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Infrastructure Report

Milldale Stages 10-13
131 Argent Lane, Upper Orewa
Fulton Hogan Land Development Limited
28/03/2025
Final

DOCUMENT CONTROL

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STATEMENT OF QUALIFICATIONS AND EXPERIENCE

Originator: Brandon Olver - Senior Associate Engineer

I am a Senior Associate Engineer at Wood & Partners Consultants Ltd. Wood & Partners Consultants Ltd is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since December, 2014.

I hold the qualifications of Bachelor of Engineering Technology (Civil Engineering) from Open Polytechnic, which I completed in 2016. I am a Chartered Professional Engineer member of the Engineering New Zealand.

I have 19 years of professional experience in the Civil Engineering field, including roles such as Contract Engineer at Downer Group and Engineering Technician at Opus International Consultants Ltd. My experience includes design, construction supervision and contract management of land development projects. Projects I have worked on include Milldale earthworks, Milldale civil works, Wiri North Quarry filling and redevelopment, Equidae Estate development, and 75 Valley Road subdivision

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.

Reviewer: Albert Perez - Senior Associate Engineer

I am a Senior Associate Engineer at Wood & Partners Consultants Ltd. Wood & Partners Consultants Ltd is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since March 2013.

I hold the qualifications of Bachelor of Science in Civil Engineering from Silliman University, Philippines, which I completed in 2004; and gained my Professional Civil Engineering from the Philippine Regulatory Commission in 2005. I am a Chartered Professional Engineer member of the Engineering New Zealand.

I have 19 years of professional experience in the Civil Engineering field and Land Development industry. My experience includes design, development planning, resource consent documentation and approval, building consent documentation and approval, engineering plan approval, contract administration, construction observation and project management, for small to large scale Civil Infrastructure and Land Development projects.

I confirm that, in my capacity as reviewer 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.

Approval: Jamie Whyte – Principal

I am a Principal at Wood & Partners Consultants Ltd. Wood & Partners Consultants Ltd is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since January 2004.

I hold the qualifications of a Bachelor of Surveying from the University of Otago (BSurv), which I completed in 2003. I hold a professional qualification as a Register Professional Surveyor (RPSurv). I am a Full (voting) Member of Survey and Spatial New Zealand.

I have 20 years of professional experience in Subdivision Engineering and the Land Development industry. I have extensive knowledge in the design, construction and delivery of large-scale land development projects. My experience includes major roles on some of New Zealand's largest subdivision projects including Stonefields, Long Bay, Millwater and Milldale.

I confirm that, in my capacity as reviewer 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.

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APPENDICES

1. INTRODUCTION

1.1. General Proposal

This report has been prepared in support of the application by Fulton Hogan Land Development Limited (FHLD) for a resource consent to the Environmental Protection Authority (EPA) under the Fast-Track Approvals Act 2024 (FTAA).

Resource consent is required for bulk earthworks, subdivision, streamworks, water permits and discharge consents for the development of residential lots, residential super lots, jointly owned access lots (JOALS), roads to vest, esplanade and reserves to vest, landscaping, infrastructure and all associated works for the proposed development.

1.2. Site Description

1.2.1. Site Location

The site subject to this application is located within the Milldale development and referred to as the Milldale Stages 10 – 13 subdivision areas (the Site). The site consists of Land covered by LOT 9006 DP 602895; Lot 9007 DP 602895; Lot 3 DP 151229; Lot 1 DP 147739; Lot 1 DP 488814; Lot 2 DP 488814; Lot 3 DP 488814; and Lot 2 DP 147739. Stages 10 – 13 are located within the northern and western extents of the Milldale development and comprise the remaining undeveloped greenfield stages of Milldale.

Overall, the Site covers a total area of approximately 71 ha. The Site is bordered by Wainui Road to the north, Lysnar Road to the north-east, and undeveloped land to the west. Previously consented Milldale stages are located to the south of the Site including Stages 5 – 8 and the Milldale Town Centre.

A full description of the Site and surrounds is provided in the application AEE.

The site location is shown below in Figure 1, and a site location plan is provided with the application drawing set P24-128-00-0001-GE.

Note that this report does not cover the works in Stages 4C or the temporary wastewater treatment plant.

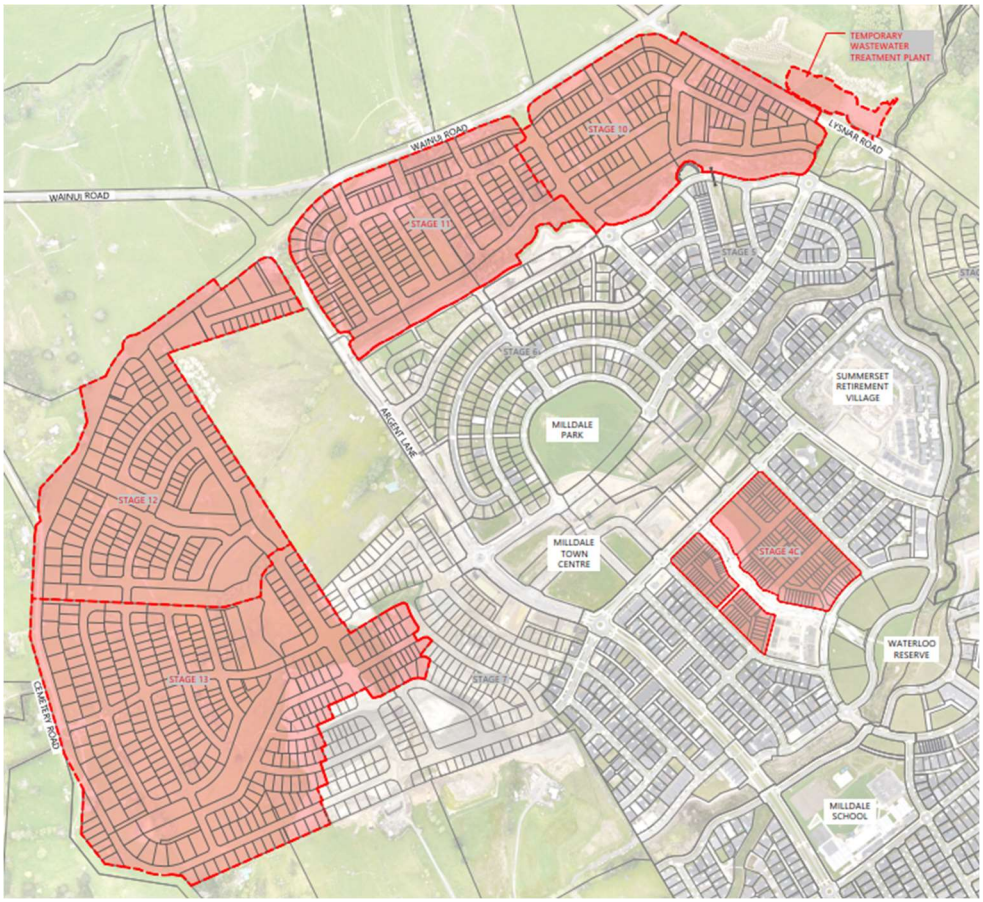

Figure 1: Site Location Plan

1.3. Project Description

FHLD are proposing the subdivision and development of the site into a medium density residential development. The proposal will result in the development of the site into residential lots, residential super lots, jointly owned access lots (JOALS) and roads to vest, esplanade and reserves to vest, and all associated works, landscaping and infrastructure.

The development will require land and stream modification works to facilitate Stages 10-13 of the Milldale Fast Track application. This includes bulk earthworks across the site to refine the site to the required finished levels.

A full description of the project is provided in the application AEE.

This will be the 10th, 11th, 12th, and 13th subdivision consent application as an extension of previously consented stages as shown in Woods' drawing No. P24-128-00-0007-GE. Stages 10 to 13 consist of 17 sub-stages known as Stage 10A to 10D, 11A to 11C, 12A to 12D, and 13A to 13F, with the proposal to create:

- 623 standalone lots.
- 27 superlots with anticipated dwelling yield of approximately 296 dwellings.
- 1 neighbourhood centre lot.
- 9 accessways.
- 2 recreational reserves.
- 23 drainage reserves.

The development consists of approximately 71 hectares.

The infrastructure and utilities required to accommodate this development will be designed and constructed to Auckland Council design standards and meet the requirements of all relevant service providers.

This report is in support of the Earthworks and Subdivision Consent Application and covers the existing and proposed infrastructure required to facilitate the urbanisation of Milldale Stages 10 to 13.

The associated drawing set for this consent application is provided in **Appendix A**.

1.4. Staging of the Development

The staging of the works is dependent on the earthworks completed within an earthworks season. Civil works and subdivision will follow the completion of each earthworks season.

It is proposed for the first season of bulk earthworks to commence in October 2025, and continue over three earthworks seasons until the bulk earthworks is complete in April 2028.

As detailed in the Earthworks Methodology Report, the earthworks will be staged over three seasons, working in both Stages 10 and 11 and Stages 12 and 13 simultaneously. This will enable civil works stages to progress on two separate works fronts.

Works in Stages 10 to 13 will follow this high-level time frame:

SEASON	EARTHWORKS	CIVIL / SUBDIVISION WORKS
Season 1 - 2025-26	Bulk Earthworks Season 1 Enable earthworks for Season 2 civil works	STAGE 10A
Season 2 - 2026-27	Bulk Earthworks Season 2 Enable earthworks for Season 3 civil works	STAGES 10B, 10C, 10D, 11A 123 Standalone Lots and 12 superlots
Season 3 - 2027-28	Bulk Earthworks Season 3 Enable earthworks for Season 4 civil works	STAGES 11B, 11C, 12D, 13A 147 Standalone Lots and 11 superlots
Season 4 - 2028-29	No Bulk Earthworks remaining	STAGES 13B, 13C, 13D, 13E 184 Standalone Lots and 2 superlots
Season 5 - 2029-30	No Bulk Earthworks remaining	STAGES 13F, 12A, 12B, 12C 169 Standalone Lots and 2 superlots

Table 1: Stage 10 to 13 High-Level Time Frames

1.5. Level of Design Provided

A sufficient level of engineering design has been provided to support the Milldale Stages 10 – 13 resource consent application. The engineering drawings and infrastructure report have a sufficient level of design to define the proposed land use and subdivision activities within the site. The extent of design detail confirms the scope of the proposed activities and accurately supports the envisaged development outcomes. Sufficient land areas have been set aside within areas to vest in Council to support transport and stormwater infrastructure.

It is noted that, subject to resource consent approval, Engineering Approvals (EA) will be prepared and applied for that are in general accordance with the resource consent conditions and plans. This is the appropriate time to provide Council with the necessary detailed engineering design, calculations and plans. This is also the most appropriate time for Council to review the detailed design and confirm compliance with their respective development engineering standards.

It should be noted that all future Engineering Approvals (EA) will deliver the necessary detailed design to fully confirm compliance with Auckland Councils development standards. This additional detailed design will include:

1.5.1. Earthworks & Retaining

Note – Further design for Earthworks and Retaining is not subject to an EA, but these elements of the consent design will be further detailed / approved / certified prior to construction.

- Detailed design for geotechnical ground improvement features, such as shear keys, undercut areas, subsurface drainage and RE Slopes (pre construction detailing for earthworks)
- Detailed Design for retaining walls (Building Consent)
- Site specific Sediment and Erosion Control drawings for each respective earthworks season and civil stage (pre-construction condition)
- Detailed design for stream enhancement (Streamworks Management Plan)

1.5.2. Roading

- Detailed horizontal geometry
- Detailed vertical geometry (road long sections)
- Intersection design (horizontal and vertical geometry)
- Vehicle tracking to support horizontal intersection designs
- Sight distance assessments

- Pedestrian Accessway long sections
- JOAL long sections
- Parking bay layout
- Line marking and signage layout
- Pedestrian and cycling crossing facilities
- Final traffic calming design layout.
- Streetlight design
- Streetscape design (Landscape Approval)

1.5.3. Stormwater

- Final stormwater reticulation layout
- Stormwater pipe sizing and long sections
- Dry Basin detailed design, including hardware, site access, operation and maintenance, and landscaping.
- Detailed design for overland flow path assessments, including any necessary scour protection for flow paths.
- Stormwater outlet details
- Detailed design for culverts
- JOAL detention design and sizing
- Landscape design for drainage reserves.

1.5.4. Wastewater

- Final wastewater reticulation layout
- Wastewater pipe sizing and long sections

1.5.5. Water Supply

- Final water supply reticulation layout and pipe sizing, in accordance with the approved Water Supply Report
- Detailed design for the Booster Pump, in accordance with the Booster Pumping Station Concept Letter.
- Detailed design for the Booster Pumping Station site, including site access, architecture design for pumping shed, and landscape design.

2. EARTHWORKS

2.1. Bulk Earthworks

Bulk earthworks are proposed to commence in October 2025, and continue over three earthworks seasons until the bulk earthworks are complete in April 2028.

A specific report detailing the proposed earthworks, how the sediment and erosion controls will be implemented, and the works methodology is provided in **Appendix B: Milldale Earthworks 10-13 – Earthworks Methodology Report.**

Bulk earthworks will shape the pre-development landform into a landform that is suitable for residential development.

As well as reshaping the landform, the bulk earthworks will also complete the necessary geotechnical improvements, streamworks and bulk retaining features. This will ensure that any secondary earthworks required at the subdivision phase is minimised. Setting up relatively flat building sites also ensure any secondary earthworks during the house build phase is minimised.

Following the completion of each earthworks season, the earthworks sites will be stabilised and made available for the civil construction and subdivision phase of works.

2.2. Erosion & Sediment Control Methodology

2.2.1. Overview

A best practice management strategy will be implemented for the proposed earthworks. This will involve the application of best practice from Auckland Council Guidance Document 2016/005 (GD05), Amendment 3. It is noted that the adaptive management approach has been and is being undertaken on adjacent earthworks sites. This assesses the performance of the sediment and erosion control network and then adapts in response to any non-conforming performance or sediment discharges should they occur.

The primary sediment controls for the site will be sediment retention ponds (SRP). Secondary controls include decanting earth bunds (DEB) for smaller areas not captured within SRP catchments, silt fences, and / or super silt fences. There will also be a strong focus on erosion prevention prior to rain events.

During each earthworks season it is anticipated to have 30 hectares of bulk earthworks area open and active at any given time. This area of bulk earthworks will exclude any open areas associated with civil works stages.

The works will be staged as the Contractor expands the scale of their operation into the height of summer. The methodology is to gradually extend the area open to earthworks, complete the works and progressively stabilise completed areas. Emphasis will be placed on getting areas cut / filled to grade as quickly as possible and then immediately stabilised.

2.2.2. Team Approach

The team approach ensures that adequate resources, commitment, and expertise are provided to support the Erosion and Sediment Control Methodology from start to finish. This team will undertake pre and post storm surveys, discuss Erosion and Sediment Control Methodology at weekly site meetings. At all times the team will utilise a significant resource and "expertise base" to ensure appropriate and technically sound decisions are made. Stakeholders involved in the project will include:

2.2.3. Principal – Fulton Hogan Land Development Ltd

FHLD is committed to development of their landholdings at Milldale, Wainui East in an environmentally responsible manner. The Principal has an environmental policy in which they are committed to protecting the environment from damage and minimising nuisance from its operations and activities through effective planning and site management and controls.

The Principal has an excellent track record in managing environmental effects. They are prepared to invest in additional measures that will enable robust systems to be utilised in the effective management of environmental risks.

2.2.4. Civil Engineering, Planning & Surveying – Woods

Woods have been engaged by FHLD to provide civil engineering, planning and surveying services associated with development in Milldale. Woods will act as the lead consultant on the project and liaise with the Principal, all other members of the project team, and statutory authorities and will supervise the Contractor as Engineer to the Contract (under NZ3910). Woods will review as-built data provided by the Contractor and will undertake and submit compliance documents.

Woods has an excellent track record in managing large residential projects and has a wealth of in-house knowledge to prepare and administer effective sediment and erosion control plans.

Woods will prepare contract documents with a significant allocated budget to allow Contractors to implement sediment and erosion controls and manage the site for the duration of works. Contract allowances will provide sufficient scope for adjusting sediment and erosion control as required in advance of rain events.

2.2.5. Independent Expertise and Oversight – Southern Skies

Southern Skies have been engaged by FHLD to provide technical expertise as specialists in sediment and erosion control and are the author of the Adaptive Management Plan for Milldale (AMP). Southern Skies have been involved with the Milldale project in this capacity for six years, and have a strong understanding of how the site operates during earthworks construction.

As set out in the AMP, Southern Skies monitor water turbidity within key waterways as a marker of the sites performance during rain events. Southern Skies undertake site walkovers following rain fall trigger events, report of the sites performance managing those rain events and provide recommendations under the adaptive management of the site.

These recommendations are then implemented under the contract works.

2.2.6. Earthworks Contractor – TBC

The Principal will appoint a suitably experienced earthmoving Contractor with experience in large earthmoving projects. This Contractor will have experience with many of the commonly used erosion and sediment control practices detailed in GD05 as well as a history of implementing other innovative measures to improve erosion control and discharged water quality. The Contractor will be responsible for implementation, management and maintenance of erosion and sediment control measures. The Contractor will liaise with the site engineer, erosion and sediment control consultant and statutory authorities to ensure all erosion and sediment control measures are operating effectively.

Prior to the pre-construction meeting the Contractor shall produce all pre-construction documentation including:

- Construction Management Plan (CMP);
- Updated Sediment and Erosion Control Plan (SECP);
- Chemical Treatment Management Plan (CTMP);
- Dust Management Plan (DMP); and
- Any other plans and documentation required to address the pre-construction conditions of resource consent.

As we have experienced in previous stages of bulk earthworks, the Contractor plays a critical role in the successful performance of the sediment and erosion control network. There will be a strong emphasis on the Contractor's sediment and erosion control track record when tendering for the works. Only Contractors with an excellent record will be considered when awarding works that fall under this consent.

2.2.7. Statutory Authorities – Auckland Council (AC)

The Principal, Engineer and Contractor will liaise with representatives of AC to ensure that erosion and sediment control measures are implemented, maintained and monitored in accordance with consents granted. Weekly inspections undertaken with AC's representative will be utilised for discussion of site variables as works progress.

3. ROAD NETWORK AND DESIGN

The roading network within the proposed development is based on the Wainui Precinct Plan. Deviations from the Precinct Plan are the result of refining the road layout for enhanced urban design outcomes and working with / around existing features and site constraints. A design philosophy of providing linkages and connectivity with existing and potential future routes and developments has been adopted.

The proposed roading layout is shown on the road typology plan (refer to roading typology plans P23-095-2000-RD to 2003-RD and typical cross sections P23-095-2010-RD to 2015-RD).

3.1. Existing Roading Network

Stages 10 to 13 are located approximately 1.1 km west of the Wainui Interchange ramps, through Wainui Road and Lysnar Rd; and 2.7km from north west of the Silverdale Interchange through Dairy Flat Highway, Pine Valley Road, Argent Lane, and local / collector roads formed in previous stages. These interchanges provide the main transport connection for Stages within the Milldale development.

Roading infrastructure installed with the previous stages of Milldale will provide the initial network connections to the existing roading network. The Milldale roading network will be further integrated into the existing roading network with the extension of the development into Stages 10 to 13.

As part of Stages 10 to 13 the following works are proposed for the existing road network:

- Lysnar Road upgrade to urban Collector Road,
- Cemetery Road upgrade to urban Local Road, and
- Cemetery Road Link (paper road) constructed as part Collector Road and part Local Road. This provides a link between Cemetery Road and the Wainui Road / Argent Lane Roundabout.

3.2. Design Standards

The geometric design of all the roads within Stages 10 to 13 are to be designed to the following relevant road design guidelines and standards:

- Auckland Transport Design Manual (TDM). TDM permits to have a maximum gradient of 12.5% on local roads and 8% on collector roads (bus route). The proposed roading network meets these requirements, while being designed so that the location and gradient of the final landform complement the existing landform;
- Austroads: Guide to Road Design (Austroads) series; and
- Waka Kotahi NZ Transport Agency - Manual of traffic signs and markings (MOTSAM) series and Traffic Control Devices (TCD) series.

3.3. Design Speed

A design speed of 50km/h has been used for all collector roads in Milldale. Designated pedestrian crossing points have been placed on raised tables to ensure safe speeds at these conflict points.

A design speed of 30km/h has been used for all local roads in Milldale. A combination of road geometry, intersections and traffic calming is used to ensure this target design speed is achieved.

3.4. Geometric Design

The road design completed to date is considered sufficient for resource consent. Detailed design for the roads will be provided at Engineering Plan Approval (EA) stage.

All standard intersections are designed based on the AT residential compound kerb return with a 1 in 20m taper on the entry and exit, and a radius of 4m on the approach curve and 15m on the exit curve.

Custom intersections and vehicle crossing access points with non-standard kerb returns, will be designed based on the vehicle tracking movements of the respective design vehicles. This detail will be provided at EA stage.

The site has major topographical constraints which have significantly influenced the overall geometric and stormwater catchments of Stages 10 to 13. The constraints are identified and discussed below:

To provide a robust road network and preserve the topographical landform and its catchment to the existing watercourses. The road layouts have been designed with consideration to balancing the following factors:

- Precinct Plan conformance
- Quality urban design outcomes
- Balancing earthworks volumes
- Existing and future road connection points
- Respecting levels at neighbouring property boundaries
- Maintaining an acceptable design gradient and minimise the steep gradient as low as possible
- Creating buildable lot gradients for future development
- Overland flow path management
- Striking a balance between retention and realignment of key streams, and creating a quality urban environment.
- Culverts – consideration for appropriate number of crossings, which is a balance between connectivity and ecology outcomes.

3.5. Proposed Road Network

The proposed roading network consists of the following road typologies:

- Local roads; and
- Collector roads.

3.5.1. Local Road Typologies

Local road typologies adopted for this project include:

- Cemetery Road Upgrade (20.12m Road Reserve);
- Local Road Type 1 (16.20m Road Reserve);
- Local Road Type 2 (16.20m Road Reserve); and
- Stream Edge Road (16.90m Road Reserve).

Back berm width of the local road Types 1 and 2 above will be 1.0m. The Cemetery Road Upgrade and Stream Edge Road back berm widths are 1.0m on the residential side of the road.

3.5.1.1. Cemetery Road Upgrade

The Cemetery Road Upgrade will be a dual crossfall carriageway. The residential side of the road will have a 2.7m lane width, 450mm kerb and channel, 2.15m front berm corridor, 1.8m footpath, and 1.0m back berm. The rural edge side will have a 3.0m lane width, 1.0m wide shoulder with half being asphalt and half being 1 coat chipseal, 3.60m grassed swale, 4.42m back berm including for the variable width bank to tie into existing boundaries.

3.5.1.2. Local Road Type 1

This type of Suburban Street is a single crossfall carriageway, with 2.7m lane widths, 450mm kerb and channel on the downhill side and 300mm kerb and nib on the uphill side; a 2.15m wide front berm corridor, 1.8m footpath, and 1.0m back berm on both sides.

3.5.1.3. Local Road Type 2

This type of Suburban Street is a dual crossfall carriageway, with 2.7m lane widths, 450mm kerb and channel, a 2.15m wide front berm corridor, 1.8m footpath, and 1.0m back berm on both sides.

3.5.1.4. Stream Edge Road

The Stream Edge Road is a single crossfall carriageway with 2.7m lane widths and 450mm kerb and channel on the downhill side and 300mm kerb and nib on the uphill side. The uphill side has a 2.15m

front berm corridor, 1.80m footpath and a 1.0m back berm. The downhill side has a 2.65m front berm and a 3.0m recreational path.

3.5.2. Collector Roads

Collector road typologies for the Wainui Precinct have been developed during consultation with the Development Programme Office (DPO) and AT during the pre-plan variation application phase for the Argent Lane - Special Housing Area (SHA) in 2016.

Improvements to these typologies have been made as part of previous development applications and in coordination with AT to enable compliance with the AT TDM.

3.5.2.1. Collector Road and Lysnar Road

The Collector Road typology will be used throughout the development and on the Lysnar Road alignment (a road link between the consented Stage 8 and Wainui Road Upgrade).

The Collector Road typology is a dual crossfall road with 3.2m wide lane widths, 450mm kerb and channel, 3.25m wide front berm corridor, 2.00m cycleway, 300mm cycle kerb type 15, 1.80m footpath and a 1.00m back berm. The front berms will accommodate rain gardens, 2.25m wide fully indented parking bays and street trees where appropriate.

This typology is illustrated on application drawing P24-128-00-2010-RD.

3.5.2.2. Cemetery Road Link Collector Road

The Cemetery Road Link Collector Road typology will be used on the western side of the Wainui Road and Argent Lane Road roundabout and will connect with the Cemetery Road Link to the west.

The Cemetery Road Link Collector Road typology, with a typology as an extension of the consented Wainui Road Upgrade, will be a dual crossfall road with 3.2m wide lane widths, 450mm kerb and channel, with berm widths varying each side. The west bound side berm is made up of 2.95m wide front berm corridor, 3.20m two-way cycleway, 300mm cycle kerb type 15, 1.80m footpath and a 2.10m back berm. The east bound side berm is made up of 2.45m wide front berm corridor, 1.80m footpath and a 2.10m back berm.

This typology is illustrated on application drawing P24-128-00-2011-RD.

3.5.3. Intersections

Intersection design remains preliminary for the purposes of this consent application. Detailed design of all intersections will be provided at EA stage. The detailed intersection design will be supported by vehicle tracking to TDM standards.

Intersection typologies are set out on drawings P24-128-00-2040 to 2043-RD.

Concept intersection designs have been provided for typical intersections within Stages 10 – 13, and specific designs are included for seven specific design intersections.

3.5.3.1. Typical Design Intersections

Typical concept designs have been provided for a number of the intersections where a typical arrangement can be considered at consent stage. These typical intersections are shown on drawings P24-128-00-2044 to 2045-RD are include the following intersections:

- **Local to Local Road mini roundabout (drawing 2044)**

This intersection is proposed for local to local road cross road intersections where longitudinal grades allow (<5%) for a roundabout typology.

- **Local to Local Road raised priority intersection (drawing 2044)**

This intersection is proposed for local to local road cross road intersections where longitudinal grades are too steep (>5%) for a roundabout typology. Raised thresholds will be used to control traffic speeds on all 4 legs.

- **Local to Local Road Tee (drawing 2045)**

This intersection is proposed for local to local road tee. This detail is used through Milldale.

- **Local Road Tee to Collector Road (drawing 2045)**

This intersection is proposed for a local road tee onto a Collector Road (Type 1). This is a standard arrangement used throughout Milldale.

- **Local Road Tee to Wainui Road (Arterial) and Cemetery Road Link (Collector) (drawing 2045)**

This intersection is proposed for the 4 x local road tees onto a Wainui Road and the Cemetery Road Link.

3.5.3.2. Concept Design Intersections

Concept design drawings have been provided for seven specific intersection, where a typical design intersection could not be applied. These specific design intersections are shown on drawings P24-128-00-2046 to 2047-RD are include the following intersections:

- 3 Leg Collector / Local Road Roundabout, Stage 13 (drawing 2046);
- 2 Leg Collector / Local Road Roundabout, Cemetery Road Link Stage 12 (drawing 2046);
- Collector / Local Road Intersection, Stage 13 (drawing 2046);
- Possible Future Concept Design for Cemetery Road / Young Access Link (drawing 2046);
- Left in / Left Out Local Tee to Argent Lane (drawing 2047);
- Cemetery Road Tee to Cemetery Road Link (drawing 2047); and
- Local Road Tees to Waiwai Drive (drawing 2047).

These concept intersection design will be further refined at EA stage.

3.5.4. Car Parking

Both kerbside and fully indented parking bays will be allowed for within Stages 10 to 13. This arrangement is depicted on the road cross section plans provided on drawings P24-128-00-2010 to 2015-RD.

The desired parking allocation is proposed at 0.5 carparks per lot. However, parking allocation is subject to other streetscape requirements, including the adjacent lot density, vehicle crossings, street trees, streetlights, raingardens, and safety in design aspects.

A detailed car parking layout will be provided with detailed design at EA stage.

3.5.5. Culverts

With several streams being retained and enhanced with the development, culvert crossings become a necessary requirement to maintain an urban structure with a high degree of connectivity. Culvert crossing locations have been carefully considered with the roading design, with the design principle of minimising the number of culverts from an ecological perspective, whilst still enabling a high degree of connectivity.

Refer to culvert drawings P24-128-00-3050 to 3070-DR and typical offline and online culvert installation drawings 3075-DR to 3076-DR.

There are 11 culverts in total proposed for Stages 10 to 13, Milldale. All of which are supporting roading connections across retained / realigned waterways.

Culvert #	Diameter (m)	Length (m)	Grade (%)
2-1	0.9	29.9	8.01
9-1	1.80	27.58	3.48
20-1	1.05	27.26	7.28
21-1	2.10	29	2.08
26-1	1.20	29.9	4.15
26-2	0.825	29.1	9.16
35-1	1.05	29.90	3.11
42-1	1.05	29.89	4.32

42-3	0.825	26.74	3.00
43-1	1.05	21.60	10.34
43-2	0.825	23.63	3.81

Table 2: Summary of Culvert Details.

