.1C climate change*
100-yr 24-hr rainfall	197.4	mm	← *Hasting rainfall charts including 2.1C climate change*
Event duration (D)	3600	s	

	Subcatchment	Area	Q_2	V_2	Q_{10}	V_{10}	Q_{100}	V_{100}
EX. 2	A	10.11 ha	0.80m³/s	5,490m³	1.44m³/s	9,820m³	2.53m³/s	17,140m³
	D	4.71 ha	0.22m³/s	1,520m³	0.48m³/s	3,250m³	0.95m³/s	6,400m³
	Total existing outlet 2	14.82 ha	1.01m³/s	7,010m³	1.92m³/s	13,070m³	3.49m³/s	23,540m³
EX. 1	B	5.20 ha	0.43m³/s	2,940m³	0.76m³/s	5,190m³	1.33m³/s	8,980m³
	C	2.01 ha	0.17m³/s	1,140m³	0.30m³/s	2,020m³	0.52m³/s	3,480m³
	E	2.12 ha	0.12m³/s	0,830m³	0.24m³/s	1,650m³	0.46m³/s	3,100m³
	Total existing outlet 1	9.33 ha	0.71m³/s	4,910m³	1.30m³/s	8,860m³	2.30m³/s	15,560m³
	Total site	24.15 ha	1.73m³/s	11,920m³	3.22m³/s	21,930m³	5.79m³/s	39,100m³

**Runoff rates and volumes determined using HEC-HMS*

Water Quality Volumes (WQV)

Subcatchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
A	10.11 ha	59%	59,755m³	0.018m	1,046m³
D	4.71 ha	8%	3,797m³	0.018m	0,066m³
B	5.20 ha	64%	33,237m³	0.018m	0,582m³
C	2.01 ha	65%	13,044m³	0.018m	0,228m³
E	2.12 ha	24%	5,047m³	0.018m	0,088m³

**Water quality rainfall calculated per SW Management Guidelines for the Hawkes Bay region 6.3.4*

**A_{wq} & WQV calculated per SW Management Guidelines for the Hawkes Bay region 6.3.4*

Maven Associates	Job Number 135041	Sheet 2	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Wetland Preliminary Design - Runoff - Water Quality	Author RH	Date 26/05/2026	Checked BB

Estimated Post Development Residential Land Use (per 1000m²)

Catchment		% Imp	A (ha)	CN
Land use in Runoff Calculations Sheet *F:\MAVEN\Projects\135041 BROOKVALE\Excel\Stormwater\SW Runoff summary TP108.xlsx*				
Catchment A	Post development Impervious %	59.1%	10.11	88.19

Design Storm

Storm Event	90% rainfall event
Water Quality Storm (WQS)	17.50

**WQS Rainfall is from fig. 6-5 in the Stormwater Management Guidelines for the Hawkes Plenty region 6.3.1, page 71*

Subcatchment Info - Pre Development

Subcatchment	Area	Q_2	Q_{10}	Q_{100}	V_{100}
1	16.71 ha	1.03m³/s	2.02m³/s	3.76m³/s	25,370m³
2	7.45 ha	0.31m³/s	0.71m³/s	1.45m³/s	9,720m³
Total	24.15 ha	1.33m³/s	2.73m³/s	5.21m³/s	35,090m³

**Runoff rates determined using ARC TP108*

Wetland Catchment Info - Post Development

CN	88.19		
2-yr 1-hr rainfall	72.4	mm	← *Hasting rainfall charts including 2.1C climate change*
10-yr 1-hr rainfall	120.3	mm	← *Hasting rainfall charts including 2.1C climate change*
100-yr 1-hr rainfall	197.4	mm	← *Hasting rainfall charts including 2.1C climate change*
Event duration (D)	3600	s	

Subcatchment	Area	Q_2	V_2	Q_{10}	V_{10}	Q_{100}	V_{100}
A	10.11 ha	0.80m³/s	5,490m³	1.44m³/s	9,820m³	2.53m³/s	17,140m³

**Runoff rates determined using ARC TP108*

**Volume using ARC TP108*

Water Quality Volumes (WQV)

Subcatchment	Area	Impervious	A_{EFF}	Water quality rainfall	WQV
A	10.11 ha	59%	59,755m³	0.018m	1,046m³

**Water quality rainfall calculated per SW Management Guidelines for the Hawkes Bay region 6.3.4*

**A_{wq} & WQV calculated per SW Management Guidelines for the Hawkes Bay region 6.3.4*

Attenuation targets

Pre development	Pre Q_2	Pre Q_{10}	80% Pre Q_{100}
Catchments 1 and 2	1.33m³/s	2.73m³/s	4.17m³/s

Post development	Post Q_2	Post Q_{10}	Post Q_{100}
Catchments B, C, D, E	0.93m³/s	1.78m³/s	3.26m³/s
Wetland A outlet	0.40m³/s	0.95m³/s	0.91m³/s
Total	1.33m³/s	2.73m³/s	4.17m³/s

Full site Detention targets

	Pre	Post	Pre to post
V_2	9,290m³	11,920m³	2,630m³
V_{10}	18,580m³	21,930m³	3,350m³
V_{100}	35,090m³	39,100m³	4,010m³

Maven Associates	Job Number 135041	Sheet 3	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Wetland Preliminary Design - Wetland A	Author RH	Date 15/06/2026	Checked BB

Wetland A Design Considerations

Wetland function	Treatment and detention
Peak flow control	100 Year
Stream channel erosion control	Yes
Extended detention (ED)	Yes, for stream protection

Wetland A Sizing and Dimensions

Percentage of catchment area	2	%	← *per SW Management Guidelines for the Hawkes Bay region 7.47*
Min. wetland area	2,022	m²	
Width to Length Ratio	1:8	OK	*min. 1:3. Not critical when ED provided*
Length x Width	127m × 16m		

Wetland A Depth Requirements

Wetland Design Type	Banded bathymetric		
Dead Storage 0.5–1.0m Depth	40% total wetland area		← *per SW Management Guidelines for the Hawkes Bay region 7.47*
Dead Storage 0–0.5m Depth	60% total wetland area		← *per SW Management Guidelines for the Hawkes Bay region 7.47*
Forebay Depth	1.5	m	*Min. 1m, Max. 2m*

Wetland A Catchment Information *(from tables in calc sheet runoff and water quality)*

Parameter	Allowed outflow	Post-development
Q_2	0.40m³/s	
V_2		5,490m³
Q_{10}	0.95m³/s	
V_{10}		9,820m³
Q_{100} (maximum discharge rate)	0.91m³/s	
V_{100}		17,140m³
WQV		1,046m³
ED volume *(1.2x WQV)*		1,255m³

Wetland A Summary

Actual Wetland surface area	2,426	m²	
Permanent WQV *(adjusted)*	523	m³	← *WQV reduced by 50% as pond discharges 1.2x WQV over 24hrs*
Forebay vol *(30% adjusted WQV)*	157	m³	← *per SW Management Guidelines for the Hawkes Bay region 7.47*
Permanent water level (PWL)	9.49	RL	← *RL set to gravity drain to northern stream*
Permanent water depth	0.48	m	← *from Bathymetry table below*
Batter slope	1:5		

Bathymetry

Catchment	Area	Pool Area	Depth	RL	Volume	
Shallow Marsh	1,456m²	60%	0–0.5m	9.24	0,364m³	←*Appx*
Deep Marsh/Outlet Zone	0,866m²	40%	0.5–1.0m	8.74	0,649m³	←*Appx*
Forebay	0,105m²		1.50m	7.99	0,157m³	
		Av.	0.48m			

	Elevation	Available Volume	Depth	Depth above PWL	
Stage-storage Wetland only	9.01 RL	0m³	0.0m	-0.5m	
	9.49 RL	1,170m³	0.48m	*0.0m*	*Approx. actual dead storage (PWV)*
	9.6 RL	0,248m³	0.6m	*0.1m*	*Vol. Excluding dead storage*
	9.7 RL	0,505m³	0.7m	*0.2m*	
	9.8 RL	0,772m³	0.8m	*0.3m*	
	9.9 RL	1,047m³	0.9m	*0.4m*	
	10.0 RL	1,439m³	1.0m	*0.5m*	*ED*
Stage-storage Wetland and detention area	10.1 RL	3,534m³	1.1m	*0.6m*	
	10.2 RL	4,112m³	1.2m	*0.7m*	
	10.3 RL	4,722m³	1.3m	*0.8m*	
	10.4 RL	5,351m³	1.4m	*0.9m*	
	10.5 RL	6,001m³	1.5m	*1.0m*	*Emergency spillway RL 10.54*
	10.6 RL	6,673m³	1.6m	*1.1m*	
	10.7 RL	7,368m³	1.7m	*1.2m*	
	10.8 RL	8,083m³	1.8m	*1.3m*	
	10.9 RL	8,811m³	1.9m	*1.4m*	
	11.0 RL	9,180m³	2.0m	*1.5m*	

Event	Elevation	Available Volume	Storage Depth	Pond depth	Required Volume From HEC-HMS	
ED	9.95 RL	1,255m³	0.46m	0.95	1,255m³	**OK**
2YR	10.06 RL	2,630m³	0.57m	1.05	2,630m³	**OK**
10YR	10.21 RL	4,160m³	0.72m	1.20	4,160m³	**OK**
100YR	10.49 RL	5,920m³	1.00m	1.48	5,920m³	**OK**

Adjust storage depth until avaliable volume equals required volume

Maven Associates	Job Number 298002	Sheet 4	Rev A
Job Title: Brookvale Green Havelock North Calc Title: Wetland Design, Inlet and outlet sizing -	Author RH	Date 15/06/2026	Checked BB

Wetland A Outlet Sizing - Extended Detention Outlet

Lowest outlet =	Extended detention outlet		
Permanent WQV storage	523	m³	← *50% WQV for live storage*
ED live storage	1,255	m³	
ED and WQV live storage	1,778	m³	
ED Depth to PWL	0.46	m	
Live storage WSE	9.95	RL	
Q_{ED} *(= ED / 24hrs)*	0.015	m³/s	
Q_{max} *(= 2Q ED)*	0.029	m³/s	← *Outflow should not exceed Qmax*
ED orifice/outflow size	140	mm	
ED orifice/outflow height	0.392961494	m	
Q *(= 0.62A(2gh)^1/2)*	0.027	m³/s	OK *Q is less than Qmax*
Cover plate required	NO		*ED orifice exceeds 50mm*

Wetland A Outlet Sizing - Overflow Weir - 2YR

WQV	523	m³	← *50% WQV for live storage*
2YR pre dev flow rate	0.404	m³/s	← *Outflow should not exceed pre development flows*
2YR post dev vol	5490	m³	
2YR pond volume required	6,013	m³	
Ponded water level	10.06	RL	
Weir invert level (ED level)	9.95	RL	
$h_{ED\ orifice}$	0.50	m	
Q_{ED} *(= 0.62A(2gh)^1/2)*	0.030	m³/s	
Weir type	Broad crested		
Weir width (L_{weir})	1.89	m	
h_{weir}	0.10	m	
Q_{weir} *(= 1.7 x L weir x h weir ^1.5)*	0.108	m³/s	
2YR weir flow	0.137	m³/s	OK *Qpost is less than Qpre*
			Pre vs post irrelevant due to discharge to internal attenuation area

Wetland A Outlet Sizing - Overflow Weir - 10YR

WQV	523	m³	← *50% WQV for live storage*
10YR pre dev flow rate	0.95	m³/s	← *Outflow should not exceed pre development flows*
10YR post dev vol	9820	m³	
10YR pond volume required	10,343	m³	
Ponded water level	10.2	RL	
Weir invert level (ED level)	10.0	RL	
$h_{ED\ orifice}$	0.65	m	
Q_{ED} *(= 0.62A(2gh)^1/2)*	0.03	m³/s	
Weir type	Broad crested		
Weir width (L_{weir})	1.89	m	
h_{weir}	0.25	m	
Q_{weir} *(= 1.7 x L weir x h weir)*	0.41	m³/s	
10YR weir flow	0.45	m³/s	OK *Qpost is less than Qpre*

Wetland A Outlet Sizing - Overflow Weir - 100YR

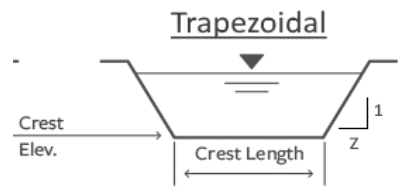
WQV	523	m³	← *50% WQV for live storage*
100YR pre dev flow rate	0.91	m³/s	← *Outflow should not exceed pre development flows*
100YR post dev vol	17140	m³	
100YR pond volume required	17,663	m³	
Ponded water level	10.5	RL	
Weir invert level (ED level)	10.0	RL	
$h_{ED\ orifice}$	0.93	m	
Q_{ED} *(= 0.62A(2gh)^1/2)*	0.04	m³/s	
Weir type	Broad crested		
Weir width (L_{weir})	1.89	m	
h_{weir}	0.53	m	
Q_{weir} *(= 1.7 x L weir x h weir)*	1.26	m³/s	
100YR weir flow	1.30	m³/s	NOT OK *Qpost exceeds 80% Qpre*

Wetland A Outlet Sizing - Outlet pipe - 100YR

100YR post dev flow rate	1.30	m³/s	← *Outlet should be designed to take design flows*
Outlet Pipe dia	0.9	m	
Pipe grade	0.55	%	
Pipe Ks factor	1.5		
Velocity	2.08	m/s	
Capacity	1.33	m³/s	OK

Wetland A Emergency Spillway - 100YR

Gravity	g =	9.81	m/s²
Crest length	L =	24	m
Depth of design flow	h =	0.157	m
Side slope 1:Z	Z =	3	m
100YR post dev design flow rate	Q =	2.534	m³/s
100YR post dev spillway flow rate	Q =	2.552	m³/s
100YR post dev spillway velocity	V=	0.664	m/s



← *spillway should be designed to take design flows*

Wetland A HEC-HMS Results

Total site run off	Q_2	Q_{10}	Q_{100}	80% Q_{100}
Pre development	1.33m³/s	2.73m³/s	5.21m³/s	4.17m³/s
Post development	1.02m³/s	1.96m³/s	4.15m³/s	

Maven Associates	Job Number	Sheet	Rev
	135041	1	A
Job Title: 174-176 Brookvale Road, Havelock North	Author	Date	Checked
Calc Title: Wastewater Discharge	RH	18/06/2026	BB

As per HDC Engineering Code of Practice 2020 & NZS4404:

Discharge Rates

Average dry weather flow =	250	litres/person/day
Peak dry weather diurnal flow (2.5x) =	625	litres/person/day
Peak wet weather flow (1.5x) =	938	litres/person/day

Population

No. of Dwelling	People	Occupancy
203	3.5	**710.5**

Discharges

	Persons	Rate l/p/day	Flow l/s
ADWF	710.5	250	2.056
PDWDF	710.5	625	5.140
PWWF	710.5	938	**7.709**

Pipe Capacity Check

Pipe K	PWWF	Pipe dia	Gradient	Capacity	Velocity	
	l/s	m	%	l/s	m/s	
0.6	litres/person/day	0.15	0.55	13.31	0.75	OK

MAVEN ASSOCIATES	Job Number	Sheet	Rev
	135041	1	A
Job Title: 174-176 Brookvale Road, Havelock North	Author	Date	Checked
Calc Title: Site Water Demand	RH	30.4.2026	BB

As per HDC Engineering Code of Practice 2020 & NZS4404:

3 people per dwelling

Demand = 400 l/person/day

Demand Rates

Average Demand = 400 litres/person/day

Peak Demand (2x) = 800 litres/person/day

Population	Dwellings	People	Occupancy
Proposed Dwellings	203	3	609

Demand	Persons	Rate l/p/day	Flow l/s
AD Water	609	400	2.82
PD Water	609	800	5.64

Peak Demand	Persons	Rate l/p/day	Flow l/s
PD Water	609	800	**5.64**

Maven Associates	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Calc Title: Wetland A Detention Basin Orifice Size Calc	Author: RH	Date: 15/06/2026	Checked: BB

Detention Volume

1565.00 m^3

Flow Rate (Q_p) if released over 24 hours

0.01811 m^3/sec (Average Discharge Flow-Rate)

Dry Detention Pond Details

Water Height 1.950 m

Orifice Height 0.000 m (Above base of detention area)

Orifice Sizing (to atmo)

$Q_P=0.62*A*(2*G*H_{2/3})^{1/2}$

Q_P	0.01811	m^3/sec (Peak Discharge Flow-Rate)
G=	9.810	m^2/sec
H_T=	1.950	m (Height of water above Discharge Point)
$H_{2/3}$=	1.300	m (Average Head of Water in pond = Two-Thirds of H_T)

A= 0.005785 m^2 (Cross-Sectional of the Discharge Pipe)

Circular Area Formula

$A=(\pi*D^2)/4$

A= 0.005785 m^2 (Cross-Sectional of the Discharge Pipe)

D= 0.085822 m (Diameter of Discharge Pipe) = 86 mm

Minimum size 70mm

Use 90mm Orifice

MAVEN ASSOCIATES

Job Number	Sheet	Rev	Job Title: Brookvale Green	Author	Date	Checked
135041	1	A	Calc Title: Wastewater Pipe capacity	RH	17/06/2026	BB

As per HDC COP standards:	3.5	people per dwelling	L/person/day	250
PWWF =	937.5	l/person/day	PEAK DWF Factor	2.5
ks for uPVC =	0.6		Peak WWF Factor	1.5

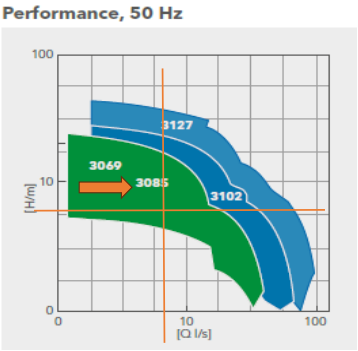
Pipe Line number	Units no	Persons no	PWW Flow l/s	Additional Flow Catchment/Line	Cum. Flow l/s	Pipe dia m	Gradient %	Capacity l/s	Velocity m/s	Check ?
Line A										
A19- to A-18	3	11	0.11	Catchment 1	0.11	0.150	1.00	17.96	1.02	OK
A-18 to A-17	5	18	0.19	Catchment 1	0.30	0.150	1.00	17.96	1.02	OK
A17- to A-16	6	21	0.23	Catchment 1	0.53	0.150	0.60	13.90	0.79	OK
A-16 to A-15	2	7	0.08	Catchment 1	0.61	0.150	0.60	13.90	0.79	OK
A-15 to A-14	0	0	0.00	Catchment 1	0.61	0.150	0.60	13.90	0.79	OK
A-14 to A-13	8	28	0.30	Catchment 1	0.91					
Line H	11	39	0.42	Catchment 8	1.33	0.150	0.60	13.90	0.79	OK
A-13 to A-12	4	14	0.15	Catchment 1	1.48					
Line G	10	35	0.38	Catchment 7	1.86	0.150	0.60	13.90	0.79	OK
A-12 to A-11	3	11	0.11	Catchment 1	1.97	0.150	0.60	13.90	0.79	OK
A-11 to A-10	0	0	0.00	Catchment 1	1.97	0.150	0.60	13.90	0.79	OK
A-10 to A-9	8	28	0.30	Catchment 1	2.28	0.150	0.60	13.90	0.79	OK
A-9 to A-8	8	28	0.30	Catchment 1	2.58					
Line E	7	25	0.27	Catchment 2	2.85	0.150	0.60	13.90	0.79	OK
A-8 to A-7	0	0	0.00	Catchment 1	2.85					
Line D	8	28	0.30	Catchment 4	3.15	0.150	0.60	13.90	0.79	OK
A-7 to A-6	1	4	0.04	Catchment 1	3.19	0.150	0.60	13.90	0.79	OK
A-6 to A-5	1	4	0.04	Catchment 1	3.23	0.150	0.60	13.90	0.79	OK
A-5 to A-4	1	4	0.04	Catchment 1	3.27	0.150	0.60	13.90	0.79	OK
A-4 to A-3	1	4	0.04	Catchment 1	3.30	0.150	0.60	13.90	0.79	OK
A-3 to A-2	0	0	0.00	Catchment 1	3.30					
Line B	87	305	3.30	Catchment 2	6.61	0.150	0.60	13.90	0.79	OK
Line B										
B12- to B-11	7	25	0.27	Catchment 2	0.27	0.150	1.20	19.67	1.11	OK
B11- to B-10	8	28	0.30	Catchment 2	0.57	0.150	1.00	17.96	1.02	OK
B10- to B-9	4	14	0.15	Catchment 2	0.72					
Line M	6	21	0.23	Catchment 13	0.95	0.150	0.60	13.90	0.79	OK
B9- to B-8	2	7	0.08	Catchment 2	1.03					
Line I	11	39	0.42	Catchment 9	1.44	0.150	0.60	13.90	0.79	OK
B8- to B-7	4	14	0.15	Catchment 2	1.60	0.150	0.60	13.90	0.79	OK
B7- to B-6	6	21	0.23	Catchment 2	1.82	0.150	0.60	13.90	0.79	OK
B6- to B-5	8	28	0.30	Catchment 2	2.13	0.150	0.60	13.90	0.79	OK
B5- to B-4	2	7	0.08	Catchment 2	2.20	0.150	0.60	13.90	0.79	OK
B4- to B-3	1	4	0.04	Catchment 2	2.24	0.150	0.60	13.90	0.79	OK
B3- to B-2	2	7	0.08	Catchment 2	2.32	0.150	0.60	13.90	0.79	OK
B2- to B-1	0	0	0.00	Catchment 2	2.32					
Line C	18	63	0.68	Catchment 3	3.00	0.150	0.60	13.90	0.79	OK
B1- to A-3	0	0	0.00	Catchment 3	3.00					
Line L	8	28	0.30	Catchment 12	3.30	0.150	0.60	13.90	0.79	OK
Line C										
C-8- to C-7	2	7	0.08	Catchment 3	0.08	0.150	1.20	19.67	1.11	OK
C-7- to C-6	3	11	0.11	Catchment 3	0.19	0.150	1.00	17.96	1.02	OK
C-6- to C-5	3	11	0.11	Catchment 3	0.30	0.150	0.60	13.90	0.79	OK
C-5- to C-4	0	0	0.00	Catchment 3	0.30	0.150	0.60	13.90	0.79	OK

Pipe Line	Units	Persons	PWW Flow	Additional Flow	Cum. Flow	Pipe dia	Gradient	Capacity	Velocity	Check
number	*no*	*no*	*l/s*	*Catchment/Line*	*l/s*	*m*	*%*	*l/s*	*m/s*	*?*
C-4- to C-3	2	7	0.08	Catchment 3	0.38	0.150	0.60	13.90	0.79	OK
C-3- to C-2	1	4	0.04	Catchment 3	0.42	0.150	0.60	13.90	0.79	OK
C-2- to C-1	1	4	0.04	Catchment 3	0.46	0.150	0.60	13.90	0.79	OK
C-1- to B-2	0	0	0.00	Catchment 3	0.46					
Line K	6	21	0.23	Catchment 4	0.68	0.150	0.60	13.90	0.79	OK
Line D										
D-3- to D-2	8	28	0.30	Catchment 4	0.30	0.150	1.20	19.67	1.11	OK
D-2- to D-1	0	0	0.00	Catchment 4	0.30	0.150	0.60	13.90	0.79	OK
D-1- to A-8	0	0	0.00	Catchment 4	0.30	0.150	1.64	23.00	1.30	OK
Line E										
E-2- to E-1	7	25	0.27	Catchment 5	0.27	0.150	1.20	19.67	1.11	OK
E-1- to A-9	0	0	0.00	Catchment 5	0.27	0.150	0.60	13.90	0.79	OK
Line F										
F-8 to F-7	12	42	0.46	Catchment 6	0.46	0.150	1.00	17.96	1.02	OK
F-7 to F-6	4	14	0.15	Catchment 6	0.61	0.150	1.00	17.96	1.02	OK
F-6 to F-5	1	4	0.04	Catchment 6	0.65	0.150	0.60	13.90	0.79	OK
F-5 to F-4	4	14	0.15	Catchment 6	0.80	0.150	0.60	13.90	0.79	OK
F-4 to F-3	3	11	0.11	Catchment 6	0.91					
Line J	4	14	0.15	Catchment 10	1.06	0.150	0.60	13.90	0.79	OK
F-3 to F-2	1	4	0.04	Catchment 6	1.10	0.150	0.60	13.90	0.79	OK
F-2 to F-1	0	0	0.00	Catchment 6	1.10	0.150	0.60	13.90	0.79	OK
F-1 to A-2	0	0	0.00	Catchment 6	1.10	0.150	0.60	13.90	0.79	OK
Line G										
G-3 to G-2	10	35	0.38	Catchment 7	0.38	0.150	1.00	17.96	1.02	OK
G-2 to G-1	0	0	0.00	Catchment 7	0.38	0.150	1.00	17.96	1.02	OK
G-1 to A-13	0	0	0.00	Catchment 7	0.38	0.150	1.47	21.78	1.23	OK
Line H										
H-3 to H-2	8	28	0.30	Catchment 8	0.30	0.150	1.00	17.96	1.02	OK
H-2 to H-1	3	11	0.11	Catchment 8	0.42	0.150	1.00	17.96	1.02	OK
H-1 to A-14	0	0	0.00	Catchment 8	0.42	0.150	0.86	16.65	0.94	OK
Line I										
I-2 to I-1	9	32	0.34	Catchment 9	0.34	0.150	1.00	17.96	1.02	OK
I-1 to B-9	2	7	0.08	Catchment 9	0.42	0.150	1.00	17.96	1.02	OK
Line J										
J-1 to F-4	4	14	0.15	Catchment 10	0.15	0.150	2.00	25.41	1.44	OK
Line K										
K-5 to K-4	2	7	0.08	Catchment 11	0.08	0.150	1.20	19.67	1.11	OK
K-4 to K-3	1	4	0.04	Catchment 11	0.11	0.150	2.00	25.41	1.44	OK
K-3 to K-2	1	4	0.04	Catchment 11	0.15	0.150	3.00	31.12	1.76	OK
K-2 to K-1	1	4	0.04	Catchment 11	0.19	0.150	6.70	46.52	2.63	OK
K-1 to C-1	1	4	0.04	Catchment 11	0.23	0.150	6.70	46.52	2.63	OK
Line L										
L-4 to L-3	4	14	0.15	Catchment 12	0.15	0.150	1.00	17.96	1.02	OK
L-3 to L-2	2	7	0.08	Catchment 12	0.23	0.150	0.60	13.90	0.79	OK
L-2 to L-1	1	4	0.04	Catchment 12	0.27	0.150	0.60	13.90	0.79	OK
L-1 to B-1	1	4	0.04	Catchment 12	0.30	0.150	0.60	13.90	0.79	OK

Pipe Line	Units	Persons	PWW Flow	Additional Flow	Cum. Flow	Pipe dia	Gradient	Capacity	Velocity	Check
number	*no*	*no*	*l/s*	*Catchment/Line*	*l/s*	*m*	*%*	*l/s*	*m/s*	*?*
Line M										
M-2 to M-1	6	21	0.23	Catchment 13	0.23	0.150	1.00	17.96	1.02	OK
M-1 to B-10	0	0	0.00	Catchment 13	0.23	0.150	1.00	17.96	1.02	OK
Total to Pump station										
Line A			6.61	Catchment 1	6.61					
Line F			1.101	Catchment 6	7.71					
Total PWWF					**7.71**	0.150	0.60	13.90	0.79	OK

Maven Associates Limited

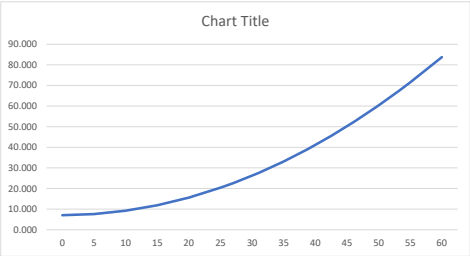
Job: Brookvale Pump Station



Static Pump Head:

			RL	
Invert Level at Pump			5 m	Pump Start
Invert Level at Discharge Manhole			11.5 m	
hs	Head	=	6.5 m	
Discharge Pipework Required		=	150 mm	
Distance from Pump to Discharge		=	580 m	
Diameter of Rising Main		=	150mm OD PE 100 SDR 13.6 PN 12.5	
	ID	=	150 mm	
Velocity range DP06		=	0.9 to 1.5 m/s	
Inflow to Pump Station		=	7.71 L/s	WWPF
Minimum to pump		=	2.1 L/s	ADWF
		=	4.2 L/s	PDWDF
Desired Pump Start/Stop		=	6 max	

Diameter wetwell	=	2.4 m		
Area of Chamber	=	4.52 m2		
Depth between duty start/stop	=	0.27 m		
Volume in Pump Chamber	=	1220.4 Litres		
Time taken to fill chamber	=	158.2879 sec	0.043969 hr	PWWF
		581.1429 sec	0.161429 hr	ADWF
		290.5714 sec	0.080714 hr	PDWDF



Head Loss: $hf=635 \times n^2(V/D^{2/3})^2$ m/100m

hf = friction loss
v = velocity in m/s
n = Mannings coefficient 0.012
D = Rising main ID in m 0.15

$hf = 0.09144 \times 12.54715\ v^2$

$hf = 1.147\ v^2$ (A)

$Q=vA$ $A= \pi r^2$

$v=Q/A$ $= 0.017671$

$v = 56.588\ Q$ (B)

7.71 L/s

Use: 3085 Flygt Pumps 27.7m3/hr m3/hr

	Q(L/s)	0	5	10	15	20	25	30	35	40	45	50	55	60
USE (B):	V (m/s)	0	0.283	0.566	0.849	1.132	1.415	1.698	1.981	2.264	2.546	2.829	3.112	3.395
	v^2	0.000	0.080	0.320	0.721	1.281	2.001	2.882	3.923	5.124	6.485	8.006	9.687	11.528
	hf/100m	0.000	0.092	0.367	0.827	1.470	2.296	3.307	4.501	5.878	7.440	9.185	11.114	13.226
	hf/1.26km	0.000	0.533	2.131	4.795	8.524	13.318	19.178	26.104	34.095	43.151	53.273	64.460	76.713
	hs	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
	Other H	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Total Head	7.050	7.583	9.181	11.845	15.574	20.368	26.228	33.154	41.145	50.201	60.323	71.510	83.763

MAVEN ASSOCIATES	Job Number	Sheet 1	Rev A
Job Title: Brookvale Green Calc Title: Design Modulus from Indirect Tensile Test (ITT) Results and Fatigue Factor Calculation	Author: bb	Date: 3/02/2022	Checked: BB

Asphalt Modulus Calculation

AC10 **35MM THICK**

In-Service Air Voids	5	%
Weighted Mean Annual Pavement Temperature WMAPT	**22**	°C
Heavy vehicle speed	**40**	km/h

Resilient Modulus	3000	Mpa from lab ITT test
Air Voids Adjustment	0.941	Figure 6.6 or
Temperature Adjustment	1.271	Figure 6.7 or
Speed Adjustment	0.730	Figure 6.8 or
E (or S_{mix})	2600	Mpa*

*round to 2 significant figures

Austroads Part 2 Equations

from Appendix B Austroads Part 2

$$\frac{\text{Modulus at in-service air voids}}{\text{Modulus at test air voids}} = \frac{21 - AV_{in\text{-}service}}{21 - AV_{test}}$$

AV_{test} 4 %

$$\frac{\text{Field modulus at WMAPT}}{\text{Laboratory modulus at test temperature (T)}} = e^{(-0.08(\text{WMAPT}-\text{T}))}$$

T 25 °C

$$\frac{\text{Modulus at speed V}}{\text{Modulus at test loading rate}} = 0.19V^{0.365}$$

V 40 km/h

Fatigue Factor Calculation

1st constant	6918	
2nd constant	0.856	
3rd constant	1.08	
Vb	10	%
E (or S_{mix})	2600	Mpa
k=	0.003932	

$$N = \frac{SF}{RF}\left[\frac{6918(0.856V_b + 1.08)}{E^{0.36}\mu\varepsilon}\right]^5 \qquad 25$$

where

N = allowable number of repetitions of the load-induced tensile strain

$\mu\varepsilon$ = load-induced tensile strain at the base of the asphalt (microstrain)

V_b = percentage by volume of bitumen in the asphalt (%)

E = asphalt modulus (MPa)

SF = shift factor between laboratory and in-service fatigue lives (presumptive value = 6)

RF = reliability factor for asphalt fatigue (Table 6.16)

Table 6.16: Suggested reliability factors (RF) for asphalt fatigue

Desired project reliability					
50%	80%	85%	90%	95%	97.5%
1.0	2.4	3.0	3.9	6.0	9.0

Load-Induced Strain Calculation

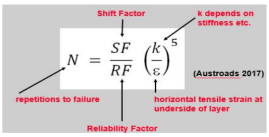
SF	6	*
RF	6	*
N	1.92E+06	
ε	0.00022	m
$\mu\varepsilon$	217.77	μ m

*presumptive value = 6

*95% Desired project reliability

Online Shell Equation - Circly

The following calculator outputs the asphalt fatigue constant (k) based on the the Shell Equation – see equation 25 on page 84 of Austroads Guide to Pavement Technology: Part 2: Pavement Structural Design.



ε = 1x10^6 $\mu\varepsilon$

Hence:

$$k = \frac{6918(0.856V_b + 1.08)}{E^{0.36} \times 1\text{x}10^6}$$

Please note: the Calculator is valid for both Austroads 2004-12 and 2017 Design Methods.

The value of k is in the units used by CIRCLY:

https://pavement-science.com.au/pavement-design-guides/austroads-pavement-design-guide/austroads-calculate-asphalt-fatigue-constant-k-using-shell-equation/

MAVEN ASSOCIATES	Job Number 135041	Sheet 1	Rev A
Job Title: Brookvale Green Design Traffic Calc Title: Mechanistic-empirical Design of Flexible Pavements to Determine Design Traffic	Author BB	Date 12/06/2026	Checked BB

From Austroads Part 2: Chapter 7 - Design Traffic

mechanistic-empirical design applicable to new flexible pavements which contain one or more layers of bound material (asphalt, cemented material or lean concrete).

Average Daily Traffic (ADT) Recorded in the Commute Report:

3,000	7-Day ADT (veh/Day)
6.7	% Heavy

(Recorded by Mobile Road Output in 6.2026)

Use highest number:	1821
Use	6.70

Determining Total Vehicle Axle Groups (Section 7.4.2 to 7.4.7):

Design Period (P)	25	years
Annual Average Daily Traffic (AADT)	3000	
Theoretical AADT	3000	
Direction Factor (DF)	0.5	
Percentage heavy vehicles (%HV)	6.70	%
Lane Distribution Factor (LDF)	1	
Heavy Vehicle Growth Rate (R)	2	%

Estimated from AADT traffic count 2011 to present

I.1 Total number of heavy vehicle axle groups

Initial Daily Heavy Vehicles (N_i)	101	N_i = AADT x DF x %HV/100 x LDF	(Eq 30)
Cumulative Growth Factor (CGF):	32.0	CGF = $((1+0.01xR)^P-1)/(0.01xR)$ for R>0 = P for R = 0, see Table 7.4	(Eq 31)
Cumulative Heavy Vehicles (N_{HV})	1.17E+06	N_{HV} = 365 x CGF x Ni	(Eq 32)
Rural or Urban Road (N_{HVAG})	2.8	N_{HVAG}*	
Cumulative Heavy Axle Groups (N_{HVAG})	3.29E+06	$N_{DT}=N_{HV}*N_{HVAG}$	(Eq 35)

*either NHVAG = 2.8 (Rural) or 2.5 (Urban) or use WIM Data

In the absence of WIM or classification counter data, a presumptive value for N_{HVAG} needs to be selected. Appendix E provides a list of N_{HVAG} values based on WIM data obtained at sites throughout Australia. In addition, typical N_{HVAG} values for rural roads and urban moderate-to-heavily trafficked roads have been calculated using WIM data. These presumptive values are given in Table 7.6. Section 12.7 provides guidance on procedures for lightly-trafficked pavements.

Table 7.6: Presumptive numbers of heavy vehicle axle groups per heavy vehicle (N_{HVAG})

Location	N_{HVAG}
Rural roads	2.8
Urban roads	2.5

From Austroads Part 2: Chapter 7 - Design Traffic

Determine ESA per Axle Group from WIM Data and calculate DESA (Section 7.6.2)

The calculation of the ESAs of damage due to the design traffic requires the estimation of the average number of ESAs per heavy vehicle axle group (ESA/HVAG) from the Traffic Load Distribution (TLD, Section 7.5) for a project. The TLD may be based on:

- project-specific WIM data
- data selected from the WIM data given in Appendix E.

The ESA/HVAG values for a range of selected WIM sites are provided in Appendix E.

ESA/HVAG: 0.573 from Appendix E Table 1 WIM Data Drury

Design Number of Equivalent Standard Axles of traffic loading (DESA)

DESA 1.89E+06 DESA=ESA/HVAG x N_{DT}

Design Traffic for Mechanistic-empirical Design Procedure for Asphalt Fatigue (Section 7.6.3)

As an interim measure, pending further research to quantify the increase in crack healing with increasing temperature, an upper limit may be used in the design traffic loading used in the asphalt fatigue damage calculations. Table 7.9 provides suggested limiting design traffic loadings in ESA. The limit reduces with increasing temperature due to the increase in crack healing. Based on the ESA limits and using the number of ESAs per heavy vehicle axle groups, the upper limit in terms of cumulative HVAG used in the asphalt fatigue damage calculations is determined using Equation 38.

Table 7.9: Suggested upper limits on design traffic for asphalt fatigue

WMAPT	≤ 25 °C	26–34 °C	≥ 35 °C
Design traffic loading limit (DESA)	4×10^8	2×10^8	10^8

$$N_{DT\ limit} = \frac{DESA_{limit}}{(ESA/HVAG)} \qquad 38$$

where

$N_{DT\ limit}$ = upper limit of cumulative number of Heavy Vehicle Axle Groups over design period for use in the asphalt fatigue damage calculations

$DESA_{limit}$ = upper limit of the design traffic expressed as Equivalent Standard Axles (ESA) for use in the asphalt fatigue damage calculations (Table 7.9)

$ESA/HVAG$ = average number of ESA per HVAG from the project traffic load distribution

Note that such design traffic loading limits are only used in the asphalt fatigue calculations; they are not applicable to the design traffic used for cemented materials and lean-mix concrete fatigue or permanent deformation damage calculations.

Weighted Mean Annual Pavement Temperature

WMAPT 23 deg Auckland

$DESA_{limit}$ 4.00E+08 see Table 7.9 above

Asphalt fatigue damage upper limit

$N_{DT\ limit}$ 6.98E+08 (Eq 38)

Project Details

This sheet contains the top level information for the current project.

Report Generated:	2026-06-18 11:46:38 AM
Project Name:	Brookvale Green
Completed On:	2026-06-18 11:46:18 AM
Design Date:	18/06/2026
AustPads version:	v3.1
APADS version:	1.0a
Location Name:	Havelock North
Coordinates:	
Comments:	ıt stabilised subgrade, CBR 5, 450mm granular for 35mm AC10
Designer:	Barry Beaurain
WMAPT:	22
Design Speed:	40
Cemented Material Fatigue Reliability Factor:	1.00
Asphalt Fatigue Reliability Factor:	6.00
Pavement Layers:	11
Load Type:	User Defined Load / Response Coordinates

Pavement Layer Details **Inputs**

This sheet shows the pavement configuration detail.

No	Layer Type	Layer Characteristics	Thickness [mm]	Vertical Modulus [MPa]	Bulk Density	Ev / Eh	Volume of Binder [%]	Poisson's Ratio	K	Shift Factor	Linear/Nonlinear	K1	K2	K3	Emin	Emax	Res. Compact. Stress	Performance Criterion
1	Granular	User defined	80	450	2.00	2.00	NA	0.35			Linear							Horizontal tensile strain
2	Granular	User defined	80	326	2.00	2.00	NA	0.35			Linear							Horizontal tensile strain
3	Granular	User defined	80	236	2.00	2.00	NA	0.35			Linear							Horizontal tensile strain
4	Granular	User defined	80	171	2.00	2.00	NA	0.35			Linear							Horizontal tensile strain
5	Granular	User defined	80	124	2.00	2.00	NA	0.35			Linear							Horizontal tensile strain
6	Selected Subgrade	Treated	40	90	2.00	2.00	NA	0.35			Linear							Vertical compressive strain
7	Selected Subgrade	Treated	40	80	2.00	2.00	NA	0.35			Linear							Vertical compressive strain
8	Selected Subgrade	Treated	40	71	2.00	2.00	NA	0.35			Linear							Vertical compressive strain
9	Selected Subgrade	Treated	40	63	2.00	2.00	NA	0.35			Linear							Vertical compressive strain
10	Selected Subgrade	Treated	40	56	2.00	2.00	NA	0.35			Linear							Vertical compressive strain
11	Subgrade	User Defined	0	50	2.00	2.00		0.45			Linear							Vertical compressive strain

APADS Response

This sheet shows the APADS result summary, input loads and resulting responses and coordinates, there may be more than one APADS result in a single project depending on the load configuration (number of different axle types used).

Pavement Loading (API)

Axle Model: User Defined Load

Number of Loads: 2

Load No	Load Radius [mm]	Contact Stress [kPa]	X Coordinate [mm]	Y Coordinate [mm]	CF=	-0.15768
1	105.06	580.00	0.0000	0.0000		
2	105.06	580.00	330.00	0.0000		

ocation Response (APO)

Number of Locations: 24

Point	X Coordinate [mm]	Y Coordinate [mm]	Z Coordinate [mm]	X Displacement [mm]	Y Displacement [mm]	Z Displacement [mm]	X Normal Strains [microstrain]	Y Normal Strains [microstrain]	Z Normal Strains [microstrain]
1	165.00	0.0000	0.10000	0.0000	-0.88703E-17	-0.68351	306.86	-878.07	153.27
2	165.00	0.0000	79.900	0.0000	0.15672E-18	-0.69287	-532.33	15.582	-19.394
3	165.00	0.0000	159.90	0.0000	0.38656E-17	-0.67266	-209.82	382.63	-372.79
4	165.00	0.0000	239.90	0.0000	0.50173E-17	-0.63112	84.761	496.61	-524.87
5	165.00	0.0000	319.90	0.0000	0.52309E-17	-0.58161	247.85	517.74	-576.52
6	165.00	0.0000	399.90	0.0000	0.50983E-17	-0.52954	323.44	504.61	-595.24
7	165.00	0.0000	439.90	0.0000	0.48662E-17	-0.50156	334.75	481.64	-665.27
8	165.00	0.0000	479.90	0.0000	0.46262E-17	-0.47416	337.65	457.89	-652.43
9	165.00	0.0000	519.90	0.0000	0.43753E-17	-0.44721	333.92	433.05	-642.60
10	165.00	0.0000	559.90	0.0000	0.41078E-17	-0.42060	324.60	406.57	-635.10
11	165.00	0.0000	599.90	0.0000	0.38172E-17	-0.39427	310.15	377.82	-628.65
12	165.00	0.0000	600.10	0.0000	0.38155E-17	-0.39414	310.05	377.65	-667.30
13	165.00	200.00	0.10000	0.0000	-0.94844E-01	-0.52583	-209.08	-84.669	79.384
14	165.00	200.00	79.900	0.0000	-0.22912E-01	-0.53201	-142.61	-155.77	63.635
15	165.00	200.00	159.90	0.0000	0.28448E-01	-0.53254	-24.113	-102.17	-48.182
16	165.00	200.00	239.90	0.0000	0.58372E-01	-0.52129	108.39	22.293	-192.54
17	165.00	200.00	319.90	0.0000	0.73200E-01	-0.49858	209.67	136.31	-307.76
18	165.00	200.00	399.90	0.0000	0.78879E-01	-0.46733	270.85	212.88	-389.36
19	165.00	200.00	439.90	0.0000	0.77947E-01	-0.44823	283.63	233.84	-468.28
20	165.00	200.00	479.90	0.0000	0.76184E-01	-0.42837	289.92	247.21	-484.52
21	165.00	200.00	519.90	0.0000	0.73680E-01	-0.40787	290.47	253.90	-498.25
22	165.00	200.00	559.90	0.0000	0.70456E-01	-0.38683	285.78	254.57	-510.03
23	165.00	200.00	599.90	0.0000	0.66488E-01	-0.36534	276.12	249.69	-519.72
24	165.00	200.00	600.10	0.0000	0.66463E-01	-0.36523	276.05	249.64	-544.52

Results Summary (SUM)

Layer No	Layer Type	Layer Characteristics	Thickness [mm]	Ev [MPa]	Fatigue K	Max Critical Microstrain Horizontal (tensile)	Max Critical Microstrain V Vertical (compressive)
1	Granular	User defined	80	450.00	0	N/A	N/A
2	Granular	User defined	80	326.00	0	N/A	N/A
3	Granular	User defined	80	236.00	0	N/A	N/A
4	Granular	User defined	80	171.00	0	N/A	N/A
5	Granular	User defined	80	124.00	0	N/A	N/A
6	Selected Subgrade	Treated	40	90.000	9150	N/A	N/A
7	Selected Subgrade	Treated	40	80.000	9150	N/A	N/A
8	Selected Subgrade	Treated	40	71.000	9150	N/A	N/A
9	Selected Subgrade	Treated	40	63.000	9150	N/A	N/A
10	Selected Subgrade	Treated	40	56.000	9150	N/A	N/A
11	Subgrade	User Defined	0	50.000	9150	N/A	N/A

User Defined Axle Loads

When userdefined load is selected then this sheet is includec

Load Type: User Defined Load / Response Coordin

Axle Details

User Defined Load

Tyre#	Radius [mm]	Tyre Pressure [kPa]	X Position [mm]	Y Position [mm]
1	105.06	580	0	0
2	105.06	580	330	0

User Defined Response Coordinates

Tyre#	X Coordinate [mm]	Y Coordinate [mm]
1	165	0
2	165	200

User Defined Loads

No	Layer Type	Layer Characteristics	Thickness [mm]	Modulus [MPa]	Ev / Eh	ESAs	Horizontal Strain	Vertical Strain	K
1	Granular	User defined	80	0	2.0000	N/A	N/A	N/A	0
2	Granular	User defined	80	0	2.0000	N/A	N/A	N/A	0
3	Granular	User defined	80	0	2.0000	N/A	N/A	N/A	0
4	Granular	User defined	80	0	2.0000	N/A	N/A	N/A	0
5	Granular	User defined	80	0	2.0000	N/A	N/A	N/A	0
6	Selected Subgrade	Treated	40	0	2.0000	9.31E07	N/A	665	9150
7	Selected Subgrade	Treated	40	0	2.0000	1.07E08	N/A	652	9150
8	Selected Subgrade	Treated	40	0	2.0000	1.19E08	N/A	643	9150
9	Selected Subgrade	Treated	40	0	2.0000	1.29E08	N/A	635	9150
10	Selected Subgrade	Treated	40	0	2.0000	1.38E08	N/A	629	9150
11	Subgrade	User Defined	Semi-Infinite	50	2.0000	9.11E07	N/A	667	9150

Project Details

This sheet contains the top level information for the current project.

Project Name:	Brookvale Green
Location Name:	Havelock North
Report Generated:	2026-06-18 11:45:23 AM
Completed On:	2026-06-18 11:44:48 AM
Design Date:	18/06/2026
AustPads version:	v3.1
APADS version:	1.0a
Chainage:	
Comments:	Collector Road cement stabilised subgrade, CBR 5, 450mm granular for 35mm AC10
Designer:	Barry Beaurain
WMAPT (°C):	22
Design Speed (km/h):	40
Cemented Material Fatigue Reliability Factor:	1.00
Asphalt Fatigue Reliability Factor:	6.00
Pavement Layers:	11
Load Type: [TLD]	Eskdale TLD 500259 W

Load Summary

Design Traffic (HVAGs): 3.29E+06

Design Traffic (ESAs): 1.885E+06

ESA/HVAG: 0.573

Pavement Details

Layer Type	LayerChar	Thickness [mm]	Modulus [MPa]	Poisson's Ratio
Granular	User defined	80	450	0.35
Granular	User defined	80	326	0.35
Granular	User defined	80	236	0.35
Granular	User defined	80	171	0.35
Granular	User defined	80	124	0.35
Selected Subgrade	Treated	40	90	0.35
Selected Subgrade	Treated	40	80	0.35
Selected Subgrade	Treated	40	71	0.35
Selected Subgrade	Treated	40	63	0.35
Selected Subgrade	Treated	40	56	0.35
Subgrade	User Defined	0	50	0.45

Pavement Performance

Layer Type	Layer Name	Critical Strain SAST-53	Critical Strain SADT-80	Damage
Granular	User defined			N/A
Granular	User defined			N/A
Granular	User defined			N/A
Granular	User defined			N/A
Granular	User defined			N/A
Selected Subgrade	Treated	655	736	4.107E-002
Selected Subgrade	Treated	607	719	3.487E-002
Selected Subgrade	Treated	572	706	3.069E-002
Selected Subgrade	Treated	545	696	2.778E-002
Selected Subgrade	Treated	525	688	2.562E-002
Subgrade	User Defined	503	664	1.998E-002

Layer Material Information

Granular:

Name:	User defined
Thickness[mm]:	80
Vertical Modulus[MPa]:	450
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Granular:

Name:	User defined
Thickness[mm]:	80
Vertical Modulus[MPa]:	326
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Granular:

Name:	User defined
Thickness[mm]:	80
Vertical Modulus[MPa]:	236
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Granular:

Name:	User defined

Thickness[mm]:	80
Vertical Modulus[MPa]:	171
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Granular:

Name:	User defined
Thickness[mm]:	80
Vertical Modulus[MPa]:	124
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Selected Subgrade:

Name:	Treated
Thickness[mm]:	40
Vertical Modulus[MPa]:	90
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Selected Subgrade:

Name:	Treated
Thickness[mm]:	40
Vertical Modulus[MPa]:	80
Ev/Eh:	2.00
Poisson's Ratio:	0.35

Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Selected Subgrade:

Name:	Treated
Thickness[mm]:	40
Vertical Modulus[MPa]:	71
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Selected Subgrade:

Name:	Treated
Thickness[mm]:	40
Vertical Modulus[MPa]:	63
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Selected Subgrade:

Name:	Treated
Thickness[mm]:	40
Vertical Modulus[MPa]:	56
Ev/Eh:	2.00
Poisson's Ratio:	0.35
Volume of Binder[%]:	0.00
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	

Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

Subgrade:

Name:	User Defined
Thickness[mm]:	0
Vertical Modulus[MPa]:	50
Ev/Eh:	2.00
Poisson's Ratio:	0.45
Volume of Binder[%]:	
K:	
Bulk Density[t/m3]:	2.00
Shift Factor:	
Nonlinear Flag:	Linear
K1[MPa]:	
K2[-]:	
K3[-]:	
Emin[MPa]:	
Emax[MPa]:	
Residual Compaction Stress[kPa]:	

TLD Table

LoadValue	SAST	SADT	TAST	TADT	TRDT	QADT
10	0.0019757490	0.0090365400	0.0000000000	0.0003094740	0.0000000000	0.0000000000
20	0.0368770860	0.0544939070	0.0000148711	0.0086271700	0.0000052989	0.0000000000
30	0.0229640760	0.0406003410	0.0001383010	0.0187564780	0.0001404220	0.0000000000
40	0.0147193290	0.0184393020	0.0005680750	0.0187374330	0.0016479680	0.0000540224
50	0.0318496060	0.0154088110	0.0009353900	0.0210680070	0.0026017750	0.0002370980
60	0.0273107240	0.0123691650	0.0021176400	0.0176637980	0.0030680810	0.0006422660
70	0.0050728690	0.0148320110	0.0075113750	0.0190992790	0.0032138020	0.0012635240
80	0.0004004900	0.0104739630	0.0172891010	0.0218012210	0.0029250100	0.0011314690
90	0.0000213594	0.0025406690	0.0316872670	0.0269813320	0.0031343180	0.0012605230
100	0.0000053399	0.0005722230	0.0279576040	0.0425502320	0.0036191700	0.0012185050
110	0.0000000000	0.0003204450	0.0071500080	0.0693720670	0.0043954640	0.0009754040
120	0.0000000000	0.0001556450	0.0007420660	0.0755020240	0.0046127200	0.0009513950
130	0.0000000000	0.0001327560	0.0000773295	0.0605163620	0.0049121100	0.0009213820
140	0.0000000000	0.0000457778	0.0000163582	0.0498133390	0.0054764460	0.0009153800
150	0.0000000000	0.0000000000	0.0000014871	0.0345681950	0.0062474400	0.0008913700
160	0.0000000000	0.0000000000	0.0000000000	0.0142500670	0.0056354140	0.0009093770
170	0.0000000000	0.0000000000	0.0000000000	0.0029185740	0.0042762380	0.0009063760
180	0.0000000000	0.0000000000	0.0000000000	0.0004451660	0.0029382580	0.0008673600
190	0.0000000000	0.0000000000	0.0000000000	0.0001214090	0.0019341100	0.0011344700
200	0.0000000000	0.0000000000	0.0000000000	0.0000380891	0.0009644060	0.0014255910
210	0.0000000000	0.0000000000	0.0000000000	0.0000047611	0.0004583580	0.0009123780
220	0.0000000000	0.0000000000	0.0000000000	0.0000095223	0.0002013590	0.0004201740
230	0.0000000000	0.0000000000	0.0000000000	0.0000047611	0.0000874324	0.0002310960
240	0.0000000000	0.0000000000	0.0000000000	0.0000023806	0.0000450409	0.0001080450
250	0.0000000000	0.0000000000	0.0000000000	0.0000023806	0.0000132473	0.0000420174
260	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000026495	0.0000150062
270	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000026495	0.0000090037
280	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000090037
290	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
300	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
310	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
320	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
330	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
340	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
350	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
360	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
370	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
380	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
390	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
400	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
410	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
420	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
430	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
440	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
450	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
460	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
470	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
480	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
490	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
500	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 16 2026