3.6. Lot Access

3.6.1. Standalone Lot Access

Private access to lots will be via vehicle crossings for standalone lots. These private access vehicle crossings will not be constructed as part of the Stages 10 to 13 civil works as the location of each will be subject to future layout of the built form on those lots.

Potential positions of future crossings are to be carefully considered in the development of the streetscape layout to enhance the design. Refer to Woods' drawings P24-128-00-2070-RD series for standard vehicle crossing details and tracking curves.

3.6.2. Front-Accessed Superlots

These type of superlots are to be addressed with the same type of access as the standalone lots. Depending on the future redevelopment of these superlots, private access to each dwelling will also be via a vehicle crossing. These vehicle crossings will not be constructed as part of the Stages 10 to 13 civil works as the location will be subject to future layout of the built form on those lots.

3.6.3. Rear-Accessed Lots

Joint Owned Access Lots (JOALs) are proposed for rear private access lots and lots fronting the restricted accessed roads of Argent Lane and Wainui Road.

There are three JOAL typologies provided: Refer to drawing P24-128-00-2016-RD for JOAL details.

- JOAL – Type 1: 5m wide legal width with 3m wide formation. Serving 2 rear lots only.
- JOAL – Type 2: 7m legal width with a 5.5m wide formation with no footpath. Serving rear vehicle access to superlots where the superlot also has legal road frontage and pedestrian frontage to that road reserve.
- JOAL – Type 3: 7m legal width with a 5.5m wide formation and 1.5m footpath. Serving rear vehicle access to superlots where the superlot also has no legal road frontage.

Full details for the JOALs will be provided with detailed design at engineering approval stage.

3.7. Pedestrian and Cycling Network

3.7.1. Overview

The design philosophy for the proposed road cross sections are derived from the Milldale IFA and the Milldale Integrated Transportation Assessment (ITA) prepared by Stantec, with the aim to provide a safe connection route for pedestrians and cyclists through the wider Milldale development.

Table 3 describes how the walking and cycling network for this project has been developed to align with AT policies and guidelines:

AT Policy / Guideline Document	How the walking and cycling network proposed for this Project aligns with AT guidelines?
Auckland Transport Local Path Design Guide (rev 1.2)	Aligns with the Local Paths design framework based on the following principles: Safe: Conflict points and high speeds have been minimised by providing a consistent level of experience across the collector road corridor, including physical speed-calming measures (speed tables and raised pedestrian crossings) at all road intersections. Provides a (footpath) standard pedestrian-only path along most streets, which is not accessible for cyclists. Connected: This Project considers the wider Milldale development and includes provisions for connecting to local destinations such as

AT Policy / Guideline Document	How the walking and cycling network proposed for this Project aligns with AT guidelines?
	residential neighbourhoods, schools, Local Centres, and bicycle facilities. These connections shall be designed to be easily navigated through the use of clear and consistent line marking and consistent wayfinding. Accessible & Comfortable: Accessible for all users, including children and people with disabilities, including design considerations for increased cycleway width and gentle gradients. Enabling: Improve ecological function through planting and kerbside raingardens providing a water sensitive design adjacent to the walking and cycling facilities.
Auckland Transport Engineering Design Code – Cycling Infrastructure Version 1	Aligns with the principles set out in the AT EDC Cycling Infrastructure (version 1): Physical separation between cycleway and carriageway, avoids conflict between vehicles and people on bikes. Physical separation between cycleway and footpath minimises conflict between pedestrians and people on bikes. Wide enough to allow a comfortable environment for all ages and abilities – The bi-directional cycle facility is designed and located to support the land use and anticipated future land use.

Table 3: Proposed Walking and Cycling Network in Accordance with AT Guidelines.

The walking and cycling facilities will be designed to comply with the requirements of the AT TDM, as well as through previous consultations with AT as part of the previous stages consent applications.

The proposed design provides for active modes of transport, including physically separated compliant walking and cycling facilities. Separation from the carriageway is achieved via vertically by kerb and channel and horizontally by a buffer zone.

3.7.2. Pedestrian Network

The proposed scheme allows pedestrian access to be well connected within Stages 10 to 13, as well as to the existing Milldale network.

1.80m wide footpaths are provided in the road reserves and dedicated pedestrian accessways provide mid-block connections to increase pedestrian network permeability.

A 3.00m wide recreational path is provided along the full length of the stream side of stream edge roads.

Pedestrian accessways are proposed at mid-block locations to provide connectivity and permeability to the pedestrian network. Pedestrian Accessways will be 8.0m wide and include a 3.0m formed concrete path. Stairs will be required within five of these accessways where accessways are adjacent to reinforced earth slopes. Full details for the stairs will be provided with detailed design at EA stage.

A key active modes connection is provided through Stage 11. This is an extension of the previous consented and constructed active modes link through the core of the Milldale development. This link extends from the Waterloo Reserve, through Stage 4C, the Town Centre, the Milldale Reserve and into Stage 6. An active modes bridge is proposed to connect the extension of the active modes link across the Milldale Stream and then into Stage 11. The walkway, then climbs adjacent to a realigned water to link up with Wainui Road at the northern edge of the development. It is proposed that the active modes link will connect into Milldale North in the future. This path with be a 4m wide shared path.

3.7.3. Cycle Network

The Wainui Precinct has a strong focus on cycle networks and the Stages 10 to 13 design facilitates this with off-road cycle way facilities.

The proposed Collector Roads include 2.0m wide single way, or 3.2m wide two-way, off-road cycleways located in the road reserves as shown on the Woods' drawings P24-128-00-2010-RD and 2011-RD. The cycleways are separated from the footpath by a 0.3m wide AT type 15 cycle kerb.

Traffic calming measures have been considered at the intersections to reduce vehicle speeds creating a safer environment for cyclists to share the road carriageway with other road vehicles.

3.7.4. Pedestrian Bridges

Including the active modes bridge mentioned above, there are a total of five pedestrian bridges proposed for the purpose of pedestrian connectivity across streams. These bridges are shown on the road typology plans, P24-128-00-2000-RD to 2003.

The bridges will be constructed using timber, with vertical clearance and freeboard to the 100-year flood level. Piles will be required within the 100-year flood plain but will not be located within the regular streambed.

Longsections of the proposed bridge designs are provided on drawings P24-128-00-2080-RD to 2082.

These bridge designs are preliminary only and are subject to EA, detailed structural design and building consent. Detailed design will be completed through the building consent process.

3.8. Public Transport

The existing public transport (PT) network within Milldale will be extended as part of the collector road extensions with Stages 10 to 13. Drawing P24-128-00-2060-RD shows the existing and proposed PT networks, proposed, future, and existing bus stop locations, and planned and potential bus routes This plan includes Bus Stop catchments which are indicated with 400m radius catchment circles.

With the exception of a cluster of lots in the southern west corner of Stage 13, all of the lots within the Stages 10 to 13 development are inside of one or more of the 400m radius catchments of an existing or proposed bus stop.

There has been consideration for collocating urban density with the PT network along the arterial roads within Milldale. This density is present along Argent Lane and Wainui Road. With the intentions of Plan Change 78 to upzone to the Wainui Precinct to Mixed Housing Urban zone, and with the proposal for further Mixed Housing Urban zone in Milldale North to the north side of Wainui Road, there is strong rationale for lining the PT network along Argent Lane and Wainui Road with high density housing.

3.9. Pavement Design

The Milldale generic pavement design has been adopted for each road hierarchy, these pavement designs are reliant on ground type and in-situ CBR testing at the earthworks construction stage. Specific modifications to the design parameters may occur under consultation with Auckland Council Engineers.

The generic pavement design for Stages 10 to 13 are:

Local Roads

- 40mm thick of DG10 placed over a bitumen membrane seal;
- 120mm thick TNZ M/4, Basecourse;
- 200mm thick GAP 65, Sub-base; and
- 250mm thick 3% Lime / 3% Cement stabilised. Effective CBR 8%.

Collector Roads

- 40mm thick of DG10 placed over a bitumen membrane seal;
- 220mm thick TNZ M/4, Basecourse;
- 230mm thick GAP 65 Stabilised with 1.5% Cement, Sub-base; and
- 250mm thick 3% Lime / 3% Cement stabilised. Effective CBR 8%.

Standard AT type 3 slip-formed vertical kerb and channel is proposed to be widely used within the development.

Standard AT type 7 kerb and nib is proposed to use for the upper side of local roads with single crossfall.

Standard AT type 4 extruded kerb is utilised on the front of the parking bays for the conveyance of surface water flows while a cast in situ kerb will be used at the back of the parking bays for the lower side of the local roads and both sides of collector roads.

The pavement designs will be further assessed and refined at EA stage.

3.10. Street Lighting

Street lighting shall be provided on all corridors, in accordance with the following standards:

- Applicable standards listed within the AT TDM Engineering Design Code – Street Lighting standard;
- AT Road Lighting Column Approved List – AT-LCAL;
- Appendix documents for Street Lighting Engineering Design Code; and
- AS/NZS 1158 Lighting for roads and public spaces.

Lighting shall be provided along the edge of the road on all corridors, with lighting fixtures placed at appropriate intervals, whilst not obstructing walking and cycling paths and to improve safety at night and allow street users to be clearly seen.

Separate fittings will be investigated during the EA design phase to cater for the different lighting needs for both pedestrians and vehicle traffic.

3.11. Streetscape

The proposed streetscape shown in **Appendix G** – Landscape Proposal prepared by LASF indicates the typologies on all corridors. The detailed design will be provided at engineering approval stage.

4. STORMWATER CATCHMENT ANALYSIS & MANAGEMENT

4.1. Existing Stormwater Infrastructure

There is stormwater infrastructure and several watercourses which Stages 10 to 13 discharge into:

- Waterloo Creek that runs from south to north and is located to the east of stage 10. All watercourses and contributing stormwater infrastructure within Stages 10 to 13 will ultimately discharge to the Waterloo Creek.
- The Milldale Stream (referred to as Watercourse 21), is an existing stream that discharges to Waterloo Creek. Stream 21 will collect all stormwater discharged from Stages 10 to 13.
- An existing culvert is present on the Stream 21 at the Argent Lane crossing. This culvert is currently undersized for passing flood flows. It has been consented for being upgraded to a 6m wide inverted 'U' culvert as part Milldale, Stage 6.
- Several other existing farm culverts of varying sizes are located across the site. These existing culverts are defined on the streamworks plans P24-128-00-1400-EW to 1403. These existing farm culverts will be removed as part of the proposed streamworks.
- Proposed public stormwater infrastructure is planned for construction on adjacent consented stages of Milldale. In particular Stage 7, Stage 8 and the Wainui Road / Argent Lane upgrade consents will have stormwater reticulation that has overlapping and connecting stormwater catchments with Stages 10 to 13.

The stormwater catchments are shown on the stormwater catchment plans in Woods' drawing P24-128-00-3010-DR series.

4.2. Stormwater Management Strategy and Flood Modelling Report

A Stormwater Management Plan (SMP), entitled Wainui East Stormwater Management Plan, dated July 2016, and corresponding updated Flood Modelling Report for the Milldale Development have been completed by Woods. The SMP was prepared based on the mediated Proposed Auckland Unitary Plan (PAUP) Stormwater Management Area Flow 1 (SMAF1) hydrology mitigation requirements.

The SMAF1 hydrology mitigation requirements in the Auckland Unitary Plan (AUP) for detention and retention are similar to those included in the Wainui East SMP.

The proposed Milldale Stages 10 and 11 extents are located within the SMP Stormwater Management Zone C and Stages 12 and 13 extents are located within the Stormwater Management Zone D, as shown on Figure 2: Stormwater Management Zones below. The general approach for discharge from both Zone C and Zone D is to meet SMAF hydrology mitigation requirements (retention, detention) at source. The recommendation as per the Wainui East Stormwater Management Plan is to allow flows from larger storm events to be passed forward (no detention).

The modelling undertaken and revisions to the flood model have been developed to allow for this, primarily including culverts, to adopt a pass flow forward strategy and allow for full flows from developed upstream sub-catchments. The updated Woods' flood model report allow for the topographical and land use changes and are included in **Appendix C – Milldale Stages 10 to 13 – Flood Assessment**.

The stormwater design for Stages 10 to 13 has been prepared to meet the requirements set out in the SMP which adopts the principles of Water Sensitive Design (at source treatment train approach).

It is to be noted that whilst the options assessment is guided by the Wainui East Stormwater Management Plan, guidance is also sought from the underlying planning requirements of the AUP, with consideration being given to the principles of Water Sensitive Design as discussed in Auckland Councils Guideline Document 04 (GD04), the Stormwater Management Devices in the Auckland Region as discussed in Auckland Council Guidance Document (GD01) as recommended in the PAUP and the AT Bioretention Design Guide.

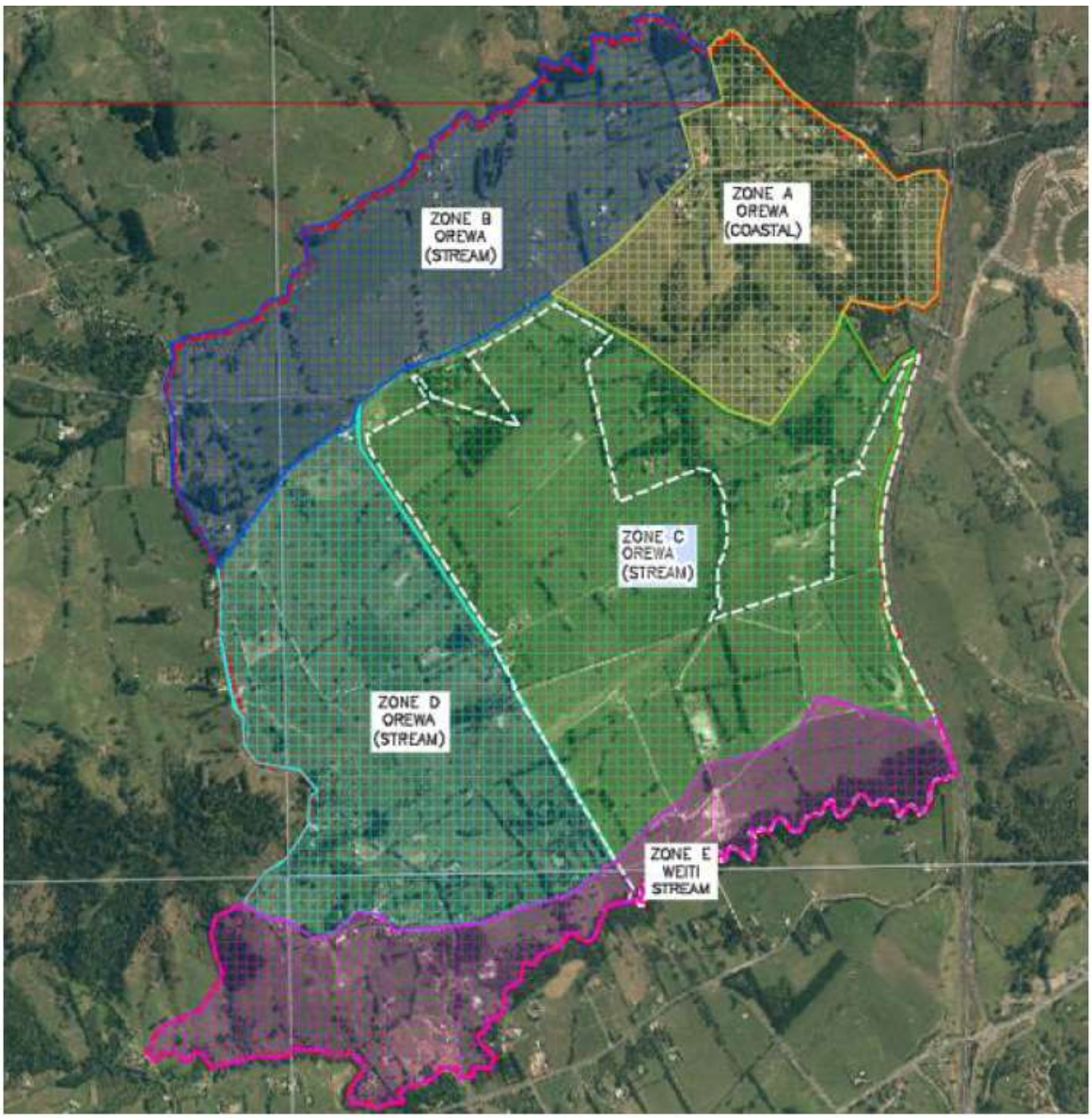

Figure 2: Stormwater Management Zones

4.3. Stormwater Network Overview

The primary stormwater network is comprised of a total of 20 catchments as listed below:

Stage 10:

- Stream 43 Catchment: discharges to 43 diversion, treated via swales and raingardens as part of the previously consented Wainui Road Upgrades LUC60393114 and private tanks.
- Stream 42 Catchment: dischargers to 42 diversion, treated via private tanks.
- Basin 3 (Stage 8) Catchment: discharges to 21, treated via the previously consented Stage 8 drainage basin and private tanks.
- Basin A Catchment: discharges to 21, treated via drainage basin and private tanks.
- Basin B Catchment: discharges to 21, treated drainage basin and private tanks. This also includes treatment via swales and raingardens as part of the previously consented Wainui Road Upgrades LUC60393114.

Stage 11:

- S10/11 Watercourse P5 Catchment to 21, treated via private tanks .
- Stream 35 Catchment: discharges to 35 diversion, treated via private tanks.

- Basin C Catchment: discharges to 21, treated via drainage basin and private tanks.
- Basin D Catchment: discharges to 21, treated via drainage basin and private tanks.
- Basin E Catchment: discharges to 21, treated via drainage basin and private tanks.

Stage 12:

- S10/11 Watercourse P5 Catchment to 21, treated via private tanks. This catchment connects to the previously consented Wainui Road Upgrades LUC60393114.
- Stream 26 Catchment: discharges to 26 diversion, treated via private tanks.
- Stream 20 Catchment: discharges to 20 diversion, treated via private tanks.
- Basin F Catchment: discharges to 26, treated via drainage basin and private tanks.
- Basin I Catchment: discharges to 21, treated via drainage basin and private tanks.
- Basin J Catchment: discharges north of the site, treated via drainage basin and private tanks.

Stage 13:

- S12/13 Watercourse 21 Catchment to 20, treated via private tanks.
- Stream 20 Catchment: discharges to 20 diversion, treated via private tanks.
- Stream 2 Catchment: discharges to 02 diversion, treated via private tanks.
- Basin G Catchment: discharges to 26, treated via drainage basin and private tanks.
- Basin H Catchment: discharges to 09, treated via drainage basin and private tanks.
- Basin I Catchment: discharges to 21, treated via drainage basin and private tanks.
- Basin J Catchment: discharges north of the site, treated via drainage basin and private tanks.

The overall stormwater design and catchments are shown on the stormwater catchments plan in Woods' drawing P24-128-00-3010-DR series.

Most of the road catchments will be treated through the proposed basins while some minor road catchments are discharged directly to the watercourses. Additional storage is provided in basins to offset the road catchments discharging directly to streams.

On-site stormwater mitigation devices shall be provided within each JOAL at EA stage.

On-site stormwater mitigation devices shall be provided within each lot at building consent stage for lot development.

The proposed piped reticulation will convey storm runoff up to the 10% AEP storm, in accordance with the Auckland Council standards for engineering design and construction.

Flows from stormwater events greater than the 10% AEP storm, will be conveyed via roadways and secondary flow paths to the permanent watercourses without risk of damage to properties.

For the stormwater reticulation network depicting the proposed reticulation see Woods' drawing P24-128-00-3000-DR series. This stormwater reticulation layout tis subject to detailed design at EA stage.

For overland flow path plans and details see drawings P24-128-00-3020-DR to 3039-DR.

4.3.1. Stormwater Network Watercourse Discharge

Stormwater catchments will discharge to watercourses via wingwalls and scruffy dome outlets.

As part of detailed design at EA stage, details will be provided on outfall type, flow velocity, and velocity reduction measures along with landscaping plans designed to reduce the visual effects of the outlet structures.

Stormwater outlets to the streams will be designed in accordance with TP10, Chapter 13. Each structure and channel will be designed to minimise any scouring or erosion within the watercourse, while conveying the 10% AEP flow. Specific landscape planting will be provided as part of the EA Application.

4.3.2. Stream Recharge

There are six main stream tributaries to the Milldale Stream (Stream 21) that will be retained and enhanced as part of the proposed development. Each of these six streams will have some form of

realignment to ensure the final enhanced alignments can be integrated into the proposed development layout.

A key part of stream retention within an urban development is stream recharge. Stream recharge will be achieved for these six watercourses by diverting an appropriate amount of the proposed stormwater primary network and underfill drainage into the upper most reaches of these watercourses.

The proposal for the primary network is to mimic the post-development stormwater flows, with (at least) that of the pre-development flows. The pre-development catchments for the retained streams are shown on drawing series P24-128-00-3080-DR.

The post-development catchments allocated to these stream heads has then been defined to ensure the same contributing runoff flow is assigned to the heads of each of those streams in their realigned positions. In doing so, there is also a focus on ensure the contributing catchment has 'at source' stormwater mitigation, by way of the private detention tanks on residential lots. This will ensure the contributing flows will have stormwater detention and a 24-hour draw down period. The stream heads will therefore not receive un-mitigated stormwater flows.

The post-development stream recharge catchments are shown on drawing series P24-128-00-3090-DR.

These drawings show the contributing catchments to each of the retained streams' heads. With the exception of Stream Catchment 43, all contributing catchments are isolated to catchments from private property which will contain on site 'at-source' stormwater mitigation as defined by the Wainui SMP. Stream 43 Catchment will contain runoff from Wainui Road, but the flows will have 'at-source' detention in the form of rain gardens along Wainui Road, as consented under the stormwater management strategy for that consent.

The table shown on plan 3090-DR, shows all post-development catchments will contribute at least that of the pre-development flows. The contributing catchments are considered sufficient for providing stream recharge via the proposed primary stormwater network.

In addition to the primary network, stream recharge will also be provided for via the underfill drainage network. This network of sub-surface drain coils is defined in the Geotechnical Investigation Report (GIR), included with the application.

Underfill drainage is designed to collect groundwater and divert it away from sensitive soils to manage ground stability. This provides an opportunity to discharge ground water to the heads of the retained streams, providing base flows in addition to the flows loaded from the stormwater network.

By diverting both underfill drainage networks and the appropriate amount of mitigated post-development flows via the stormwater primary network, this will ensure the 6 retained watercourses will have sufficient flows to support an intermittent stream environment.

4.3.3. Stormwater Management on 147 Argent Lane (Lot 4 DP 151229).

4.3.3.1. Stormwater Primary Network

147 Argent Lane is a 12ha site that is located in a downstream stormwater catchment to Stages 12 and 13.

In the pre-development situation, stormwater runoff from existing titles Lots 1, 2, and 3 DP 488814, and Lot 2 DP 147739 (Stages 12 & 13) discharge stormwater across 147 Argent Lane. This includes Stream 21 which extends across 147 Argent Lane from Stage 12 on the western side of 147 Argent Lane to the eastern side at Argent Lane. Pre-development sheet flow runoff across the common boundary with 147 Argent Lane is also present in the pre-development scenario.

The management of stormwater generated with the proposed development has been carefully considered with respect to discharging onto 147 Argent Lane.

Given 147 Argent Lane is zoned for residential development, the proposed stormwater reticulation has been designed to ensure there are no adverse effects with regards to future development potential. This is achieved by avoiding stormwater outcomes that would require the future development of 147 Argent Lane to collect and extend stormwater networks from Stages 12 & 13. With reference to drawing P24-128-00-3002-DR and P24-128-00-3122-DR, stormwater catchments on adjoining developed land to 147 Argent Lane will be diverted to two discharge locations to ensure the land at 147 Argent Lane is not burdened by stormwater discharge points:

i- The Stage 12D catchment that will be reticulated around 147 Argent Lane to the east and connect with the stormwater network within Argent Lane. This catchment will discharge to Stream 21 on the eastern side of Argent Lane, and therefore avoid 147 Argent Lane.

ii- All other stormwater catchments in Stages 12 and 13 will discharge to Stream 21 and its retained tributaries within Stages 12 and 13. The stormwater runoff will be mitigated with detention basins in accordance with the Wainui Stormwater Management Plan (SMP). This results in stormwater network flows from Stage 12 and 13 to be concentrated into Stream 21 prior to entering 147 Argent Lane.

No other primary network stormwater discharge points in relation to 147 Argent Lane are proposed.

4.3.3.2. Wetland Recharge

As identified in the Ecological Impact Assessment, potential wetlands are present on adjoining property at 147 Argent Lane.

Drawing P24-128-00-3085 defines the catchment areas associated with these potential wetlands. These wetland catchments extend across 147 Argent Lane and into the proposed development within Stage 12.

Drawing P24-128-00-3095 defines the post development catchments for those potential wetlands. As shown on the plan the catchments are effectively reduced in size as a result of the development. This is because the post development stormwater flows will be collected in the public stormwater network for the development and diverted around 147 Argent Lane as explained in section 4.3.3.1 above.

As the stormwater is collected and reticulated into the public stormwater network, there is no logical opportunity to replicate the pre-development scenario, where stormwater runoff can ‘sheet flow’ across the property boundary from the Stage 12 area into 147 Argent Lane.

In consideration of the above, it is evident that stormwater recharge of these potential wetlands is problematic.

A potential alterative has been assessed where the stormwater from private property adjoining 147 Argent Lane, can discharge directly to 147 Argant Lane via individual lot connections, as opposed to being collected in the primary stormwater network. This alternative works well from a hydrology perspective with multiple private stormwater outlets providing a correlation to pre-development sheet flows. However, from a legal perspective it is not feasible to collect and discharge private stormwater onto another private property without agreement and the appropriate easements formed. Multiple stormwater outlets would also severely burden the land at 147 Argent Lane, leaving future development potential effected by numerous stormwater outlets that would need to be collected and extended across the burdened areas of the site. We have therefore discarded this as a viable alternative.

The net effect of the above will result in reduced catchments contributing to the potential wetlands on 147 Argent Lane. This will have an impact of the wetlands.

It is therefore proposed to offset this impact on the wetlands via the offset mitigation plan for wetland creation on Milldale North.

4.4. Water Quality Treatment

The Wainui East – Stormwater Management Plan requires the stormwater quality treatment be provided for runoff from high use roads and carparks. The Unitary Plan defines high use roads as those roads carry more than 5000 vehicles per day.

Traffic modelling provided by Stantec indicates that the proposed Stages 10 to 13 road network will not trigger the threshold as the traffic will be low and therefore water quality treatment will not be required.

5. WASTEWATER DESIGN

5.1. Existing Wastewater Infrastructure

Milldale is part of a master planned wastewater catchment. Stages 10 to 13 are situated within the broader framework identified as the Waterloo Wastewater catchment. Refer to drawing P24-128-00-4010-DR for the wastewater catchment plan.

The Waterloo Wastewater catchment accumulates at the lower reaches of the catchment into an existing wastewater transmission line, 675mm ID. This transmission line then extends through to Wainui Road, where it discharges to the Milldale Wastewater Tunnel. This tunnel then conveys wastewater flows through to the Orewa West Pump Station.

The existing wastewater infrastructure will be available at the downstream ends of Stage 10 and Stage 13. These connections will be utilised to serve all of the proposed development for wastewater flows via new gravity networks.

5.2. Wastewater Servicing Strategy

The wastewater network proposed for Stages 10 to 13 will comprise of a series of gravity sewer networks. There will be two main connection points to the existing wastewater network.

The wastewater network will be located in road reserves where possible, but due to the narrow street scape and limited space with other utility services, wastewater networks will primarily be located in lot frontages.

Stage 10 and 11 will connect into the Wastewater Transmission Main, via a short section of wastewater network through Stage 8. This line is consented, but yet to be built. Refer to drawing P24-128-00-4001-DR for the wastewater layout plan. Stage 12D will also fall into this Stage 10 and 11 catchment. Refer to drawing P24-128-00-4002-DR for the wastewater layout plan.

Stage 12 and 13 will connect into the existing 300mm trunk network line. This line extends from the Wastewater Transmission Line, through Stages 5, 6, and 7 into the lower end of the Stage 12 and 13 catchments. Refer to drawing P24-128-00-4003-DR for the wastewater layout plan.

A wastewater pipe bridge is proposed to cross a watercourse at the lower end of Stage 13D. This is to enable a gravity connection into the lower level lots within this stage. It is proposed to co-locate this pipe bridge with a proposed pedestrian to enable screening on the pipe. Both the wastewater pipe and pedestrian bridge will be located clear of the 100 year flood plain. Detailed design of this wastewater pipe and pedestrian bridge with be provided at EA stage.

Detailed design of the wastewater reticulation for the site will be undertaken in accordance with the Watercare Code of Practice standards for engineering design and construction as part of the future Engineering Approval applications.

6. WATER RETICULATION

6.1. Existing Water Infrastructure

Existing water supply infrastructure for Milldale has been constructed in Stage 1, Stage 2, Stage 3, Stage 4, Stage 5, parts of Stage 6 (the remainder of Stage 6 is currently under construction) and as part of the water supply transmission infrastructure for the wider zone. This infrastructure is sized to supply potable water including for the water demands of Stages 10 to 13.