LOT 172 Swale

Trapezoidal

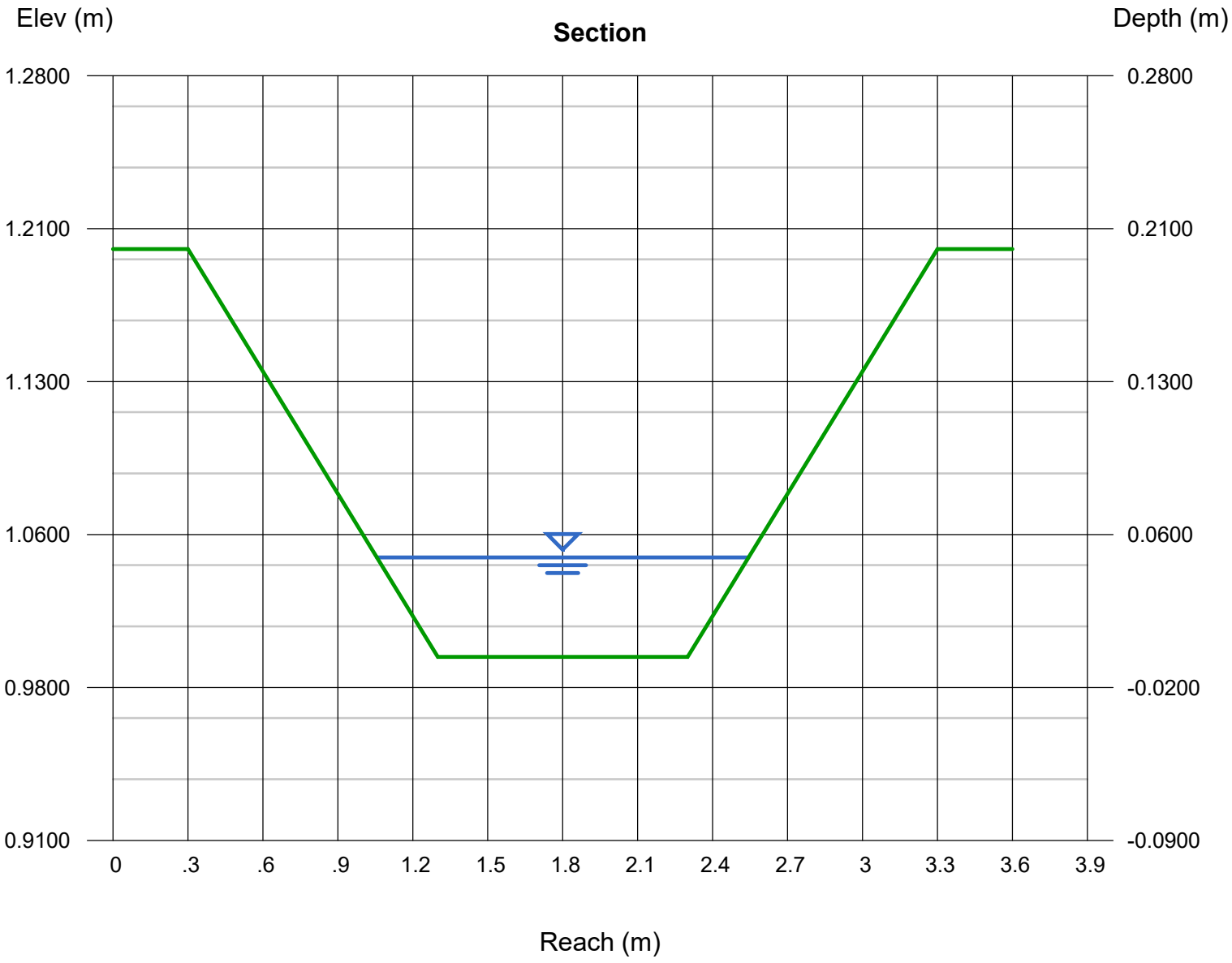
Bottom Width (m)	=	1.0000
Side Slopes (z:1)	=	5.0000, 5.0000
Total Depth (m)	=	0.2000
Invert Elev (m)	=	1.0000
Slope (%)	=	8.4000
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.0630

Highlighted

Depth (m)	=	0.0488
Q (cms)	=	0.063
Area (sqm)	=	0.0607
Velocity (m/s)	=	1.0386
Wetted Perim (m)	=	1.4973
Crit Depth, Yc (m)	=	0.0671
Top Width (m)	=	1.4877
EGL (m)	=	0.1038



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 16 2026

OLFP Section AA

User-defined

Invert Elev (m)	=	10.7300
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

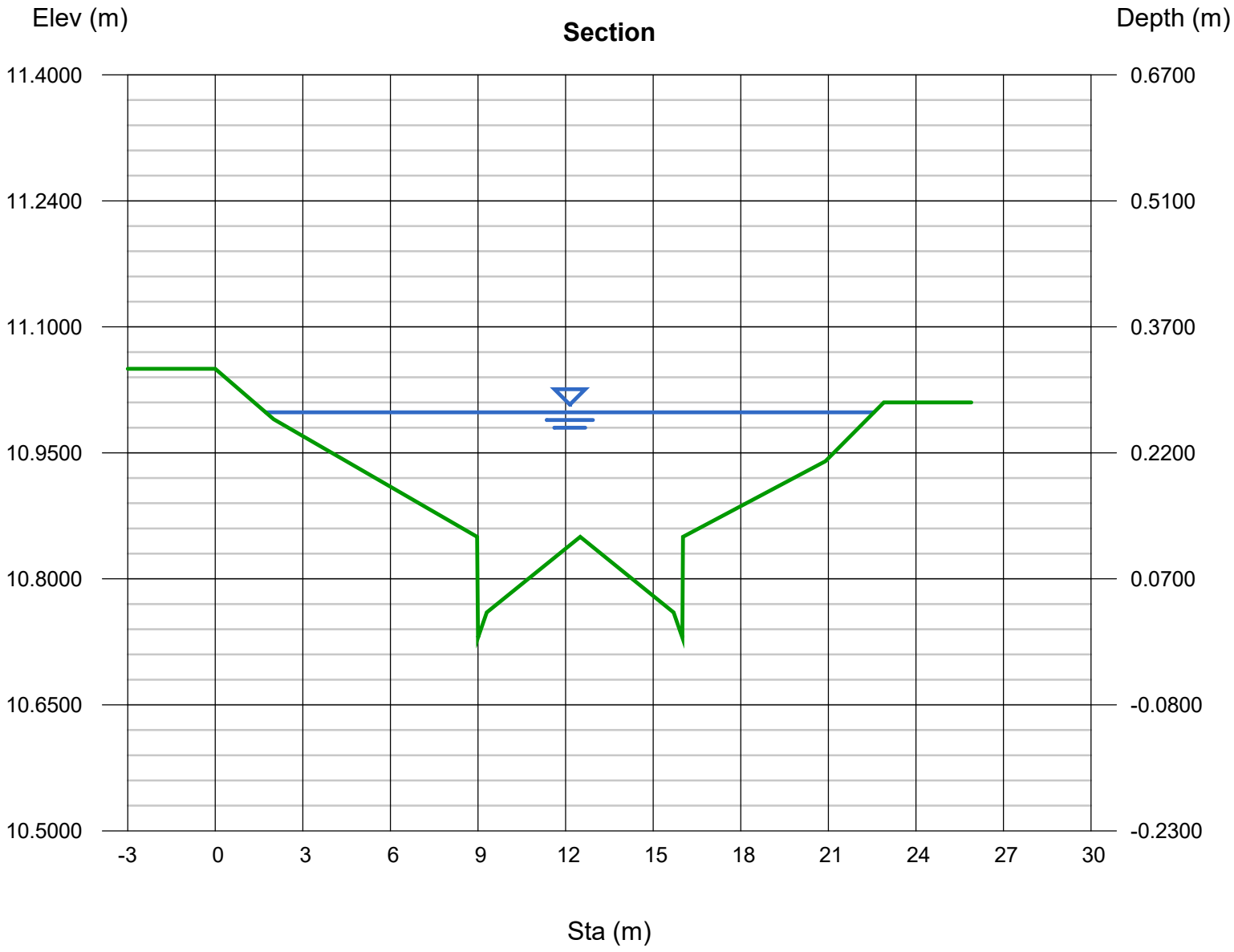
Compute by:		Known Q
Known Q (cms)	=	1.8430

Highlighted

Depth (m)	=	0.2682
Q (cms)	=	1.8430
Area (sqm)	=	2.4975
Velocity (m/s)	=	0.7379
Wetted Perim (m)	=	21.0419
Crit Depth, Yc (m)	=	0.2377
Top Width (m)	=	20.8377
EGL (m)	=	0.2960

(Sta, El, n)-(Sta, El, n)...

(0.0000, 11.0500)-(2.0000, 10.9900, 0.025)-(8.9700, 10.8500, 0.025)-(9.0000, 10.7300, 0.025)-(9.3000, 10.7600, 0.025)-(12.5000, 10.8500, 0.025)-(15.7000, 10
-(16.0000, 10.7300, 0.025)-(16.0200, 10.8500, 0.025)-(20.9000, 10.9400, 0.025)-(22.9000, 11.0100, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 16 2026

OLFP Section BB

User-defined

Invert Elev (m)	=	11.7900
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

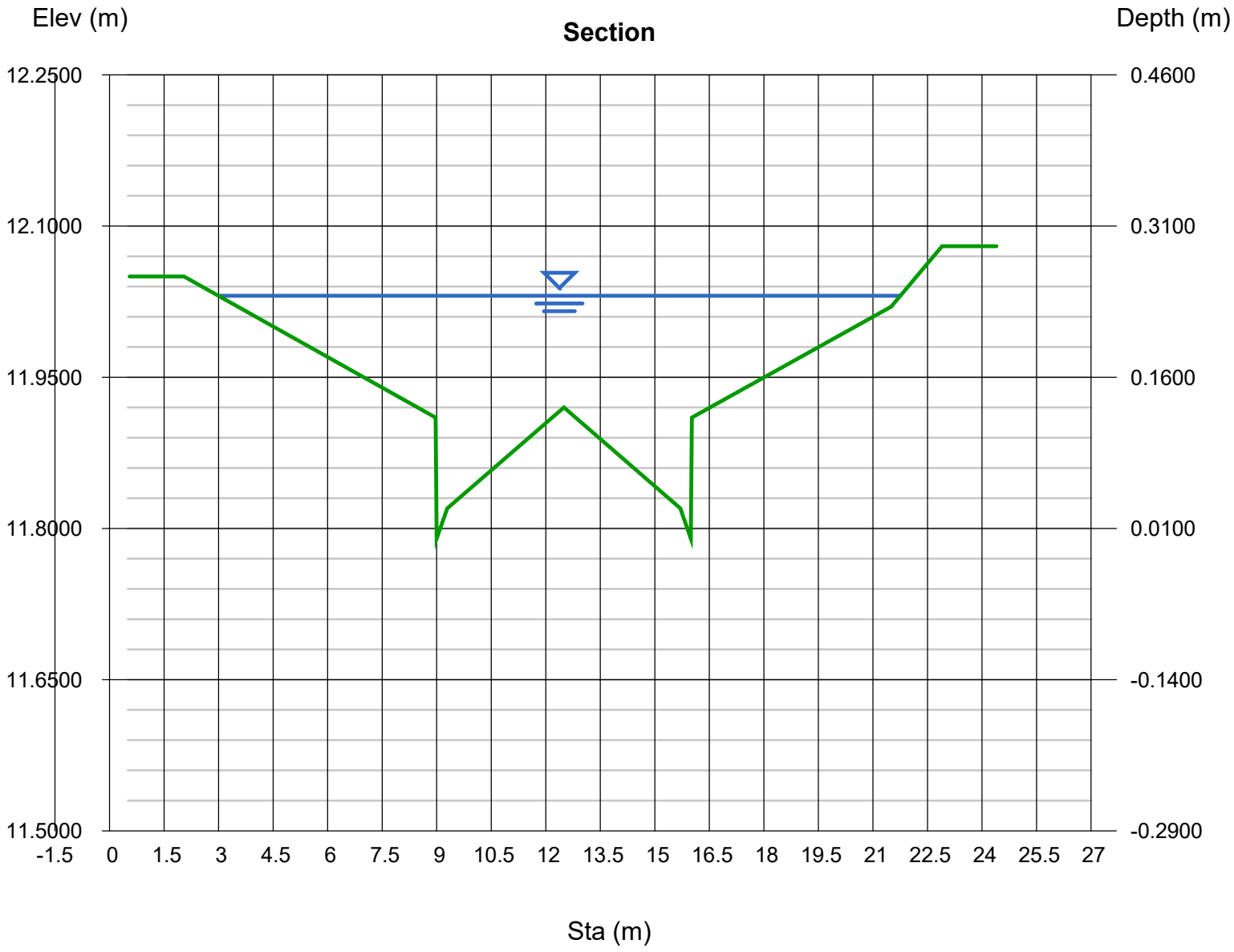
Compute by:		Known Q
Known Q (cms)	=	1.2580

Highlighted

Depth (m)	=	0.2408
Q (cms)	=	1.2580
Area (sqm)	=	1.8950
Velocity (m/s)	=	0.6639
Wetted Perim (m)	=	18.9486
Crit Depth, Yc (m)	=	0.2134
Top Width (m)	=	18.7524
EGL (m)	=	0.2633

(Sta, El, n)-(Sta, El, n)...

(2.0500, 12.0500)-(8.9700, 11.9100, 0.025)-(9.0000, 11.7900, 0.025)-(9.2900, 11.8200, 0.025)-(12.5000, 11.9200, 0.025)-(15.7000, 11.8200, 0.025)-(15.9900, 1
-(16.0200, 11.9100, 0.025)-(21.5000, 12.0200, 0.025)-(22.9000, 12.0800, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 16 2026

OLFP Section CC

User-defined

Invert Elev (m)	=	13.1100
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

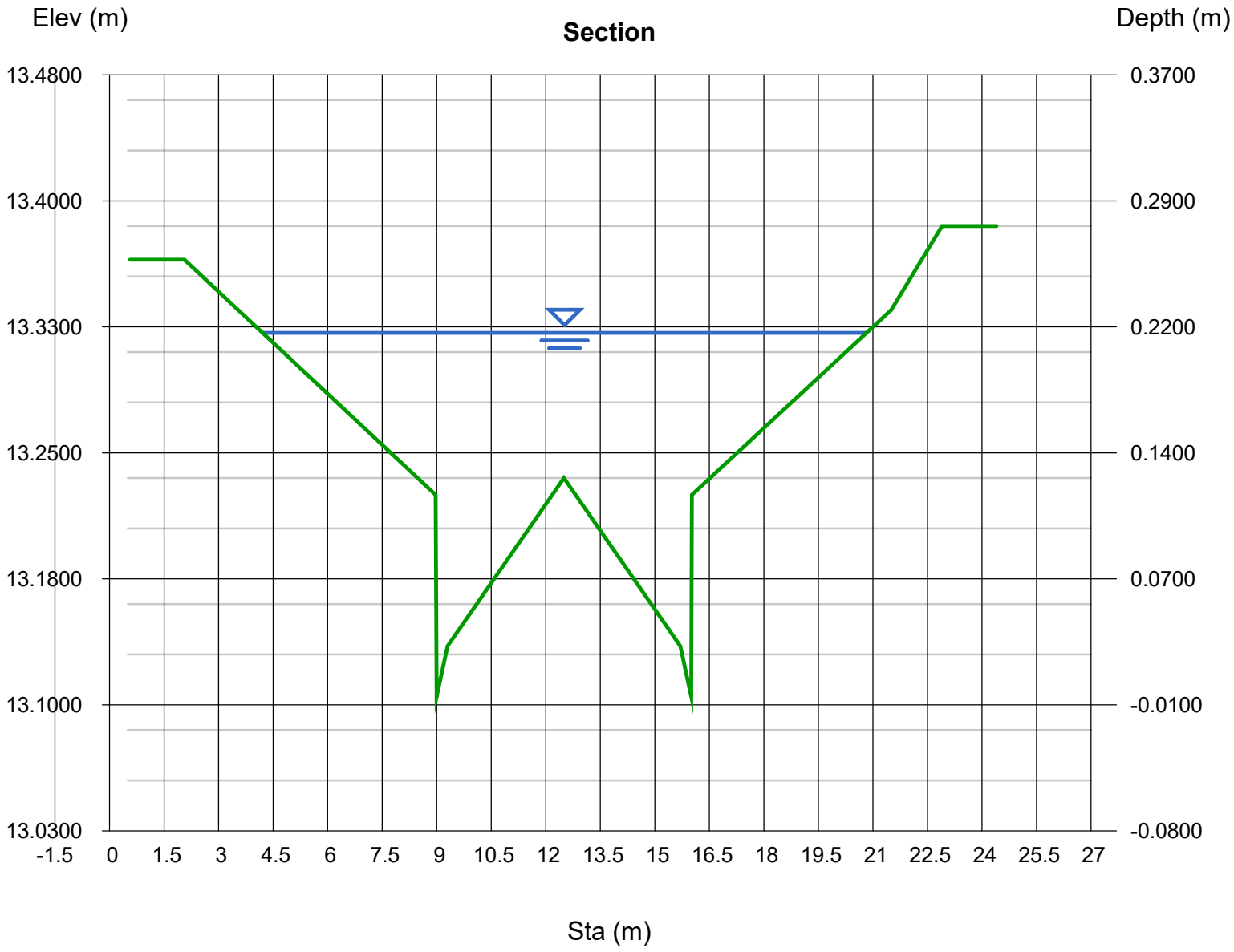
Compute by:		Known Q
Known Q (cms)	=	0.8860

Highlighted

Depth (m)	=	0.2164
Q (cms)	=	0.8860
Area (sqm)	=	1.4626
Velocity (m/s)	=	0.6058
Wetted Perim (m)	=	16.8147
Crit Depth, Yc (m)	=	0.1890
Top Width (m)	=	16.6113
EGL (m)	=	0.2351

(Sta, El, n)-(Sta, El, n)...

(2.0600, 13.3700)-(8.9700, 13.2300, 0.025)-(9.0000, 13.1100, 0.025)-(9.3000, 13.1400, 0.025)-(12.5000, 13.2400, 0.025)-(15.7000, 13.1400, 0.025)-(16.0000, 1
-(16.0200, 13.2300, 0.025)-(21.5000, 13.3400, 0.025)-(22.9000, 13.3900, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 16 2026

OLFP Section DD

User-defined

Invert Elev (m)	=	14.0100
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

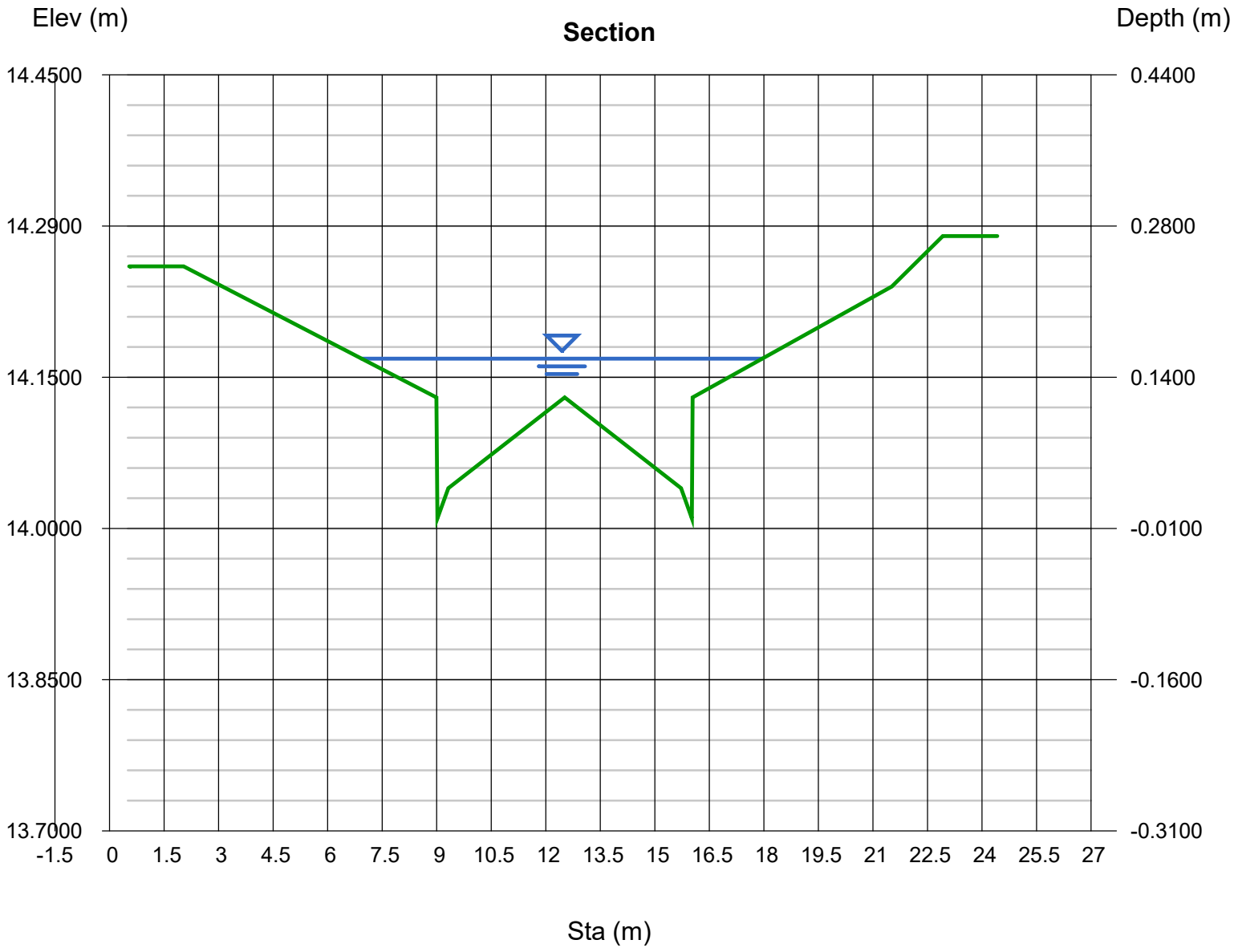
Compute by:		Known Q
Known Q (cms)	=	0.3230

Highlighted

Depth (m)	=	0.1585
Q (cms)	=	0.3230
Area (sqm)	=	0.7019
Velocity (m/s)	=	0.4602
Wetted Perim (m)	=	11.2274
Crit Depth, Yc (m)	=	0.1341
Top Width (m)	=	11.0258
EGL (m)	=	0.1693

(Sta, El, n)-(Sta, El, n)...

(2.0400, 14.2600)-(8.9900, 14.1300, 0.025)-(9.0200, 14.0100, 0.025)-(9.3200, 14.0400, 0.025)-(12.5200, 14.1300, 0.025)-(15.7200, 14.0400, 0.025)-(16.0200, 1
-(16.0400, 14.1300, 0.025)-(21.5200, 14.2400, 0.025)-(22.9200, 14.2900, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 17 2026

OLFP Section EE

User-defined

Invert Elev (m)	=	10.7900
Slope (%)	=	1.0000
N-Value	=	0.025

Calculations

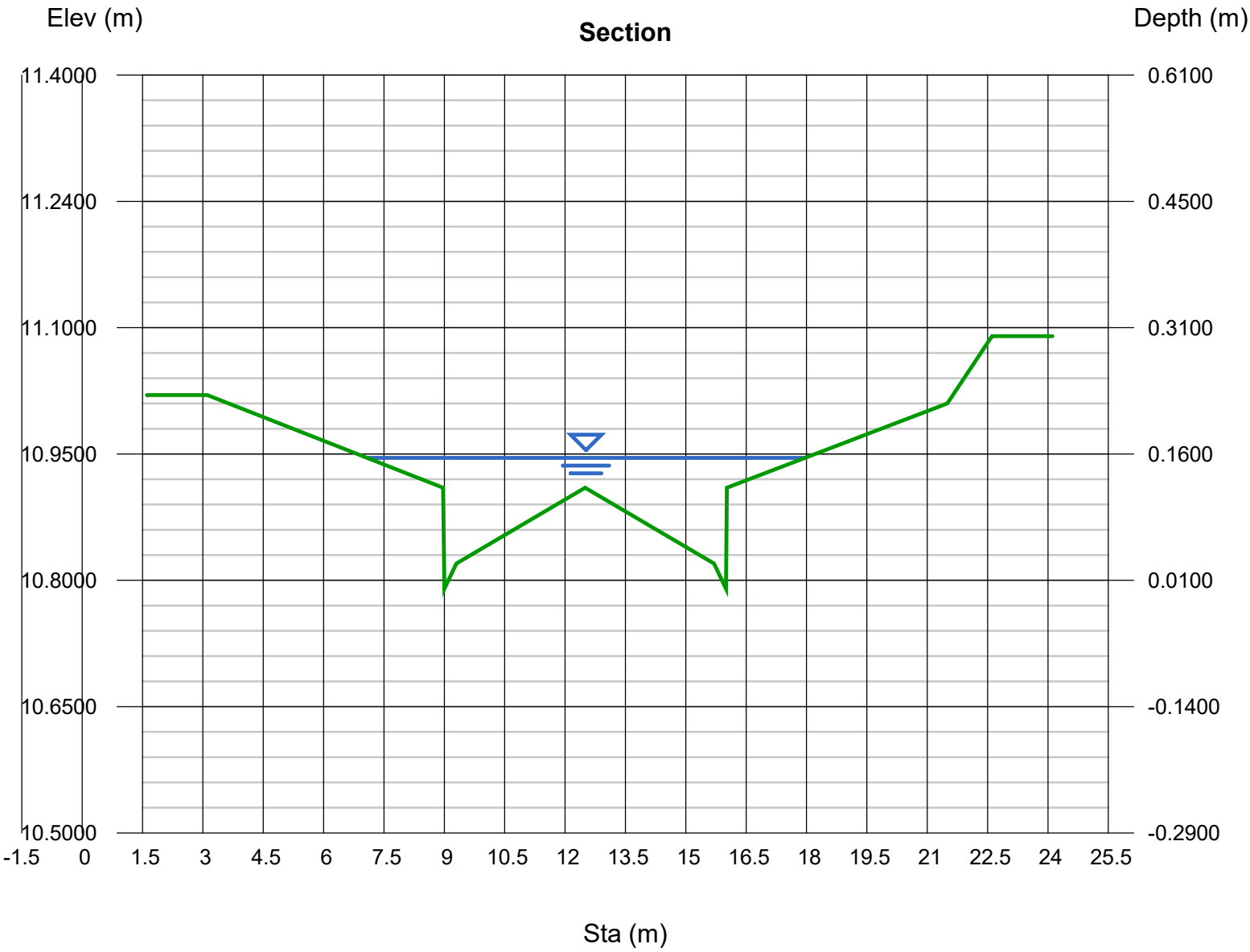
Compute by:		Known Q
Known Q (cms)	=	0.4030

Highlighted

Depth (m)	=	0.1554
Q (cms)	=	0.4030
Area (sqm)	=	0.6718
Velocity (m/s)	=	0.5999
Wetted Perim (m)	=	11.0824
Crit Depth, Yc (m)	=	0.1433
Top Width (m)	=	10.8809
EGL (m)	=	0.1738

(Sta, El, n)-(Sta, El, n)...

(3.1100, 11.0200)-(8.9700, 10.9100, 0.025)-(9.0000, 10.7900, 0.025)-(9.3000, 10.8200, 0.025)-(12.5000, 10.9100, 0.025)-(15.7000, 10.8200, 0.025)-(16.0000, 1
-(16.0200, 10.9100, 0.025)-(21.5000, 11.0100, 0.025)-(22.6100, 11.0900, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 22 2026

OLFP Section F-F

User-defined

Invert Elev (m)	=	11.2800
Slope (%)	=	0.6000
N-Value	=	0.028

Calculations

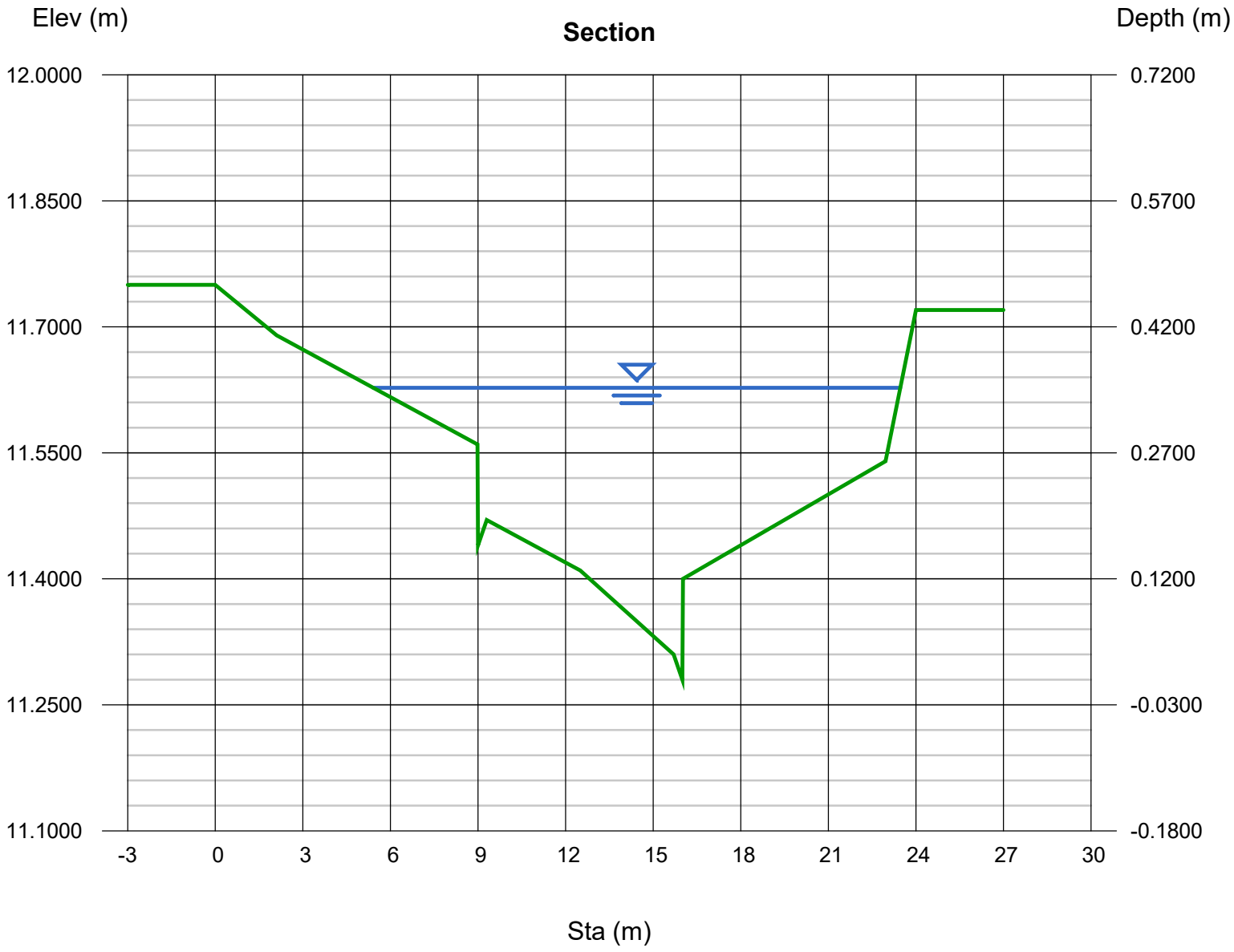
Compute by:		Known Q
Known Q (cms)	=	2.2200

Highlighted

Depth (m)	=	0.3475
Q (cms)	=	2.2200
Area (sqm)	=	2.8510
Velocity (m/s)	=	0.7787
Wetted Perim (m)	=	18.2742
Crit Depth, Yc (m)	=	0.2957
Top Width (m)	=	18.0562
EGL (m)	=	0.3784

(Sta, El, n)-(Sta, El, n)...