The existing water reticulation in Stages 5, 6, 7, and 8 shall be extended into Milldale Stages 10 to 13 to provide water supply connections.

6.2. Water Supply Servicing Strategy

Master planning "*Milldale Water Supply Master Planning: Model Build and Design Summary*, dated 21 September 2017" modelled the pipe size required to supply the first 500, 1200 and the full 4,500 properties planned for the Milldale development and determined what works would be required to secure supply for the development. The network design has been developed to service the full Milldale development with the existing bulk supply and includes a local pumped zone to service the ridge along Cemetery Road.

The Wainui Bulk Supply Point (BSP) located at Millwater Parkway On-Ramp and the DN355 watermain across the Northern Motorway are now complete. These assets are fully operational and will be the source for the entire Milldale development in the short term. In the medium to long term a new supply from the Orewa 3 transmission main and BSP will provide additional supply and resilience for the area. This will include a new reservoir at Cemetery Road. The reticulation proposed for Milldale allows for the additional BSP and reservoir to be incorporated into the future network.

A report detailing the water supply design and modelling for the Stages 10 to 13 area is attached in **Appendix E** – **Milldale Stages 4C, 10 to 13 - Water Supply Report**. This is to be read in conjunction with the previous reports submitted to Watercare as part of the modelling undertaken for the wider Milldale Water Supply Zone.

From the modelling undertaken, Stages 10 to 13 (modelled with 919 dwellings) will comply with the Watercare Code of Practice "The Water and Wastewater Code of Practice for Land Development and Subdivision v 2.4 June 2021".

Refer to the overall water reticulation layout plan drawing series numbered P24-128-00-5000-WR series, which depicts the proposed reticulation system.

6.3. Water Supply Booster Pump

A booster pump is required to supply the elevated areas which are above RL 50 m within Milldale. It is planned to be a temporary installation until supply from Orewa 3 watermain is available in the long term.

A memorandum detailing the water booster pumping station for the Milldale elevated areas is attached in **Appendix F** – **Water Booster Pumping Station – Fast Track RC Memo**.

7. UTILITY SERVICES

7.1. Power Reticulation

Stages 10 to 13 will be supplied by extending power reticulation laid with Stages 5, 6, 7, and 8 civil works. Any reticulation extension or upgrades required for the development of Stages 10 to 13 will be undertaken following reticulation design by Vector.

7.2. Telecommunication

Stages 10 to 13 will be supplied by extending telecommunications reticulation laid within Stages 5, 6, 7, and 8 civil works. Any reticulation extension or upgrades required for the development of Stages 10 to 13 will be undertaken following reticulation design by Tuatahi First Fibre.

7.3. Natural Gas

Natural gas is not proposed to be installed in Stages 10 to 13.

8. SAFETY IN DESIGN

While developing the design, the philosophy was to integrate hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life cycle of the development.

Safety in Design (SiD) has been considered during the design of Stages 10 to 13. The SiD commentary in this Section should be used to inform further detailed design of the project.

A detailed review of SiD will also be provided as part of the future EA application, which will incorporate further SiD considerations with detailed design.

8.1. Construction Considerations

8.1.1. Site Access

Stabilised site accesses can be provided is to be provided from public roads to each Stage. These site access points should be located in areas of good visibility both to and from the access point. Priority for these locations should be given to public roads with posted speeds of 50 km/hr and must be accompanied by suitable temporary traffic control.

8.1.2. Steep Batter Slopes

Batter interfaces are required where the design model interfaces with the following features:

- Existing ground levels at the extents of the earthworks area (batter slopes typically 1V:5H to maximum 1V:3H).
- Riparian margin either side of the Streams and dry basins (batter slopes typically 1V:3H).
- RE Slopes (1V:2H)

Construction mitigation:

- Riparian margin batter slopes modelled to a maximum grade of 1V:3H.
- All batter slopes will be identified with the contractor at the pre-construction meeting.
- Batter slopes are to be fenced at the top of batter with high-visibility safety mesh fencing or high-visibility line flags at the completion of each stage.

8.1.3. Trenching

The proposed stormwater and wastewater reticulation networks have been designed in accordance with the Auckland Council Stormwater Code of Practice Version 3, January 2022 (AC SW COP v3, 2022) and to Watercare Code of Practice standards.

All trenching operations shall be carried out in accordance with the Approved Code of Practice for Safety in Excavation and Shafts for Foundations, Part One: Trenches and Open Excavations.

Trenching depths have been minimised based on the design finished surface where possible. It should be noted that Watercare Services Limited clearance standards have the effect of forcing drainage lines deeper to achieve clearances. Full details of trenching are to be provided on drainage long sections at EA Stage.

8.1.4. Drainage Networks Layout

The layout of the drainage networks (stormwater and wastewater) will be reviewed with detail design drawings to be submitted with the EA.

At this stage consideration has been given to the network layout including:

- Location of manholes to provide for safe maintenance access.
- Locating manholes out of the future riparian margin to provide safe maintenance access. Only stormwater outlets will be located adjacent to the stream with the upstream manhole located on, or in close proximity to the future road reserves or pedestrian accessways.
- Minimising the number of stormwater pipes crossing future roads, to reduce the amount of possible future maintenance works within the carriageway.

8.2. Operations Considerations

Stages 10 to 13 have been designed for the purposes of a residential subdivision. The design has considered the following maintenance operations risks:

8.2.1. Safe Access for Maintenance

Manholes are generally located in the road reserve or within 3.0m set back of lot frontage, clear of the carriageway, to provide safe access.

Landscaped batters are no steeper than 1V:3H, providing a safe working slope for landscape operations.

8.2.2. Dry Basin

Dry basins are designed with batter no steeper than 1V:3H providing a safe working slope to access the basin inlet and outlet structures.

The standing water within the basins is designed up to 600mm during wet period to minimize the potential drowning hazard.

Maintenance access of the dry basins will be via a 3.5m wide formed concrete path.

8.2.3. Retaining Walls and Reinforced Earth Slopes

The retaining walls (no higher than 3.0m in height) will be constructed as part of this consent. All retaining walls will be fenced in accordance with the building code.

Reinforced earth slopes will be completed as part of the Stages and are no steeper than 1V:2H. These will be fenced above the top of the slope to prevent falls. These slopes will also be planted with low maintenance plantings, to avoid the need for access to the slope.

8.2.4. Safe Transport Operations

SiD has been considered for vehicle, cyclist, and pedestrian modes of transport.

A planned roading hierarchy is implemented with a low-speed environment on local roads connecting to collector roads.

The majority of the road layout is designed in accordance with the Wainui Precinct Structure Plan and in accordance with the AT TDM, Austroads and NZS 4404 where applicable.

Detailed intersection and street lighting designs will be provided at EA stage.

8.2.5. CPTED

A safe pedestrian environment has been created with:

- 8m wide pedestrian accessways;
- Passive surveillance from lots;
- Lots orientated towards pedestrian amenities; and
- Lighting of pedestrian accessways.

8.2.6. Stormwater Overland Flow Paths

Overland flow paths are designed in accordance with the AC SW COP v4, 2024. The design model ensures that no private property is located within the 1% AEP flow. Overland flow paths are generally contained within the road reserve, pedestrian accessway, stairway, or riparian reserve and are clear of private property. Refer to Woods' drawing P24-128-00-3020-DR series for the overland flow path plans and sections.

9. CONCLUSION

FHLD is seeking consent to develop Milldale Stages 10 to 13 within the Wainui Precinct.

This application is for the subdivision of 623 new standalone residential lots and 27 super lots. The anticipated dwelling yield from the superlots is approximately 296 dwellings, which equates to 919 total dwellings for this application. The subdivision will also create public roads, joint owned access lots, pedestrian accessways, local purpose recreational reserves and local purpose drainage reserves.

This Infrastructure Design Report explains the servicing strategy for Milldale Stages 10 to 13. The report identifies where existing infrastructure is located in relation to the site and where connections will be made to service the development.

This report confirms that Milldale Stages 10 to 13 within the Wainui Precinct can be adequately serviced by implementing the new infrastructure as shown on the application drawings and as described in this report.

Appendix A – Milldale Stages 10 to 13 – Engineering Plans (bound separately)

Appendix B – Milldale Earthworks 10 to 13 – Earthworks Methodology Report
(bound separately)

Appendix C – Milldale Stages 10 to 13 - Flood Assessment (bound separately)

Appendix D – Milldale Stages 10 to 13 - Stormwater Design Memorandum

To
Auckland Council

From
Woods
Brandon Olver – Senior Associate Engineer

W-REF: P24-128
27 January 2025
Reviewer: Jamie Whyte

Stormwater Design Memorandum

Milldale Stages 10-13

This memo has been prepared in support of the application by Fulton Hogan Land Development (FHLD) for a resource consent to the Environmental Protection Authority (EPA) under the Fast-Track Approvals Act 2024 (FTAA). This memo outlines the stormwater design for the development with a focus on the proposed treatment devices.

1. Stormwater Requirements

1.1. Wainui East Stormwater Management Plan

Milldale falls within the Wainui East Stormwater Management Plan (WE-SMP) (September 2016) prepared by Woods as part of the original plan change works enabling urban development in the area.

The plan discusses the stormwater management requirements for the site, and broadly aligns with the Unitary Plan and Auckland Council Stormwater Code of Practice requirements.

1.2. Base Storm Parameters

The below table shows the rainfall depths for various storm events as listed in the WE-SMP. These depths have been calculated with allowance for 2.1 °C climate change.

It is acknowledged that Auckland Council will increase this required climate change allowance to 3.8 °C at some point in the near future. The EPA design for these stages will be undertaken under the latest code of practice and the resulting rainfall depths have also been listed in the table.

Milldale Design Rainfall Depth (mm)			
ARI	**Rainfall**	**SWCoP V2 (2.1°C)**	**SWCoP V3 (3.8°C)**
1 year	71.8	78.3	91.5
2 year	88	95.9	112.1
5 year	120	133.6	155.5
10 year	145	164.1	189.6
100 year	225	262.8	298.6

Table 1 – Milldale Design Rainfall Depths

The corresponding peak intensities are listed below.

Milldale Development Intensity (mm/hr) - 10 mins				
ARI	**Rainfall**	**No Climate Change**	**SWCoP V2 (2.1°C)**	**SWCoP V3 (3.8°C)**
1 year	71.8	48.47	54.37	70.72
2 year	88	59.41	66.64	86.68
5 year	120	81.01	92.79	120.24
10 year	145	97.89	114.03	146.63
100 year	225	151.9	182.57	230.83

Table 2 – Milldale Peak Design Rainfall Intensities

The stormwater management devices are to be designed to the 95th percentile event. This event is defined as a 37mm, 24hr storm.

1.3. Stormwater Management

The WE-SMP was prepared based on the mediated Proposed Auckland Unitary Plan (PAUP) Stormwater Management Area Flow 1 (SMAF1) hydrology mitigation requirements.

The SMAF requirements outlined in the WE-SMP follows the recommended amendments to Chapter J 7.X Stormwater Management Area Flow – Rules (mediated SMAF provisions). The retention and detention criteria have been further defined as follows:

Provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile (SMAF1), 24-hour rainfall event minus any retention volume that is achieved, over the impervious area for which hydrology mitigation is required.

The WE-SMP requires that 5mm of runoff from the site be retained. This can be done using a variety of methods but for road catchments it is primarily accomplished through infiltration and evapotranspiration.

To date, retention through the use of infiltration has not been able to be achieved on the Milldale site due to the low permeability of the clay soils. Additionally, infiltration to highly fractured underlying rock zones needs to be prevented to avoid geotechnical issues, primarily rock slaking. The advice from the Geotechnical Engineers (CMW) is that infiltration will continue to not be achievable in Stage 10 to 13.

Green treatment devices such as dry basins and rain gardens help to promote evapotranspiration, and this makes them a preferred device for the development. Evapotranspiration rates have been defined by Auckland Council as 3mm/day over the area of the treatment device. The calculations have not taken this into account and instead have discounted any evapotranspiration while accepting that it occurs.

Where retention is not possible, the WE-SMP allows for retention volumes to be included in the detention volume.

The WE-SMP requires that stormwater quality treatment be provided for runoff from high use roads and carparks. The Unitary Plan defines high use roads as those roads carry more than 5000 vehicles per day.

Traffic modelling provided by Stantec (dated 07/02/2025) indicates that none of the proposed roads in Stages 10-13 would trigger the quality treatment; as such the proposed treatment devices will focus solely on detention.

2. Previous Milldale Stages Stormwater Strategy

The previous stages of Milldale have achieved stormwater mitigation primarily through kerb side rain gardens or dry basins for the road carriageways and stormwater tanks for the private ways and lots. Most

of the rain gardens and dry basins were required for detention only, with no requirement to provide quality treatment.

With Milldale Stages 4, 5 and 6 there was acceptance with Healthy Waters and Auckland Transport that in the effort to rationalise rain garden numbers, detention requirements could be offset across the catchment. This allows for the utilisation of available berm areas on the collector roads for rain gardens.

The number and size of the rain gardens required on the local roads are to be minimised or eliminated by utilising dry basins where possible. A dry basin relies on an outlet orifice to control the flow rate of stormwater runoff into the streams or downstream reticulation system. To protect this orifice, a gross pollutant trap (GPT) must be installed upstream of the orifice to capture any contaminants entrained in the stormwater flow.

3. Stormwater Management Options Assessment

3.1. Rain Gardens

Rain gardens, as the primary treatment device under the WE-SMP, and the incumbent device from previous stages, have been considered as an alternative option for Stages 10 to 13. This type of device is an at-source stormwater management treatment device, which satisfies the WE-SMP hierarchy treatment preferences.

GD01 Compliance: These are compliant with the GD01 requirements and with the AT Bioretention Guide.

Treatment: These devices provide both detention and quality treatment. The rain garden design allows opportunity for some retention through evapotranspiration, but this has not been quantified within the design calculations at this stage. The rain garden sizing would allow for the required retention volumes to be accounted for within the detention requirements.

Construction Costs: Moderate – From a construction or total acquisition cost standpoint, kerb side rain gardens tend to be similar to alternatives such as underground tanks. The ability for kerb side rain gardens to be located within the front berm of the road reserve provided significant savings as no additional land is required to be dedicated to them.

Maintenance Costs: High – Rain gardens require both frequent and long-term maintenance. Regular maintenance requires approximately two personnel every three months, which can lead to significant labour costs on an ongoing basis, whilst longer-term maintenance costs are a consequence of debris/sediment removal and media/sand layer replacement, requiring large machinery and temporary traffic management (TTM), approximately every 10 years.

Overall, kerb side rain gardens are considered expensive to maintain, relative to other treatment devices, given the likelihood of having to clean them out and replace the filter media at least once within their working life span.

The developer will help mitigate maintenance costs by undertaking a two-year maintenance programme following the issue of 224c. This will ensure plants are established and free of weeds prior to Council taking over the maintenance.

Safety in Design: The construction of the rain garden is undertaken as part of the civil works. From a construction point of view, rain gardens do not present an issue, they are a relatively shallow trench compared with other drainage systems.

Routine maintenance inspections and surface works can generally be accomplished by carrying out works from the footpath side of the rain garden. Rain gardens can be accessed by foot for planting maintenance and to remove mass pollutants. This work would not generally require TTM.

Debris/sediment removal and media/sand layer replacement requiring larger machinery will require TTM to shut down the area around the rain garden, both the footpath, cycle path, and potentially the live traffic lane.

As per the specifications provided in GD01 and the AT bioretention design guide, a minimum ponding layer depth of 200mm for a SMAF1 overlay is considered appropriate and safe in terms of vehicle roll over and for pedestrians (children) walking on the footpath adjacent to the rain gardens.

Summary: Kerb side rain gardens is an at-source stormwater management treatment device, which satisfies the WE-SMP hierarchy treatment preferences. They add biodiversity and aesthetic value to the development.

They are neutral from a construction cost perspective but add to the complexity for the design of the development and design of the adjoining lots. Additionally, they are space efficient, making use of land otherwise destined for low biodiversity grass berms.

Rain gardens require a high level of maintenance and based on previous discussions on other stages, it is understood that the use of rain gardens solely for detention is not a preferred option from Auckland Transports perspective.

3.2. Dry Basins

Dry basins have been considered as the primary option for Stages 10 to 13. As consented initially in Milldale Stage 4A, and subsequently in the following staged subdivisions. These devices provide a good alternative to rain gardens where quality treatment is not required.

Compliance: The dry basins are designed in compliant with the GD01 and SMP requirements.

Treatment: These devices provide detention but not quality treatment of stormwater flows. This is suitable for the road catchments within Stages 10 to 13.

In order to protect the dry basins outlet orifice, a gross pollutant trap will be included in the system to remove objects which may block the orifice. This could be in the form of a forebay or proprietary device.

Construction Costs: Moderate/ High – Offline dry basins are traditionally more expensive to provide than other devices. This is due to the land required to be dedicated to these devices. An indicative associated cost of developable land is \$1,000 / m^2. Where land is available in drainage reserves this additional land cost can be negated.

The requirement to transport water to the dry basin can lead to deep stormwater networks. There is less head loss through dry basins than offline rain gardens, as water can be allowed to build up against the outlet structure, but there are still losses associated with the catchpit intake and discharge to the device. This adds cost to the drainage networks supporting the device.

The provision of a Gross pollutant trap in the system adds significant cost to construction.

Maintenance Costs: Low – Dry basins are expected to be cheaper and easier to maintain compared to other devices predominantly because there is no replacement of media required. Maintenance involves general maintenance of landscaped and grassed areas, upkeep of plant species, removal of mass pollutants and regular inspections, cleaning, and repair upkeep of key components such as the inlet and outlet control structures and gross pollutant trap.

Safety in Design: The construction of dry basins is undertaken as part of the civil works and involves similar construction techniques to normal earthworks operations.

Dry basins can introduce a dammed water hazard and temporary standing water can be a potential safety issue. Design of these devices must take into consideration these issues and address them adequately.

Dry basins should be able to be accessed by foot for plant maintenance and for access to inlet and outlet structures.

Summary: Dry basins satisfy the WE-SMP requirements. Depending on the planting, dry basins can add biodiversity and aesthetic value to the development.

The construction costs vary significantly depending on what land is available to build each basin on. Costs compared to other devices may vary from neutral to very high.

Maintenance costs are relatively lower for dry basins than other devices, such as rain gardens.

3.3. Underground Tanks

Underground tanks have been considered as an option for Stages 10 to 13. These devices are used throughout the development on private land as an efficient solution to the stormwater treatment requirements.

GD01 Compliance: Rainwater tank systems are compliant with GD01 requirements, although the design/ maintenance of underground tanks is not covered within the scope of GD01.

Treatment: These devices provide detention but not quality treatment of stormwater flows. This is suitable for the road catchment being treated in Stages 10 to 13.

To protect the tanks outlet orifice, a gross pollutant trap must be included in the system to remove objects which may block the orifice.

Construction Costs: Moderate – The costs to construct underground tanks is similar to bioretention devices.

The provision of a Gross Pollutant Trap in the system adds a significant cost to construction but the overall cost is expected to remain comparable to other devices.

Maintenance Costs: Low – Underground tank systems are expected to be significantly cheaper and easier to maintain compared to other devices predominantly because there is no replacement of media required.

Maintenance involves regular cleaning of the Gross Pollutant Trap and Orifice to ensure blockages are avoided.

Where a blockage does occur, it can be difficult to detect from the surface and would not be obvious to members of the public as it is with other systems where ponding is visible. For this reason, maintenance must be more vigilant to avoid the tank system blocking and the treatment device going offline.

Maintenance can require confined spaces work, but the design of the device should avoid the need for entry where possible.

Safety in Design: The construction of the tanks is undertaken as part of the civil works. From a construction point of view, they are similar to installing drainage lines and the hazards can be managed through safe trench procedures.

Routine maintenance inspections and maintenance can predominantly be carried out from the surface. This work is unlikely to require TTM and but does present a confined space risk if entry is required.

Summary: A underground tank will satisfy the WE-SMP requirements. Unlike other devices there are no additional biodiversity or aesthetic benefits associated with tanks.

From a cost perspective, tanks are comparable to dry basins with neutral construction costs and low maintenance costs.

Tanks are considered an option for Stages 10 to 13 stormwater treatment where dry basins are not deemed appropriate. They will also be considered as a secondary device where a basin is an option but may not be able to store the full required detention volume.

3.4. Other treatment devices

A range of other treatment devices have also been considered for use in Stages 10 to 13. This consideration process is summarised in the below table.

Treatment Device	Achieve GD01/ WE-SMP Requirements	Shortlisted	Comments
Kerb side rain gardens	✓	✓	Incumbent treatment device for Milldale subdivision and Wainui SMP Compliant.

Treatment Device	Achieve GD01/ WE-SMP Requirements	Shortlisted	Comments
			Promotes at-source stormwater management as per WE-SMP.
Offline rain gardens	✓	✘	Not a preferred device as dry basins provide a more efficient solution to required stormwater detention where quality treatment is not required given similar available land.
Ponds (wet)	✘	✘	Not considered an alternative due to temperature issues associated with the standing water. The standing water also presents a safety in design issue as a drowning risk. The devices are not supported by Mana Whenua.
Wetland	✓	✘	Not considered an alternative due to temperature issues associated with the standing water and the required mitigation to prevent this. The standing water also presents a safety in design issue as a drowning risk. In addition, quality treatment is not required so dry basins are a preferable alternative to provide detention only.
Dry basins	✓	✓	Preferred treatment device for Milldale going forward where quality treatment is not required and suitable land is available.
Underground rainwater tanks	✓	✓	Potential Secondary treatment device for Milldale where quality treatment is not required and suitable land for a dry basin is limited or not available.
Swales	✓	✓	Swales do not provide detention and as such are not appropriate for treatment in Stages10 to 13.
Detention swales	✓	✘	Detention swales are proposed on Wainui Road as part of the upgrade works on that project. They require significant width in the road cross-section and are not deemed appropriate for use in Stages 10 to 13.

Table 3 – Summary of Treatment Devices Considered

4. Stormwater Design Discussion

4.1. Natural Watercourses

Stages 10 to 13 discharges to several watercourses:

Stage 10:

- Watercourse 21 via piped stormwater reticulation network and dry basins.
- Watercourse 42 via piped stormwater reticulation network.
- Watercourse 43 via piped stormwater reticulation network.

Stage 11:

- Watercourse 21 via piped stormwater reticulation network and dry basins.
- Watercourse 35 via piped stormwater reticulation network.

Stage 12:

- Watercourse 21 via piped stormwater reticulation network and dry basins.
- Watercourse 26 via piped stormwater reticulation network.
- Unnamed Watercourse north of the Wainui Structure Plan extents via piped stormwater reticulation network and dry basins.

Stage 13:

- Watercourse 21 via piped stormwater reticulation network and dry basins.
- Watercourse 09 via piped stormwater reticulation network and dry basins bypass.
- Watercourse 26 via piped stormwater reticulation network.
- Watercourse 02 via piped stormwater reticulation network.

4.2. Private Lots

Stormwater runoff from private lots will need to be treated at source privately. This will likely be achieved with the use of tanks to store roof runoff, and permeable paving for hardstand areas.

Stormwater treatment details for private lots will be approved through the building consent process. For this application is it sufficient to assume runoff from lots will already have been treated in accordance with the WE-SMP prior to release to the public stormwater system.

4.3. Joint Owned Access Lots (JOAL)

Unlike the private lots, treatment for the Joint Owned Access Lots (JOAL) will need to be installed as part of the subdivision development works. A series of underground tanks are proposed to treat the JOALs. These tanks will be privately owned and operated by the JOAL owners. Details of these tanks will be provided at EPA stage.

A minimum orifice size of 10mm has been selected for the tanks to protect against blockage. Litter traps will be installed in the JOAL catchpits to protect the tank orifices from blockage.

4.4. Road Reserve Detention

As runoff from private land will be treated at source, public treatment devices are required to provide detention for the Road Reserve runoff only.

The detention requirements have been calculated on a catchment wide basis, with offset storage being utilised to treat difficult areas of the site not able to gravitate to the proposed devices. Accurate flow to the various devices will need to be calculated at EPA stage to ensure devices are sufficient to provide the required offset storage.

Detention requirements will be sized as agreed with Healthy Waters and in line with Section 1.3 above.

4.5. Stormwater Catchments

The stormwater drainage network in Stages 10 to 13 splits the stages into 13 stormwater catchments. Refer to drawings P24-128-00-3400-DR to 3403-DR which is included as part of Appendix A.

- Stage 10: Catchment to be Offset by Basins (discharged directly to stream)
    - Catchment Area – Road: 947 m^2
    - Required detention volume: 18.2 m^3

- Stage 10: Basin 3 Catchment (Consented under Stage 8 – BUN60430899)
    - Catchment Area – Road: 14,183 m^2, Stage 8: 3,996m^2 and Stage 10: 10,190m^2
    - Required detention volume: 272.5 m^3, Stage 8: 76.7m^3 and Stage 10: 195.7m^3
- Stage 10: Basin A Catchment
    - Catchment Area – Road: 10,190 m^2
    - Required detention volume: 195.7 m^3
- Stage 10: Basin B Catchment
    - Catchment Area – Road: 15,387 m^2
    - Required detention volume: 295.5 m^3
- Stage 11: Catchment to be Offset by Basins (discharged directly to stream)
    - Catchment Area – Road: 10,004 m^2
    - Required detention volume: 192.1 m^3
- Stage 11: Basin C Catchment
    - Catchment Area – Road: 4,004 m^2
    - Required detention volume: 76.9 m^3
- Stage 11: Basin D Catchment
    - Catchment Area – Road: 9,317 m^2
    - Required detention volume: 178.9 m^3
- Stage 11: Basin E Catchment
    - Catchment Area – Road: 10,204 m^2
    - Required detention volume: 196.0 m^3
- Stage 12 and 13: Catchment to be Offset by Basins (discharged directly to stream)
    - Catchment Area – Road: 13,753 m^2
    - Required detention volume: 264.1 m^3
- Stage 12: Basin F Catchment
    - Catchment Area – Road: 4,848 m^2
    - Required detention volume: 93.1 m^3
- Stage 12: Basin G Catchment
    - Catchment Area – Road: 2,844 m^2
    - Required detention volume: 54.6 m^3
- Stage 12: Basin J Catchment
    - Catchment Area – Road: 9,215 m^2
    - Required detention volume: 177.0 m^3
- Stage 13: Basin H Catchment
    - Catchment Area – Road: 55,939 m^2, Stage 7D: 13,862m^2 and Stage 10: 42,077m^2
    - Required detention volume: 1074.4 m^3, Stage 7D: 266.2m^3 and Stage 10: 808.13m^3

- Stage 13: Basin I Catchment
    - Catchment Area – Road: 55,556 m^2
    - Required detention volume: 1067.0 m^3

Stage 10, Basin 3 catchment has been allowed for in the Milldale Stage 8 consent, BUN60430899. At time of writing detention devices in Stage 8 are yet to be installed but will contain sufficient capacity for the detention volume for this catchment.

Stage 10, Basin H catchment allows for the Milldale Stage 7, consent BUN604425347, catchment that is serviced by the private temporary dry basin. Dry basin H will replace the private temporary dry basin.

4.6. Underground Tanks

Where there is not sufficient land available for rain gardens or dry basins, such as JOALs, underground tanks will be required for detention. Underground tanks are not proposed to be used as public devices in the development but will likely still be used for private lots and JOALs.

4.7. Dry Basins

Ten new dry basins are proposed to provide detention volume for Stages 10 to 13 road catchments.

These dry basins have been designed as broad shallow basins, with a peak water depth of 600mm, 650mm or 700mm and an allowance of 300mm depth freeboard.

To protect the dry basins, the water from upstream pipe networks will need to pass through a gross pollutant trap device prior to entering the basin, allowing contaminants in the flow to be filtered.

Most of the private lots discharge into the public network upstream of the proposed dry basins. The dry basins will to be designed to pass the private flows as well as the detention discharge flows. This is beneficial to the design as it helps to enable offset detention, it also allows larger orifice sizing which reduces the likelihood of blockages.

Because the basins are designed as an online device to the drainage network, the 10% AEP event will need to pass through the basin to the outlet device. Where possible a bypass system will also be utilised to attenuate the flow going to the dry basins. Standing water in the basin, and well-established planting will help to minimise erosion during large events by reducing water velocities. The outlet structures will be designed to provide sufficient flow through the device in these large events.

An outlet structure will need to be constructed in each basin and will consist of an orifice pipe and an overflow scruffy dome. Details of these structures will be provided at EPA stage.

When draining down, water above the 50mm level will flow through the orifice outlet directly, but water below the 50mm level water will be allowed to soak through the ground. This helps to keep leaves and other contaminants within the dry basin and not entering the orifice, but also provides an increased opportunity for retention through evapotranspiration and soakage.

Water velocities are expected to be low through the basins, especially as a basin drains, with a peak outlet flow rate controlled by the orifice. This will minimise the material sucked into the orifice as the water drains and the established plants will help to keep contaminants away from the outlet.

It is anticipated that the basins will not be lined and that they will be heavily planted to discourage public access. Plant species will be selected to withstand the intermittent wet conditions. A nominal 300mm of quality topsoil will be placed to line each basin, enabling planting.

These basins are proposed to be generally located within or adjacent to the drainage reserve and large storm events are anticipated to cause the adjacent stream to flood. The embankment levels around the basins are designed to stop the 1% AEP event from entering the basin from the watercourses.

5. Operations & Maintenance Requirements

The maintenance of the proposed stormwater systems will need to be considered as a key aspect of the design, ensuring that the design considers the full design life of the system. The below section discusses the expected required maintenance of the key aspects of the stormwater system.

5.1. Pipe Network

The proposed stormwater network will have a 100-year design life in accordance the Auckland Council Stormwater Code of Practice. Very little maintenance is expected to be required to the pipe network during this time.

The stormwater network will utilise sumps on the proposed catchpits and these will require regular cleaning to remove sediment build-up. It is anticipated that this be done twice per year, but may vary.

5.2. Dry Basins

The public dry basins are anticipated to be planted to discourage public access to the devices. Regular maintenance will be limited to the upkeep of the planting and weeding which is anticipated to be caried out four times per year. Part of the planting maintenance should include checks on the scruffy dome manhole to ensure build-up of plant matter is not causing a blockage risk.

Access to the dry basins is expected to be on foot via adjacent concrete shared paths and access tracks. It is not anticipated that machinery will be required as part of the maintenance protocols. 1 in 3 side batters enable accessible slopes for accessing by foot.

5.3. Rain Gardens

Rain gardens require some regular maintenance to ensure they continue to perform as stormwater management devices and as attractive landscape features.

Runoff flowing into rain gardens may carry litter and debris with it. Rubbish and debris should be removed regularly to keep the area from becoming unsightly.

Weeding of the facilities is not absolutely necessary for the proper functioning of the rain garden facility. However, unwanted plants can be invasive, consuming the intended planting and destroying the aesthetic appeal and biodiversity benefits of the rain garden. Therefore, weeding is encouraged to control growth of unwanted plants. Non-chemical methods (hand pulling and hoeing) are preferable.

Media replacement will be required approximately every 10 years. The volume of replacement will be dependent on the contaminant loading being captured by the rain garden and could vary from a skim of the top 50mm of media, through to full media replacement. It is expected that contaminant loadings will be low for the proposed rain gardens outside of the initial construction period.

During earthworks and construction works sediment laden runoff needs to be prevented from entering the stormwater network by utilising prescribed sediment and erosion control methods. Any sediment laden runoff entering a rain garden device can affect the soakage rate of the media mix and may cause replacement to be required. It is essential therefore, that filter socks remain over rain garden inlets until construction works within their catchment are complete and stabilised.

6. Proposed Treatment Devices

The below section outlines the proposed treatment devices for each catchment utilising the assessment of preferable devices from the previous sections of this document.

The total required detention for all road catchments is 4,156.1 m^3 and the detention volume provided by all dry basins is 4,164.2 m^3. This equates to a total surplus detention volume of 8.1 m^3 being provided for Stages 10 to 13.

6.1. Stage 10: Catchment to be Offset by Basins

The road network within the Stage 10: Catchment to be Offset by Basins requires a detention volume of 18.2 m^3.

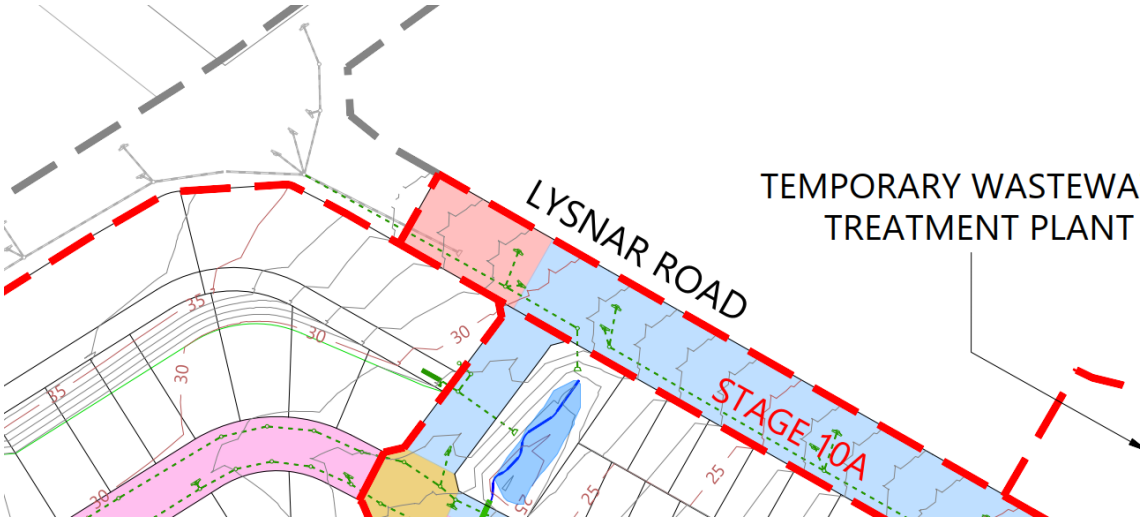

Image 1: Stage 10: Catchment to be Offset by Basins - Red

This small catchment on Lysnar Road abuts the Wainui Road Upgrades (BUN60393113) and connects this stormwater network to the discharge point to Watercourse 43. Detention requirements for this portion of road are offset by dry basins in other catchments.

6.2. Stage 10: Basin 3 Catchment (Consented under Stage 8)

The road network within the Stage 10: Catchment to be Offset by Basins requires a total detention volume of 272.5 m^3, this is 76.7m^3 from Stage 8 and 195.7m^3 from Stage 10.

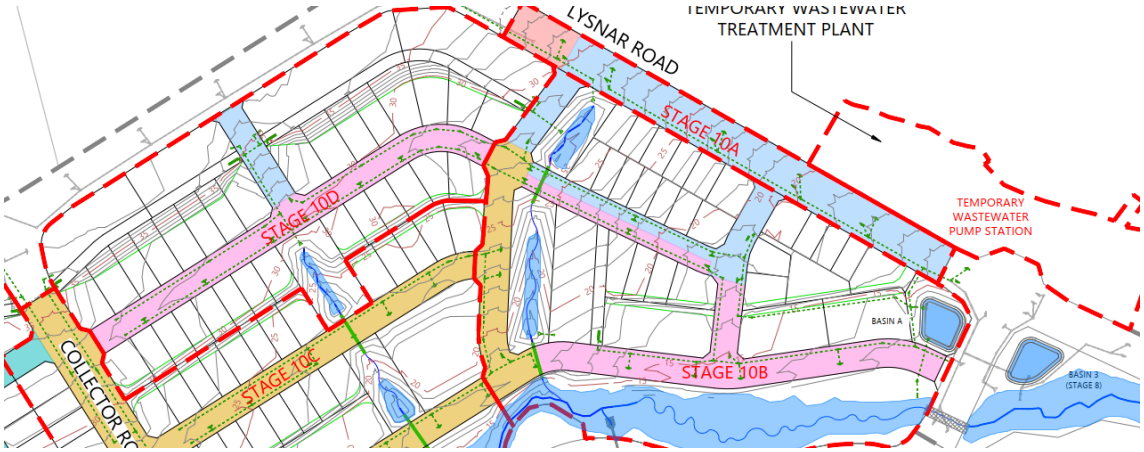

Image 2: Stage 10: Basin 3 Catchment (Consented Under Stage 8) - Pink

The Stage 8 Basin 3 was consented under BUN60430899 to include for a required storage of 248.4 m^3 for both Stage 8 and Stage 10, from Stage 8 reports, and is designed to have available storage of 272.6 m^3.

6.3. Stage 10: Basin A Catchment

The road network within the Stage 10: Basin A Catchment requires a detention volume of 195.7 m^3.

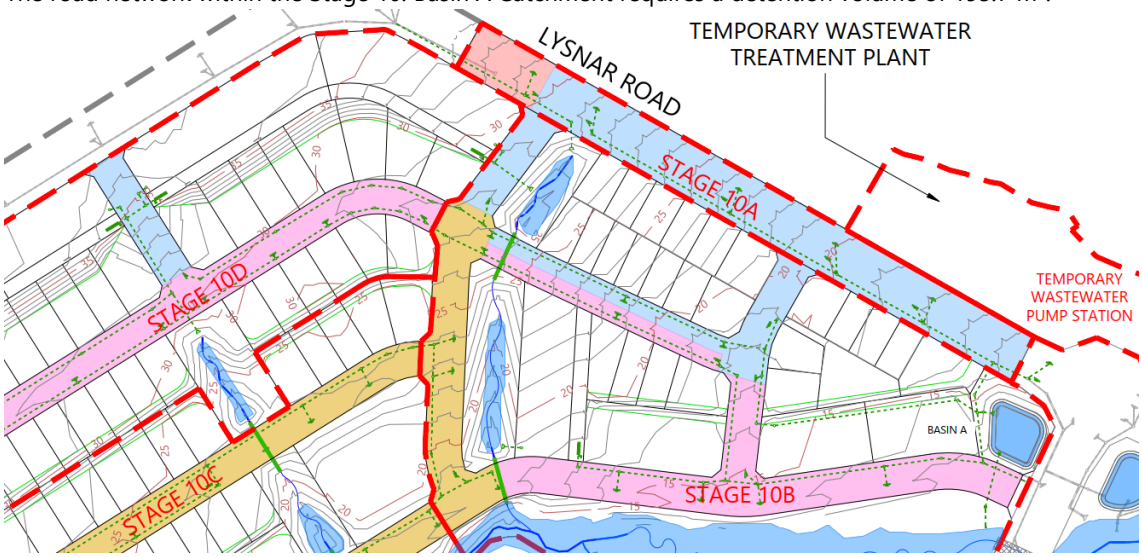

Image 3: Stage 10: Basin A Catchment - Blue

Dry basin A is proposed adjacent to the boundary with Stage 8, west of the Stage 8 roundabout on Lysnar Road. This dry basin outlets to Watercourse 21 and is proposed to provide up to 220.6 m^3 of storage. This provides for an additional storage of 24.9 m^3 which is used as offset storage for other catchments.

6.4. Stage 10: Basin B Catchment

The road network within the Stage 10: Basin B Catchment requires a detention volume of 295.5 m^3.

Image 4: Stage 10: Basin B Catchment - Brown

Dry basin B is proposed within the drainage reserve of Watercourse 21, located within the southern portion of Stage 10. This dry basin outlets to Watercourse 21 and is proposed to provide up to 197.1 m^3 of storage. This is a shortfall storage of 98.4 m^3 which is offset by other dry basins.

6.5. Stage 11: Catchment to be Offset by Basins

The road network within the Stage 11: Catchment to be Offset by Basins requires a detention volume of 192.1 m^3.

Image 5: Stage 11: Catchment to be Offset by Basins - Red

A large portion of the stream edge road within Stage 11, part of a local road and two walkway lots, are discharged directly to the watercourses. Detention requirements for this portion of Stage 11 are offset by dry basins in other catchments.

6.6. Stage 11: Basin C Catchment

The road network within the Stage 11: Basin C Catchment requires a detention volume of 76.9 m^3.

Image 6: Stage 11: Basin C Catchment - Green

Dry basin C is proposed within the drainage reserve of Watercourse 21, located within the eastern corner of Stage 11. This dry basin outlets to Watercourse 21 and is proposed to provide up to 55.6 m^3 of storage. This is a shortfall storage of 21.3 m^3 which is offset by other dry basins.

6.7. Stage 11: Basin D Catchment

The road network within the Stage 11: Basin D Catchment requires a detention volume of 178.9 m^3.

Image 7: Stage 11: Basin D Catchment - Yellow

Dry basin D is proposed directly east of the drainage reserve of Watercourse 35, located in the centre of Stage 11. This dry basin outlets to Watercourse 21 and is proposed to provide up to 236.6 m^3 of storage. This provides for an additional storage of 57.7 m^3 which is used as offset storage for other catchments.

6.8. Stage 11: Basin E Catchment

The road network within the Stage 11: Basin E Catchment requires a detention volume of 196.0 m^3.

Image 8: Stage 11: Basin E Catchment - Purple

Dry basin E is proposed directly east of the drainage reserve of Watercourse 35, located in the centre of Stage 11. This dry basin outlets to Watercourse 21 and is proposed to provide up to 223.2 m^3 of storage. This provides for an additional storage of 27.2 m^3 which is used as offset storage for other catchments.

6.9. Stage 12 and 13: Catchment to be Offset by Basins

The road network within the Stage 12 and 13: Catchment to be Offset by Basins requires a detention volume of 264.1 m^3.

Image 9: Stage 12: Catchment to be Offset by Basins – Orange

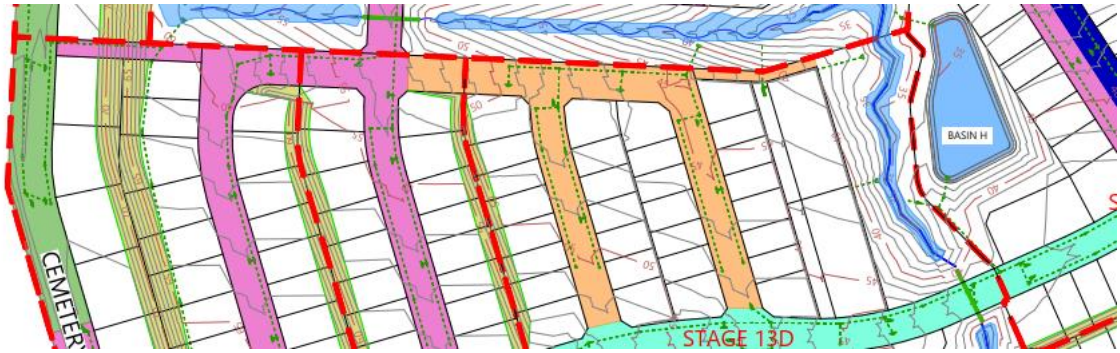

Image 10: Stage 13: Catchment to be Offset by Basins – Orange

The roads in the northern portion of Stage 12 and a small number of local roads and a walkway within Stage 13 are discharged directly to watercourses. Detention requirements for these portions of Stage 12 and 13 are offset by dry basins in other catchments.

6.10. Stage 12: Basin F Catchment

The road network within the Stage 12: Basin F Catchment requires a detention volume of 93.1 m^3.

Image 11: Stage 12: Basin F Catchment – Dark Green

Dry basin F is proposed directly north west of the intersection of Watercourse 21 and 26, located on the eastern side of Stage 12. This dry basin outlets to Watercourse 26 and is proposed to provide up to 109.8

m^3 of storage. This provides for an additional storage of 16.7 m^3 which is used as offset storage for other catchments.

6.11. Stage 12: Basin G Catchment

The road network within the Stage 12: Basin G Catchment requires a detention volume of 54.6 m^3. Basin G services a catchment located wholly within Stage 13.

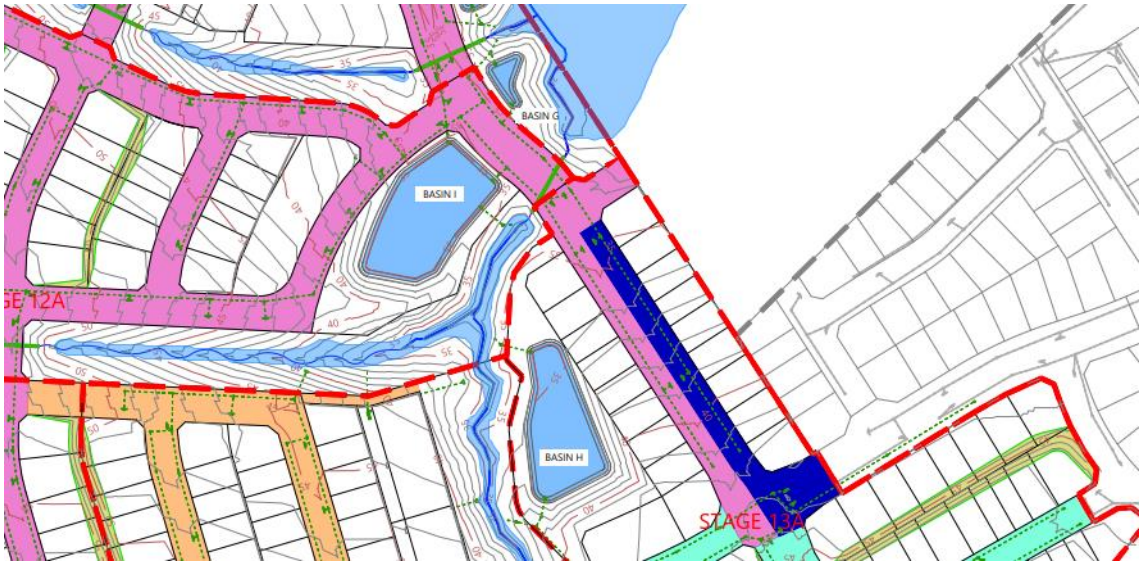

Image 12: Stage 12: Basin G Catchment – Dark Blue

Dry basin G is proposed directly south west of the intersection of Watercourse 21 and 26, located on the eastern side of Stage 12. This dry basin outlets to Watercourse 26 and is proposed to provide up to 80.4 m^3 of storage. This provides for an additional storage of 25.8 m^3 which is used as offset storage for other catchments.

6.12. Stage 12: Basin J Catchment

The road network within the Stage 12: Basin J Catchment requires a detention volume of 177.0 m^3. Basin J services a catchment located within both Stages 12 and 13. Basin J discharges to a watercourse north of the Wainui Structure Plan extents, this watercourse is north of the Cemetery Road Link.

Image 13: Stage 12: Basin J Catchment Stage 12 – Green

Image 14: Stage 12: Basin J Catchment Stages 12 and 13 – Green

Dry basin J is proposed on the north west side of the Cemetery Road Link. This dry basin outlets to a Watercourse north of the Wainui Precinct Plan Boundary and is proposed to provide up to 182.8 m^3 of storage. This provides for additional storage of 5.8 m^3, this excess storage is not used to offset other catchments.

6.13. Stage 13: Basin H Catchment

The road network within the Stage 13: Basin H Catchment requires a detention volume of 1074.4 m^3.

Image 15: Stage 13: Basin H Catchment – Cyan

Dry basin H is proposed east of Watercourse 9, located on the northern side of Stage 13. This dry basin outlets to Watercourse 9 and is proposed to provide up to 1039.8 m^3 of storage. This is a shortfall storage of 34.6 m^3 which is offset by other dry basins.

6.14. Stage 12: Basin I Catchment

The road network within the Stage 12: Basin I Catchment requires a detention volume of 1067.0 m^3. Basin I services a catchment located within both Stages 12 and 13.

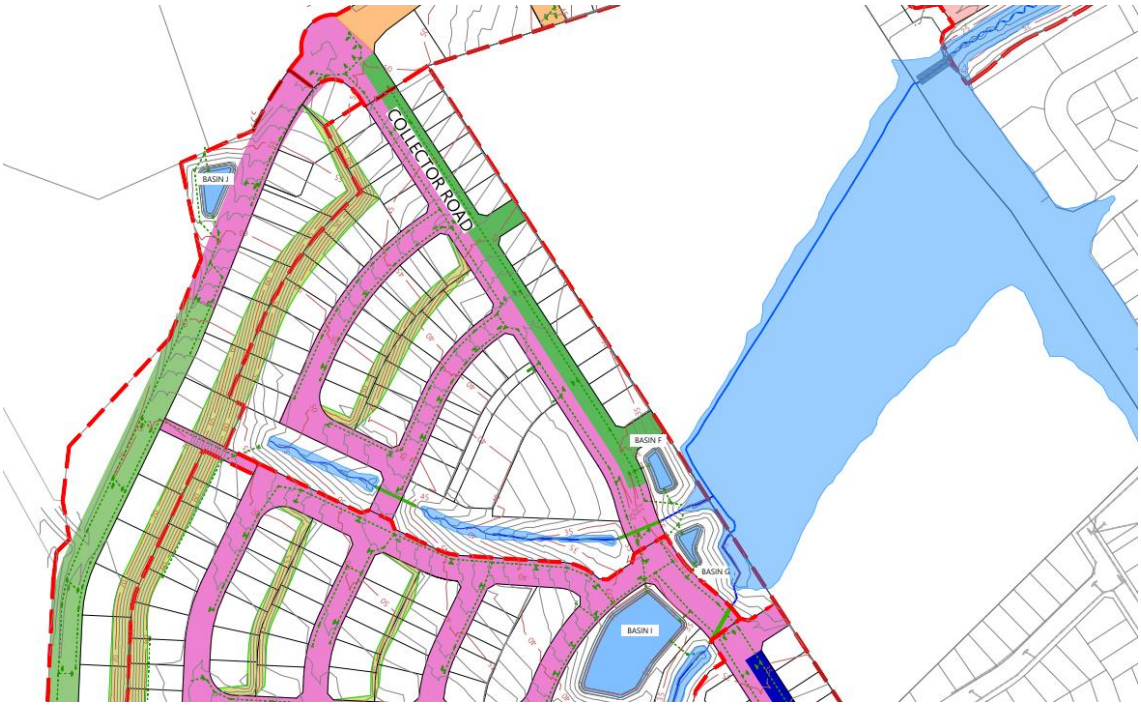

Image 16: Stage 12: Basin I Catchment Stage 12 – Dark Pink

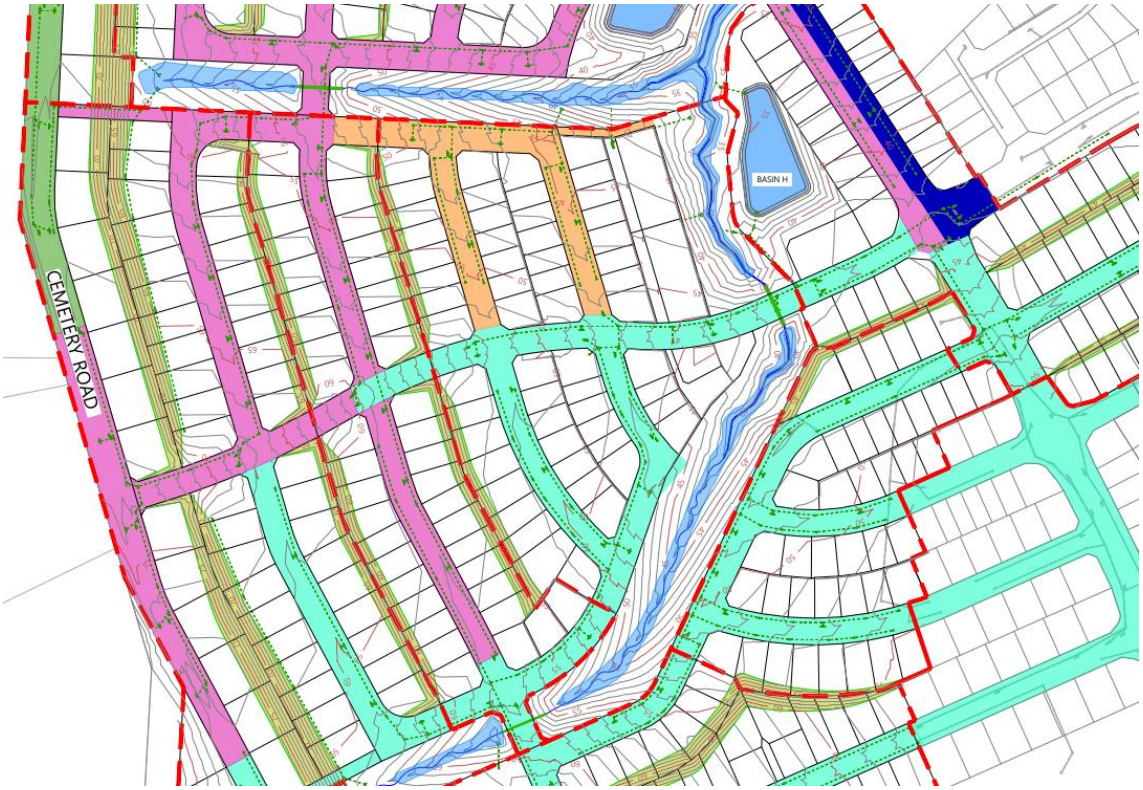

Image 17: Stage 13: Basin I Catchment Stages 12 and 13 – Dark Pink

Dry basin I is proposed north of the intersection of Watercourse 21 and 9, located on the south eastern side of Stage 12. This dry basin outlets to Watercourse 21 and is proposed to provide up to 1539.7 m^3 of storage. This provides for an additional storage of 472.7 m^3 which is used as offset storage for most other catchments.

7. Conclusion

The proposed treatment devices will meet the requirements of the WE-SMP and this will be confirmed with detailed design at the EPA stage.

The proposed design responds to the constraints and goals of the developer and takes onboard the advice from Auckland Transport and Healthy Waters from previous stages.