(0.0000, 11.7500)-(2.1000, 11.6900, 0.025)-(8.9800, 11.5600, 0.025)-(9.0000, 11.4400, 0.250)-(9.3000, 11.4700, 0.025)-(12.5000, 11.4100, 0.025)-(15.7000, 11
-(16.0000, 11.2800, 0.025)-(16.0200, 11.4000, 0.025)-(22.9600, 11.5400, 0.025)-(24.0000, 11.7200, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 22 2026

OLFP Section GG

User-defined

Invert Elev (m)	=	12.5200
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

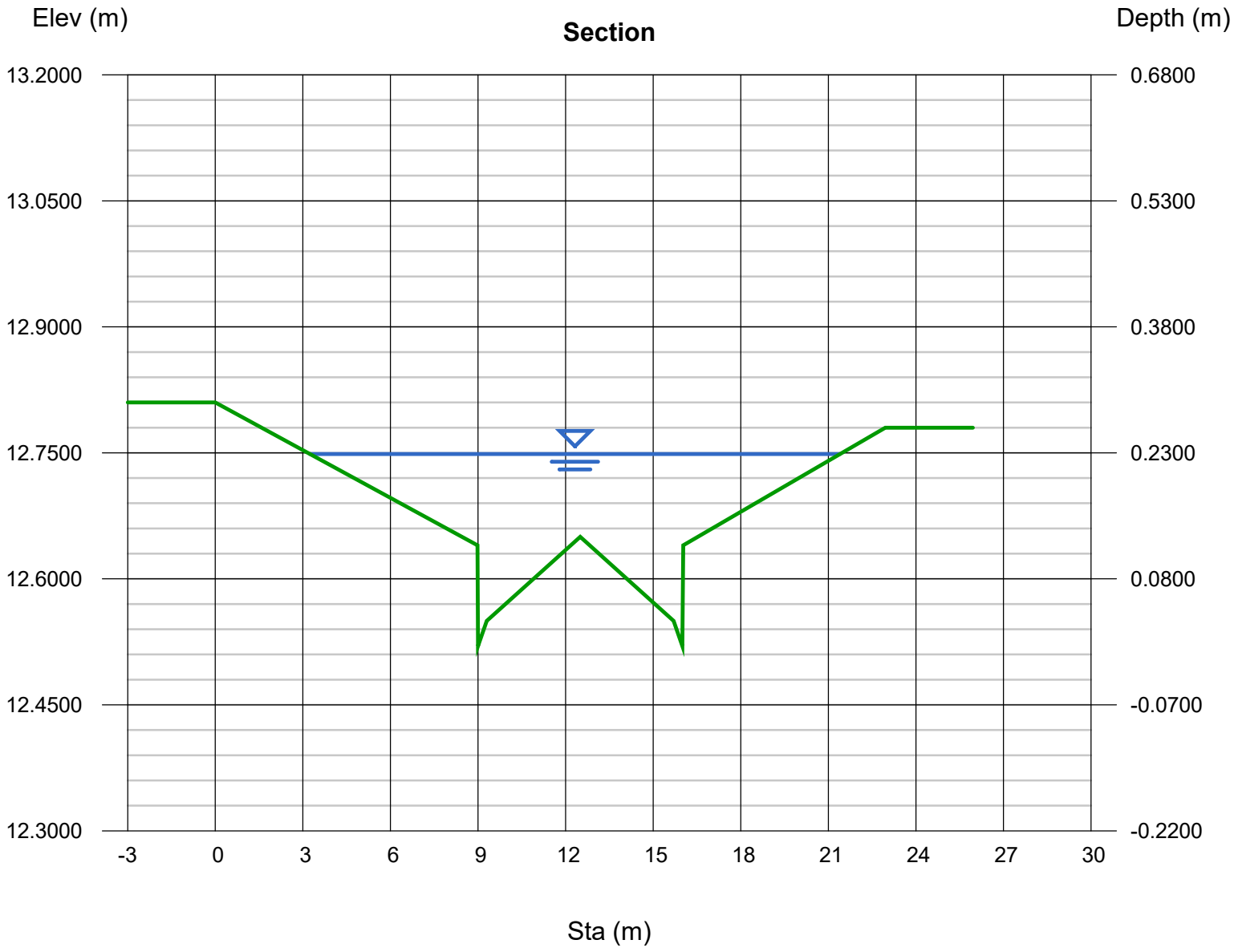
Compute by:		Known Q
Known Q (cms)	=	1.0320

Highlighted

Depth (m)	=	0.2286
Q (cms)	=	1.0320
Area (sqm)	=	1.6906
Velocity (m/s)	=	0.6104
Wetted Perim (m)	=	18.3581
Crit Depth, Yc (m)	=	0.1981
Top Width (m)	=	18.1545
EGL (m)	=	0.2476

(Sta, El, n)-(Sta, El, n)...

(0.0000, 12.8100)-(8.9800, 12.6400, 0.025)-(9.0000, 12.5200, 0.025)-(9.3000, 12.5500, 0.025)-(12.5000, 12.6500, 0.025)-(15.7000, 12.5500, 0.025)-(16.0000, 1
-(16.0300, 12.6400, 0.025)-(22.9500, 12.7800, 0.025)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 17 2026

OLFP Section HH

User-defined

Invert Elev (m)	=	11.0400
Slope (%)	=	0.5000
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.2680

Highlighted

Depth (m)	=	0.1554
Q (cms)	=	0.268
Area (sqm)	=	0.6203
Velocity (m/s)	=	0.4320
Wetted Perim (m)	=	10.0596
Crit Depth, Yc (m)	=	0.1280
Top Width (m)	=	9.9291
EGL (m)	=	0.1650

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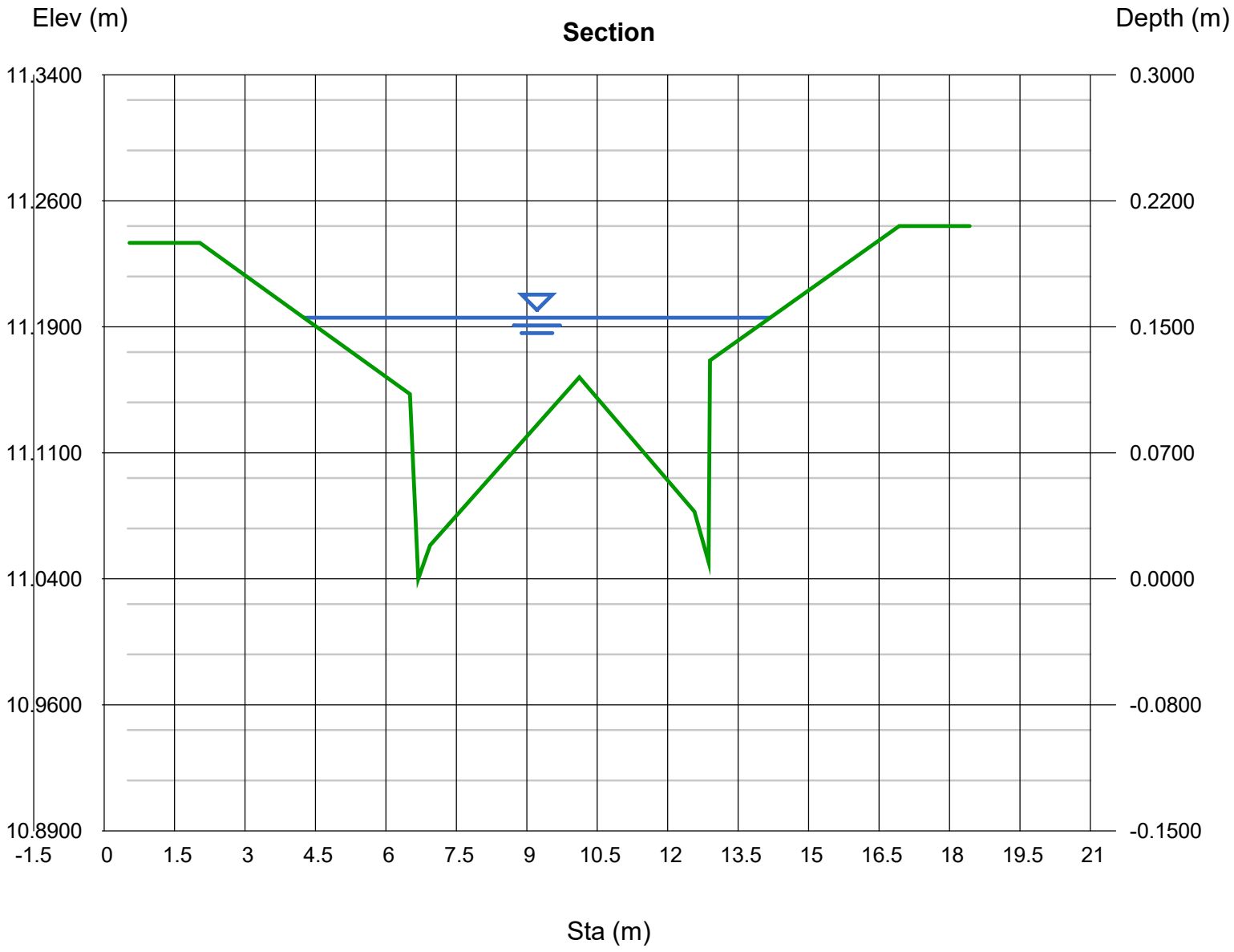

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 28 2026

OLFP Section II

User-defined

Invert Elev (m)	=	15.4500
Slope (%)	=	3.3000
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.1110

Highlighted

Depth (m)	=	0.0884
Q (cms)	=	0.111
Area (sqm)	=	0.1501
Velocity (m/s)	=	0.7396
Wetted Perim (m)	=	4.3621
Crit Depth, Yc (m)	=	0.0975
Top Width (m)	=	4.2134
EGL (m)	=	0.1163

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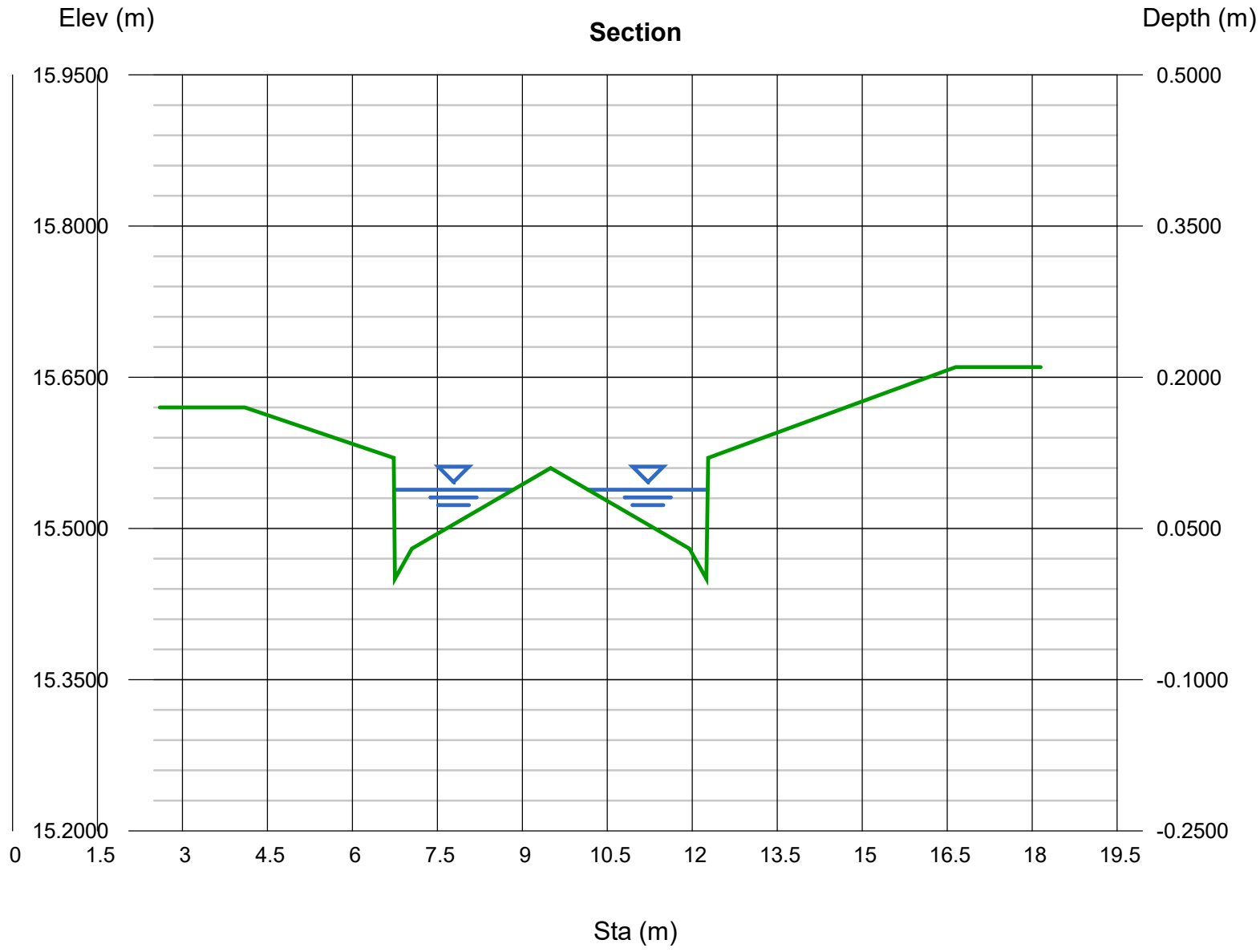

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 17 2026

OLFP Section JJ

User-defined

Invert Elev (m)	=	11.3900
Slope (%)	=	2.3000
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.1880

Highlighted

Depth (m)	=	0.1250
Q (cms)	=	0.188
Area (sqm)	=	0.2553
Velocity (m/s)	=	0.7363
Wetted Perim (m)	=	5.9140
Crit Depth, Yc (m)	=	0.1311
Top Width (m)	=	5.7654
EGL (m)	=	0.1526

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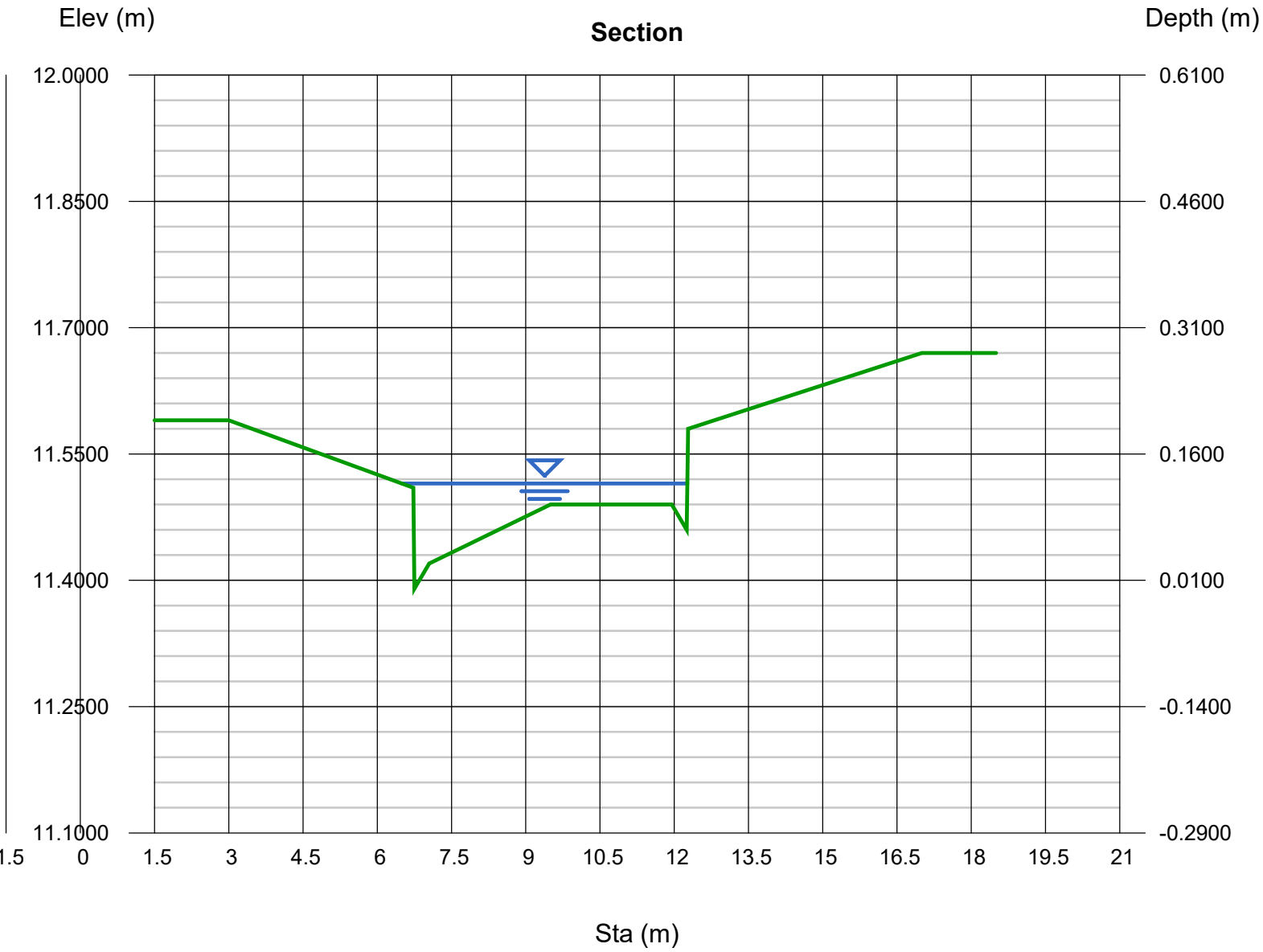

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 28 2026

OLFP Section KK

User-defined

Invert Elev (m)	=	9.9300
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.1930

Highlighted

Depth (m)	=	0.1311
Q (cms)	=	0.193
Area (sqm)	=	0.4366
Velocity (m/s)	=	0.4421
Wetted Perim (m)	=	7.9856
Crit Depth, Yc (m)	=	0.1128
Top Width (m)	=	7.7843
EGL (m)	=	0.1410

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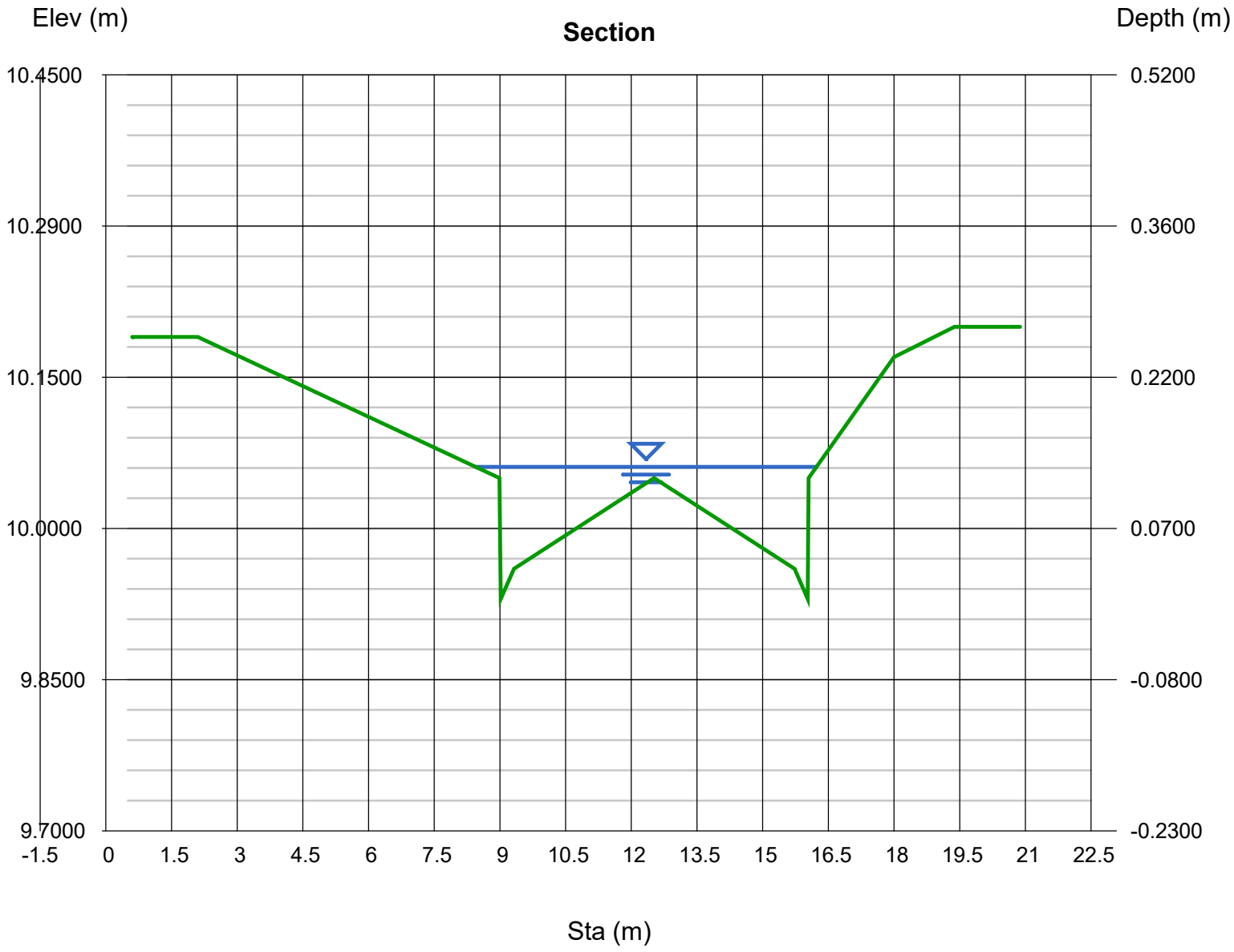

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 15 2026

OLFP Section LL

User-defined

Invert Elev (m)	=	11.9900
Slope (%)	=	0.6000
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.1180

Highlighted

Depth (m)	=	0.1463
Q (cms)	=	0.118
Area (sqm)	=	0.2634
Velocity (m/s)	=	0.4480
Wetted Perim (m)	=	4.7876
Crit Depth, Yc (m)	=	0.1219
Top Width (m)	=	4.6900
EGL (m)	=	0.1565

(Sta, El, n)-(Sta, El, n)...

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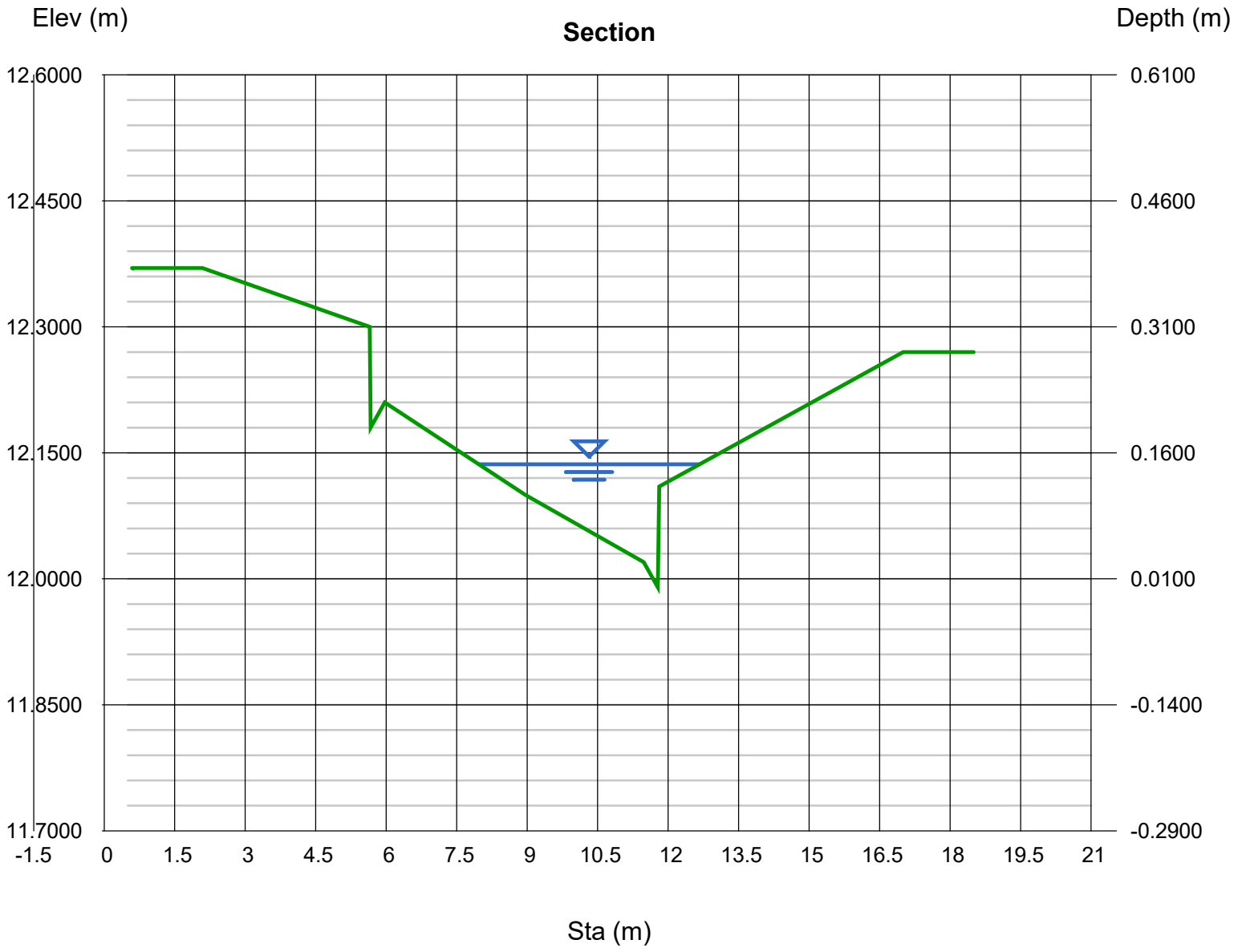

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 22 2026

Rain garden B Spillway section MM

User-defined

Invert Elev (m)	=	11.1500
Slope (%)	=	1.3000
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cms)	=	2.4880

Highlighted

Depth (m)	=	0.1250
Q (cms)	=	2.4880
Area (sqm)	=	1.2757
Velocity (m/s)	=	1.9502
Wetted Perim (m)	=	11.8091
Crit Depth, Yc (m)	=	0.1600
Top Width (m)	=	11.7956
EGL (m)	=	0.3190

(Sta, El, n)-(Sta, El, n)...