Appendix A: Drawings (bound separately)

Appendix B: Basin Catchment Calculations

MILLDALE FAST TRACK STAGES 10 TO 13
STORMWATER DETENTION VOLUMES SUMMARY

MW rev 1
24/07/2025
P24-128 Reviewer: BLO

BASIN SUMMARY TABLE	SUMMARISED DETENTION FOR WATERCOURSE 21 FROM UPSTREAM TO DOWNSTREAM				
	Required Detention Volume (m3)	External Stage Required Detention Volume (m3)	Total Required Detention Volume (m3)	Design Detention Volume (m3)	Surplus (+)/Deficit (-) Detention Volume (m3)
BASIN H (STAGE 13)	808.1	266.2	1074.4	1039.8	-34.6
BASIN I (STAGE 12)	1067.0		1067.0	1539.7	472.7
BASIN G (STAGE 12)	54.6		54.6	80.4	25.8
BASIN F (STAGE 12)	93.1		93.1	109.8	16.7
OFFSET CATCHMENT (STAGE 12/13)	264.1		264.1	0.0	-264.1
BASIN E (STAGE 11)	196.0		196.0	223.2	27.2
BASIN D (STAGE 11)	178.9		178.9	242.5	63.5
BASIN C (STAGE 11)	76.9		76.9	55.6	-21.3
OFFSET CATCHMENT (STAGE 11)	192.1		192.1	0.0	-192.1
BASIN B (STAGE 10)	295.5		295.5	197.1	-98.4
BASIN A (STAGE 10)	195.7		195.7	220.6	24.9
OFFSET CATCHMENT (STAGE 10)	18.2		18.2	0.0	-18.2
BASIN 3 (STAGE 10) (LOCATED IN S8)	195.7	76.7	272.5	272.6	0.2
TOTAL	**3636.1**	**343.0**	**3979.1**	**3981.4**	**2.3**
					Surplus Volume (m3)

*Assuming 80% Impervious Road Catchments
Including Roads, Pedestrian Accessway

BASIN SUMMARY TABLE	SUMMARISED DETENTION FOR MILLDALE NORTH STREAM FROM CEMETERY RD				
	Required Detention Volume (m3)	External Stage Required Detention Volume (m3)	Total Required Detention Volume (m3)	Design Detention Volume (m3)	Surplus (+)/Deficit (-) Detention Volume (m3)
BASIN J (STAGE 12)	177.0		177.0	182.8	**5.8**
					Surplus Volume (m3)

*Assuming 80% Impervious Road Catchments
Including Roads, Pedestrian Accessway

Required Detention Volume Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 10
BY: MW
DATE: 24/07/2025
DEVICE NO: Offset Catchment (Stage 10)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	947	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	757.6	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	757.6	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		1.599640481
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	24586.6	6398.6	32.5	8.4	7998.2

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	18188.1	L	24.0	L	-18188.1	L	0.0	l
Release rate over 24hrs (L/S)	**0.21**	L/s	**0.00**	L/s	**-0.21**	L/s	**1.89**	l/s

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 10
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin 3 (Stage 8)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	14186	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	11348.8	m2	1	m2

Stage 10 Rd	10190
Stage 8 Rd	3996
Total Road	14186

Retention Volume

Retention depth 0 mm
Impervious Area 11348.8 m2
Retention volume required 0 l

Detention volume

Detention depth 37 mm (95th percentile storm)
TP-108 "CN" Values
Impermeable Surface: 98 23.96251306
Permeable Surface: 74

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	368306.2	95850.1	32.5	8.4	119812.6

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	272456.1	L	24.0	L	153.9	L	272610.0	l
Release rate over 24hrs (L/S)	**3.15**	L/s	**0.00**	L/s	**0.00**	L/s	**2.90**	l/s
Peak Release rate (No treatment) (L/s)	17.98		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	1.92	41513.2	2.9	62584.3	0.0
180	0.74	1.14	4.18	45176.1	3.0	31292.1	13886.9
60	0.96	1.48	5.43	19535.6	1.0	10430.7	22992.8
60	1.4	2.16	7.91	28489.4	1.0	10430.7	41052.5
30	2.2	3.39	12.44	22384.5	0.5	5215.4	58222.2
10	3.8	5.86	21.48	12888.1	0.2	1738.5	69372.0
10	4.8	7.40	27.13	16279.7	0.2	1738.5	83913.4
10	8.7	13.41	49.18	29506.9	0.2	1738.5	111682.0
10	16.2	24.98	91.57	54943.9	0.2	1738.5	164887.6
10	5.9	9.10	33.35	20010.4	0.2	1738.5	183159.7
10	4.2	6.48	23.74	14244.7	0.2	1738.5	195666.2
30	2.9	4.47	16.39	29506.9	0.5	5215.4	219958.2
60	1.7	2.62	9.61	34594.3	1.0	10430.7	244122.8
60	1.2	1.85	6.78	24419.5	1.0	10430.7	258112.6
180	0.75	1.16	4.24	45786.6	3.0	31292.1	272610.0
360	0.4	0.62	2.26	48839.0	3.4	62584.3	258868.2
		Peak Q	91.57				
			Total flow	488118.7	18.4	250337.2	
						Peak Storage volume	272610.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	2.90	
$A_{ORIFICE}$:	1218.64	m2
$D_{ORIFICE}$:	39	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 10
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin A (Stage 10)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	10190	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	8152	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	8152	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		17.21260455
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	264559.4	68850.4	32.5	8.4	86063.0

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	195709.0	L	24.0	L	24935.0	L	220644.0	l
Release rate over 24hrs (L/S)	**2.27**	L/s	**0.00**	L/s	**0.29**	L/s	**1.55**	l/s
Peak Release rate (No treatment) (L/s)	12.92		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	1.38	29819.5	2.9	33391.5	0.0
180	0.74	1.14	3.00	32450.6	3.0	16695.7	15757.9
60	0.96	1.48	3.90	14032.7	1.0	5565.2	24226.3
60	1.4	2.16	5.68	20464.3	1.0	5565.2	39126.4
30	2.2	3.39	8.93	16079.1	0.5	2782.6	52423.4
10	3.8	5.86	15.43	9257.7	0.2	927.5	60753.7
10	4.8	7.40	19.49	11693.9	0.2	927.5	71520.3
10	8.7	13.41	35.33	21195.2	0.2	927.5	91788.1
10	16.2	24.98	65.78	39467.0	0.2	927.5	130327.7
10	5.9	9.10	23.96	14373.8	0.2	927.5	143774.1
10	4.2	6.48	17.05	10232.2	0.2	927.5	153078.9
30	2.9	4.47	11.78	21195.2	0.5	2782.6	171492.0
60	1.7	2.62	6.90	24849.6	1.0	5565.2	190777.3
60	1.2	1.85	4.87	17540.9	1.0	5565.2	202753.9
180	0.75	1.16	3.05	32889.1	3.0	16695.7	218950.3
360	0.4	0.62	1.62	35081.7	3.4	33391.5	220644.0
		Peak Q	65.78				
			Total flow	350622.4	18.4	133565.9	
						Peak Storage volume	220644.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	1.55	
$A_{ORIFICE}$:	650.20	m2
$D_{ORIFICE}$:	29	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER:	P24-128
ADDRESS:	Milldale Stage 10
BY:	MW
DATE:	24/07/2025
DEVICE NO:	Dry Basin B (Stage 10)

DESIGN RAINFALL

RAINFALL EVENT:	95%AEP, 24hr	
RAINFALL DEPTH:	37	mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	15387	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	12309.6	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	12309.6	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		25.99120178
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	399487.3	103964.8	32.5	8.4	129956.0

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	295522.5	L	24.0	L	-98383.5	L	197139.0	l
Release rate over 24hrs (L/S)	**3.42**	L/s	**0.00**	L/s	**-1.14**	L/s	**6.36**	l/s
Peak Release rate (No treatment) (L/s)	19.50		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	2.08	45027.7	2.9	137345.7	0.0
180	0.74	1.14	4.54	49000.7	3.0	68672.8	0.0
60	0.96	1.48	5.89	21189.5	1.0	22890.9	0.0
60	1.4	2.16	8.58	30901.4	1.0	22890.9	8011.4
30	2.2	3.39	13.49	24279.6	0.5	11445.5	20846.1
10	3.8	5.86	23.30	13979.2	0.2	3815.2	31010.3
10	4.8	7.40	29.43	17657.9	0.2	3815.2	44853.2
10	8.7	13.41	53.34	32005.0	0.2	3815.2	73043.2
10	16.2	24.98	99.33	59595.5	0.2	3815.2	128823.7
10	5.9	9.10	36.17	21704.5	0.2	3815.2	146713.2
10	4.2	6.48	25.75	15450.7	0.2	3815.2	158348.9
30	2.9	4.47	17.78	32005.0	0.5	11445.5	178908.9
60	1.7	2.62	10.42	37523.1	1.0	22890.9	193542.1
60	1.2	1.85	7.36	26486.9	1.0	22890.9	197139.0
180	0.75	1.16	4.60	49662.9	3.0	68672.8	178132.1
360	0.4	0.62	2.45	52973.8	3.4	137345.7	93763.6
		Peak Q	99.33				
			Total flow	529443.3	18.4	549382.7	
						Peak Storage volume	197139.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	6.36	
$A_{ORIFICE}$:	2674.39	m2
$D_{ORIFICE}$:	58	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 11
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin C (Stage 11)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	4004	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	3203.2	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	3203.2	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		6.763421846
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	103954.5	27053.7	32.5	8.4	33817.1

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	76900.8	L	24.0	L	-21304.8	L	55596.0	l
Release rate over 24hrs (L/S)	**0.89**	L/s	**0.00**	L/s	**-0.25**	L/s	**1.44**	l/s
Peak Release rate (No treatment) (L/s)	5.08		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	0.54	11717.1	2.9	31005.4	0.0
180	0.74	1.14	1.18	12751.0	3.0	15502.7	0.0
60	0.96	1.48	1.53	5513.9	1.0	5167.6	347.4
60	1.4	2.16	2.23	8041.1	1.0	5167.6	3221.9
30	2.2	3.39	3.51	6318.0	0.5	2583.8	6956.7
10	3.8	5.86	6.06	3637.7	0.2	861.3	9733.2
10	4.8	7.40	7.66	4594.9	0.2	861.3	13467.1
10	8.7	13.41	13.88	8328.3	0.2	861.3	20934.3
10	16.2	24.98	25.85	15507.9	0.2	861.3	35581.1
10	5.9	9.10	9.41	5647.9	0.2	861.3	40368.0
10	4.2	6.48	6.70	4020.6	0.2	861.3	43527.5
30	2.9	4.47	4.63	8328.3	0.5	2583.8	49272.5
60	1.7	2.62	2.71	9764.2	1.0	5167.6	53870.2
60	1.2	1.85	1.91	6892.4	1.0	5167.6	55596.0
180	0.75	1.16	1.20	12923.3	3.0	15502.7	53019.5
360	0.4	0.62	0.64	13784.8	3.4	31005.4	35802.4
		Peak Q	25.85				
			Total flow	137771.6	18.4	124021.8	
						Peak Storage volume	55596.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	1.44	
$A_{ORIFICE}$:	603.74	m2
$D_{ORIFICE}$:	28	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 11
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin D (Stage 11)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	9317	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	7453.6	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	7453.6	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		15.73796237
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	241894.0	62951.8	32.5	8.4	78689.8

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	178942.2	L	24.0	L	63518.8	L	242461.0	l
Release rate over 24hrs (L/S)	**2.07**	L/s	**0.00**	L/s	**0.74**	L/s	**0.90**	l/s
Peak Release rate (No treatment) (L/s)	11.81		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	1.26	27264.8	2.9	19535.3	7732.4
180	0.74	1.14	2.75	29670.5	3.0	9767.7	27638.2
60	0.96	1.48	3.56	12830.5	1.0	3255.9	37213.8
60	1.4	2.16	5.20	18711.1	1.0	3255.9	52670.1
30	2.2	3.39	8.17	14701.6	0.5	1627.9	65744.2
10	3.8	5.86	14.11	8464.6	0.2	542.6	73666.3
10	4.8	7.40	17.82	10692.1	0.2	542.6	83815.9
10	8.7	13.41	32.30	19379.4	0.2	542.6	102652.8
10	16.2	24.98	60.14	36085.7	0.2	542.6	138196.0
10	5.9	9.10	21.90	13142.3	0.2	542.6	150795.9
10	4.2	6.48	15.59	9355.6	0.2	542.6	159609.0
30	2.9	4.47	10.77	19379.4	0.5	1627.9	177360.9
60	1.7	2.62	6.31	22720.6	1.0	3255.9	196826.6
60	1.2	1.85	4.46	16038.1	1.0	3255.9	209609.9
180	0.75	1.16	2.78	30071.4	3.0	9767.7	229916.7
360	0.4	0.62	1.49	32076.2	3.4	19535.3	242461.0
		Peak Q	60.14				
			Total flow	320583.8	18.4	78141.2	
						Peak Storage volume	242461.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	0.90	
$A_{ORIFICE}$:	380.39	m2
$D_{ORIFICE}$:	22	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 11
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin E (Stage 11)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	10204	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	8163.2	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	8163.2	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		17.23625288
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	264922.9	68945.0	32.5	8.4	86181.3

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	195977.9	L	24.0	L	27199.1	L	223177.0	l
Release rate over 24hrs (L/S)	**2.27**	L/s	**0.00**	L/s	**0.31**	L/s	**1.51**	l/s
Peak Release rate (No treatment) (L/s)	12.93		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	1.38	29860.4	2.9	32694.1	0.0
180	0.74	1.14	3.01	32495.2	3.0	16347.0	16151.2
60	0.96	1.48	3.90	14052.0	1.0	5449.0	24755.1
60	1.4	2.16	5.69	20492.5	1.0	5449.0	39799.6
30	2.2	3.39	8.95	16101.2	0.5	2724.5	53176.8
10	3.8	5.86	15.45	9270.4	0.2	908.2	61539.2
10	4.8	7.40	19.52	11710.0	0.2	908.2	72341.2
10	8.7	13.41	35.37	21224.3	0.2	908.2	92657.5
10	16.2	24.98	65.87	39521.2	0.2	908.2	131270.7
10	5.9	9.10	23.99	14393.5	0.2	908.2	144756.2
10	4.2	6.48	17.08	10246.2	0.2	908.2	154094.4
30	2.9	4.47	11.79	21224.3	0.5	2724.5	172594.7
60	1.7	2.62	6.91	24883.7	1.0	5449.0	192030.4
60	1.2	1.85	4.88	17565.0	1.0	5449.0	204147.4
180	0.75	1.16	3.05	32934.3	3.0	16347.0	220737.7
360	0.4	0.62	1.63	35129.9	3.4	32694.1	223177.0
		Peak Q	65.87				
			Total flow	351104.2	18.4	130776.2	
						Peak Storage volume	223177.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	1.51	
$A_{ORIFICE}$:	636.62	m2
$D_{ORIFICE}$:	29	mm

Required Detention Volume Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 11
BY: MW
DATE: 24/07/2025
DEVICE NO: Offset Catchment (Stage 11)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	10004	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	8003.2	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	8003.2	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		16.89841962
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	259730.4	67593.7	32.5	8.4	84492.1

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	192136.7	L	24.0	L	-192136.7	L	0.0	l
Release rate over 24hrs (L/S)	**2.22**	L/s	**0.00**	L/s	**-2.22**	L/s	**1.89**	l/s

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 12
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin F (Stage 12)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	4848	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	3878.4	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	3878.4	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		8.189078199
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	125866.9	32756.3	32.5	8.4	40945.4

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	93110.6	L	24.0	L	16731.4	L	109842.0	l
Release rate over 24hrs (L/S)	**1.08**	L/s	**0.00**	L/s	**0.19**	L/s	**0.66**	l/s
Peak Release rate (No treatment) (L/s)	6.15		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	0.66	14186.9	2.9	14266.3	0.0
180	0.74	1.14	1.43	15438.7	3.0	7133.1	8308.6
60	0.96	1.48	1.85	6676.2	1.0	2377.7	12608.1
60	1.4	2.16	2.70	9736.1	1.0	2377.7	19967.5
30	2.2	3.39	4.25	7649.8	0.5	1188.9	26428.9
10	3.8	5.86	7.34	4404.4	0.2	396.3	30437.3
10	4.8	7.40	9.27	5563.5	0.2	396.3	35604.6
10	8.7	13.41	16.81	10083.8	0.2	396.3	45292.4
10	16.2	24.98	31.29	18776.8	0.2	396.3	63673.1
10	5.9	9.10	11.40	6838.5	0.2	396.3	70115.4
10	4.2	6.48	8.11	4868.1	0.2	396.3	74587.4
30	2.9	4.47	5.60	10083.8	0.5	1188.9	83482.9
60	1.7	2.62	3.28	11822.4	1.0	2377.7	92928.6
60	1.2	1.85	2.32	8345.3	1.0	2377.7	98897.1
180	0.75	1.16	1.45	15647.3	3.0	7133.1	107414.3
360	0.4	0.62	0.77	16690.5	3.4	14266.3	109842.0
		Peak Q	31.29				
			Total flow	166812.3	18.4	57065.1	
						Peak Storage volume	109842.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	0.66	
$A_{ORIFICE}$:	277.79	m2
$D_{ORIFICE}$:	19	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 12
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin G (Stage 12)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	2844	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	2275.2	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	2275.2	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		4.803988943
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	73837.8	19216.0	32.5	8.4	24019.9

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	54621.8	L	24.0	L	25771.2	L	80393.0	l
Release rate over 24hrs (L/S)	**0.63**	L/s	**0.00**	L/s	**0.30**	L/s	**0.20**	l/s
Peak Release rate (No treatment) (L/s)	3.60		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	0.39	8322.5	2.9	4370.8	3954.7
180	0.74	1.14	0.84	9056.9	3.0	2185.4	10829.2
60	0.96	1.48	1.09	3916.5	1.0	728.5	14018.2
60	1.4	2.16	1.59	5711.5	1.0	728.5	19002.3
30	2.2	3.39	2.49	4487.6	0.5	364.2	23126.2
10	3.8	5.86	4.31	2583.8	0.2	121.4	25588.7
10	4.8	7.40	5.44	3263.7	0.2	121.4	28731.2
10	8.7	13.41	9.86	5915.5	0.2	121.4	34525.5
10	16.2	24.98	18.36	11015.1	0.2	121.4	45419.4
10	5.9	9.10	6.69	4011.7	0.2	121.4	49309.8
10	4.2	6.48	4.76	2855.8	0.2	121.4	52044.3
30	2.9	4.47	3.29	5915.5	0.5	364.2	57596.1
60	1.7	2.62	1.93	6935.4	1.0	728.5	63804.1
60	1.2	1.85	1.36	4895.6	1.0	728.5	67972.2
180	0.75	1.16	0.85	9179.3	3.0	2185.4	74969.1
360	0.4	0.62	0.45	9791.2	3.4	4370.8	80393.0
		Peak Q	18.36				
			Total flow	97857.7	18.4	17483.1	
						Peak Storage volume	80393.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	0.20	
$A_{ORIFICE}$:	85.11	m2
$D_{ORIFICE}$:	10	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 13
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin H (Stage 13)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	55939	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	44751.2	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	44751.2	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		94.49027338
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	1452324.7	377961.1	32.5	8.4	472451.4

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	1074363.7	L	24.0	L	-323692.7	L	1039789.8	l
Release rate over 24hrs (L/S)	**12.43**	L/s	**0.00**	L/s	**-3.75**	L/s	**12.24**	l/s
Peak Release rate (No treatment) (L/s)	70.91		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	7.58	163696.9	2.9	264358.4	0.0
180	0.74	1.14	16.49	178140.8	3.0	132179.2	45964.6
60	0.96	1.48	21.40	77033.8	1.0	44059.7	78939.7
60	1.4	2.16	31.21	112341.0	1.0	44059.7	147221.9
30	2.2	3.39	49.04	88267.9	0.5	22029.9	213460.5
10	3.8	5.86	84.70	50820.9	0.2	7343.3	256938.3
10	4.8	7.40	106.99	64194.9	0.2	7343.3	313790.1
10	8.7	13.41	193.92	116353.2	0.2	7343.3	422800.2
10	16.2	24.98	361.10	216657.7	0.2	7343.3	632114.7
10	5.9	9.10	131.51	78906.2	0.2	7343.3	703677.8
10	4.2	6.48	93.62	56170.5	0.2	7343.3	752505.2
30	2.9	4.47	64.64	116353.2	0.5	22029.9	846829.0
60	1.7	2.62	37.89	136414.1	1.0	44059.7	939184.4
60	1.2	1.85	26.75	96292.3	1.0	44059.7	991417.9
180	0.75	1.16	16.72	180548.1	3.0	132179.2	1039789.8
360	0.4	0.62	8.92	192584.6	3.4	264358.4	968019.4
		Peak Q	361.10				
			Total flow	1924776.1	18.4	1057433.6	
						Peak Storage volume	1039789.8

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.65	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.33	m
VELOCITY (m/s):	2.47	
Discharge rate (L/s):	12.24	
$A_{ORIFICE}$:	4945.64	m2
$D_{ORIFICE}$:	79	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER:	P24-128
ADDRESS:	Milldale Stage 12
BY:	MW
DATE:	24/07/2025
DEVICE NO:	Dry Basin I (Stage 12)

DESIGN RAINFALL

RAINFALL EVENT:	95%AEP, 24hr	
RAINFALL DEPTH:	37	mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	55556	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	44444.8	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	44444.8	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		93.84332269
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	1442381.0	375373.3	32.5	8.4	469216.6

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	1067007.8	L	24.0	L	142339.2	L	1539705.2	l
Release rate over 24hrs (L/S)	**12.35**	L/s	**0.00**	L/s	**1.65**	L/s	**4.30**	l/s
Peak Release rate (No treatment) (L/s)	70.42		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	7.53	162576.1	2.9	92977.7	69601.3
180	0.74	1.14	16.38	176921.1	3.0	46488.9	200036.6
60	0.96	1.48	21.25	76506.4	1.0	15496.3	261047.7
60	1.4	2.16	30.99	111571.8	1.0	15496.3	357124.3
30	2.2	3.39	48.70	87663.6	0.5	7748.1	437040.2
10	3.8	5.86	84.12	50473.0	0.2	2582.7	484930.6
10	4.8	7.40	106.26	63755.3	0.2	2582.7	546103.4
10	8.7	13.41	192.59	115556.6	0.2	2582.7	659077.4
10	16.2	24.98	358.62	215174.3	0.2	2582.7	871669.2
10	5.9	9.10	130.61	78365.9	0.2	2582.7	947452.6
10	4.2	6.48	92.98	55785.9	0.2	2582.7	1000655.9
30	2.9	4.47	64.20	115556.6	0.5	7748.1	1108464.9
60	1.7	2.62	37.63	135480.1	1.0	15496.3	1228449.7
60	1.2	1.85	26.56	95633.0	1.0	15496.3	1308587.4
180	0.75	1.16	16.60	179311.9	3.0	46488.9	1441413.5
360	0.4	0.62	8.85	191266.0	3.4	92977.7	1539705.2
		Peak Q	358.62				
			Total flow	1911597.7	18.4	371910.8	
						Peak Storage volume	1539705.2

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.70	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.35	m
VELOCITY (m/s):	2.57	
Discharge rate (L/s):	4.30	
$A_{ORIFICE}$:	1676.16	m2
$D_{ORIFICE}$:	46	mm

Dry Basin Sizing Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 12
BY: MW
DATE: 24/07/2025
DEVICE NO: Dry Basin I (Stage 12)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	9215	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	7372	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	7372	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		15.56566741
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	239245.8	62262.7	32.5	8.4	77828.3

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	176983.2	L	24.0	L	5831.8	L	182815.0	l
Release rate over 24hrs (L/S)	**2.05**	L/s	**0.00**	L/s	**0.07**	L/s	**1.75**	l/s
Peak Release rate (No treatment) (L/s)	11.68		0.00					

CATCHMENT RATIONAL "C" VALUE: 0.93 Note: Rational formula adjusted to match TP108 calc

FLOW CALCS

TIME (min)	Normalised Intensity (TP108)	Intensity mm/h	Inflow (Total) (l/s)	Inflow for period - Roads (L)	Inflow for period - Lots (L)	Potentual allowable Outflow (L)	Storage required (L)
360	0.34	0.52	1.25	26966.3	2.9	37789.9	0.0
180	0.74	1.14	2.72	29345.7	3.0	18895.0	10453.7
60	0.96	1.48	3.53	12690.0	1.0	6298.3	16846.4
60	1.4	2.16	5.14	18506.3	1.0	6298.3	29055.4
30	2.2	3.39	8.08	14540.6	0.5	3149.2	40447.3
10	3.8	5.86	13.95	8371.9	0.2	1049.7	47769.7
10	4.8	7.40	17.63	10575.0	0.2	1049.7	57295.1
10	8.7	13.41	31.95	19167.2	0.2	1049.7	75412.8
10	16.2	24.98	59.48	35690.7	0.2	1049.7	110053.9
10	5.9	9.10	21.66	12998.5	0.2	1049.7	122002.8
10	4.2	6.48	15.42	9253.1	0.2	1049.7	130206.4
30	2.9	4.47	10.65	19167.2	0.5	3149.2	146224.9
60	1.7	2.62	6.24	22471.9	1.0	6298.3	162399.5
60	1.2	1.85	4.41	15862.5	1.0	6298.3	171964.7
180	0.75	1.16	2.75	29742.2	3.0	18895.0	182815.0
360	0.4	0.62	1.47	31725.0	3.4	37789.9	176753.6
		Peak Q	59.48				
			Total flow	317074.2	18.4	151159.7	
						Peak Storage volume	182815.0

ORIFICE CALCULATIONS

$H_{PEAK\ (PEAK\ ORIFICE\ HEAD)}$:	0.60	m
$H_{Ave\ (AVERAGE\ ORIFICE\ HEAD)}$:	0.30	m
VELOCITY (m/s):	2.38	
Discharge rate (L/s):	1.75	
$A_{ORIFICE}$:	735.84	m2
$D_{ORIFICE}$:	31	mm

Required Detention Volume Spreadsheet - SMAF

PROJECT NUMBER: P24-128
ADDRESS: Milldale Stage 12/13
BY: MW
DATE: 24/07/2025
DEVICE NO: Offset Catchments (Stage 12/13)

DESIGN RAINFALL

RAINFALL EVENT: 95%AEP, 24hr
RAINFALL DEPTH: 37 mm

POST-DEVELOPMENT-CAPTURED FLOW CALCS

	Roads		Lots flowing to basin	
CATCHMENT AREA:	13753	m2	1	m2
% IMPERVIOUSNESS	80%		100%	
Impervious Area	11002.4	m2	1	m2

Retention Volume

Retention depth	0	mm
Impervious Area	11002.4	m2
Retention volume required	0	l

Detention volume

Detention depth	37	mm	(95th percentile storm)
TP-108 "CN" Values			
Impermeable Surface:	98		23.23110406
Permeable Surface:	74		

Catchment TP-108 flow calcs

	Post Development - Roads Impermeable	Pre Development - Roads	Post Development - Lots flowing to basin	Pre Development - Lots flowing to basin	Post Development - Road Berms
CN	98.00	74	98.00	74	74.00
Ia	0.00	5.00	0.00	5.00	5.00
Catchment soil storage	5.18	89.24	5.18	89.24	89.24
Catchment runoff depth	32.45	8.45	32.45	8.45	8.45
Catchment runoff volume (l/day)	357064.3	92924.4	32.5	8.4	116155.5

	Roads		Lots (treated seperately onsite)		Additional Offset Storage Provided		Target Basin Peak Storage	
Required Storage Volume	264139.9	L	24.0	L	-264139.9	L	0.0	l
Release rate over 24hrs (L/S)	**3.06**	L/s	**0.00**	L/s	**-3.06**	L/s	**1.89**	l/s

Appendix C: Basin Safety in Design

Safety In Design - Risk Register

Name:	**Basins and Outlets**
Project name:	**Milldale Civil Stages 10 to 13**
Date:	**27/01/2025**

JOB #	**P24-128**

Project Description

Communal Stormwater Device risk register to accompany the Operation and Maintenance Manuals

	IDENTIFIED SAFETY RISK						TREATMENT PLAN	RESIDUAL RISK				
				Pre-Treatment				Post-treatment				
Risk ID	**Risk Title**	**Risk description**	**Status**	**Likelyhood**	**Consequence**	**Risk rating**	**1. Eliminate, 2. Substitution 3. Isolation 4. Engineering Control 5. Administrative Control 6. Personal Protective Equipment**	**Likelyhood**	**Consequence**	**Risk rating**	**Residual controls**	**Notes**
1. CONSTRUCTION												
1.01	Falls - Batter Slopes	Rolling construction plant, workers slipping.	Open	Possible	Moderate	**Medium**	Slopes designed at 1:3 maximum to minimise the risk of falls	Unlikely	Minor	**Low**	Construction monitoring, ensuring soil strength is adequate for walls and that it has been accounted for in the design. Ensuring safety education on site for workers near walls and steep slopes. Requiring JSA and SWMS for specific activities	
1.02	Drainage	Manhole and wingwall requiring construction methodologies. Tipping, rolling or breaking during construction	Open	Unlikely	Minor	**Low**	Manholes and wingwalls have been reduced to their minimum possible sizes allowable by standards to reduce requirements for lifting plant or unfamiliar construction methodologies to the workers	Highly Unlikely	Minor	**Low**	Construction monitoring	
1.03	Mucking out Existing Sediment Pond	Incidents invoved with the process of removing silt and sediment that has built up inside the existing sediment retention pond.	Open	Possible	Moderate	**Medium**	Desilting to be done using best construction practises.	Highly Unlikely	Minor	**Low**	Construction monitoring. All basins to be maintained during construction works.	
1.04	Work around Streams	Incidents involved with working around an active stream including drowning and slipping due to wet ground.	Open	Possible	Major	**High**	Design to avoid works within stream where possible.. Where unavoidable specific design and risk assessment to be undertaken.	Highly Unlikely	Minor	**Low**	Machinery and staff to stay out of the stream at all times. Stream is to be fenced off for the duration of the works. Contractor H&S Plan. Engineer Site inspections and Audits.	
1.05	Planting near watercourses	Falls into water, drowning, slips, falls	Open	Unlikely	Moderate	**Medium**	Slopes have been reduced to 1:3 maximum or flatter to reduce risk of falling and the damage caused by a fall.	Rare	Hospitalisation	**Medium**	JSA for landscaping activities	
1.06	Planting on steep slopes	Risk of slips and falls	Open	Possible	Minor	**Low**	Slopes have been reduced to 1:3 maximum or flatter to reduce risk of falling and the damage caused by a fall.	Rare	Minor Injury	**Low**	JSA for landscaping activities	
2. OPERATION/MAINTENANCE												
2.01	Falls: Internal slopes	Falls associated with internal slopes	Open	Highly Unlikely	Minor	**Low**	Batter slopes modelled to 1:3 grade; Batter slopes will be landscaped with suitable vegetation to deter access onto slope.	Highly Unlikely	Serious	**Low**	No residual controls	
2.02	Ponding Depth/Flood depth in basin	Drowning due to falling into basin. Depth of water basin whilst in operation- max depth 600mm, 650mm or 700mm	Open	Highly Unlikely	Catastrophic	**Extreme**	Dense vegetative planting around basin, planting to deter and restrict access into basin. Selection of plant species to minimise maintenance and reduce clogging of SW structure.	Highly Unlikely	Major	**High**	No residual controls	
2.03	Stormwater Overland Flow Management	Mitigation of stormwater overland flows during large rainfall event	Open	Highly Unlikely	Serious	**Low**	Design in accordance with SWCOP. Design model ensures no private property in 1% AEP flow.	Highly Unlikely	Minor	**Low**	No residual controls	
2.04	Safe access for Maintenance Operations	Safe access for maintenace operations.Consideration for both stormwater operations teams and landscapers	Open	Highly Unlikely	Moderate	**Low**	Vehicle access is provided around all four sides of the basin. The main access is intended to be off Argent Lane where a wider footpath will be installed.	Highly Unlikely	Moderate	**Low**	No residual controls	
2.05	Overland Flow	In major storm events the basin will inundated with storm flows.	Open	Unlikely	Moderate	**Medium**	Appropriate riprap is provided in the upstream to prevent erosion during extreme event.	Unlikely	Moderate	**Medium**	No residual controls	
2.06	Maintenance of plants	Poison, minor injuries, cuts, scrapes, infections	Open	Highly Likely	Moderate	**High**	Appropriate planting plan, non-poisonous species, low maintenace plant species.	Highly Unlikely	Moderate	**Low**	No residual controls	
3. DECOMMISSION												
3.01	Decomisioning temporary Basin and outlet	Risks associated during the removal of the temporary basin and the outlet	Open	Possible	Moderate	**Medium**	Outlet location situated where plant can access while staying on the access track.	Highly Unlikely	Moderate	**Low**		
3.02	Decomisioning temporary Swale	Risks associated with the removal of the drainage swale that discharges into the temporary basin such as slipping, fall	Open	Possible	Moderate	**Medium**	Proposed swale to consist of a geotextile liner pined onto ground so decommission work is minimal	Highly Unlikely	Moderate	**Low**		

Appendix E – Milldale Stages 10 to 13 – Water Supply Report

Milldale stages 4C, 10, 11, 12 and 13

Water Supply

Fulton Hogan Land Development Limited

Issued for Consent

Document Control

Project Number	P24-128
Project Name	Water Supply
Client	Fulton Hogan Land Development Limited
Date	26/2/2025
Version	V1
Issue Status	Issued for Consent
Originators	Marcel Bear – Principal Engineer
Reviewer	Jivir Viyakesparan – Technical Director – 3 Waters
Approval	Pranil Wadan - General Manager – 3 Waters
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Contents

STATEMENT OF QUALIFICATIONS AND EXPERIENCE

Originator: Marcel Bear – Principal Water Supply Engineer

I am a Principal Engineer at Wood and Partners Consultants Limited (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed by Woods since April 2017

I hold the qualification of Batchelor of Engineering (Honours) in Civil Engineering from the University of Auckland, which I completed in 1990. I am a Chartered Engineer with Engineering New Zealand.