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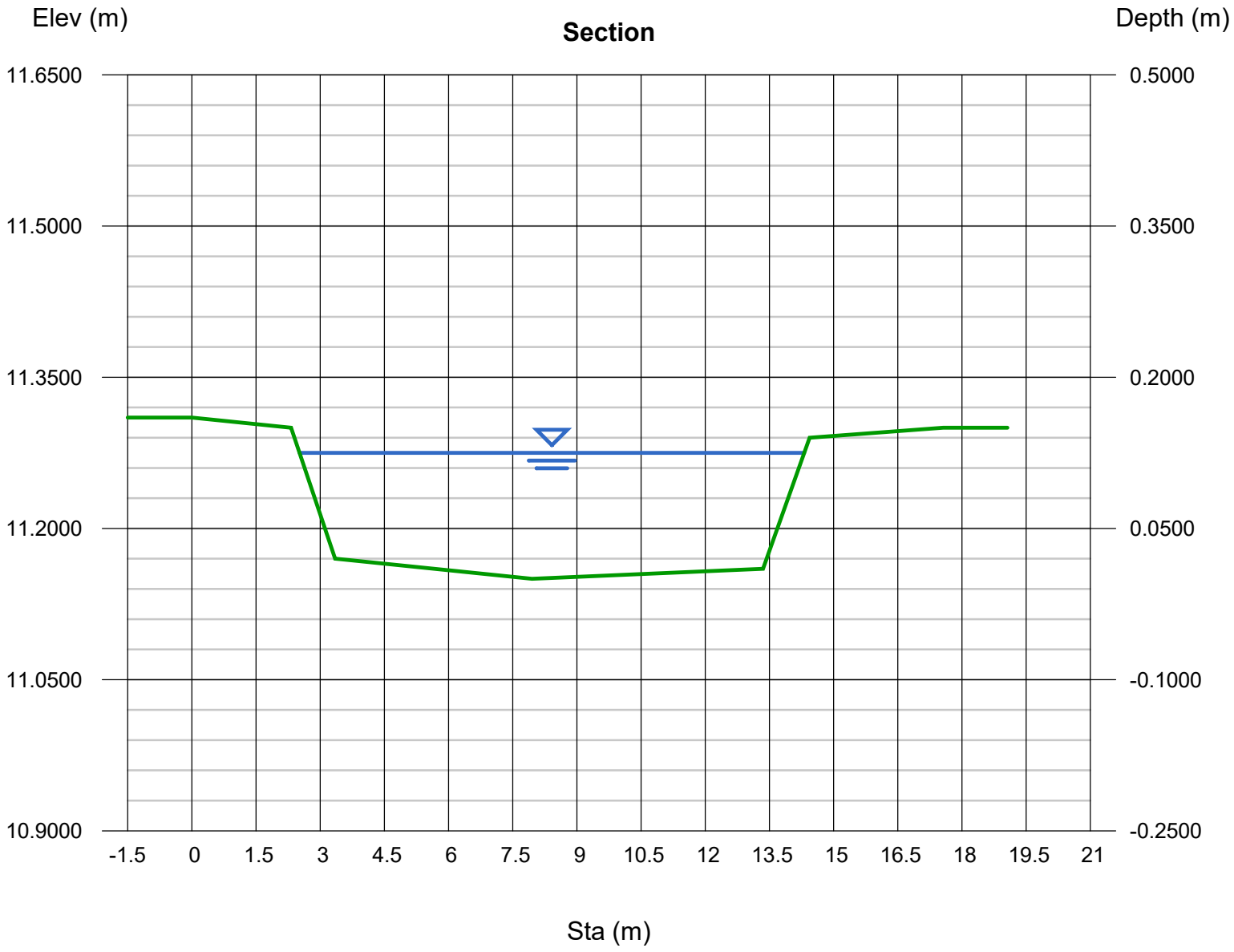

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 28 2026

Rain garden C Spillway Section NN

User-defined

Invert Elev (m)	=	11.8600
Slope (%)	=	2.0000
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.5200

Highlighted

Depth (m)	=	0.0853
Q (cms)	=	0.5200
Area (sqm)	=	0.3636
Velocity (m/s)	=	1.4300
Wetted Perim (m)	=	6.8341
Crit Depth, Yc (m)	=	0.1250
Top Width (m)	=	6.8302
EGL (m)	=	0.1896

(Sta, El, n)-(Sta, El, n)...

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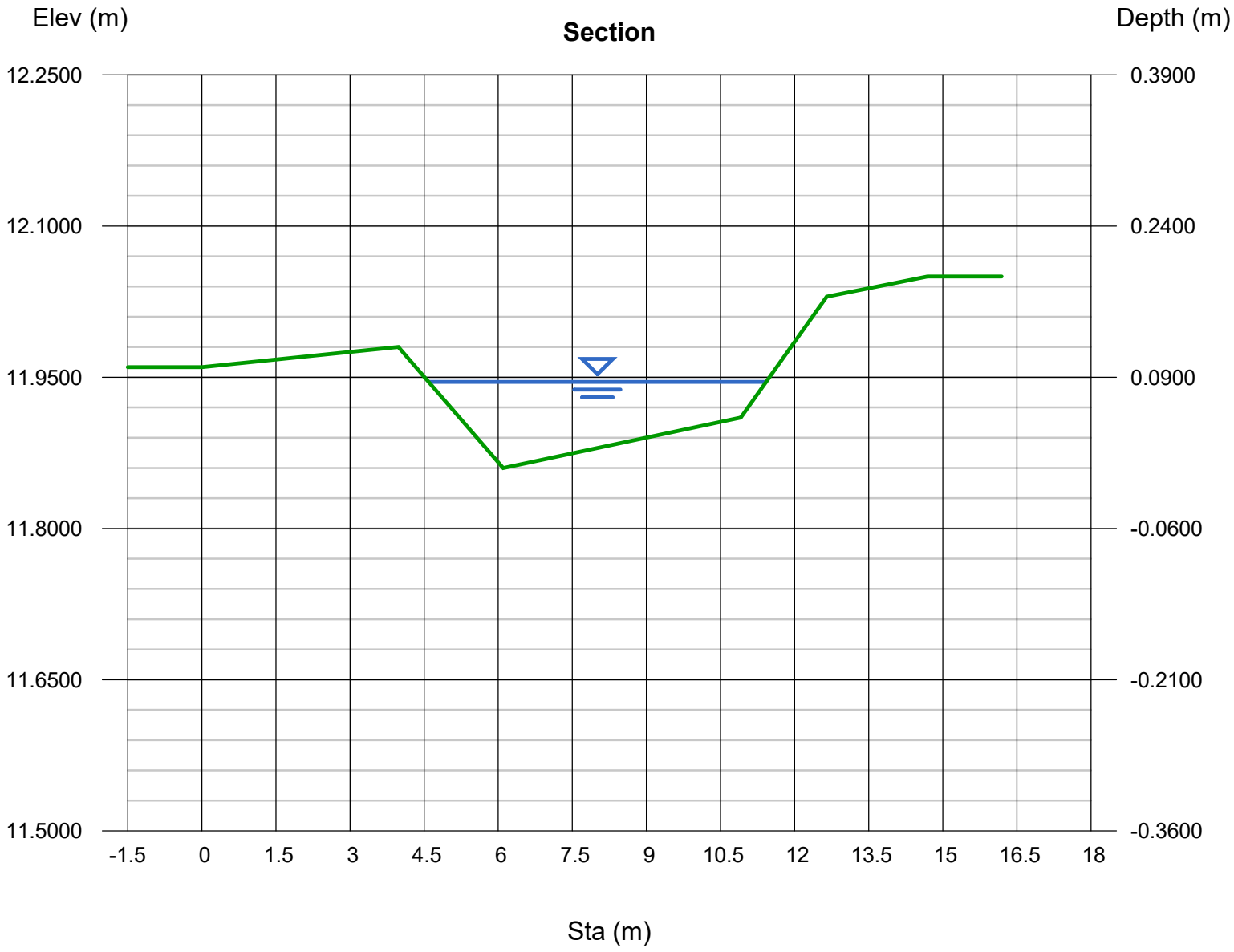

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 22 2026

Rain garden C Spillway Section PP

User-defined

Invert Elev (m)	=	11.8200
Slope (%)	=	0.4000
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.4500

Highlighted

Depth (m)	=	0.1219
Q (cms)	=	0.4500
Area (sqm)	=	0.4280
Velocity (m/s)	=	1.0514
Wetted Perim (m)	=	4.1812
Crit Depth, Yc (m)	=	0.1280
Top Width (m)	=	4.1433
EGL (m)	=	0.1783

(Sta, El, n)-(Sta, El, n)...

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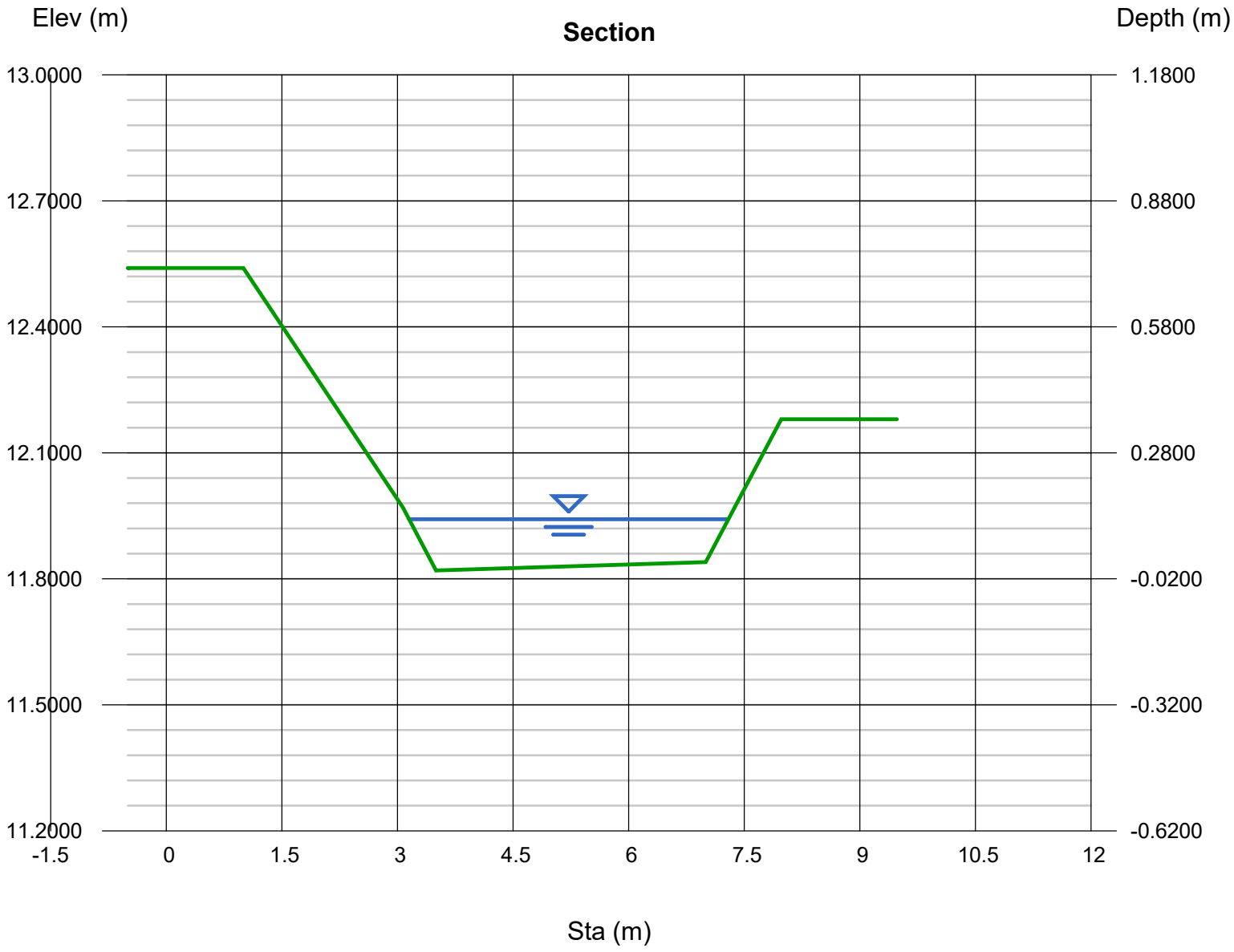


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 22 2026

Wetland A emergency spillway

Trapezoidal

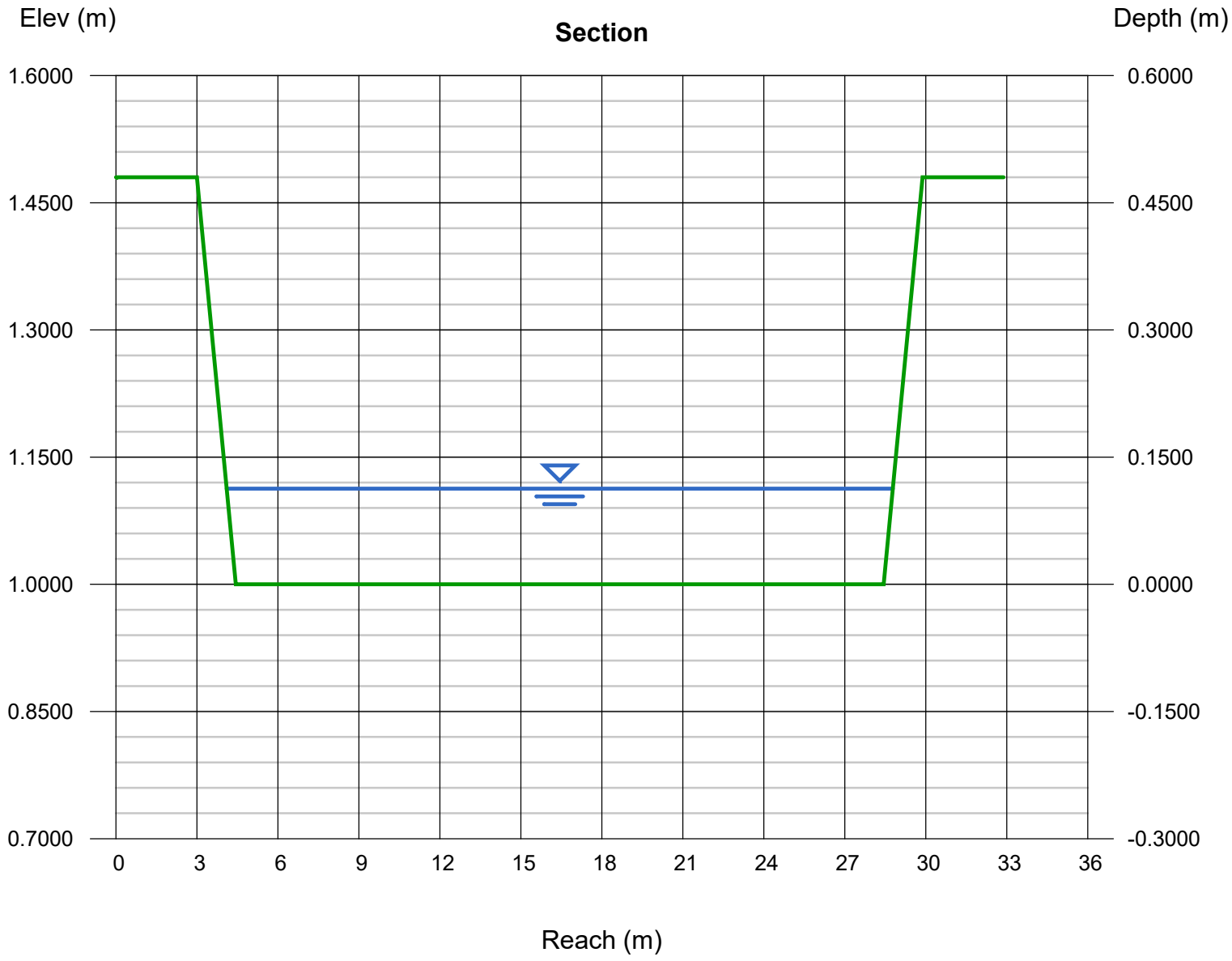
Bottom Width (m)	=	24.0000
Side Slopes (z:1)	=	3.0000, 3.0000
Total Depth (m)	=	0.4800
Invert Elev (m)	=	1.0000
Slope (%)	=	1.0000
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cms)	=	2.0800

Highlighted

Depth (m)	=	0.1128
Q (cms)	=	2.0800
Area (sqm)	=	2.7448
Velocity (m/s)	=	0.7578
Wetted Perim (m)	=	24.7133
Crit Depth, Yc (m)	=	0.0914
Top Width (m)	=	24.6767
EGL (m)	=	0.1421



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 17 2026

WETLAND A Spillway Section OO

User-defined

Invert Elev (m)	=	10.5800
Slope (%)	=	1.0000
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cms)	=	2.3440

Highlighted

Depth (m)	=	0.1585
Q (cms)	=	2.3440
Area (sqm)	=	1.2399
Velocity (m/s)	=	1.8904
Wetted Perim (m)	=	9.9230
Crit Depth, Yc (m)	=	0.2225
Top Width (m)	=	9.9054
EGL (m)	=	0.3408

(Sta, El, n)-(Sta, El, n)...

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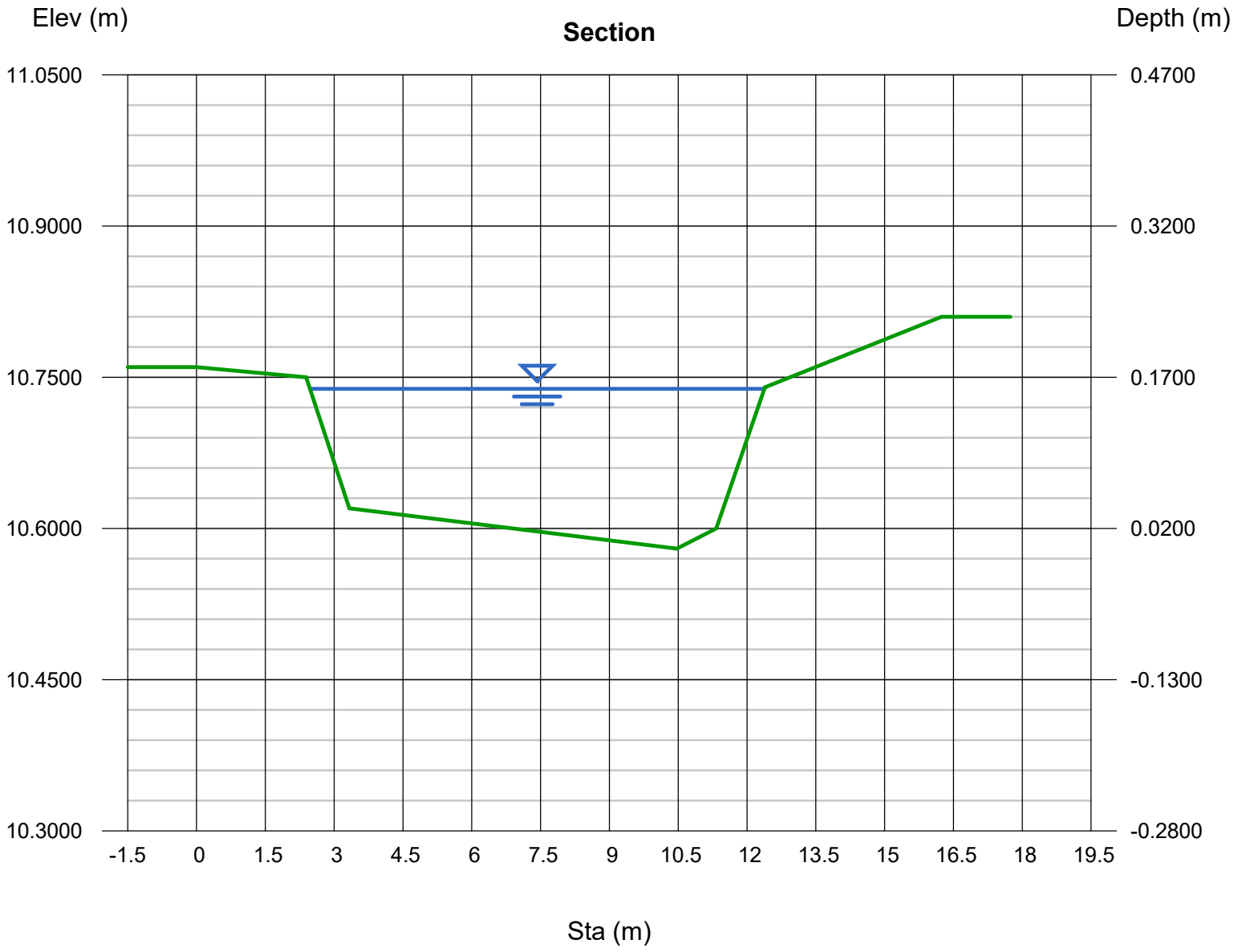

APPENDIX C – GEOTECHNICAL REPORT

(Appended to the substantive application)

APPENDIX D – HYDROGEOLOGICAL REPORT

(Appended to the substantive application)

APPENDIX E – STORMWATER MANAGEMENT PLAN

STORMWATER MANAGEMENT PLAN - FAST TRACK PROJECT

SUBSTANTIVE APPLICATION

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

MAVEN ASSOCIATES	**Job Number** 135041		**Rev** **A**
Job Title Brookvale Green, Havelock North **Title** Stormwater Management Plan	**Author** RH / BB	**Date** 06/2026	**Checked** BB

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APPENDICES

Appendix A – Operation and Maintenance Manual

Appendix B – Stormwater Modelling Report (Appended to the substantive application)

Appendix C – Stormwater management devices and network detailed plans. (Engineering Plans appended to the substantive application)

2 PURPOSE

The purpose of this report is to provide an overview of the proposed stormwater management for the 24Ha site to be developed into a residential subdivision.

The following Stormwater Management Plan (SMP) is to support an application for a Stormwater Discharge to Land Consent to divert stormwater from the new 203 lot development and discharge to land via establishment of stormwater networks, treatment devices and conveyance channels.

This Stormwater Management Plan should be read in conjunction with the:

- Flood modelling report.
- Infrastructure Report
- Planning Application for the substantive application resource consent approval

All of these reports are appended the substantive application package.

3 SITE DESCRIPTION

The site is located at 174 & 176 Brookvale Road.

The site currently houses buildings, sheds, packhouse, warehouse and carparking areas associated with the current businesses located onsite. It is currently 22% impervious.

Access to the site is via a private road from Brookvale Road. Several gravelled roads provide access throughout the site.

The site topography falls inwards from the western and southern boundaries towards the northern boundary of the site. There are two watercourses on site which are not permanent streams.

4 PROPOSED DEVELOPMENT

It is proposed to develop and subdivide the site into 203 residential sections, roading, infrastructure for servicing and public amenities.

5 STORMWATER MANAGEMENT PLAN.

A stormwater strategy has been developed for the site to demonstrate the overarching principles of how stormwater is to be managed, as required by the Hastings District Council (HDC) Code of Practice, the Hawkes Bay Regional Council (HBRC) and New Zealand Building Code Surface Water E1 will apply to private lot drainage and freeboard requirements.

The rules for development, with respect to stormwater runoff from the site, are working towards the objective of improving the current stormwater management onsite (effectively none) by implementing controls through redevelopment and thus, having a positive impact on the receiving environment by managing the post-development hydrology and discharge quality.

5.1 STORMWATER RETICULATION

The subject site will be serviced by a new stormwater network. The primary drainage network is designed to contain up to a 1 in 5-year ARI rain event within the pipes. The general concept of stormwater runoff on site to the piped reticulation network is as follows:

- Roof water is collected in the gutters of dwellings and downpipes are connected to a single outlet along the kerb adjacent to the lot frontage of each new dwelling.
- Stormwater collected from the driveway and hard surfaces on each lot will also be directed to the kerb discharge point.
- The kerb outlet discharges all flow to the kerb and channel in the road. From here the stormwater flows overland to the surface entry of either the rain gardens, or the wetland, and some areas flow into catchpits first, and then in a pipe to the forebay of the wetland.
- The site is divided into 5 catchments, which all flow to a stormwater management device before being discharged.
- Lots 181 – 188 will discharge directly to Watercourse 2 via sheet flow, however, the roof water will be directed to a kerb discharge. This is due to the roof height being sufficient for a free draining solution, but the rest of the lot surface level will be lower than Road 3.
- All other lots will generally shed rainwater runoff towards the road from which it gains access from.
- Once the stormwater is managed within each device for its respective catchment, it will discharge to either of the two watercourses on site.
- All stormwaters will flow to the same location downstream as for the existing site runoff.

5.2 STORMWATER CAPACITY

Currently, there is no existing public stormwater disposal system to connect to in the vicinity of the Site. All stormwater from the surrounding development site is managed through private on-site stormwater systems which discharge to both of the watercourses on site.

There is a 1.4m x 1.1m box culvert under Brookvale Road at the head of Watercourse 1.

There is a 400mm and 800mm culvert at the head of the watercourse 2, which also discharges to the northern side of Brookvale Road and are connected to the roadside open drain which flows to the same box culvert mentioned above, but a 300mm culvert under the entry to the site.

The capacity of the culverts is proposed to be increased in accordance with the stormwater flood model. The primary network and stormwater management devices on site have been designed to limit the discharge from the site, refer to attenuation below.

5.3 PIPE NETWORK AND OVERLAND CONVEYANCE

The new pipe network will convey stormwater to the same discharge location and the rate of discharge from the site will be no more after development than compared to the pre-development flow in the 2 and 10-yr ARI event. Any flow beyond the primary network capacity will be conveyed within overland flow paths, mostly along new road corridors. Any overland flow will discharge to the watercourses via the management devices. Each device will be equipped with a control structure to allow for attenuation and an emergency overflow to protect the device but also to allow for extreme weather events which may exceed the design parameters.

5.4 ATTENUATION

The attenuation requirements are for the post development discharge to be no greater than the pre-development flow in the 2 and 10-yr ARI event and up to 80% of the predevelopment flow in a 100yr event is also required.

The stormwater attenuation will be combined with stormwater treatment via a wetland and extended detention within the same structure.
One dry basin, four raingardens, one wetland basin with extended detention area and two enlarged conveyance channels will provide the attenuation of stormwater runoff to pre-development levels.

5.5 WATER QUALITY AND RISK MANAGEMENT

Contaminants generated from the use of vehicles on the road network will be the primary source of contaminants.

The rainwater runoff from the new public roads will be directed to the stormwater wetland and raingardens before it is discharged to either Watercourse 1 or Watercourse 2. The design principles for treatment within wetlands which are set out in the HRBC Waterway Water Design Guidelines 2009. This document suggests a low impact design approach and lists five principles in section 4.2. Water quality improvement with the use of a wetland and raingarden provides treatment as close as possible to the source and relies on the natural soil and plant processes within the wetland device at the same time as providing attenuation of rainwater runoff, thereby achieving multiple objectives.