I have 30 years of professional experience in water supply design and planning. My experience includes water supply design, hydraulic modelling and infrastructure master planning, for greenfield and brownfield developments such as; the Unitec site- Auckland, Northcote, Wesley and Waikowhai neighbourhoods and the Sleepyhead Development in Ohinewai.

I confirm that, in my capacity as originator 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.

Reviewer: Jivir Viyakesparan - Technical Director Three Waters

I am a Technical Director at Wood and Partners Consultants Limited (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since April 2024.

I hold the qualifications of Batchelor of Science (Honours) in Civil Engineering from the University of Aston in Birmingham, UK and a Master of Science in Engineering Hydrogeology from Imperial College, University of London, which I completed in 1983 and 1986 respectively. I am a Fellow member of the Institution of Civil Engineers and Chartered Institution of Water and Environmental Managers.

I have 40 years of professional experience in the water supply management and infrastructure master planning. My experience includes water supply hydraulic modelling, water supply management and infrastructure master plans, such as the Napier City Water Master Plan, Tararua Three Waters Master Plan, Waipa District Master Plan and Morrinsville and Matamata Water Master Plan.

I confirm that, in my capacity as reviewer 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.

Approval: Pranil Wadan – General Manager Water Infrastructure and Planning

I am a Technical Director and the General Manager of Water Infrastructure & Planning at Wood and Partners Consultants Limited (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since April 2012.

I hold a Bachelor of Engineering degree from the University of Auckland, which I completed in 2007. I am a Chartered Professional Engineer (CPEng) and a member of Engineering New Zealand (CMEngNZ) and Water New Zealand. In addition, I also hold the following qualifications and affiliations:

- International Professional Engineer (IntPe(NZ))
- Certified Independent Hearing Commissioner
- Certificate in Company Direction & Governance

I have over 16 years of experience in stormwater design, hydrodynamic modelling, flood risk assessments, water infrastructure and stormwater management for land development.

I confirm that, in my capacity as approver 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.

1. Executive summary

Fulton Hogan Land Development (FHLD) is developing the land in Milldale in line with the Auckland Council Spatial Land Use Strategy (2024)[1]. In the long term the development will include the adjoining areas of Milldale North and Wainui. Milldale is being developed, with over 50% of the area built as of 2024, whilst Milldale North and Wainui are future development areas not yet developed. This report concerns the water supply for Stages 4C, 10, 11, 12 and 13 within Milldale, as shown in Figure 1 . The network has been designed to supply Milldale with provision for expansion into Milldale North and Wainui. Staged development of the network has been established to fit with the expected roll out of the development and the future supply sources from Watercare-through the bulk supply points (BSPs). This report shows that the network design is generally compliant with the Watercare Code of Practice (CoP), in support of consents for the Milldale area.

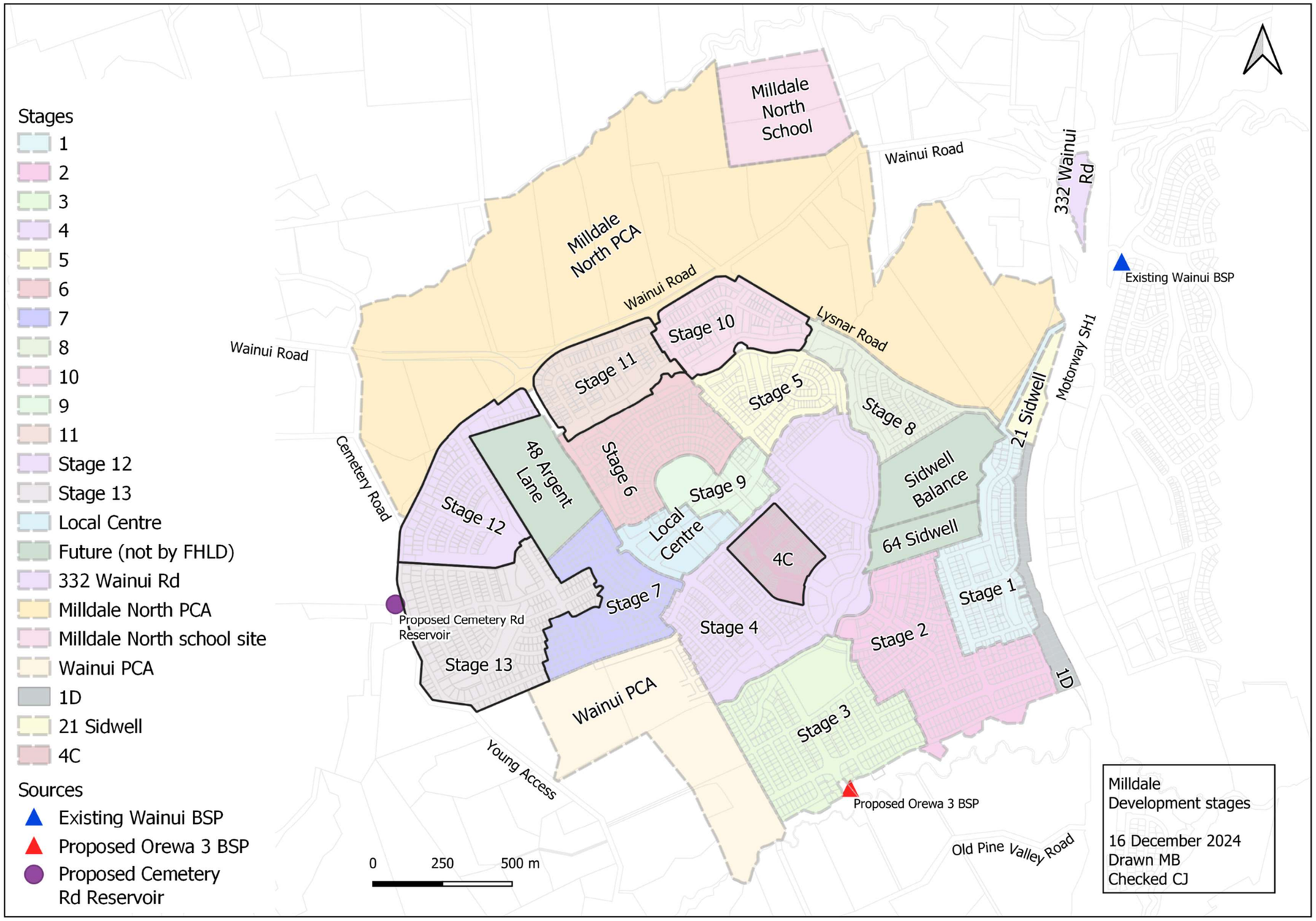


Figure 1 Development stages

[1] Spatial Land Use Strategy. Dairy Flat and Silverdale Future Urban Zones. Auckland Council. 14 March 2024.

2. Introduction

Fulton Hogan Land Development Ltd (FHLD) commissioned Wood and Partners Consultants Ltd (Woods) to develop a water supply servicing plan for the Milldale area, allowing for future development in the Wainui Plan Change area and the Milldale North Plan Change areas, as shown in Figure 1.

This report presents a servicing plan for the potable water supply system in support of consents for Stages 4C, 10, 11, 12 and 13 in Milldale, describing how it will link into the existing transmission network. The local network includes reticulation that will service the future development areas – Milldale North and Wainui – and function with the planned new transmission assets.

Watercare has a supply strategy for the Milldale and Wainui area, which includes transmission upgrading that will provide the supply for the growth anticipated in Milldale, the Milldale North and Wainui Plan Change areas. Details of the transmission network development are given in Section 5.1.

A hydraulic model of the reticulation has been developed to demonstrate compliance with Code of Practice limits for pressure, headloss, velocity and fireflow. The results of the modelling are presented in Section 6.

3. Design standards

Water demands and network design criteria are based on the Watercare Water and Wastewater Code of Practice (CoP) and the Firefighting Water Supply Code of Practice (SNZ PAS 4509: 2008), as summarised in Appendix B.

3.1.1. Level datum

All levels given in terms of AVD 1946.

4. Yield update

Table 1 summarises the total yields for the Milldale development, the Milldale North plan change area and the Wainui plan change area, shown in Figure 1. Detailed yield and demand information is included in Appendix C. As the network extends beyond the plan change areas, yields for the entire area serviced, with the plan change areas listed separately, are shown in Table 1.

Table 1 Yields for Milldale, Milldale North Plan Change and Wainui Plan Change Areas

	Milldale Development*	Milldale North PCA	Milldale North** (outside PCA)	Wainui PCA	Total
Dwellings	4,526	1,999	534	427	7,485
Population***	14,743	5,996	4,758	1,281	26,778
Peak Day Demand, l/s	58.2	22.9	7.6	4.9	93.5

*Includes population and demands from school (1040 students and staff), childcare centres (275 child and staff), retirement village (600 residents) and commercial area demands.

**Includes Ministry of Education school site

***Sum of residents, school staff, school pupils

The Plan Change area yields are based on:

- Gross area : Milldale North PCA 149.9 hectares
  : Wainui PCA 31.7 hectares
- Net Area : 60% of Gross Area
- Dwellings : 1 dwelling per 450 m^2 net area
- Secondary School : 2,946 pupils and 211 staff. Added as 128 dwellings (equivalent demand as per Watercare CoP standards in Appendix B)

4.1. Staging

The network has been designed to supply a combination of built, planned and future supply areas. The development stages are listed below, referring to the areas shown in Figure 1:

Complete: 332 Wainui Rd, 21 Sidwell, Stage 1, 2, 3, 4, 5

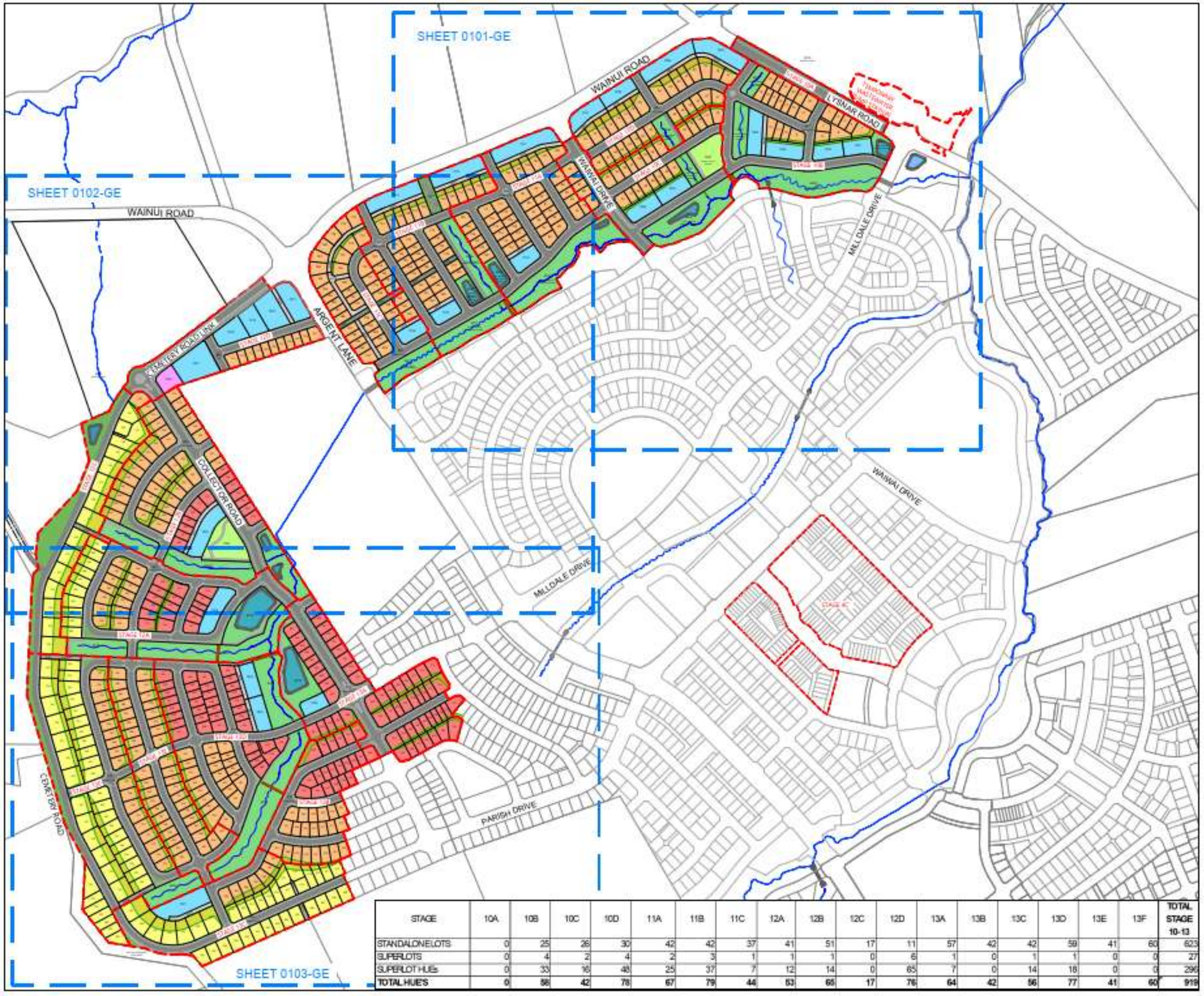
Under Construction: Stage 6, 7, 9 & Local Centre.

Consented: Stage 8

Subject of this report: Stages 4C, 10, 11, 12, and 13, as shown in Figure 2.

Future: Stage 1D, Milldale North and Wainui plan change areas, 48 Argent Lane, Sidwell balance

There is less certainty in the timing/order of the future planned development areas.



STAGE	10A	10B	10C	10D	11A	11B	11C	12A	12B	12C	12D	13A	13B	13C	13D	13E	13F	TOTAL STAGE 10-13
STANDALONE LOTS	0	25	26	30	42	42	37	41	51	17	11	57	42	42	59	41	60	623
SUPERLOTS	0	4	2	4	2	3	1	1	1	0	6	1	0	1	1	0	0	27
SUPERLOT HUES	0	33	16	48	25	37	7	12	14	0	65	7	0	14	18	0	0	296
TOTAL HUES	0	58	42	78	67	79	44	53	65	17	76	64	42	56	77	41	60	919

Figure 2 Milldale Stages 4C, 10, 11, 12 and 13

5. Supply scenarios and model boundary conditions

5.1. Transmission supply development

Watercare supply intentions for the area have evolved over the design period. The transmission pipelines supplying into the area are the existing Orewa 1 main and the proposed Orewa 3 main. The Orewa 1 main will be upgraded and eventually connected to the Orewa 3 main, both of which will be available to provide a resilient supply. A new reservoir and high level zone are planned at Cemetery Road, that will further augment the supply and provide for the elevated parts of the development.

Appendix A shows Watercare supply intentions from October 2022, which fundamentally still apply. The expected hydraulic grade available from the transmission network has been provided by Watercare for 3 time horizons: short, medium and long term, as detailed below.

5.1.1. Short term transmission supply

This includes supply to the current residential zoned land in Milldale (Stages 1 to 13 plus non FHLD land within Milldale) supplied from the Wainui BSP – at HGL 90m, see Figure 3. The proposed pumpstation shown will supply the elevated areas within Milldale. It will be a temporary local pumpstation until the supply from Orewa 3 is available in the long term, see Section 5.1.3.

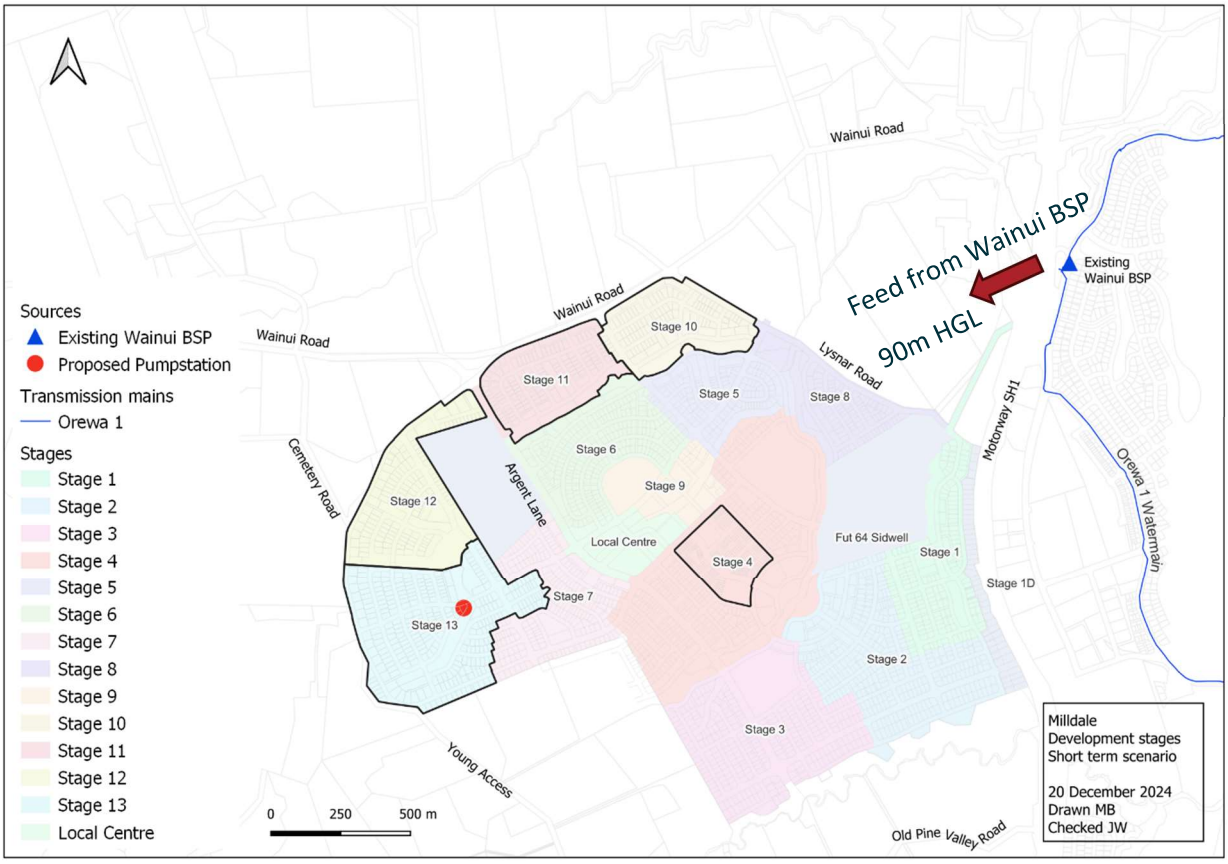


Figure 3 Short term supply and demand areas

5.1.2. Medium term transmission supply - Orewa 3 watermain part built

This includes supply to Stages 1 to 13 plus non FHLD land within Milldale supplied from the Orewa 3 BSP direct into the reticulation. The Orewa 3 BSP will be supplied from Orewa 1 main @100 m HGL to maximise turnover of Orewa 3 watermain, see Figure 4. This is an intermediate supply scenario to maximise the flow through the first part of the Orewa 3 watermain. To maximise the turnover of the new Orewa 3 main the Wainui BSP is not used.

This introduces a second supply to the west of the motorway into Milldale, for improved resilience.

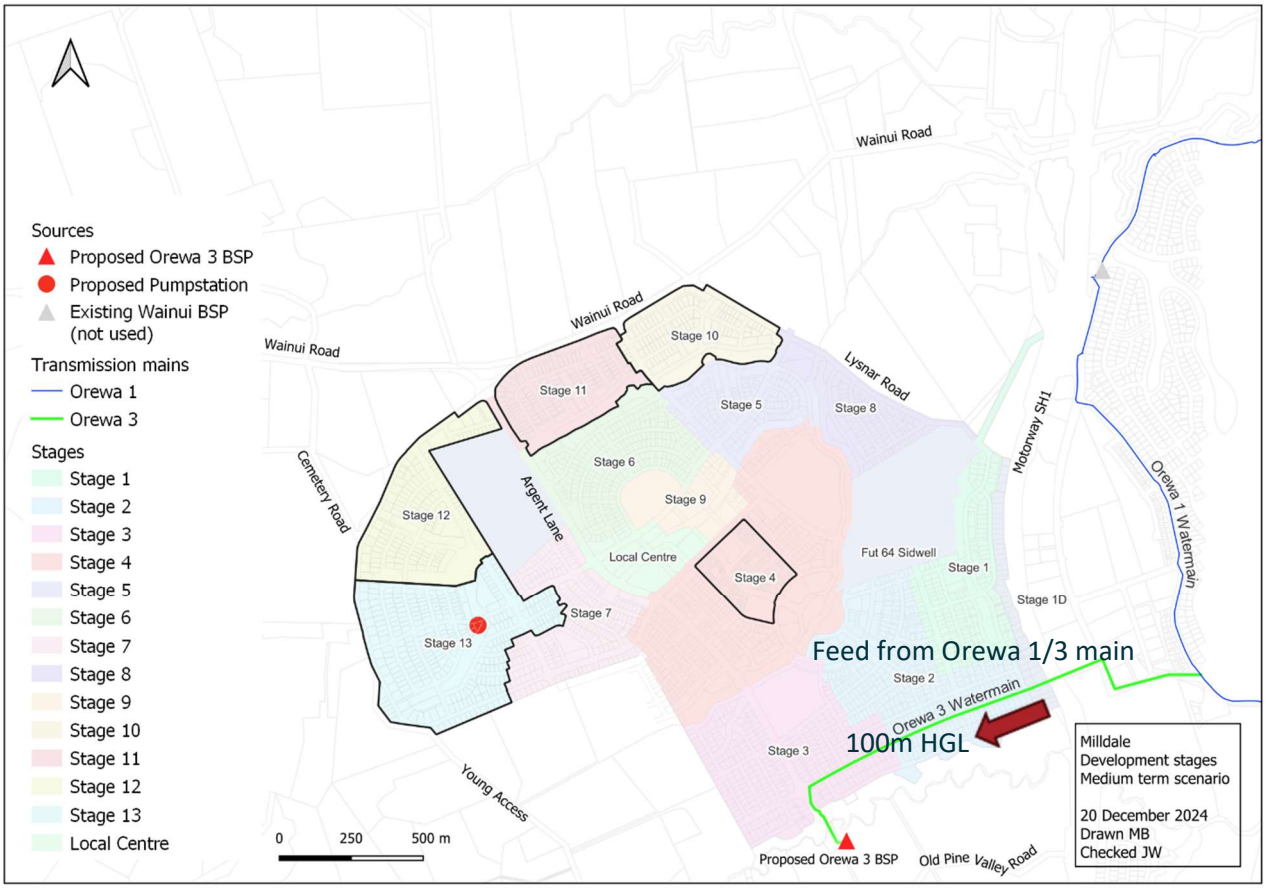


Figure 4 Medium term supply and demand areas

5.1.3. Long term transmission supply - Orewa 3 watermain complete

This includes supply to all of Milldale plus plan change areas, supplied by both BSPs. The Orewa 3 BSP will be supplied from Albany at 115 m HGL – sufficient head to supply the local high zone without local pumping. The local pumpstation used in the short and medium term supplies will no longer be needed. The Cemetery Rd Reservoir will be in place, see Figure 5. The reservoir will be the principal supply into the area with a lower supporting flow from the Wainui BSP as needed. This will maximise the load on the new Orewa 3 watermain and relieve the demands on the Orewa 1 watermain. The reservoir will be filled by a dedicated main

supplied by the Orewa 3 BSP. The dedicated main will also supply the high zone with the elevated head available from the BSP. The two sources make a resilient supply.

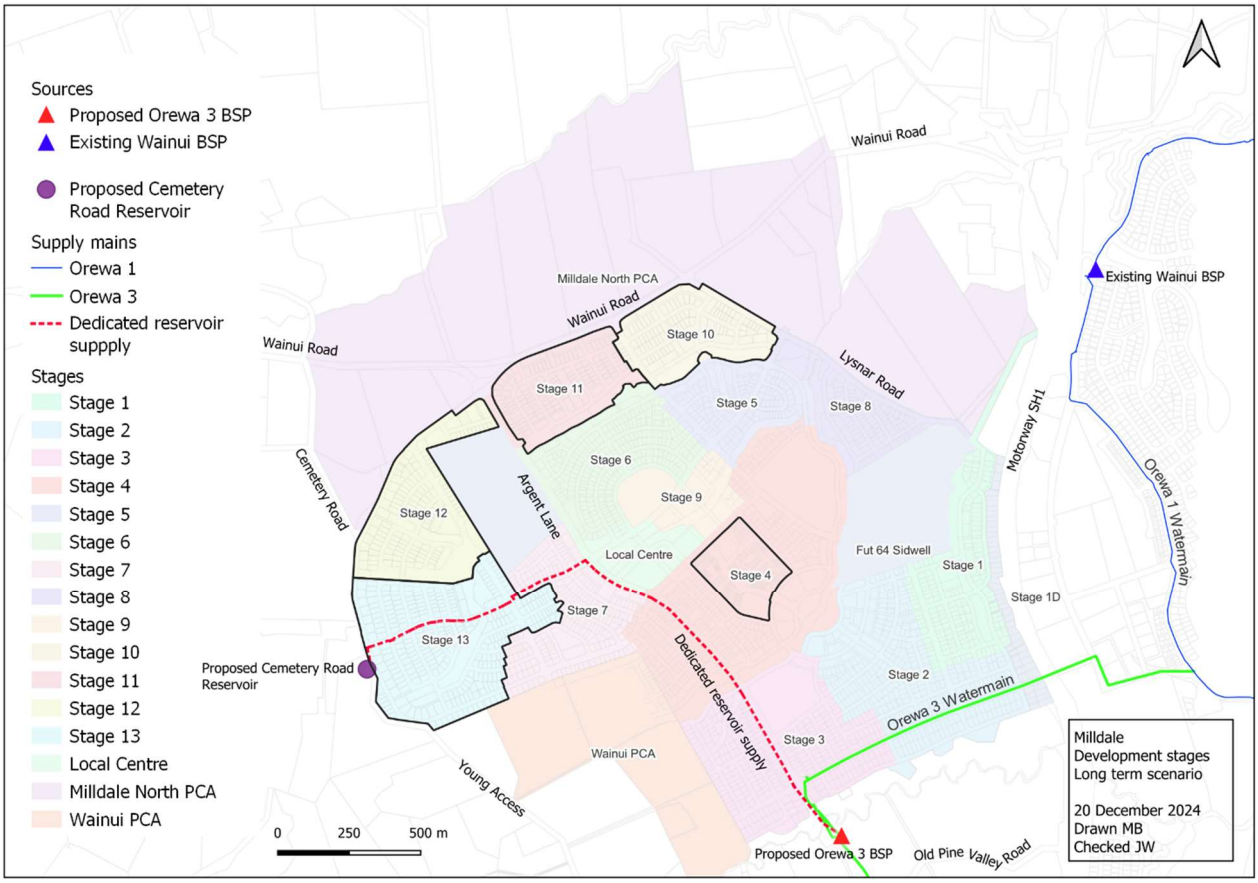


Figure 5 Long term supply and demand areas

5.2. Network zones and model components

This section describes the supply zones and active components of the network: sources, reservoir, and valves. The function of these is outlined in Section 5.1 and confirmation of the HGLs from Watercare is given in Appendix A.

The water supply network model for this analysis was developed in Innovyze InfoWorks WS Pro version 2024.5. The model was updated to show the latest as-built water network. The proposed network layout beyond the as built area was based on the masterplans for these areas where available. For areas that are not master planned, including the Milldale North and Wainui Plan Change areas (see Figure 1 overview and Figure 6 detail) the layout is indicative, to provide a sufficient level of detail for the purposes of analysing the network performance.

5.2.1. Dedicated reservoir inlet main

In the long term supply configuration a dedicated reservoir inlet main will deliver high pressure water from the Orewa 3 transmission main/BSP into the reservoir. There will be offtakes from the high pressure main to supply the high zone, as described below.

5.2.2. High zone

The proposed high zone was defined as generally the area above the 50 m RL elevation contour and follows the road layouts within the Milldale Development (shown in Figure 6). This zone will

be supplied in the short term with a temporary boost pump. In the long term the high zone would be supplied directly from the Orewa 3 watermain via the dedicated reservoir inlet main.

5.2.3. Sources

Short term scenario: The supply into the area will be the existing Wainui BSP. Model node MN-0981. HGL 90m minimum normal operation. Actual minimum HGL reported as 91 to 102 m RL. PRV downstream of the BSP.