The controlled outlet of the stormwater wetland management structure will discharge to Watercourse 1 via a concrete outfall structure and riprap protected outfall. The wetland basin will be sealed in its base with and impervious layer to prevent infiltration and protect source water within the aquifer below. The outfall structure and riprap are designed to mitigate erosion within the channel base of Watercourse 1. The raingardens (also have impervious liners in their base) B, C and G will discharge to Watercourse 2 via subsoil drains at low flow through a catchpit sump. Overflow points will be provided via roadside catchpits which will drain to Watercourse 2 and the roadside drain on Brookvale via the culvert under Road 1.

Dry Basin D is planted with vegetation and will normally be dry. It will only have water in it when Watercourse 1 overflows into it temporarily, thereby buffering the amount of water which is discharged to the culverts under Brookvale Road. The dry basin does not have any water treatment functionality. Details of the stormwater quality management devices are on Plan C450.

5.6 OVERLAND FLOW

The Brookvale SMP states that the 1 in 50 yr ARI rainfall event must be considered for overland flow.

The proposed topography of the site and the roading corridors will be shaped to allow for overland flow generated on site, to be controlled through the site to the discharge point without affecting new building floor levels. Flow depth and velocity will be minimised to provide safe passage for pedestrians and vehicles.

It is proposed to retain and enhance the open stormwater channels. The historical overland flow from the upstream catchment traversed the site. However, over many years, shallow open channels and culverts have been formed on site to divert the overland flow into the two main watercourses.

It is proposed to cut off the upstream flow and to divert it around the site to avoid substantial overland flow from the upper catchment entering the road network on site. There is currently an existing cutoff drain along the southern most boundary of the site which already acts in this way. It is proposed to widen the drain along the southern boundary by up to 3m to manage stormwater as a planted swale. This enhanced planted swale will be merged with Watercourse 1 which will also be improved to increase conveyance and storage capacity.

Watercourse 1 within the site (dry at the time of inspection) acts as a major overland flow path during the 100yr ARI storm event. The flow in this channel will bypass the site and continue under Brookvale Road to an open watercourse / reserve from which flow continues towards the west in open drain and a culvert under Davidson Road into the Crombie Drainage Reserve, and again under Romanes Drive to the Karituwhenua Stream and then discharges to the Karamu Stream.

This conveyance channel has sufficient capacity to direct the 100yr ARI storm event flow past the site however the capacity of the culvert under Brookvale Road is not sufficiently large and therefore ponding occurs on site.

The two watercourses will be enhanced by using the following methods along both channels:

- Removal of weeds and pest plants and large trees.
- Widening of the base and increasing the width of the channel with a side slope of 1 in 3 by excavating material.
- Watercourse 1 will be partially re-directed as discussed above in the earthworks section and shown on Plan C63 and C70
- The base of the channels will be inspected by Geotechnical and or Hydrogeological engineering professionals to advise on potentially adding impervious layers in the areas they deem necessary.
- The surface of the excavated channels will receive a layer of topsoil and coconut matting before landscape planting occurs.
- Erosion protection in the form of green outfall structures, rip-rip rock on Geocloth, wingwall outlet structures and gabion rock will be used to mitigate erosion in critical locations as shown in the plans.

5.7 FLOODING

The site is within the Plains Production Zone under the HDC Operative District Plan. The site is not within the Brookvale Structure Plan area, however, the design outcomes for mitigation of stormwater discharge from the site to prevent flooding upstream and downstream are considered relevant in terms of the Brookvale Structure Plan – Stormwater Management Plan.

A predictive stormwater model has been developed by Maven Associates. Refer to the model report appended to the substantive application.

The engineering design (as indicated within the provided Maven civil drawings and masterplan appended to the substantive application) provides for the required civil engineering solution, of which is summarised below:

- Avoid blocking of overland flow paths.
- Provide a finished topography of the site to allow for a complying stormwater network to act as primary drainage and secondary drainage to flow overland and mainly contained within road corridors between kerbs.
- Provide a cut-off drain (along south-eastern boundary), which intercepts sheet flows and directs this into Watercourse 1 and around the development area.
- Provide adequate overland flow channels to convey stormwater runoff from the upstream catchment and sufficient capacity within the roading network to convey rainwater runoff from the site as secondary drainage.
- Ensure the design of flood flows mimics that of the pre-existing conditions as it tops over Brookvale Road.
- Ensure that there are no effects on any downstream properties which are currently impacted by flooding as detailed in the flood modelling.
- Freeboard above the 100yr design flood level to future floor levels will be as per the building code requirements. As per the flood model results and the site runoff Hec Model report results, no 100-yr ARI ponding enters private residential lots, nor does it extend to the future building platforms. Minimum floor levels will be set at the 224c stage of subdivision when the titles are created as this information relies on certified as-built information after construction. For secondary flows the building code requires:

    -500mm freeboard where surface water has a depth of 100 mm or more and extends from the building directly to a road or car park, other than a car park for a single dwelling.
    -150 mm for all other cases.

- HBRC Waterways guidelines for Stormwater Management requires contingency freeboard above the 100 yr ARI flood level and NZS 4404 section 4.3.5.2 states that 500mm of freeboard between the top water level of the 100yr ARI event and habitable dwellings including attached garages are necessary.
- Upgrade the culverts under Brookvale Road to allow for sufficient conveyance of the 100yr ARI storm event and therefore provide adequate freeboard to new building platforms.
- Enhance to storage capacity of channels and basins on site to prevent displacement of flood water which may affect upstream or downstream properties.
- Consider the unlikely event of blocked culverts at Brookvale Road to ensure this does not have an impact on freeboard levels upstream. (Brookvale Road currently receives overflow from the upstream

Watercourse 1 in a 100yr event. Watercourse 1 upgraded and with Dry Basin D added, the post - development flood model must show the overflow scenario is no worse and safe for vehicle traffic)

The stormwater modelling concluded that the proposal meets the above target criteria.
A flood hazard risk assessment was undertaken as part of the flood model work.

For more information on the flood model results please refer to the flood model report and plans appended to the substantive application.

The general outcome of the flood hazard risk assessment was that the level of risk over the majority of the site will reduce from what it is currently, when the proposed development is completed. The hazards can be summarised as the no or very low hazard near any proposed dwellings and Hazard Class 4 and 5 within the major overland flow paths as expected.

Appropriate emergency egress is provided for within the proposed development.

The severity of any theoretical 100yr ARI flooding event is not exacerbated by the proposed development, and no overland flow is blocked by the development. The flood model plans show the extent of flooding within the site and both up and downstream of the site both in existing form and post-development form. The change of the flood extent is negligible due to the proposed mitigation provide for within the proposed development.

Flooding and overland flow on upstream and downstream properties is therefore not made any worse by the proposed development.

5.8 ONGOING MAINTENANCE REQUIREMENTS

The stormwater management devices which require ongoing maintenance are:

- Raingardens
- Wetland
- Dry detention basin
- Catchpits
- Piped network
- Flow control structures.
- Conveyance channels
- Culverts
- Outfall structures with riprap
- Spillways
- Planted swales

The spillways, outfall structures, flow control structures and planted swales, dry detention basin and raingarden inlets and wetland forebays mostly only require visual inspections every 6 months. Any rubbish to be removed, build-up of sediment or unwanted weeds are to be removed.

Rain garden and wetland basins will require less frequent maintenance and will have a longer lifespan if the inlet structures are inspected frequently and cleaned out on a 6 monthly basis.

The pipe network and culverts are to be inspected for any blockage which will show up as ponding on the surface first. Any maintenance required to unblock pipes will follow regular visual inspections however is mostly reactive maintenance.

The catchpits/manholes within the site are to be checked and maintained a minimum of every 6 months and after every 1 in 10-year rainfall event.

For plant maintenance please refer to the landscape maintenance guidelines.

The maintenance of stormwater devices will be regularly monitored and recorded on-site through the use of a monitoring register. Refer to the Maintenance and Monitoring Register along with the Inspection sheets within the O + M Manual.

The stormwater monitoring and maintenance register and stormwater management plan for the proposed onsite systems will be reviewed annually to ensure updates and changes in procedures are recorded. These will be documented by updating the inspection registers of each device.

Refer to the O+M Manual in Appendix B

6 CONCLUSIONS

Quality treatment will be provided for all trafficable areas within the site. This will be provided via rain gardens and a wetland. This approach is in line with the best practical stormwater management outcome for the site and complies with the HBRC guidelines for waterways.

Attenuation of the rainwater runoff as detailed in the plans and calculations will ensure that the downstream environmental impacts are mitigated.

Flood mitigation solutions provided within the design and based on the stormwater modelling results will ensure that the upstream and downstream properties will not be adversely affected by this development.

The freeboard requirements for future dwellings can be met.

The stormwater management on this site will be robust, practical and will remain a good amenity to the new community provided there is regular and appropriate maintenance of the new stormwater management devices.

It is recommended that the design principles of this SMP be generally accepted for the subject site.

Appendix A – Stormwater Device Operation and Maintenance Manual

STORMWATER DEVICE OPERATION AND MAINTENANCE MANUAL:

DRY DETENTION BASIN

WETLAND

RAIN GARDENS

AND GENERAL STORMWATER INFRASTRUCTURE

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

MAVEN ASSOCIATES	**Job Number** 135041		**Rev** **A**
Job Title Brookvale Road, Havelock North **Title** **O&M Manual**	**Author** RH / BB	**Date** 06/2026	**Checked** BB

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Appendix A – Raingarden and Wetland Maintenance Guides – Auckland Council documents

Appendix B – Landscape Architect's Planting and Maintenance Plan (Appended to substantive application)

Appendix C – Approved Engineering Plans (Appended to substantive application)

Appendix D – As-built Plans (To be appended once constructed)

Appendix E – Maintenance Checklist example

1.0 Overview

Public Stormwater management Assets constructed as part of the Brookvale Green development which will require operation and maintenance are the dry detention basin, wetland, raingardens, conveyance channels and the associated pipes and structures which allow these management devices to function in accordance with the design.

Figure 1. Locality Plan of Public Stormwater detention device

2.0 Operation

2.1 Raingarden

Rainwater runoff flow within the kerb and channel and enters the raingarden inlet via the kerb inlet. The inlet is protected from erosion with riprap rock at and cloth. The surface of the raingarden is planted with selected vegetation which allow for plant health even with occasion ponding of the surface up to 200mm depth. When maximum ponding is reached, the overflow drain will receive the flow and direct it to the stormwater network. Under normal working conditions the flow travels vertically through the plant media / soil and is collected by the subsoil drain. This process allows the plants to use some of the moisture (retention) and clean the water (treatment) to discharge clean runoff after 72 hours (after detention).

2.2 Wetland

Rainwater runoff flow within the kerb and channel in the road. The runoff enters the catchpits which filters out any debris and rubbish which may be lying in the road or being blown around by the wind. The catchpit also helps to collect some sediment in their sumps. Refer to catchpit maintenance. The flow now enters the piped network and flow towards the wetland forebay. As the water discharges into the forebay it is slowed down significantly, further sediment and debris removal occurs. The water level in the forebay rises until it overflows the level spreader and flow then enters the bathymetric area of the wetland. As the water slowly flows through the planted base with deep and shallow pools, the wetland treats the water. The water level in the wetland rises until it starts to discharge from the controlled outlet structure. The volume contained with the wetland now is attenuated volume. The orifice at the base of the outlet structure will drain down this volume until the permanent water level in the wetland is reached once again after the rainfall stops. Any overflow above the attenuated surface water level will spill into the scruffy dome outlet structure and discharge to the waterway via wingwall outlet and riprap protected outlet structure to prevent erosion of the channel. The wetland has a maintenance path around it, which will flood during heavy rainfall but will be dry again within 72 hours. The outlet control structure will house a valve which can be used to drain the wetland if it is required for larger maintenance or replanting works.

2.3 Dry Detention Basin

The dry basin will look like an outdoor space with grass and plants and now permanent water level. During heavy rainfall Watercourse 1 level may rise to the spillway level during a 100 yr ARI event. The water which flows into the dry detention basin will flow out of the basin once the level in the watercourse drains to a point below the outlet structure. The basin will run dry as the rainfall stops and the channel dries up. The spillway and outlet structure will be protected from erosion by either grass planted banks or rock riprap at the piped outlet to prevent erosion.

2.4 Catchpits

The catchpits receive flow from the kerb and channel via the grate. The grate filters out some debris and rubbish. Sediment particles and small rocks may still enter the catchpit sump and usually stays within the sump. Water then flows out of the catchpit via the outlet pipe and into the rest of the stormwater network. The catchpits also receive minimal flow from the subsoil drains of the roads. These subsoil drains are connected to the catchpits above the outlet pipe

2.5 Piped Network

The piped network will receive rainwater runoff via the catchpits every time rain falls on the site. The pipe network discharges to the wetland and to the watercourse via raingardens.

2.6 Flow Control Structures

These structures control the amount of flow which is discharged from raingardens and the wetland with a series of orifice, weirs and overflow inlets. This allows the designer to attenuate the runoff.

2.7 Conveyance Channels

When rain falls on the upper catchment some might soak into the topsoil and planted surface of the catchment. Eventually with enough rain it forms sheet flow which is not absorbed by the ground surface. This flow enters the conveyance channel and accumulates in the base. With enough rainfall accumulating there will be flow in the channel which flows downstream to the nearest outlet. For Brookvale Green, this outlet point is the culverts under Brookvale Road. The planted surface of the conveyance channels helps with the erosion protection and generally improves water quality by way of sedimentation removal (benefits the downstream receiving environment) which in turn has ecological benefits to the plants and environment.

2.8 Culverts

The culverts allow for stormwater accumulation to discharge freely under the roads to the other side of the road where the stormwater channel / swale or watercourse continues as an open drain.

2.9 Outfall Structures

A simple open-ended pipe which discharges large volumes of fast flowing water will cause erosion of the channel near the pipe. The outfall structure helps to prevent this erosion at the outlet and the outlet wingwall structure props up the end of the pipe so that it does not slump down. The riprap helps to slow the water flow down and prevents further erosion of the channel base. This operation is automatic as the water flows in gravity.

2.10 Spillways

Spillways receive flow when the water level within a structure reaches the highest design level. The spillway is design to receive flow without causing erosion of a stream bank for example and thereby protects the sidewalls of the rest of the structure such as a basin or wetland from collapsing if flow was to be concentrated in the wrong location.

2.11 Planted Swales

The planted swales at Brookvale Green are mostly buffer planting for aesthetical purposes. However, the planting in the swales have ecological benefits as the absorb some moisture and filters out contaminants as the water flow through the swale. The southern swale / cutoff drain will receive sheet flow from the upper catchment and as the water accumulates in its base it will convey that water to Watercourse 1.

3.0 Maintenance

3.1 Raingarden

Specific maintenance required is the removal of weeds, clearing debris, sediment and rubbish from the kerb inlet and ensuring that ponding of water on the surface infiltrates to the subsoil drain and outlet within 72 hours.

3.2 Wetland

Specific maintenance required is the removal of weeds, clearing debris, sediment and rubbish from the forebay to ensure that no foreign and unwanted materials flow to the permanent wet pond beyond the inlet forebay. Checking the outlet control structure is free-flowing and that there is no visible damage to any of the concrete structures on either the outfall structure or riprap. Inspecting signs of erosion at the outlet. Replanting any dead wetland plants.

3.3 Dry Detention Basin

Mowing and weeding on a regular basis. Clearing of all unwanted plants and rubbish removal. Inspection after storm events to replant any damaged plants and prevent erosion of the base. Check the outflow structure is clear of blockages and that the dry basin becomes dry within 48 hours after significant rainfall.

3.4 Catchpits

The catchpits/manholes within the site are to be checked and maintained a minimum of every 6 months and after every 1 in 10-year rainfall event. The catchpits are to be checked for a build-up of debris and sediment deposits to ensure that the catchpits maintain functionality. The catchpits/manholes/pipes when required, are to be cleaned by sucker truck/vacuumed to remove any accumulated debris and sediments.

3.5 Piped Network

Reactive maintenance due to any observed blockages. Proactive maintenance by visual inspection for any unwanted sediments or weed / roots growing in the inlets or outlets of any of the pipe network or near manholes.

3.6 Flow Control Structures

Inspect the structure to ensure it is functioning, not blocked and no damage. Blockage of the flow control structure will present elevated levels of water within the rain gardens and wetlands for longer periods than 48 – 72 hours. Clear all blockages and ensure that water is free draining through the structure.

3.7 Conveyance Channels

Keep clear of weeds and unwanted plants. Check the surface for erosion and damage after significant rainfall events. Check that there is not ponding in the base of the channels.

3.8 Culverts

Proactive maintenance by visual inspection for any unwanted sediments or weed / roots growing in the culverts, inlets or outlets

3.9 Outfall Structures

Check that the wingwall is not undermined. Check that the riprap is in place with no erosion around the base of the riprap or beyond the riprap within the channel.

3.10 Spillways

Keep clear of sediment and rubbish. Ensure that there is no unwanted vegetation growing on the spillways.

3.11 Planted Swales

Remove all unwanted vegetation. Check that there is no long-term ponding within the swales. Clear blockages. Replant any desired plants which are dead or dying.

General maintenance is primarily concerned with:

- Maintenance of outlet and inlet structures
- Maintenance of spillways
- Maintaining planted vegetation and preventing undesired overgrowth vegetation from taking over the area.
- Removal of accumulated sediments.
- Debris removal.
- Maintenance of the maintenance access track

Access

The dry detention basin can be accessed via Road 1 through two separate vehicle crossings and access track provided at the wetland. Removable bollards have been placed at these entrances to stop public vehicle access but allow maintenance vehicle and equipment access. A maintenance access track connects the two vehicle crossing entrances and gives close access to the wetland pond banks, rip rap and inlet/outlet structures. The dry basin can be accessed via the footpath along road 1 for mowing and weeding.

Raingardens are located next to the road kerb near the entrance of the site and intersection of Road 1 and Brookvale Road, and Road 3 and Brookvale Road intersection. Ther are also raingardens placed opposite the intersection of Road 2 and Road 1 where a vehicle crossing and parking spot is provided for a maintenance vehicle. Access to the Road 5 raingarden is via the road 5 berm and spillway or the services corridor next to lot 109.

Watercourse 1 can be accessed from the maintenance accessway by the wetland or anywhere adjacent to Road 1 parking bays next to Watercourse 1. The planted swale along 131 to 141 will be within the back of private property and the maintenance of the swale will be the responsibility of each lot owner.

Vegetation

The vegetation within the detention basin, wetland and raingardens enhances performance or stormwater treatment and reduces flow velocity and erosion so requires close attention.

Maintenance includes removing noxious plants or weeds, re-establishing plants that die.

Regular inspections by the responsible entity (Council maintenance contractor) must be done to ensure that the desired vegetation remains and is not overtaken by invasive undesirable plants.

In some situations, the replacement of the planted vegetation by a volunteer species may be beneficial, but only if the invasive species provides equal or increased water quality benefits.

Use native plants as per the approved landscaping plans to replace plants if this is required. Refer to the Landscaping plans

Avoid the use of sprays to kill weeds or algae as this will contaminate the downstream waterways.

Sediment

Build-up of sediment in the dry basin, rain garden and wetland forebay, particularly around the outlet manhole should be removed as required to maintain a clear area around the outlet orifice.

When sediments are to be removed, it is essential to restore the vegetation and soil conditions to the originally constructed condition.

Rubbish and Debris

Rubbish and debris removal is an ongoing maintenance function within all the management devices and connected stormwater system. Debris, if not removed, can block inlets or outlets, and can be unsightly if located in a visible location.

Inspection and removal of debris should be done monthly and after storm events, with debris also removed whenever it is observed on site.

Rubbish and debris should be removed from the emergency spillway swale.

Wingwall inlets/outlets, spillway inlets and emergency spillway should be checked for rubbish and debris and cleared as required.

Build-up of rubbish and debris blocking the scruffy dome outlet should be cleared and as well as around the base of the manhole, particularly the orifice outlet.

Rip rap

Rip rap at inlets and outlets should be checked and maintained as required. Replace rocks and boulders at inlets / outlets that have shifted after storm events,

Drainage Testing:

If water is not observed freely draining from the dry pond after a rain event the outlet may be blocked. Back wash through the outlet and clear any debris within or surrounding the scruffy dome structure until the water is freely draining. The wetland will have permanent water in it, and this should not be at elevated levels for a long period. The raingardens should be free of ponding within 72 hours.

Just as it is important to know when a device needs to be maintained, it is important to know when maintenance does not have to be done. The original plan for the site provides the best information at that time on the design and construction of the devices and structures. Over time the facility may change in appearance and function. These changes may not necessarily be bad.

Having a knowledgeable inspector conduct regular inspections may be one way to allow a stormwater management device to evolve into an improved facility with reduced maintenance costs.

Access track:

The maintenance access track should be repaired as required if erosion has occurred or if the timber surround securing the track has been damaged.

4.0 Responsibility for maintenance

The developer's engaged contractor will be responsible for maintenance of the stormwater management device maintenance until the assets are vested through 224c or as per the agreed vesting programme. After the maintenance period and handover, it will be Council's responsibility to maintain the new assets.

5.0 Maintenance Programme/Schedule

Requirements for the Maintenance Schedule are:

- Regular maintenance and inspection of the stormwater system.
- Regular collection and disposal of debris and sediment collected by the stormwater management device
- Post storm maintenance inspection and maintenance if required
- Periodic Inspection and maintenance of outfall erosion.
- Checklists for all aspects of the stormwater system, including visual check of inlet/outlet structures, ponds and outfalls. Refer to Appendix E.
- Inspection and maintenance of vegetation associated with the stormwater devices. Refer to Appendix B.
- Recommended on-going control methodology to eradicate established pests and invasive weeds from both terrestrial and aquatic areas. Refer to Appendix B.
- Vegetation maintenance plan. Refer to Appendix B.

Refer to Council Wetland Operation and Maintenance guide for detailed maintenance requirements and required timing of inspection in Appendix A. This guide has been created for wetlands but covers all the components used by the dry detention basin.

Refer to landscaping plans appended to the substantive application for planting specifications and maintenance.

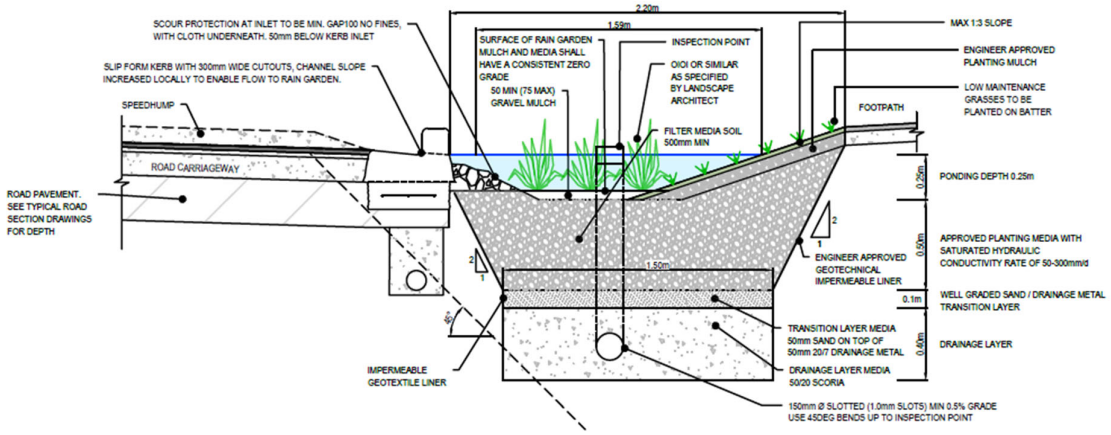
Refer to Appendix E for maintenance schedule checklist.

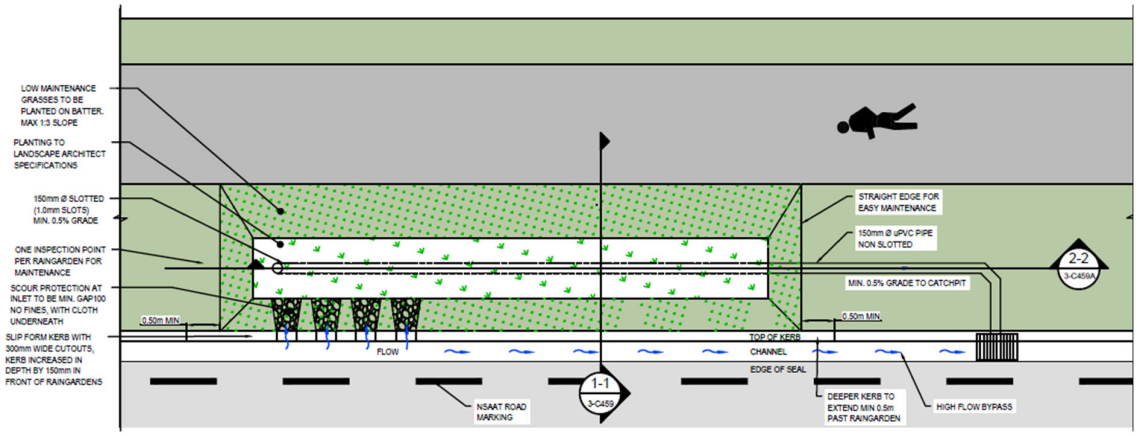
6.0 Technical Data

It is envisaged that this document will be updated during the Engineering Approval stage. Details of structures will be added after engineering approval.