Medium term scenario: The supply into the area will be from the proposed Orewa 3 BSP, connected to the Orewa 1 transmission main via a length of completed Orewa 3 watermain. Model node MD-0982. HGL 100 m RL. The Wainui BSP will not normally supply into the zone and will be a backup for emergencies only.

Long term scenario: The supply into the area will be primarily from the proposed Cemetery Road Reservoir which will be supplied via a dedicated supply main from the proposed Orewa 3 BSP at 115 m HGL. The Wainui BSP will also supply into the area, supplying a lower proportion of the demand, with the majority supplied from the reservoir. The flow balance will be achieved by controlling the setting of the PRV downstream of the Wainui BSP. The proposed Orewa 3 BSP model node is MD-0982, HGL 115 m RL.

5.2.4. Reservoir

Cemetery Road Reservoir (proposed). Model Node MD-0984. Floor elevation 80 m RL. Top water level 85 m RL. Volume 7000 m^3.

5.2.5. Control valves

Wainui pressure reducing valve (PRV). Model link MD-0981.MD-0600.1. Downstream pressure setting 63 m pressure, 82 m RL HGL (approx.). Downstream control Node MD-0600 elevation 19.4 m RL. Reservoir inlet valve level control; model link MD-0596.MD-0597.1. Open at depth 4.6 m, closed at depth 4.95 m. Reservoir inlet valve flow control; model link FRV MD-0597.MD-0984.1. Flow set point 105 l/s. Also controls time of filling to 16 hours/day, excluding 5 am until 1 pm.

6. Network performance results

The results from the short term and long term supply scenarios are summarised below. The results for the long term scenario are included for information only as the medium and long term scenarios will be the subject of a separate report. This report concerns Stage 4C, 10, 11, 12 and 13 only, ie the short term scenario. Detailed thematic plans are shown in Appendix D. The short term results show the capacity of the network, as currently supplied by the Wainui BSP and with the temporary boost pumped for the high zone, to support growth. The long term results show how this same network, suitably expanded and supplied by both the Wainui BSP and Orewa 3 BSP can supply the expected growth.

6.1. Network performance summary

Table 2 summarises the network performance in terms of the Code of Practice parameters of pressure, headloss, velocity and fireflow.

Table 2 Summary of results – Short and long term scenarios

Parameter. CoP limit	Short term Result/CoP compliant	Long term Result/CoP compliant
Supply area	Milldale	Milldale, Milldale North, Wainui
Minimum pressure, m. Over 25m required	27 to 70 m/**Yes**	26 to 70 m/**Yes**
Maximum pressure, m Under 80m required	29 to 72 m/**Yes**	33 to 74 m/**Yes**
Pressure variation, m Under 10m preferred	8 m	4 m in low zone and 13m in high zone due to reservoir filling
Maximum headloss, m/km Less than 5 m/km, pipes <=150NB Less than 3 m/km, pipes > 150NB	0.01 to 1.7/**Yes** Except for: -600m of 300NB pipe at 5.6 m/km downstream of Wainui BSP	0.01 to 4/**Yes** Except for: -340NB pipe at 3.24 m/km downstream of proposed Reservoir -Watermain supplying Reservoir at 6.6 m/km (flow limited to 105l/s)
Maximum velocity m/s, Under 2 m/s required	0.01 to 1.7 m/s - **Yes**	0.01 to 1.1 m/s - **Yes**
Available fireflow l/s 25 l/s for residential at 10m running pressure	Over 37 l/s throughout Over 78 l/s in local centre area/**Yes**	Over 28 l/s throughout Over 81 l/s in local centre area /**Yes**
Conclusions	Proposed network will supply expected growth CoP compliance achieved apart from minor headloss departures in supply pipelines that do not supply customer connections	Using the Orewa 3 BSP head available enables supply to the entire area without local pumping. CoP compliance achieved apart from minor headloss departures in supply pipelines that do not supply customer connections. Resilience is provided by the local reservoir and two BSPs supplying into the local network. Maximum pressures generally within ideal band (40 to 60 m)
Milldale supply	Satisfies CoP requirements	Satisfies CoP requirements

6.2. Network performance discussion – short term

The network proposed for the short term scenario, combined with supply from the Wainui BSP and local boost pumping would enable development of Stages 4C, 10, 11, 12 and 13 as well as the rest of Milldale.

Pressures would be within the CoP limits and pressure variation less than 10 m. Headloss would within CoP limits apart from a minor departure on the supply pipeline from the BSP. Velocity would be within CoP limits as would available fireflow.

With regards to Milldale, the pressure, velocity, headloss and fireflow requirements of the CoP would be satisfied.

6.3. Network performance discussion – long term

The ultimate network configuration would utilise the available HGL from the Orewa 3 BSP - which will be supplied by a proposed reservoir in Albany - to supply the elevated areas of the site, which would enable supply to current and future supply zones without pumping.

The transition from short to medium and then long term supplies will cause flow reversals in some parts of the network. This will have to be managed to maintain water quality with a suitable flushing programme.

The network performance is generally compliant with the Watercare CoP limits for pressure, velocity, headloss and fireflow. Two minor headloss departures are sought, as described below.

Headloss in the 340NB watermain downstream of the proposed Cemetery Road Reservoir (3.24 m/km) would be above the CoP limit (3 m/km) for a duration of 10 minutes during the peak demand day of the year. This section of watermain has no customers connected directly to it and would have no effect on customer pressure or available fireflow. Therefore, the performance of this section of pipe is considered acceptable.

Watercare Planning have indicated that a departure on headloss on the inlet watermain of the Reservoir is acceptable, to maximise the supply from this source into the development while also limiting the filling time of the reservoir to 16 hours per day. The headloss in this watermain exceeds the CoP whenever the reservoir is filling and flow has been limited to 105 l/s to give a headloss of 6.6 m/km at 105 l/s for 16 hours/day. This flow is sufficient for the reservoir to be replenished daily during the peak day demands.

With regards to Milldale, Milldale North and Wainui the pressure, velocity, headloss and fireflow requirements of the CoP would be satisfied.

Wainui Road

Wainui Road

Argent Lane

Lysnar Road

Motorway SH1

Argent Ln.

Pipe size Internal Diameter mm

- 50
- 100
- 150
- 200
- 267
- 300
- 340

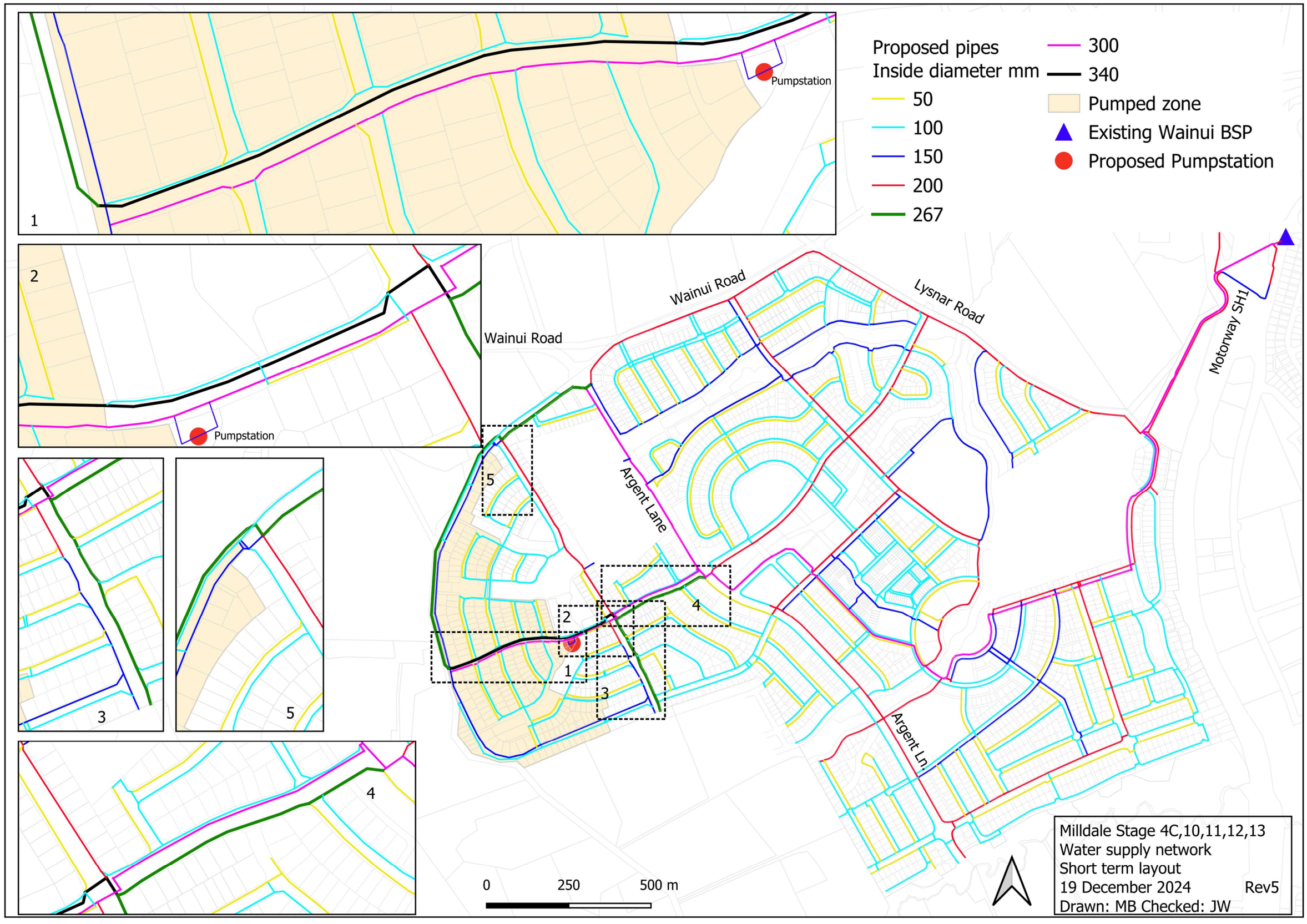
Pumped zone

Existing Wainui BSP

Proposed Pumpstation

0 250 500 m

Milldale Stage 4C,10,11,12,13
Water supply network
Short term layout
19 December 2024 Rev5
Drawn: MB Checked: JW


Proposed pipes
Inside diameter mm
50
100
150
200
267
300
340
Pumped zone
Existing Wainui BSP
Proposed Pumpstation
Pumpstation
Wainui Road
Lysnar Road
Motorway SH1
Argent Lane
Argent Ln
1
2
3
4
5
0
250
500 m
Milldale Stage 4C,10,11,12,13
Water supply network
Short term layout
19 December 2024 Rev5
Drawn: MB Checked: JW

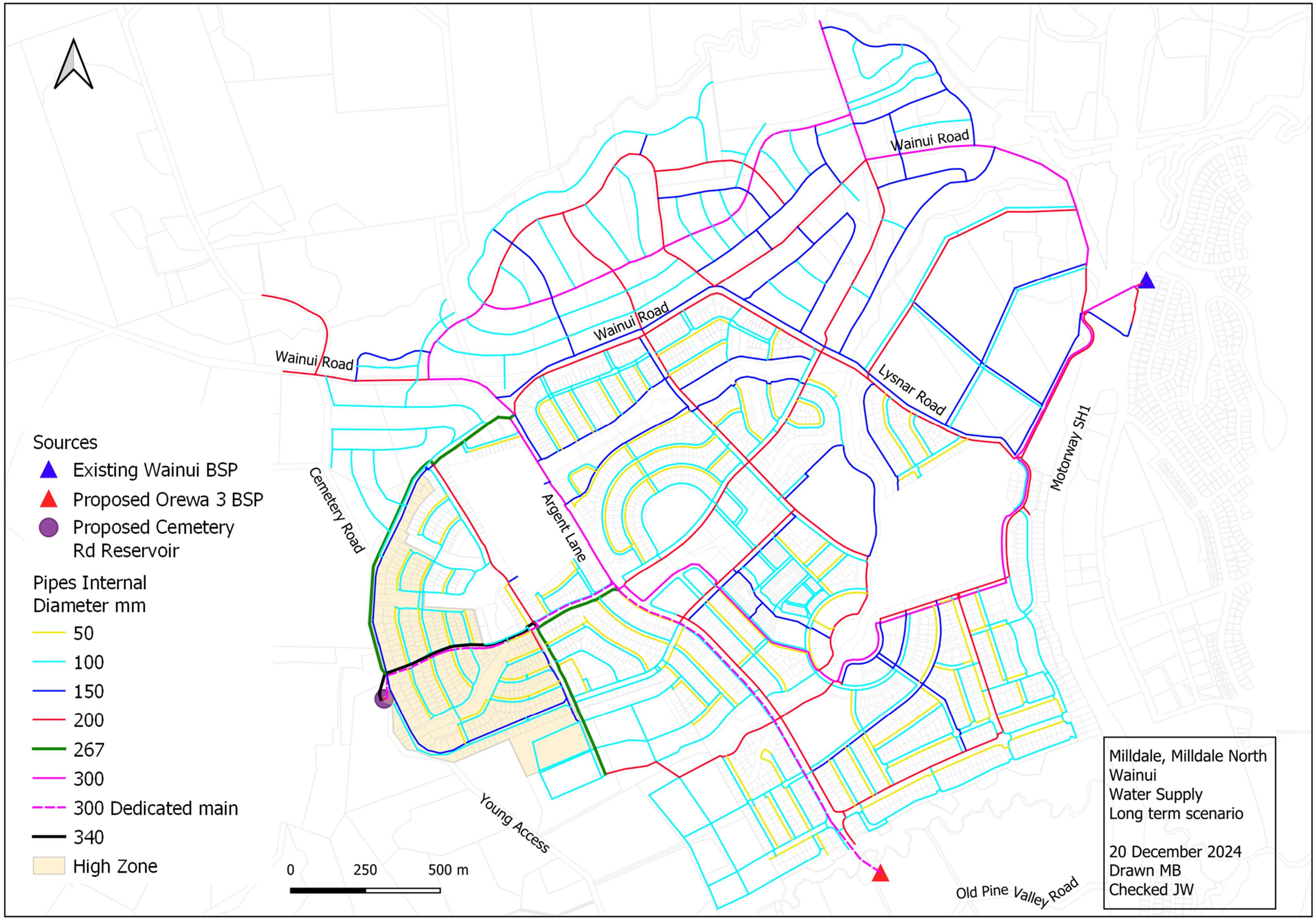


Figure 6 Proposed network

Water Supply Sources

Watercare have indicated that the proposed Cemetery Road Reservoir should deliver a significant flow, with the balance made up by the Wainui BSP. This is a change from the initial supply strategy for the development which had the majority of flow from the Wainui BSP. To achieve the desired flow balance, the flow from the reservoir was increased by lowering the HGL at the Wainui BSP using a PRV. Table 3 provides the operation conditions and the percentage of total water supplied by each source.

Table 3 Supply operation conditions

Element	Operation	Comment
Wainui BSP	82 m HGL	Reduced from 90 m HGL
	38% of total flow (3,000 m^3/d Peak day)	
Cemetery Road Reservoir	85 m Top water level	Inflow over 16 hours of the day, avoiding peak time of 5 am to 1 pm
	62% of total flow (4,800 m^3/d Peak day)	
Watermain from Orewa 3 to Reservoir	Restricted to 105 l/s for 16 hours per day	Maximum inlet pipe headloss (6.6 m/km) departure accepted

The percentage of supply from the reservoir specified above (62%) is the maximum that enables the reservoir to refill daily with 16 hours of inflow. This percentage is limited by the headloss departures in the reservoir inlet and outlet pipes. If these departures are relaxed further, greater flow could be supplied by the reservoir.

7. Summary and conclusions

This report presents analysis of the potable water supply for Stages 4C, 10, 11, 12 and 13 of the Milldale Development. Supply for future development areas was also included in the design. Watercare were consulted about the supply plans for the area and confirm that the transmission network is undergoing expansion to cater for growth, which includes a new bulk supply point and reservoir. These new sources have been included in the network analysis.

The network was analysed for the short term configuration (supply from the Wainui BSP only with supply to Milldale area only) and ultimate configuration (supply from the Wainui BSP and future Orewa 3 BSP, to supply Milldale plus the plan change areas). The performance in Stages 4C, 10, 11, 12 and 13 within Milldale has been highlighted to support the consent application for this area.

A hydraulic model was developed based on the reticulation already built and expanded to include future areas of supply and sources. The model results confirm that, in the short and long term, the proposed network and supply points would generally comply with the Watercare Code of Practice requirements. Minor headloss departures on the pipe immediately downstream of the Wainui BSP would occur in the short term, which would be resolved when the Orewa 3 BSP comes online. In the long term minor headloss departures for the inlet watermain of the proposed Cemetery Road reservoir and a 340NB pipe downstream of it would occur. The first has been accepted as a departure in discussions with Watercare with the reservoir inlet limited to a maximum inflow of 105 l/s. The second headloss issue barely exceeds the limit (3.24 m/km predicted compared with the CoP maximum of 3 m/km) and is considered acceptable as it would occur for a maximum of 10 minutes during the peak day of the year. Both these departures would not impact customer pressure or fireflow.

The supply from the Orewa 3 BSP to the proposed Reservoir would operate for a maximum of 16-hour a day as per Watercare's operational strategy for the area. Under normal operation, 62% of the water demand would be supplied from the Reservoir, while the remaining 38% would come from the Wainui BSP. Greater flows would be possible from the reservoir if the headloss departures mentioned above were relaxed further. The network would include a high pressure zone that would service above approximately 50 m RL ground elevation. In the short term the elevated areas will be supplied by a temporary pumpstation. In the long term the additional head from the Orewa 3 BSP would supply the elevated area without the need for pumping.

In both the short and long term scenarios the supply to Stages 4C, 10, 11, 12 and 13 would be within CoP limits.

In conclusion, the proposed sources and proposed network would have capacity to supply the demands expected in the Milldale, the Milldale North Plan Change area and the Wainui Plan Change area. Consideration of the evolving supply sources for these areas has shown that a satisfactory supply and demand balance can be achieved. The transition from short to medium and then long term supplies will cause some changes in flow direction. A suitable flushing programme is recommended to maintain water quality. The proposed network operation and source flow balance is in line with Watercare Operations' intentions.

On this basis, it is concluded the proposed network will provide a satisfactory supply.

Appendix A Watercare supply intentions

From: Edzard Verseput <Edzard.Verseput@water.co.nz>
Sent: Wednesday, 10 April 2024 12:41 pm
To: Marcel Bear <marcel.bear@woods.co.nz>; Dave Rooke <David.Rooke@water.co.nz>; Lars Fog <Lars.Fog@water.co.nz>
Cc: FAHEY, Grant <grant.fahey@fultonhogan.com>; Cristian Jara <cristian.jara@woods.co.nz>; Rooke, David <David.Rooke@stantec.com>
Subject: RE: Milldale North water supply meeting 22 March 2024 - notes of meeting

Hi Marcel

Apologies, I received the information back from Aurecon.

In the initial years after the Orewa 3's completion the HGL at the Orewa 3 BSP will be between 120m and 125m.

Once the entire area is supplied under the ultimate scenario the HGL will be 115m.

Nga Mihi | Kind regards

Edzard Verseput | Team Lead – Water Networks Planning

Watercare Services Limited

From: Dave Rooke <David.Rooke@water.co.nz>
Sent: Tuesday, April 9, 2024 4:50:20 pm
To: Marcel Bear <marcel.bear@woods.co.nz>; Lars Fog <Lars.Fog@water.co.nz>; Edzard Verseput <Edzard.Verseput@water.co.nz>
Cc: FAHEY, Grant <grant.fahey@fultonhogan.com>; Cristian Jara <cristian.jara@woods.co.nz>; Rooke, David <David.Rooke@stantec.com>
Subject: RE: Milldale North water supply meeting 22 March 2024 - notes of meeting

Hi Marcel

Please find information below:

- *DR to confirm Wainui BSP HGL (currently assumed to be 90m)*

We are currently checking the BSP supply as the zone may still be supplied via the Milldale zone (across the motorway). Current Pressure data shows 72m + 19m Elevation = 91m HGL but as detailed this could be the Milldale system. The model details pressures around 102m from transmission mains. Therefore, there could be benefit having full pressure of transmission if this can delay the local pump station. Might be beneficial to assess based on a 90m grade and 100m grade to see how this impact the local pump station needs.

- *DR to confirm HGL available from Orewa 1 main at connection point of Orewa 3 main (Highgate bridge)*

Links to above with 100m from Orewa 3 supplied via Orewa 1 and 2.
Many Thanks
David Rooke | Contractor **(**Stantec**)**
Watercare Services Limited

From: DRooke (David) <David.Rooke@water.co.nz>
Sent: Thursday, October 20, 2022 11:55 AM
To: Marcel Bear <marcel.bear@woods.co.nz>
Cc: FAHEY, Grant <grant.fahey@fultonhogan.com>
Subject: RE: Milldale North servicing meeting with Watercare

Hi Marcel

Sorry I thought I had sent this through.

Many Thanks

David Rooke | Principal Water Network Planner

Watercare Services Limited
Mobile: +64 21 839 280
Customer service line: +64 9 442 2222
Postal address: Private Bag 92 521, Victoria Street West, Auckland 1142, New Zealand
Physical address: 73 Remuera Road, Remuera, Auckland 1050, New Zealand
Website: www.watercare.co.nz

From: Marcel Bear <marcel.bear@woods.co.nz>
Sent: Thursday, 20 October 2022 11:27 am
To: DRooke (David) <David.Rooke@water.co.nz>
Cc: FAHEY, Grant <grant.fahey@fultonhogan.com>
Subject: FW: Milldale North servicing meeting with Watercare

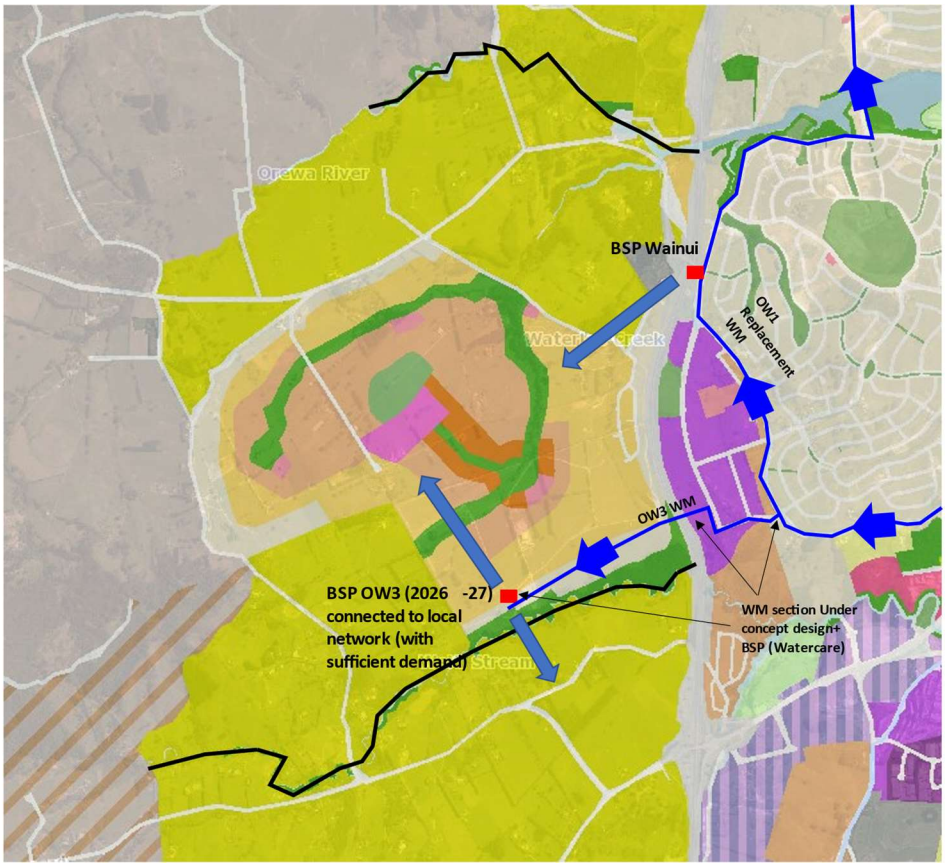
Hi David

Re the discussion of the supply for the Milldale North area, please send through the sketch of the supply configuration from the Cemetery Rd Reservoir, as noted below.

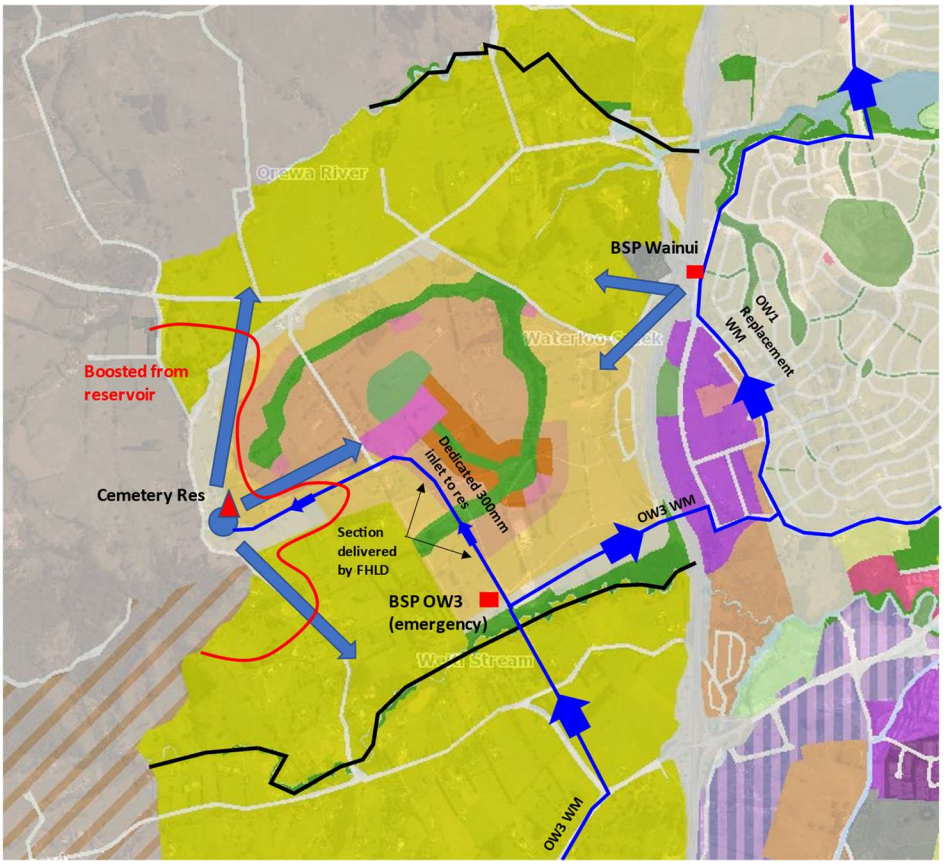
Thanks

Marcel
Marcel Bear
Water Engineer
BE(Civil)Hons CPEng
+64 9 953 8667 | +64 21 102 5485
marcel.bear@woods.co.nz
woods.co.nz

Interim



Long Term



Appendix B Design standards

Design

The design standards used in the assessment are based on the Water and Wastewater Code of Practice (CoP) for Land Development and Subdivision v2.4, dated June 2021, and are as follows:

- Pressure : 25 – 80 m
- Maximum Headloss:
    - For pipe diameter ≤ 150mm : ≤ 5m/km
    - For pipe diameter > 150mm : ≤ 3m/km
- Velocity : 0.5 – 2.0 m/s
- Fireflow : FW2, 25l/s

Water Demand

The water demand design flows are:

- Design Flow
    - Residential/Retirement Home : 220 litres per person per day
    - Commercial : 65 litres per person per day
    - School : Primary School: 20 litres per student per day
      : Secondary School 25 litres per student per day
      : 50 litres per staff member per day
- Occupancy Rate
    - Residential : 3 people per dwelling
    - Commercial : 1 person per 15 m^2 assuming Dry Retail where toilet facilities are provided to customers
- Peak Day Demand (PDD) Peak Factor : 1.5 (for populations over 10,000)
- Peak Hour Demand (PHD) Peak Factor
    - Residential : 2.5
    - Commercial : 2.25

A PDD Peak Factor of 1.5 was used because the development would form part of a network that supplies over 10,000 people as per the CoP.

Fireflow Demands

Based on SNZ PAS 4509:2008, A Fireflow of FW2 was considered for the Residential part of the development. This would mean that the minimum flow requirement is 25 litres/second (l/s); 12.5 l/s within 135m of the development and an additional 12.5l/s within 270m of the development.

Sprinkler protection is assumed for the commercial and school area and thus has the same hydrant demand (25 l/s) as residential areas.