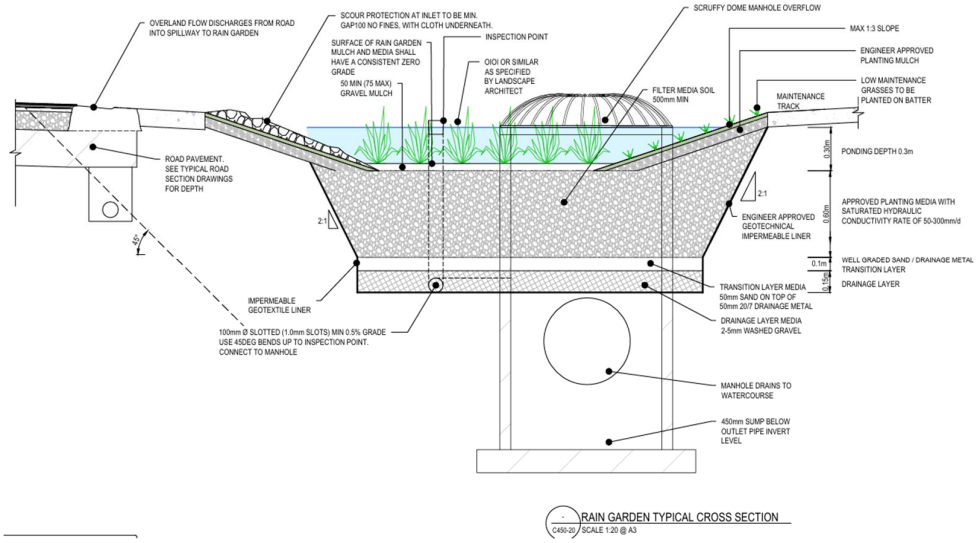
Typical technical details of the proposed management structures include:

Raingardens E, F and G: (Refer to Plan C460 and C461)



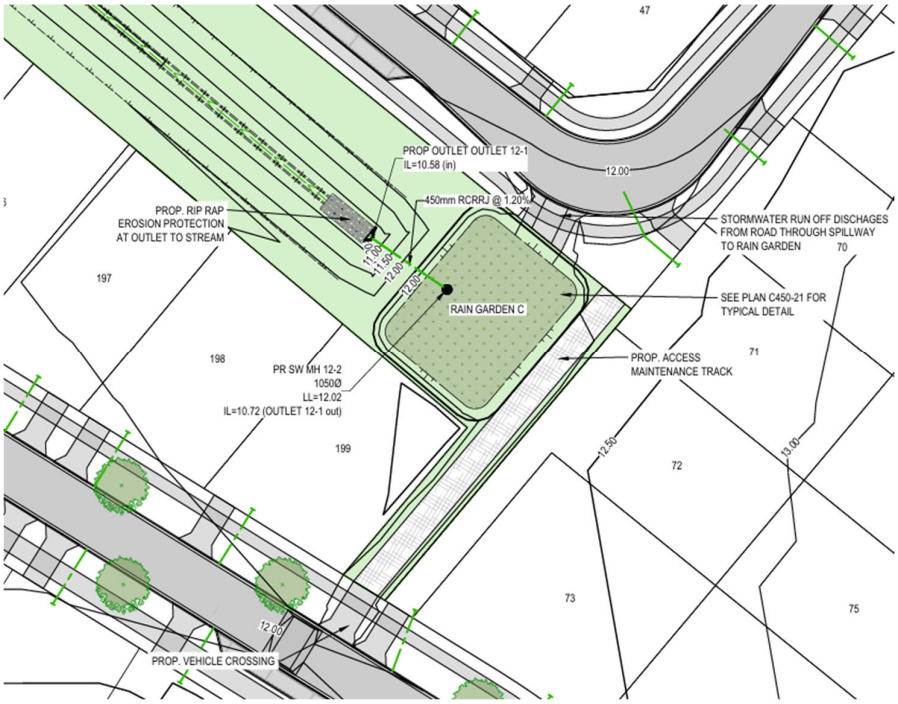


Raingardens B and C (Refer to Plan C450-12)

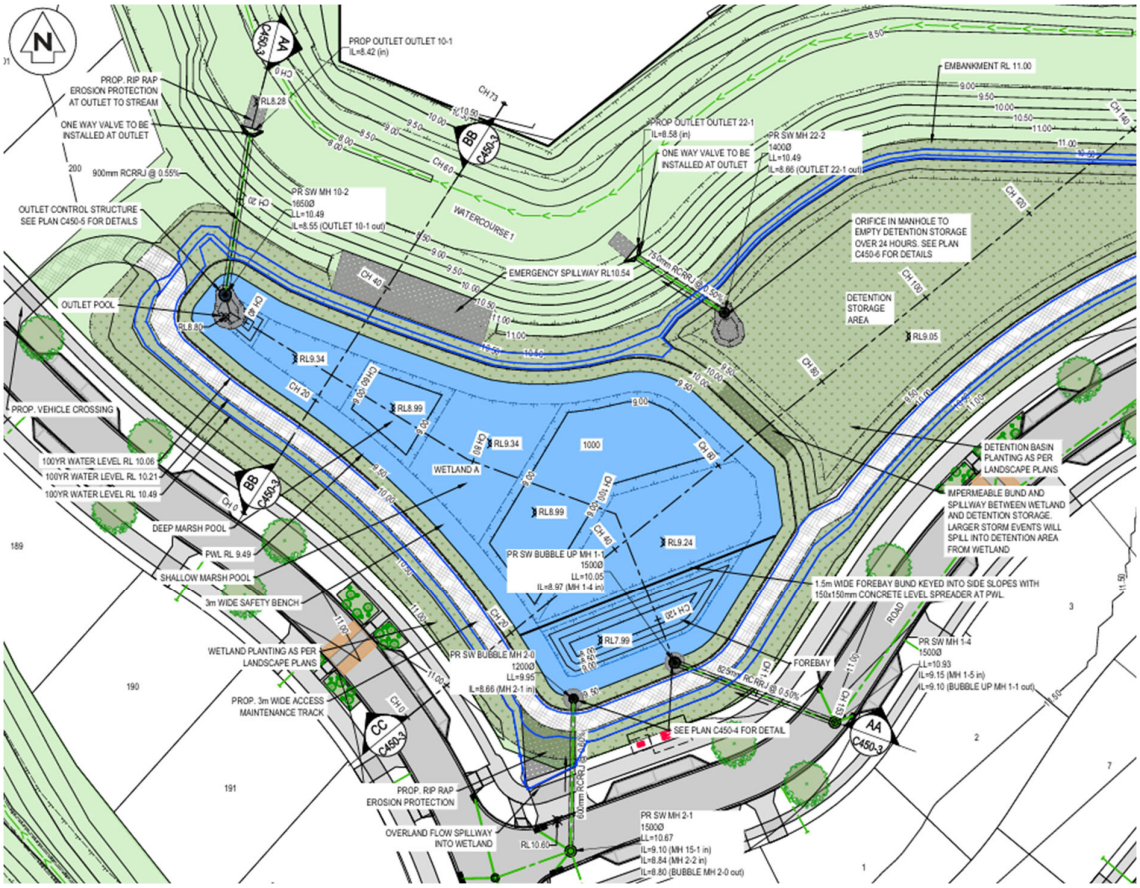


Raingarden B:

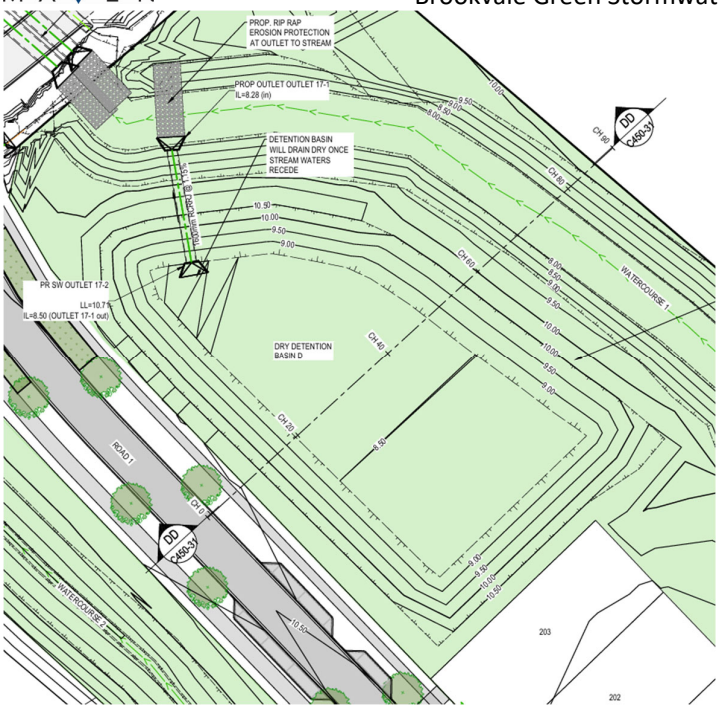
Raingarden C:



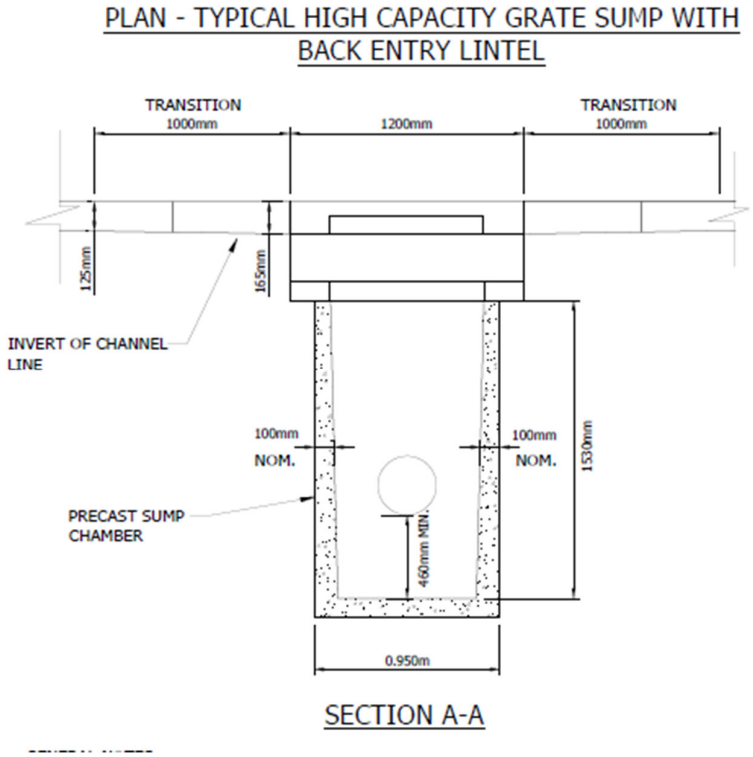
Wetland A and extended attenuation in dry basin:



Dry Detention Basin:


PROP. RIP RAP EROSION PROTECTION AT OUTLET TO STREAM
PROP OUTLET OUTLET 17-1 IL=8.28 (in)
DETENTION BASIN WILL DRAIN DRY ONCE STREAM WATERS RECEDE
PR SW OUTLET 17-2
LL=10.75
IL=8.50 (OUTLET 17-1 out)
DRY DETENTION BASIN D
WATERCOURSE 1
ROAD 1
WATERCOURSE 2
DD
C480-3Y

Catchpits:


PLAN - TYPICAL HIGH CAPACITY GRATE SUMP WITH BACK ENTRY LINTEL
TRANSITION 1000mm
1200mm
TRANSITION 1000mm
125mm
165mm
INVERT OF CHANNEL LINE
100mm NOM.
100mm NOM.
1530mm
PRECAST SUMP CHAMBER
460mm MIN.
0.950m
SECTION A-A

Conveyance Channels and Plated Swales:

Appendix A

Wetlands Operation and Maintenance Guide and Raingardens Operation and Maintenance Guide. An Auckland Council guideline document is provided for reference.

Appendix B

Landscape Architect's planting and maintenance guide (Appended to the substantive application)

Appendix C

Approved Engineering Plans – Appended to Substantive Application

Appendix D

As built Plans – To be added to this document upon completion of construction.

Appendix E

Maintenance Checklist Example/Guide

Appendix B – Stormwater Modelling Report (Appended to the substantive application)

Appendix C – Stormwater Management Devices and network detailed plans

(Appended to the substantive application)

APPENDIX F – EARTHWORKS MANAGEMENT PLAN

EARTHWORKS MANAGEMENT PLAN

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

MAVEN ASSOCIATES	**Job Number** 135041		**Rev** **A**
Job Title Brookvale Road, Havelock North **Title** Earthworks Management Plan	**Author** BB	**Date** 06/2026	**Checked** BB

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A – Refer to the chemical treatment management plan (CTMP) appended to the substantive application.

1. Introduction

1.1. Background

Maven have been engaged to undertake Earthworks Design in support of the Brookvale Green Development. The project was referred as a listed project of the Fast Track process in 2026. This document has been prepared to support the substantive application. Drawings, calculations and other specialist reports are appended to the substantive application package. Refer to the Infrastructure Report for further details of the proposed development.

1.2. Purpose of this Report

The purpose of this report is to provide an Earthworks Management Plan (EMP) for the 203-lot subdivision. The information provided herein outlines the methodology associated with the proposed earthworks onsite. This report is to be read in conjunction with the engineering drawings and the Geotechnical assessment and is to accompany the substantive application to the Fast Track Process.

1.3. Site Description

The 24Ha development is located at 174 & 176 Brookvale Road, Havelock North. The site topography falls inwards from the western and southern boundaries towards the northern boundary of the site.

2. Geotechnical Investigation

Site-specific geotechnical investigations have been conducted, and a geotechnical investigation report has been prepared by Hawkes Bay Geotechnical (HBG) to support the fast-track resource consent application.

Please refer to the Geotechnical Investigation Report for more information.

From the ground investigations undertaken by HBG the site is deemed suitable for the proposed earthwork whilst noting that the recommendations for mitigation as detailed in their report and referenced in this document must be considered during construction.

Upon completion of the proposed earthworks an Earthworks Completion Report will be prepared by the Geotechnical Engineer. This report will certify the adequacy of the earthworks and make recommendations on bearing strengths for foundation design purposes.

3. Earthworks and Sediment Control

The area of proposed earthworks is 24 Ha. The goal of earthworks on this site is to create a landform which will allow rainwater runoff in a controlled manner to the downstream discharge location. Earthworks will include the construction of stormwater management devices, improvement of overland flow channels and filling to create suitable building platforms. The earthwork design also allows for the conveyance of concentrated sheet flows during large rainfall events around the development area, within the eastern stormwater channel (Watercourse 1) with secondary stormwater flows overland along new road corridors. This ensures the developable areas are separated from any overland flow and flooding. Refer to Plan C200 series plans for further information on earthworks.

3.1. Design Standards

The potential effects of earthworks on the surrounding environment will be mitigated in accordance with the HBRC adopted Part 2 of NZS4404:2010. Section 2.3.7 provides guidance on erosion, sediment, and dust control.

3.2. Earthworks and Future Programme

Earthworks will be undertaken in stages and commence when all necessary consents are in place. A start date will be determined in the next earthworks season. It is envisaged that all earthworks will be completed within three (3) earthworks seasons. Applications for Winter Works will be lodged if required.

It is proposed that the bulk earthworks operation will comprise of four to five separated work sections that will be undertaken independent of each other as shown on the earthwork plans attached in Appendix A. Thes works sections are not stages but rather a logical sequence of earthworks operation.

Works are intended to be carried out in the following steps:

- Clear buildings and structures from the site, consider existing services on site which need to be protected / removed / altered or abandoned.
- Install silt control measures, as shown on Engineering Drawings or agreed plans provided at the pre-construction meeting.
- Install sediment controls ponds, clean and dirty water diversion bunds.
- Carry out bulk earthworks.
- Install drainage systems, outlets, and riprap.
- Form channel and building platform areas concurrently as site is stabilised.
- Stabilise Road corridors by placing the subgrade improvement layer of brown rock ready for civil construction to take place.
- Retain and maintain silt control measures until completion.

3.3. Earthworks Summary

Sediment Control must be installed prior to soil disturbing activities. The bulk movement of soil will be undertaken after demolition / removal of all buildings and structures on site. Refer to the Preliminary and Detailed Site Investigation from EAM Environmental Consultants. The report is appended to the substantive application and provides information and photos of the existing buildings and structures on site which will be removed. The report concluded that no further work is required to the investigation results showing that the soils at the site are highly unlikely to pose a risk to human health. It is therefore not envisaged that an Remediation Action Plan (RAP) would be required.

The bulk earthworks on site will be divided into four separated work sections. These include sediment retention ponds and cutoff / diversion drains, Bulk Earthworks and excavation and shaping of the stormwater management devices. Please refer to the engineering drawings appended to the substantive application.

Secondary earthworks will include the construction of roads, excavation for drainage networks and services. This activity will expose earth and require sediment controls to remain in place until completed. However, as the catchments progressively reduce in size by adding more stabilisation, the controls can be amended to suit the resultant earthworks activities.

Once all earthworks' phases are completed the earthworks catchments will be stabilised and the SRP's removed. It is envisaged that the cut material won from drainage trenches and the excavation to subgrade of road corridors will be used to fill in the SRP's.

3.4. Existing services to consider.

There is an existing overhead power supply network on the site. Unison, the electricity network utility operator, will alter the electrical network to suit the future site layout.

All existing private water, stormwater and wastewater infrastructure will be removed from the ground. Any other services ducting or infrastructure not required for the future development will be abandoned or removed. It is the responsibility of the earthworks contractor to identify all existing infrastructure on site to be removed prior to undertaking bulk earthworks. Some services will need to remain in place until agreed and will require protection.

There are at least 5 existing water bores which need protection during the start of earthworks. The bores will need to be capped in agreement with regional council to ensure no risk to contamination of the groundwater aquifer during or after the process.

The water bore decommissioning works should be undertaken by a suitably qualified contractor with knowledge of and experience with water bore decommissioning. The work must be agreed before carried out and as a minimum would include the following:

- Advise council so that the records can be updated
- Remove all borehole hardware, pumps etc.
- Seal the borehole to confine the groundwater and prevent the vertical movement of groundwater from moving across zones.
- Use non-toxic clay, sand and other materials as agreed with the geotechnical and or hydrogeological engineers.
- Cap the well at the surface and backfill with a clean clay layer to prevent all possible contamination from surface flows.

3.5. Total Earthworks

Table 3: Summary of Total Earthworks

Bulk Subgrade Earthworks (topsoil stripping exclusive)	
Total area of ground disturbance	(24ha)
Total volume of CUT	69,000 m^3
Total volume of FILL	95,000m^3
Total Volume of FILL with Compaction Factor (1.1)	26,000 m^3
Maximum CUT and FILL depth	3m FILL / 3m CUT
Total Volume (surplus of CUT)	0 m^3
Others	
Topsoil stripping (300 mm)	48,000 m^3

3.6. Stockpiles between Stages

Bulk earthworks are expected to generate a stockpile of material which are to be moved and placed in accordance with the staging below.

3.7. Proposed Staging of Earthworks

After sediment controls are completed.

Phase 1, Bulk earthworks activity in stages:

Stage1:

- Occurs in one catchment area
- Excavate the new channel alignment.
- Stabilise the surface before any water is directed to it with coconut fibre matting.
- Plant the channel.
- Enable the new section of channel to take flows (during significant rainfall events only) and block off the entry to the existing channel.
- Prepare the existing channel for backfilling. (Removed vegetation, trees and topsoil and unsuitable soils)
- Install subsoil drains as directed and inspected by Geotech / Hydrogeological engineers
- Install settlement monitoring pins.
- Backfill the existing channel and stockpile material on top to induce faster settlement.
- Plant the buffer strip along the southern and western boundary of the site

Stage2:

- Occurs in one catchment area
- Plan to retain the overhead power and poles as they are during earthworks or establish a secondary connection to 104 Arataki Road for uninterrupted power supply. This may mean a temporary ducted system on the western boundary to the power pole on the corner of the site.
- Remove all buildings and existing site features within stage 2.
- Remove all trees from council reserve and stage 2.
- Excavate the western steep bank and form the 1 in 3 batter slopes
- Inspect cut material for re-use (likely suitable)
- Prepare the subgrade where filling works are required.
- Use site won material to undertake filling as shown on the cut / fill plan
- Excavate material on Lots 181 to 188 and stockpile it. (likely unsuitable material)

Stage3:

- Occurs in two catchment areas
- Remove site features and topsoil from the surface area of Road 8 and 9, Lots 65 – 71; 74 – 82; 93 – 112 and 113 – 130.
- Geotech to inspect for unsuitable material, advise on undercuts and subsoil drains
- Install settlement monitoring pins
- Excavate the dry basin and the wetland to subgrade level
- Remove the rest of the vegetation and trees in Watercourse 1
- Shape Watercourse 1 to final shape including the northern diversion channel to the existing culvert alignment under Brookvale
- Stabilise the channel and replant

- Place the cut material within the area around Road 8 and 9 to finished level
- Use this area as a stockpile material area to induce settlement

Stage4:

- Remove the rest of buildings and site features from the rest of the site
- Prepare area for fill material, perform undercuts as necessary
- Install subsoil drains where advise by Geotechnical engineer
- Fill to final level where possible

Progressively stabilise all finished earthworks areas apart from roading corridors with topsoil and grass and mulch.

Phase 2, Secondary earthworks and infrastructure construction in stages:

The Masterplan proposed staging plan generally forms the stage boundaries for the activities in Phase 2.

Stage 1:

- Finish all works on Watercourse 1 that has not been undertaken during earthworks
- Construct the Wetland and plant it so that stormwater can be directed to it
- Construct the culverts under Brookvale Road
- Construct the wastewater pumpstation
- Construct stormwater and wastewater networks within stage 1 extent
- Use any excavated material in areas where fill is not yet complete – Stage 2 and 3 EW Stages.
- Install private drainage connections to 62 new lots
- Construct the road subgrade of Road 1 CH0 – CH300 and CH1200 – CH 1580
- Construct Road 5 and Road 6
- Install services in common trenches include water, power and telecommunications
- Install power, water and telecom connections to lot boundaries (ducting where applicable)
- Install streetlights.
- Do all necessary testing to show compliance.
- Connect water supply within Brookvale Road and make live.
- Install rising main to Brookvale Road, and then up to Arataki Road
- Construct kerbs and footpath on Brookvale Road, reinstate seal
- Construct the raingardens at the northern end of Brookvale Road
- Do concrete works and seal roads

Stage 2:

- Excavate drainage trenches, extend stormwater and wastewater network to Road 8 and 9
- Install private drainage connections to 43 new lots
- Construct CH60 – CH240 of Road 8 and CH120 – CH210 of Road 9 pavement, and CH1200 – CH1040 of Road 1
- Excavate common services trenches
- Install power, telecommunications and water supply.

- Install streetlights
- Do concrete works

Stage 3:

- Finish off any work on Watercourse two within stage 3 extents which may not have been completed.
- Install the culvert under Road 1
- Extend stormwater and wastewater networks throughout stage 3
- Provide private drainage connections to 16 new lots
- Construct Road 2 and Road 3 and CH300 – CH400 of Road 1 pavement
- Excavate common services trenches
- Install all services and connect ducting and services to Brookvale Road via Road 3 as required
- Build retaining wall
- Build walkway
- Build raingarden by pumpstation
- Build raingarden by Brookvale Road on Road 3
- Install streetlights
- Do concrete works
- Seal roads

Stage 4:

- Extend drainage networks throughout stage 4
- Provide private connections to 44 new lots
- Construct Road 1 CH400 – CH720 and the rest of Road 8 and 9 and intersections
- Construct common services trenches and install all services
- Construct rain garden
- Erect pole for 104 Arataki Road power supply
- Install streetlights
- Do concrete works
- Seal roads

Stage 5:

- Extend the drainage networks throughout stage 5
- Provide private connections to 38 new lots
- Build Road 1 CH700 – CH1040
- Construct common services trenches and all services
- Install streetlights
- Do concrete works
- Seal road

4. Proposed Erosion Control

As the site is currently a low-lying flat farmland, multiple sediment controls and devices need to be constructed onsite. Below we have outlined the general principles and philosophies that will be adopted for future proposed controls. Regular site inspections to be undertaken by council's monitoring officer and the engineer to the contract.

Silt control measures will need to be installed onsite, checked, and confirmed acceptable by the Engineer before works commence in the designated areas. During earthworks, the sediment control measures will be maintained such that they function as proposed.

The site will be progressively stabilised with topsoil and grass seed as earthwork levels are achieved. Silt control measures will only be removed once the site is considered stable in terms of silt run-off.

4.1. Proposed Controls

The following system of silt and sediment control protection measures are proposed: below sections covers the methodology for various stages of the development. For clarity, Refer to staging plans as part of this application, in conjunction with the below staging works methodology.

Topsoil and Clay stockpiles will be located outside of the Staging area each with bunding and Decanting earth bunds to mitigate rain events. Temporary haul roads to allow for stockpiling will have drop out pits and silt fencing installed to avoid localised unwanted runoff during pre-loading.

4.2. Potential Environmental Impacts

During the earthworks there is a risk of dust nuisance during dry and windy weather. To manage potential dust effects, the following management measures are proposed:

1. That a maximum earthworks area of 10ha shall be opened at any one time.
2. Earthworks shall be effectively stabilised using the following methods:
    a. Topsoiling and grassing
    b. Hydroseeding
    c. Using hay or straw mulching
3. An adequate supply of water for dust control and effective means of application is always available on-site during earthworks, until such time as the site is fully stabilised.
4. Sufficient water will be available for dust mitigation with water storage tanks retained on site until it is fully stabilised. The water tanks will be re-charged via truck and trailer water cart or by topping up at low flow via the meter water connection to the public water supply during construction.
5. Sufficient water will be available on site by using a water connection to the reticulated water main network and storage tanks placed on site. In addition to this, carted water from the nearest bulk supply point can also be used.
6. In the event dust control management is ineffective and if found necessary, the contractor shall employ the use of soil stabilisers (such as polymers or similar) or weatherproof cover where possible.

5. Additional Information

5.1. Fill Compaction

Each layer of material shall be compacted by approved compacting machinery throughout its whole area and depth to achieve:

Not less than the following percentages of maximum dry density obtainable for the material by standard compaction at optimum moisture content determined by NZS 4402, Pt 2P: Test 14:		Clays and Silty Clays	Sands and Gravel
A	Within 500mm of the finished carriageway sub grade levels and within 3m of batter edges	98%	100%
B	Elsewhere	95%	97%
Clays		Air Voids % (as defined NZS 4402: Part 1)	Undrained Shear (measured by in-situ vane)
A	Within 500mm of road subgrade levels and within 3 meters	Average value less than 8% (any 10 tests) Maximum single value 10%	Average value not less than 170 KPa minimum single value 140 KPa
B	General Fill	Average value less than 10% (any 10 tests) Maximum single value 12%	Average value not less than 150 KPa minimum single value 110 KPa
C	Reserve Areas deeper than 600mm below finished formation level	Maximum value 15%	Minimum value 75 KPa

Table 8: Fill Compaction Requirements by Soil Types

5.2. Monitoring

All sediment control measures will be checked to ensure that they are performing as intended.

A site walk over shall be undertaken daily before leaving the site to identify any corrective maintenance required. A more thorough inspection will be undertaken at the end of each week, or before and after a forecast major storm event, to identify any preventative and/or corrective maintenance required.

A regular program of sediment, debris and trash removal will be undertaken to ensure sediment control measures do not become blocked and ensure they function as proposed. Any large floating matter including any organic matter, i.e., fallen tree litter, reaching the pond or discharge structures is to be removed immediately.

Specific monitoring and maintenance of each mitigation method is included below:

5.2.1. Decant Bund

- Inspect every day and before every forecasted rainfall event. Inspect for correct operation after every runoff event. Immediately repair any damage caused by erosion or construction equipment.
- Inspect Level Spreaders after every rainfall until vegetation is established and promptly undertake any necessary repairs. Ensure vegetation is kept in a healthy and vigorous condition.

- Clean out before the volume of accumulated sediment reaches 20% of the total volume. To assist in gauging sediment loads, clearly mark 20% volume height on the riser.
- Clean out with high-capacity sludge pumps, or with excavators (long reach excavators if needed) loading onto sealed tip trucks or to a secure area.
- Deposit the sediment in such a location so that is does not lead to a direct discharge to receiving environments. Stabilise all disposal sites as required.

5.2.2. Retention Pond

- Chemical treatment will be provided to the pond if 100mm of water clarity is not achieved before discharge, this will be achieved by dossing/flocculation.

5.2.3. Diversion Drains / Clean Water Cut-off Bunds

- Inspect after every rainfall event and during periods of prolonged rainfall for scour and areas where they may breach.
- Repair immediately if required to ensure that the design capacity is maintained.
- Remove any accumulated sediment deposited in the Runoff Diversion Channel / Bund due to low gradients and velocities.
- Carefully check outlets to ensure that these remain free from scour and erosion.

5.2.4. Silt Fence

- Inspect Silt Fences at least once a week and after each rainfall. Make any necessary repairs when bulges occur, or sediment accumulation reaches 50% of the fabric height.
- Any areas of collapse, decomposition or ineffectiveness need to be immediately replaced.
- Remove sediment deposits as necessary to continue to allow for adequate sediment storage and reduce pressure on the Silt Fence. Ensure that the sediment is removed to a secure area.
- Do not remove Silt Fence materials and sediment deposition until the catchment area has been appropriately stabilised. Stabilise the area of the removed Silt Fence.

5.2.5. Silt Socks

- Inspect Filter Socks at least once a week and after each rainfall. Make any necessary repairs when necessary.

5.2.6. Stabilised Vehicle Entrance

- Maintain the Stabilised Construction Entrance in a condition to prevent sediment form leaving the construction site. After each rainfall inspect any structure used to trap sediment for the Stabilised Construction Entrance and clean out, as necessary.

5.3. Stabilisation

Stabilisation of earthworked areas shall be undertaken progressively as final ground levels are reached or where works are temporarily paused for more than 14 days.

The following stabilisation measures and timing are proposed in line with HBRC guidelines:

Condition	Stabilisation Method	Timeframe
Final earthwork levels achieved	Topsoil and grass seeding	Within 5 working days
Temporary pause in work >14 days	Hydroseeding or straw mulching	Within 7 calendar days
Final surface not expected within 60 days	Polymer stabilisation or erosion control matting	Within 10 working days
Post-winter shutdown	Stabilisation of all exposed area	Before 30 April annually

Table 9: Stabilisation Measures and Timing in HBRC Guidelines

Maintenance: All stabilised areas will be monitored weekly and after heavy rainfall (>20mm/hr) to ensure full vegetation cover (minimum 80%) is achieved. Any bare patches or erosion will be repaired promptly with mulching or swift remedial action.

5.4. Chemical Treatment Management Plan

Refer to the draft CTMP which will need to be updated once the earthworks contractor has undertaken suitable soil testing to confirm the correct chemicals / dosage of flocculation required.

CHEMICAL TREATMENT MANAGEMENT PLAN

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

Maven Associates	Job Number 135041		Rev A
Job Title Brookvale Green, Havelock North **Title** Chemical Treatment Management Plan (ChTMP)	**Author** BB	**Date** 6.2026	**Checked** BB

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Appendix A – Bench Test Results and additional details of Floc Boxes on DEB's - example

Appendix B – Monitoring sheet example

1.0 INTRODUCTION

1.1 PROJECT

The purpose of this report is to provide a Chemical Treatment Management Plan (ChemTMP) for the proposed earthworks on the Brookvale Green Development. Earthworks will typically include bulk earthworks, excavations for drainage reticulation, formation of building platforms and roading networks and, where applicable, construction of retaining walls. This Chemical Treatment Management Plan is consistent with other stages on the development. All SRP's & DEB's will be fitted with a rainfall activated dosing system.

The information provided herein outlines the following:

- Spill Contingency Plan/Safety with Reagents.
- Dosing Methodology and Rainfall Activated System
- Responsibilities for the management, monitoring, maintenance, and reporting of chemical dosing.
- Decommissioning of the rainfall activated system.

This report provides information to compliment the Erosion and Sediment Control Plan, for Resource Consent (Land Use) application. This report is to be read in conjunction with the earthwork's drawings.

2.0 GENERAL

This report intends to provide direction towards the application, operation and maintenance of the rainfall activated system with PAC (Poly Aluminium Chloride) as a reagent. The information within this report is based on the guidelines of HBRC adopted Part 2 of NZS4404:2010. Section 2.3.7 provides guidance on erosion, sediment, and dust control, we acknowledge the technical input obtained from this guideline.

All Coagulant and Flocculant treatment rely on the following two processes. These processes allow the particles to join and form bigger larger particles for rapid settlement.

- Coagulation
- Flocculation

This type of treatment is generally applied in sediment ponds. A "bench test" should be undertaken to determine the effectiveness of the proposed treatment and to determine optimum dosage. On stages 1 and 2B, a bench test was undertaken by Erosion Control Co. Ltd and the results provided to council. Further bench testing will be necessary to confirm the soil composition is similar, and to provide further guidance if it is not.

In all cases, bench testing of a variety of reagents is required to establish which option is most appropriate for sediment removal and receiving environment protection. For more information on the process please refer to Appendix A. *Chemiclear 100 (PAC) produced effective flocculation and acceptable water clarity at a dosage of 2ppm (Al).*

To date PAC (Poly Aluminium Chloride) is considered the best reagent. It is widely used and accepted NZ wide. Sediment treated water to only leave the site if the clarity is more than 100mm and the PH ranges between 5.5 and 8.5. Bench tests to be undertaken prior to stripping the land of topsoil. To date, tests were undertaken by a suitably qualified and experienced professional. Results provided by Erosion Control Co. Ltd

2.1 SAFETY WITH REAGENTS

The material Safety Data Sheet (MSDS) for each reagent used in the treatment system will be obtained and the health and safety requirements reviewed and always implemented.

The bulk reagent will be stored and transported in accordance with the standard practice for storage of hazardous materials on site. Appropriate care will be taken while storing and handling the reagent.

The reagent will be stored in a secured bunded facility. This bunded facility will be sheltered/protected to avoid rainwater. The reagent will be stored in a locked site shed. Reagent refill drums may be stored adjacent to the shed. These drums will be always stored unopened and stored at a suitable location to avoid the risk of a spill from the drums.

Any reagent spill onto the ground should be promptly contained within the area using earth bunds/other techniques to stop it from entering the stormwater network.

All the collected reagent (PAC) should be stored in polyethylene containers. If the spilled PAC cannot be recovered, it should be thoroughly mixed with a volume equal to at least ten times the volume of spilled PAC. The mixed soil should be buried a minimum 0.5 below the surface.

All reagents are to be used in accordance with the site's Health and Safety Management Plan.

3.0 DOSING METHOD - RAINFALL ACTIVATED SYSTEM

All SRP's will be controlled with this system unless agreed otherwise.

The SRP and the DES's are to be treated by the rainfall activated system that works by adding the reagent to the sediment laden runoff to increase the rate of settlement of fine particles and is a widely accepted form of treatment in the Hawkes Bay Region.

It is proposed to use a rainfall activated system for the treatment of surface water runoff as it provides a suitable dosage level based on rainfall volume and intensity.

A liquid reagent is generally used with a rainfall activated system.

The following procedures summarises the operation and maintenance of a rainfall activated system. It also outlines details of PAC (Poly Aluminium Chloride) as a proposed liquid reagent to be used with the rainfall activated system.

A rainfall activated system with a liquid reagent is to be used on site for the following reasons:

- The duration of treatment is longer than 4 weeks.
- The catchment area is greater than 0.5 ha.
- Earthworks are proposed during winters.

The following description and image (Figure 1.0) about the rainfall activated system outlines its operation:

- The catchment tray collects the rainwater and discharges into the header tank.
- Storage capacity is provided within the header tank to avoid dosing during short rainfall followed by a dry period and to attenuate dosing at the beginning and end of a rainfall event.
- The rainwater is then discharged through low and high flow orifice into the displacement tank as shown in Figure 1.0 below. The displacement tank floats in the flocculant reservoir tank and the liquid reagent is displaced as the displacement tanks gets filled with water, this lets the reagent through the outlet in the flocculant reservoir tank which eventually flows downstream to the dosing point.

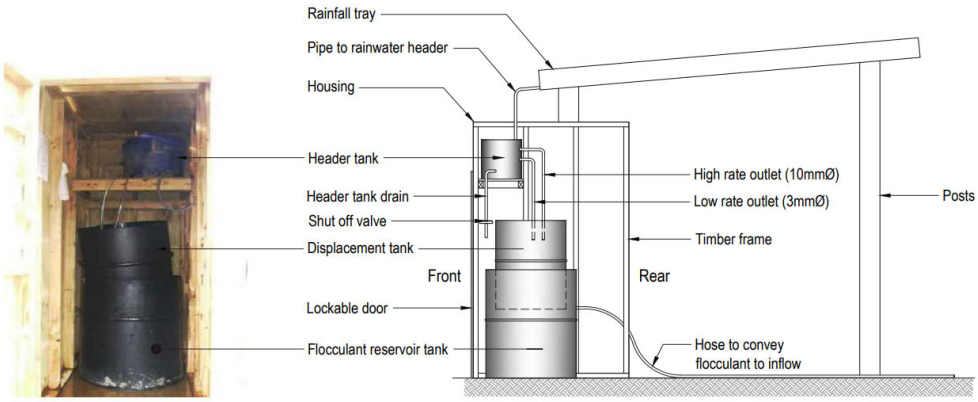

Figure 1: Rainfall activated System Overview.

Main components of a rainfall activated system:

- **Catchment Tray:** The size of the catchment draining into the sediment pond governs the size of the rainfall tray. The catchment tray is designed to treat for 100% of the sediment laden runoff from the exposed areas and 60% from the stabilised contributing area.
- **Header Tank:** The rainfall volume can be adjusted manually depending on the site by adding or removing water from the header tank. An allowance of 12mm of rainfall is allowed prior to the commencement of the dosing. The 10mm orifice (High rate) outlet should be located above the point reached by 12mm of rainfall.
- **Displacement Tank:** The displacement tank should be installed tidily inside the flocculant reservoir. The displacement tank should be designed to hold rainfall from a 1 in 50-year event.

- **Flocculant Reservoir Tank:** The flocculant reservoir should be only slightly bigger than the installed displacement tank. Sufficient capacity within the flocculant reservoir should be provided for the dosing of run-off from a 1 in 50-year rainfall event. A 20mm outlet is installed to convey flocculant into the pond inlet. The dosing point should be 5m upstream of the forebay to promote mixing. The discharge of the flocculant should be to the turbulent section of the inlet drain, to ensure the floc mixes thoroughly with the dirty water.

3.1 CONSTRUCTION OPERATION AND MAINTENANCE:

The application of the treatment should only be undertaken by a suitably qualified professional. The subsequent provides direction towards the installation, operation and maintenance of the rainfall activated system using PAC (Poly Aluminium Chloride).

Construction (Installation)

- The shed is typically constructed of plywood. A Floc box can also be used instead of a shed. Contractor should ensure that the construction is durable to withstand storm events.
- The contractor should ensure that the catchment tray is of the appropriate size and well secured to avoid damage from storm events.
- The shed should be locked always due to safety reasons.

Operation and maintenance:

- Site foreman to check the chemical treatment system at regular intervals to ensure compliance.
- Post every rainfall event or through/prolonged heavy rainfall event, the maintenance requirements need to be assessed, and monitoring results recorded.
- Prior to the site being left for weekends or holidays, the rainfall activated system should be adequately serviced with flocculant topped up.
- Water in the pond to be monitored using the black disc method or as appropriate.

Header Tank:

- The release of the flocculant is controlled by the header tank. Generally, the release is higher during heavy rainfall events, and this duration is increased beyond the end of rainfall.
- The three outlets allow the volume in the header tank to be lowered.
  -After 3 days without rain – reduce volume to 50%
  -After 6 days without rain -reduce volume to empty (at lowest outlet)
- Water can be manually added to the header tank to decrease the release time of the flocculant.
- It is recommended to operate the rainfall activation system on ‘no delay’ to significantly decrease release time.

- The release of the flocculant from the header tank should be controlled carefully to avoid under or overdosing.

Topping up the flocculant reservoir:

- The flocculant should always have sufficient flocculant to dose heavy rainfall events.
- A drum pump is generally used to fill the flocculant reservoir.

Monitoring and adjusting as per varying site conditions:

- The system needs to be evaluated carefully by a suitably qualified person after every rainfall event to make sure that the system is operative.
- A modification in the catchment area will require the catchment tray to be modified accordingly.
- Remarkably clear water in the pond indicates overdosing or stabilisation of the site. Appropriate tests should be undertaken for further analysis and the dosing regime to be adjusted to suit.
- The rainfall activated system should be evaluated for any blockages or debris.

Floc boxes used elsewhere. As an example, only:

400 L flocboxes	
Catchment	40,000 m2 (4.0 ha)
Flocbox size	400 L
Roof Size	1.43m2
Low flow	80mm – **17.1 L**
High Flow	160mm – **34.2 L**
Catchment	35,000 m2 (3.5 ha)
Flocbox size	400 L
Roof Size	1.25m2
Low flow	70mm – **15.0 L**
High Flow	140mm – **29.9 L**

Decanting Earth Bund floc informaiton to be provided by the contractor when required.

Limitations:

- Treatment should cease when the PH drops below 5.5 or above 8.5 (when using PAC).
- This treatment requires a high degree of ongoing monitoring and maintenance.

Earthworks to commence only after approval of the sediment control as-built plans and calculations provided by the contractor at the onset of construction.

4.0 DECOMMISSIONING

Any reagent should be removed as a part of the decommissioning process. Any remaining reagent should be re-used where practical but should not be mixed with fresh reagent.

Collected sediment must be correctly removed and disposed offsite.

Appendix A
Example of Bench Test Results and details of additional chemical floc boxes as required.

Aim & Methodology

The purpose of this bench testing is to chemically test soil samples from the Brookvale Green Development as received from [CHOSEN CONTRACTOR]. Ultimately, the chemical coagulant should result in effective flocculation that gives solids settling with a clear supernatant. This provides a good benchmark for scale up into an earthworks project that utilises a sediment pond.

A Jar Tester (sometimes termed a gang stirrer) was used for simultaneous testing of up to 6 beakers. The tester has 6 paddles with adjustable speed (rpm). Supernatant clarity was measured using the Secchi black disc method.

Jar Tester

Chemical Tests:

Coagulant was added to the 1L samples at the following dose rates.

	Jar 1	Jar 2	Jar 3	Jar 4	Jar 5	Jar 6
CHEMICAL	BLANK	Chemiclear 100	Chemiclear 100	Chemiclear 100	Chemiclear 100	Chemiclear 100
Aluminium Concentration (ppm Al)		2.0	4.0	6.0	8.0	10.0
Product Concentration (ml/m^3)		31	62	93	124	155

Results

SAMPLE –

CHEMICLEAR 100 (PAC – Polyaluminium Chloride)

Chemiclear 100 - 60 mins settling

Sample Dosed with Chemiclear 100 - Water Clarity & pH

Chemical	Product Dose (ml/m³)	Clarity (mm) 5 Mins	Clarity (mm) 30 Mins	Clarity (mm) 60 Mins	Final pH	Notes
BLANK	0	<60	<60	<60	7.2	
Chemiclear 100	31.0	90	>100	>100	7.1	Recommended
Chemiclear 100	62.0	80	>100	>100	7.0	
Chemiclear 100	93.0	70	100	>100	6.8	
Chemiclear 100	124.0	<60	90	100	6.7	
Chemiclear 100	155.0	<60	<60	60	6.6	

Chemiclear 100 produces effective flocculation with solids settling and acceptable supernatant clarity of

>100mm, within 30 minutes of chemical addition.

Recommendation

The chemical coagulant, Chemiclear 100 (PAC – Polyaluminium Chloride) is recommended for treatment of the site's rainwater in conjunction with a sediment retention pond and rainfall activated chemical dosing system (Floc Box that Erosion Control builds and supplies).

The recommended dose rate of Chemiclear 100 is 2 ppm (as Al) or 31.0 ml product /m^3.

Chemical	Aluminum Dose	Product Dose Rate
Chemiclear 100 (PAC)	2 ppm (as Al)	31.0 ml/m^3

Acceptable water clarity of > 100mm was measured within 30 minutes with the recommended chemical dosage.

pH is also within the acceptable range of 5.5 – 8.5 for earthworks run-off discharge.

Floc Box example:

Input		
Floc Box Size	75	L
Dose rate in ppm	2	ppm Al
Dose rate in ml/m3	31	ml/m3
	0.3	ha

Output		
Roof area	0.11	m2
Roof Error	Good	*
Low Flow Rain Volume	1.4	L
High Flow Rain Volume	2.7	L
Low Flow Height	21	mm**
High Flow Height	41	mm**
Header Tank Height	Good	***
Amount of rainfall before refill required	667	mm

Any questions please contact:
Wesley Lawrence
Sales Manager
Erosion Control Co
027 489 5929

Appendix B
Monitoring Sheet example

MAVEN ASSOCIATES		Job Number	Sheet 1	Rev A
Job Title	Brookvale Green	Author	Date	Checked
Calc Title	Sediment Control Monitoring Plan and Record Sheet	BB	06/2026	
Date of Inspection:				

Refer to NZTA Field Guid for detailed ESC construction/monitoring/decommisioning checklists	FREQUENCY			
	As Required	Daily	Weekly	Immediately
DRAIN INLET PROTECTION				
Check for blockages and leaks		✓		
Inspect during and after rainfall events	✓			
Effectiveness				
Action Required				

PROTECTED / BENCHED SLOPES				
Inspection after rainfall events	✓			
Surface water is diverted away from all cut and fill slopes		✓		
Check for erosion or rework	✓			
Effectiveness				
Action Required				

SILT FENCES				
Clean out when sediment 50% of height max	✓			
Inspection after rainfall events	✓			
Repair bulges/breaches				✓
Identify all collapsed or ineffective fences and repair				✓
Sediment removed to secure locations	✓			
Effectiveness				
Action Required				

DIVERSION DRAINS				
Inspection after rainfall events	✓			
Repair all breaches				✓
Remove excess sediment build up to secure location	✓			
Check outlets remain free of scour and erosion			✓	
Effectiveness				
Action Required				

APPENDIX G – CONSTRUCTION MANAGEMENT PLAN

CONSTRUCTION MANAGEMENT PLAN (CMP) - FAST TRACK PROJECT SUBSTANTIVE APPLICATION

174 – 176 BROOKVALE ROAD

HAVELOCK NORTH

HAWKES BAY

FOR

VERMONT STREET PARTNERS NO. 4 LIMITED

MAVEN ASSOCIATES	Job Number 135041		Rev A
Job Title Brookvale Road, Havelock North **Title** **Construction Management Plan**	**Author** RH / BB	**Date** 06/2026	**Checked** BB

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1. Project Introduction

1.1 CMP Objectives

This Construction Management Plan ("CMP"), combined, Dust Management Plan, Construction Traffic Management Plan and reference to the Earthworks Management Plan have been formulated as a draft Plan to be adopted / amended / used by the future contractor for bulk earthworks and / or infrastructure work on the Brookvale Green Development.

The CMP has been developed as a real-time management tool to evaluate, provide suitable methodologies and monitor activities controls. As the results, all resource consent requirements and environmental objectives shall be achieved for these works, and the CMP will be continuing to be updated to achieve the best outcomes.

1.2 Scope of Works

Earthworks

- Sediment Control: Installation of sediment control measures as per the approved ESCP plan, including super silt fence, clean and dirty water diversion bunds, and other devices such as decanting earth bunds and flocculation devices.
- Stabilized Entrance: The proposed entrance is at Brookvale Road entry.
- Topsoil Works: Topsoil within each earthwork's catchment will be stripped and stockpiled for re-use.
- Bulk Earthworks: The proposed bulk earthworks include cut-and-fill, some areas of cut and stockpile for filling to occur later, secondary earthworks / infrastructure works may be carried out by the same contractor or multiple contractors.
- Mulching and Stabilizing: Straw mulching will be applied where topsoil has been respread.

Planting Works

- Planting works will be scheduled to start of the next planting season. Refer to the planting plans by the Landscape architect. The planting required in the waterways, rain gardens, dry basin, wetland and street tree planting will be undertaken as per the agreed programme.

Civil Works

- Drainage is typically the first construction item during civil works. Stormwater and wastewater networks will be constructed, along with the wastewater pumpstation.
- Private connections for the drainage systems to stormwater and wastewater networks for each new lot will be installed as they are under the road and will need to be completed before pavement works start.
- The haul road which is used for access during drainage works will be excavated to prepare the subgrade and to construct the layers of paving material for the roads. Catchpits are then added to the stormwater connections.
- Kerbs will be formed along the edges of all new roads after the sub-base have been installed. Once cured, the final layers of metal can be added to the pavement – AP40 material is placed. The roads are sealed later in the programme once the services trenching works have been completed.
- Stormwater Culverts and Weirs will be constructed at the outlet of management devices and under Brookvale Road. These assets will link the flow to the watercourses 1 and 2.
- Footpaths: Both concrete and gravel footpaths are proposed to be constructed in the park.
- Car Parking bays: Concrete parking bays will be constructed.
- Park Furniture and Structures: Refer Landscaping requirements.

2. Roles and Responsibilities

2.1 Responsibilities and Contact Details

Role	Name	Organisation	Phone	Email
Engineer	Barry Beaurain	Maven Associates Ltd	022 492 4790	barryb@maven.co.nz
Contractor	?	Earthmoving Contractor	?	?
Contractor	?	Earthmoving Contractor	?	?
Public complaints	?	Earthmoving Contractor	?	?
Client	Edward Sundstrom	Brookvale Green	021653323	Edward@vermonstreetpartners.co.nz

NAME	RESPONSIBILITES
Name *-Contract Manager*	• Overall responsibility for the management of the contract and principal contact with the Client's or the Engineer's representative. • Authority to address, resolve and commit the Contractor on contractual and commercial matters. • Authorised to address and resolve issues of dispute relating to compliance with the requirements of the contract.
Name *-Project Engineer/Manager*	• Responsible for inspection of the works and communications on such matters with the Client's or Engineer's site representative and authorised to receive on behalf of the Contractor any instructions from the Client, Engineer and Council. • Responsible for the day-to-day site supervising, ensuring this construction management plan is correctly implemented. • Oversee the site activities and managing internal and sub-contractors onsite.
Name *-Health & Safety, Quality and Environmental Manager*	• Responsible for compliance with the requirements of the Health and Safety in Employment Act and the Resource Management Act

2.2 Emergency Contacts

Follow procedure on the Site-Specific Safety Plan, if there is an emergency situation. Otherwise, contact the Site Manager.

2.3 Complaints Procedure

All Complaints will be investigated and reported to the H&S Manager or site manager.

The Client & Engineers representatives are to be notified of any complaints within 24hrs.

2.4 Plant & Equipment

The following machinery will be used on site at varying times. Based on a percentage of time a machine is required to be dedicated to the project during the construction timeframe. Earthmoving Contractor will make the required plant available to complete the contract works as per the Construction programme.

MACHINE	TIME ONSITE (%)
20t Excavator x 3	As required
Track Truck x 2	As required
5t Excavator x 2	As required
Compactor x 2	As required

3. Construction Methodology

3.1 Description

The proposed earthworks are detailed in the earthworks management plan and engineering plans which are appended to the substantive application. After bulk earthworks phase 2 will start. The civil works will require movement across the site to construct drainage and infrastructure in 5 stages.

3.2 Site Access

The proposed site entrances are illustrated on the plan below.

3.3 Operation Hours

Approved operation hours at below will be followed. No works will be carried out on any public holidays (and any following Monday on which that public holiday is observed).

3.4 Construction Methodology

Initial silt control measures will be implemented before any major earthworks commence. Based on the approved starting time and conditions. The surface will be stabilised before sediment controls are removed.

After the cut to fill work is completed, the civil works will be carried out.

Planting will commence as soon as possible to meet the deadline before the end of the planting season on all new watercourse and channel or basin ground surfaces which have been disturbed during earthwork and / or civil works.

The sequence of works will be carried out as per following:

Earthworks:

Stage 1 to 4 as detailed in the Earthworks Management Plan and Geotechnical report.

Planting Works:

To follow earthworks and civil works as the planting season approaches and as per agreement by the team and council.

Civil Works:

To follow staging as set out in the earthworks management plan over 5 residential stages.

4. Environmental Management Plan

4.1 Erosion and Sediment Control

The specifications and designs on approved erosion and sediment control plans will be followed, and all devices will be constructed as per the requirements, maintained and checked regularly throughout the contract period.

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4.2 Noise Management

Any noise related to the proposed construction works shall not exceed Hawkes Bay District Council noise limits. Should noise levels exceed the standards the cause will be remedied immediately. Monitoring for noise will be done as required or when a reasonable complaint is received. In the event of a non-complying activity being identified, a suitable qualified acoustic consultant shall be engaged to ensure activities are compliant.

Note: Noise levels shall be measured and assessed in accordance with the requirements in NZS 6801:1999. The noise shall be measured with a sound meter complying with the international standard Sound Level Meters, Type 1.

4.3 Vibration Management

Any vibration related to the proposed construction works shall not exceed the limits set out by HBRC. Should vibration levels exceed the standards the cause will be remedied immediately. Monitoring for vibration will be done as required or when a reasonable complaint is received. In the event of a non-complying activity being identified, a suitable qualified acoustic consultant shall be engaged to ensure activities are compliant.

Note: Vibration shall be measured and assessed in accordance with DIN 4150-3:1986 “structural vibration in buildings – effects on structures.

4.4 Notifications To inform public of construction site.

Signage will be erected on site prior to the start of construction.

4.5 Rubbish Maintenance

Onsite rubbish bins are provided. All large construction rubbish is stockpiled until the end of each working day and then removed via truck and placed in the skip bin.

5. Dust Management Plan

5.1 Purpose and objectives of the DMP

The DMP has been prepared to manage, mitigate, and monitor dust emissions during construction of the project. The objective of the DMP is to detail the best practicable option to avoid dust nuisance being caused by construction works and to mitigate any such effects should they occur.

The DMP identifies the followings:

- Potential sources of dust that may be created during the construction period.
- Potential receptors.
- Dust management and mitigation methods.
- Monitoring methods.

5.2 Potential sources of dust

- Excavation.
- Cut to fill operation.
- Soil stabilisation.
- Loading, unloading and stockpiling of bulk materials.
- Vehicle movements onsite and on public road.
- Wind erosion from exposed areas and stockpiles.

5.3 Potential receptors

- Contractors & Subcontractors.
- Surrounding residents.
- Site visitors.

5.4 Dust management and mitigation methods.

Source of Dust	Control
General mitigation measures	• Planning of site layout so that dust causing activities are located away from sensitive boundaries where practicable. • Site personnel trained in dust management controls. • Monitoring of site conditions (weather/soil conditions) to anticipate and prevent dust effects. • Limiting operations which have the potential to cause high dust during strong wind events (10knots). • Use of water cart and sprays to keep surfaces damp as required near sensitive receptors. A critical part of this control measure is identification of a sufficient water supply at the site for this purpose with adequate volume. A metered water supply by connection to the HDC public supply (application for a construction supply to council) and the use of 5m3 a day with holding tanks where required will be adequate. A carted water supply from the nearest network bulk supply point is also possible.

Stockpiles (including material placement and removal)	• Making sure stockpiles exist for the shortest possible time. • Stockpiles oriented to maximize wind sheltering where possible. • Stockpiles positioned as far as practical away from potential receptors. • Limiting the height and slope of stockpiles to reduce wind entrainment near sensitive receptors. • Take into account the predominant wind direction when siting stockpiles to reduce the likelihood of affecting potential receptors. • Surfaces of stockpiles to be kept damp to reduce dust emissions (e.g. through wet suppression systems) or covered or stabilized to reduce dust generation in areas adjacent sensitive receptors.
Vehicle movements	• When 'strong winds' are present during site works, earthmoving machinery shall cease work or operations will be modified to reduce dust generation. • Set the traveling speed to 10k/h if 'strong winds' and dry conditions exist. • Set the travelling speed as low when the vehicle is leaving the site. • Use water cart to water the public road if dry conditions exist.
Earthworks and Construction Activities	• Drop heights of materials to be minimized to reduce dust generation. • Use water carts during the operations. • Use windsocks to identify the wind speed (if it excesses 10 knots) and direction. • Stage earthwork operations and allow for progressive stabilization. • Monitoring and managing of earthworks activities to limit dust generation during dry or windy weather conditions.

5.5 Monitoring methods

Monitoring Activities	Frequency
Check weather forecasts for strong winds and rainfall to plan appropriate dust management response (e.g., www.metservices.co.nz).	Daily
Inspect land adjacent to the site, construction exits and adjoining roads for the presence of dust deposits.	Daily
Observe weather conditions, wind via observations and data outputs from weather stations and presence of rain.	Daily and as conditions change

Inspect all haul road for dampness and to ensure that surface exposure is minimised, check for visible clouds being generated on site orcarried off site.	Daily and as conditions change
Inspect stockpiles to ensure enclosure, covering, stabilisation or dampness. Ensure stockpile height is limited or appropriately stabilised.	Daily and as conditions change
Inspect dust generating activities (as listed above) to ensure dust emissions are effectively controlled.	Daily and as new activities commence
Inspect watering systems (sprays and water carts) to ensure equipment is maintained and functioning to effectively dampen exposed areas.	Weekly
Additional visual monitoring of dust generating activities and water application rate.	In winds over 5 m/s
Inspect site access and egress points to ensure the public road is not dusty	Daily and as conditions change
Check the dust mesh conditions, if it is installed.	Weekly

6. Draft Traffic Management Plan

The objective of the traffic management is to minimise construction traffic, vehicle movements and the impact of traffic associated effects, including safety, noise and traffic flow on both site roads and the roading network.

All traffic management will be as per the approved traffic management plans. No works will commence on any public roads until approval has been granted by HDC.

All traffic management will comply with NZ transport Agency's Traffic Control Devices Manual, part 8 Code of practice for temporary traffic management (CoPTTM).

6.1 Methods

A professional traffic management agent will be engaged to finalise the traffic management plan and it will detail the following measures and strategies:

- Details of the construction traffic, No. of trucks, size of trucks, material bringing in / carting out and trucks timings.
- Construction traffic controls on public roads will be released.
- Management of site traffic during construction including any speed limits, dust adjacent and restricted times of operation to minimise the effects of noise is required.

7. Chemical Treatment Management Plan

A detailed chemical treatment management plan must be prepared by the contractor undertaking the earthworks. Refer to the CTMP appended to the substantive application for more information on the typically proposed chemical treatment for this site.