Appendix C Water demand calculations

ASSUMPTIONS:

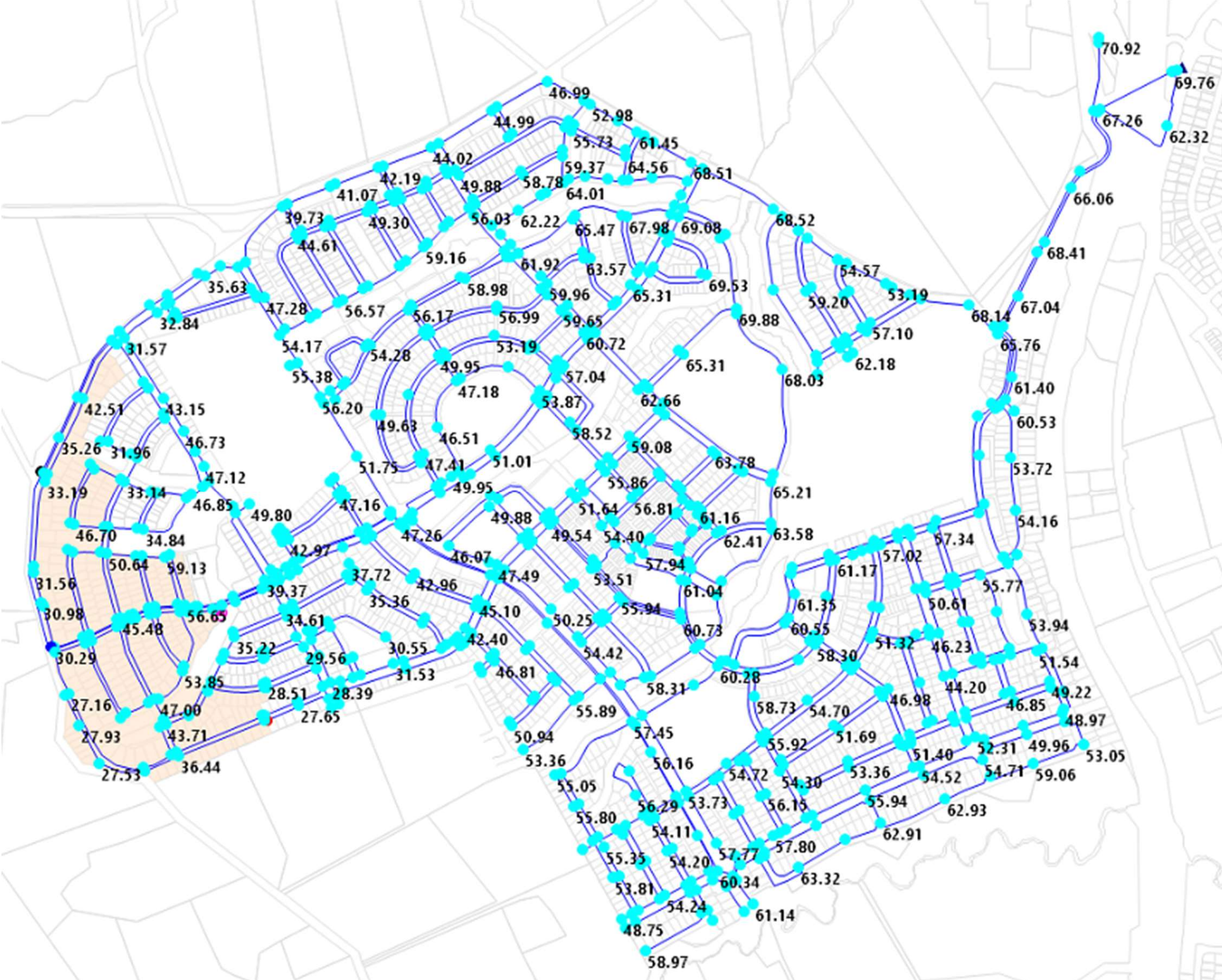
Design Flow		
Residential/Retirement Home	220	liters per capita per day
Commercial	65	liters per person per day; 1 person per 15m2 (Dry Retail where toilet facilities are provided to customers)
Childcare	45	liters per child per day
School	20	liters per student (Primary) per day
	25	liters per student (Secondary) per day
School/Childcare	50	liters per staff per day
Occupancy Rate		
Residential	3	people/dwelling
Commercial	1	people/15m2
Retirement Home	2.4	people/dwelling
PDD Peak Factor		
Residential	1.5	
Retirement Home	2	
PHD Peak Factor		
Residential	2.5	
Commercial	2.25	

Summary

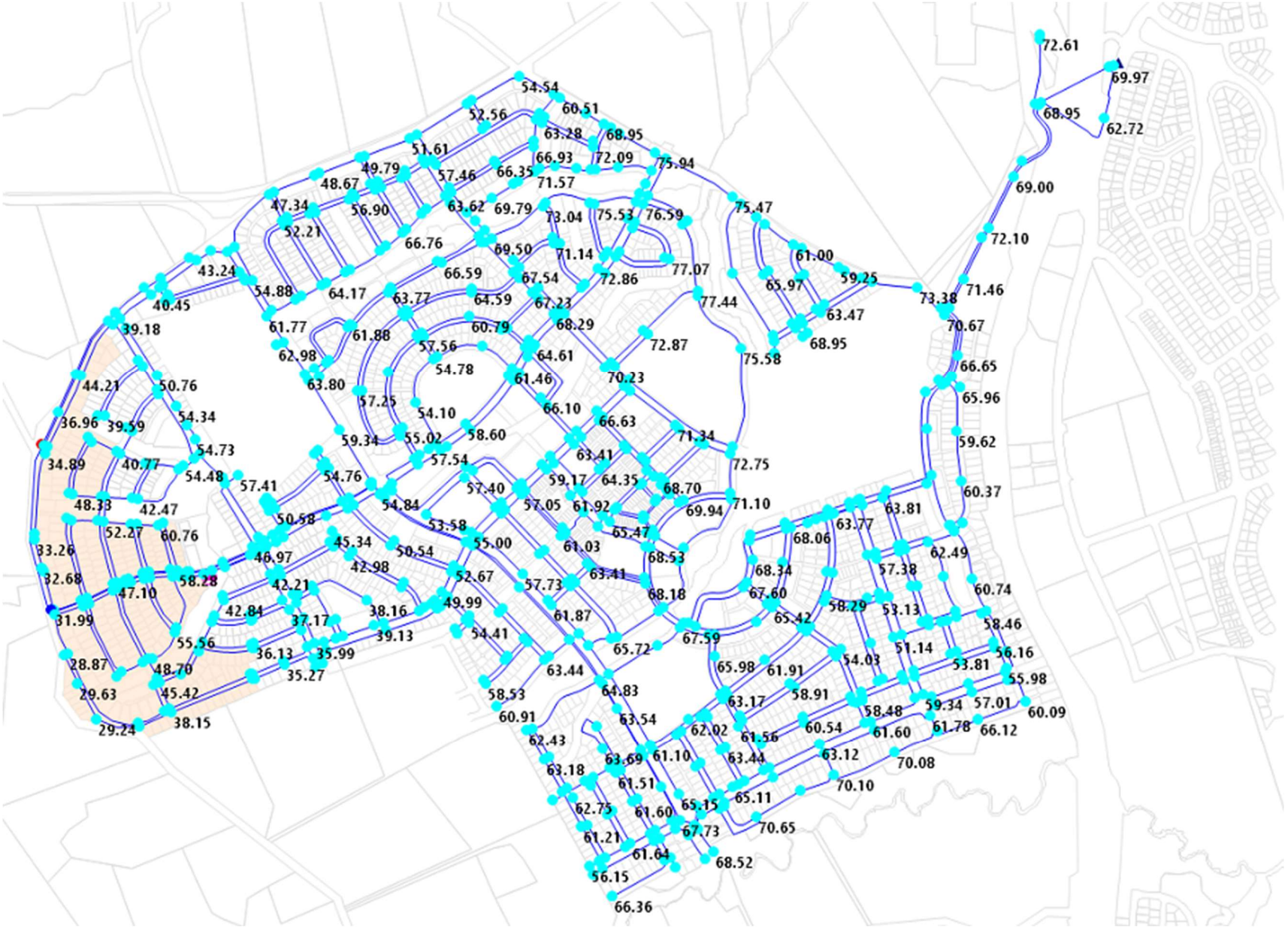
																		Non FHLDL							
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Local Centre	Stage 7	Stage 9	Stage 8	Stage 10	Stage 11	Stage 12	Stage 13	Stage 1D	21 Sidwell	332 Wainui Rd	64 Sidwell	Sidwell Balance	48 Argent Ln	Total Milldale	Milldale North PCA	Milldale North (rest of)	Wainui PCA	Total Overall
Dwellings TOTAL	180	510	290	1,043	188	298	22	241	96	142	178	190	211	340	31	36	30	123	192	185	**4,526**	1,999	534	427	**7,485**
-Standalone Lot	148	300	280	248	122	218	4	189	13	81	81	121	120	301	31	36	30	74	192	185	**2,774**	1,999	534	427	**5,733**
-Superlot	32	67	10	133	66	80	18	52	17	61	97	69	91	39	-	-	-	21	-	-	**853**	-	-	-	**853**
-THAB Superlot	-	143	-	412	-	-	-	-	66	-	-	-	-	-	-	-	-	28	-	-	**649**	-	-	-	**649**
-Retirement village	-	-	-	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**250**	-	-	-	**250**
Population TOTAL	673	1,672	1,910	2,979	564	894	66	723	288	426	534	570	633	1,020	93	108	90	369	576	555	**14,743**	5,996	4,758	1,281	**26,778**
-Standalone lots, superlots, THAB	540	1,530	870	2,379	564	894	66	723	288	426	534	570	633	1,020	93	108	90	369	576	555	**12,828**	5,996	1,601	1,281	**21,706**
-Retirement village	-	-	-	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**600**	-	-	-	**600**
-School/childcare	133	142	1,040	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1,315**	-	3,157	-	**4,472**
Average Daily Demand, l/s	1.4	4.2	2.5	7.6	1.4	2.3	2.9	1.8	1.5	1.1	1.4	1.5	1.6	2.6	0.2	0.3	0.2	0.9	1.5	1.4	**38.3**	15.3	5.1	3.3	**61.8**
Peak Day Demand, l/s	2.2	6.3	3.7	12.1	2.2	3.4	4.3	2.8	2.2	1.6	2.0	2.2	2.4	3.9	0.4	0.4	0.3	1.4	2.2	2.1	**58.2**	22.9	7.6	4.9	**93.5**
Peak Hour Demand, l/s	5.4	15.7	9.2	30.4	5.4	8.5	9.7	6.9	4.1	5.2	5.1	5.4	6.0	9.7	0.9	1.0	0.9	3.5	5.5	5.3	**143.9**	57.2	18.6	12.2	**231.9**

Appendix D System performance

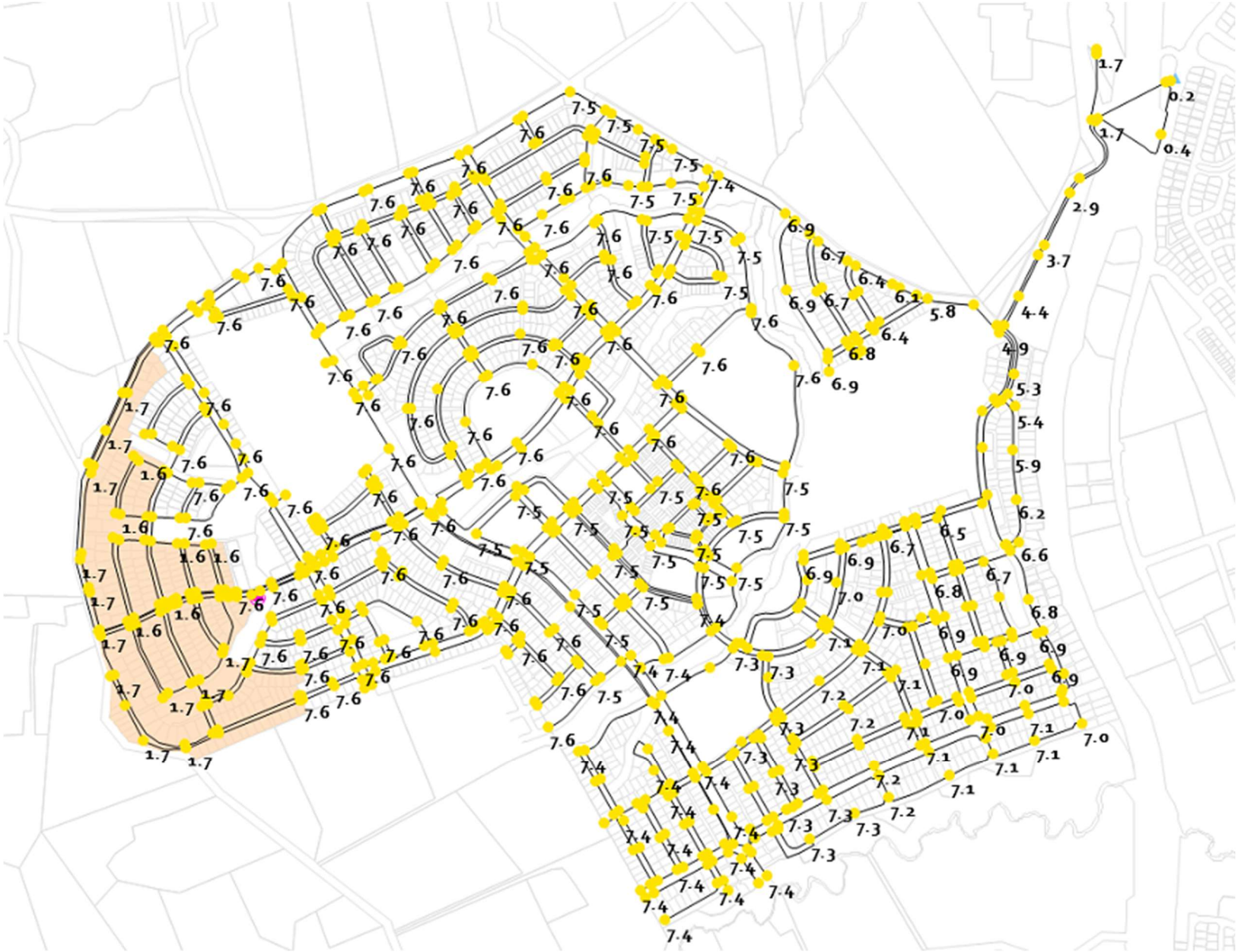
Short term scenario Minimum pressure m



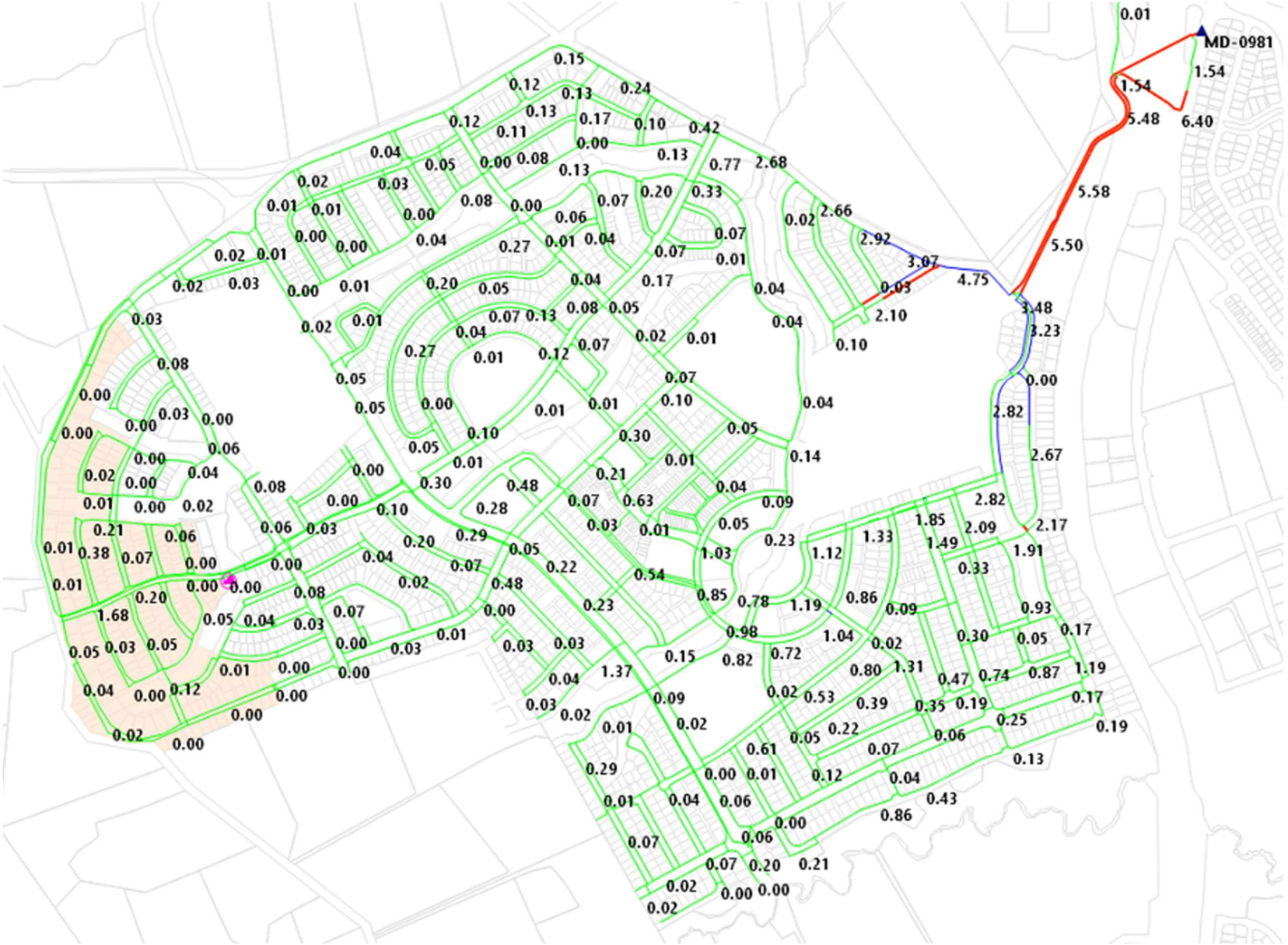
Short term scenario Maximum pressure m



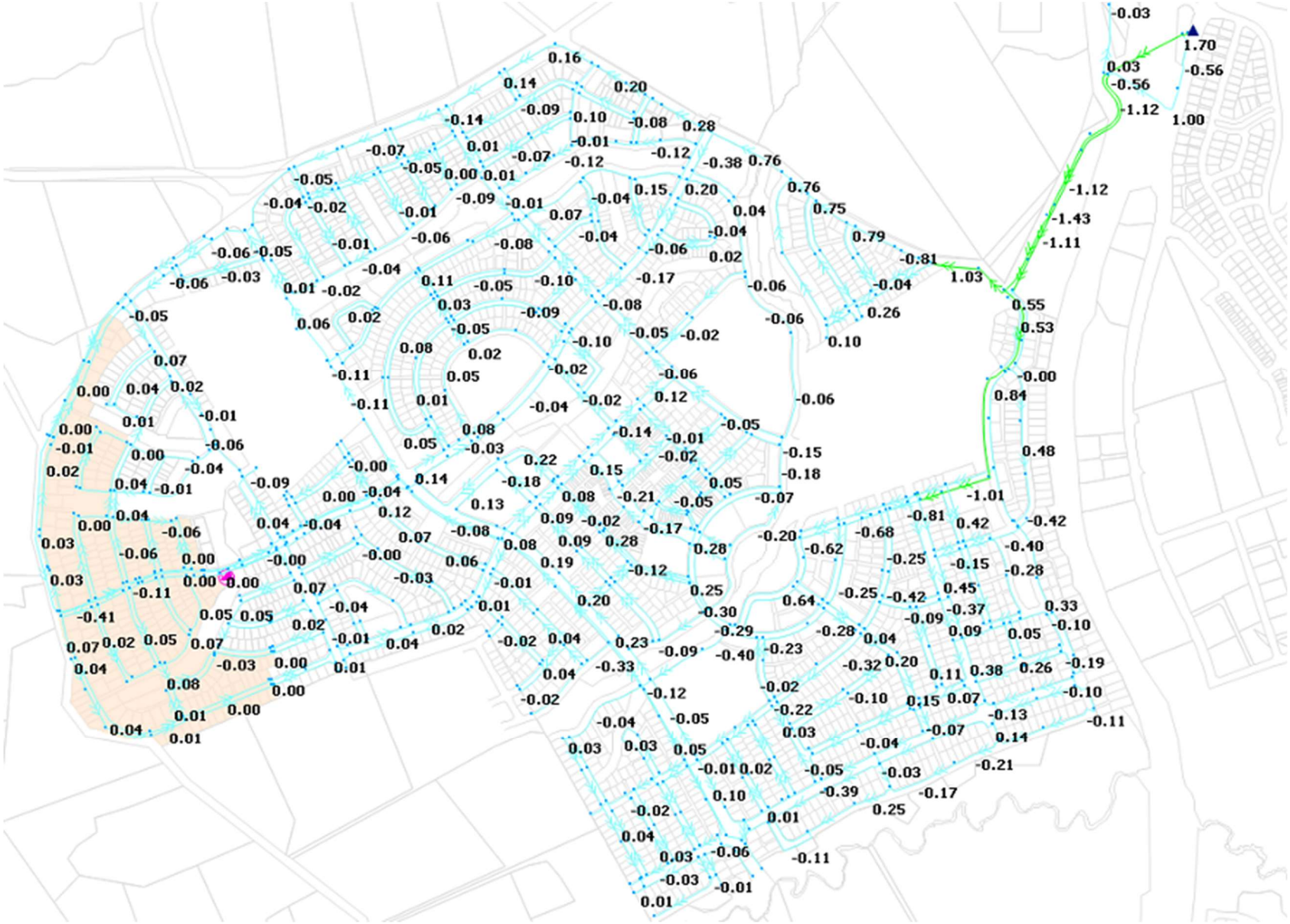
Short term scenario Pressure variation m



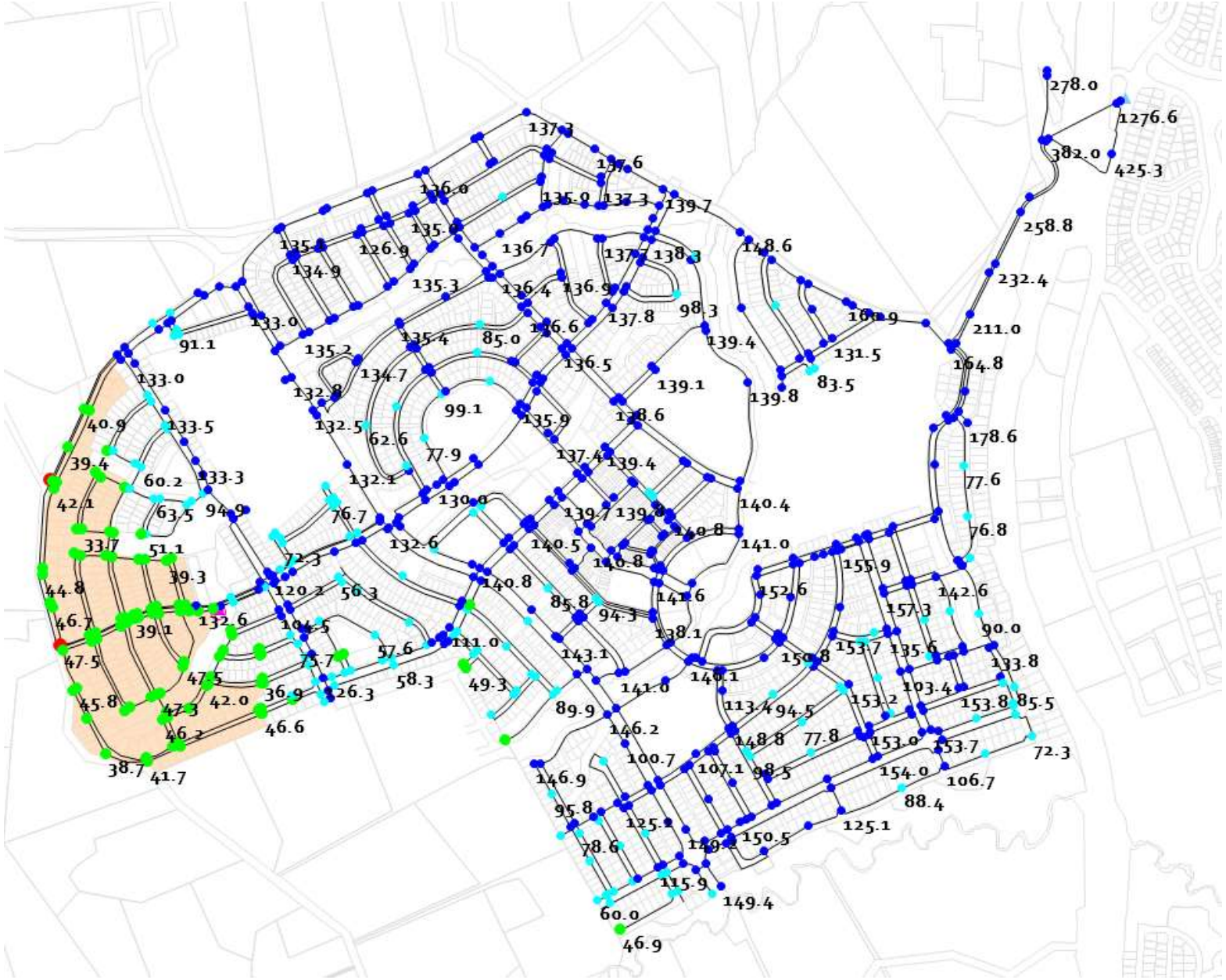
Short term scenario Maximum headloss m/km



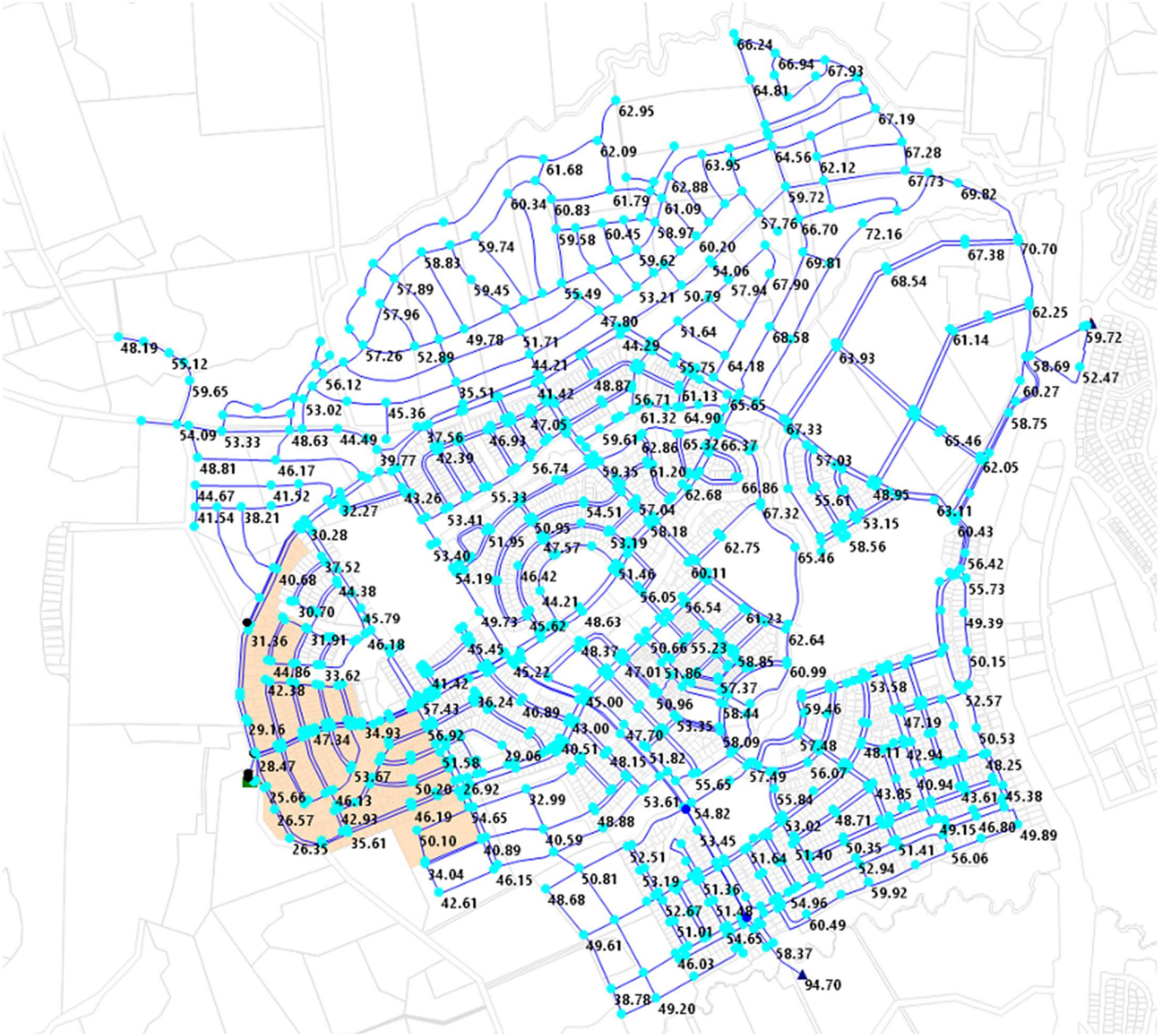
Short term scenario Maximum velocity m/s



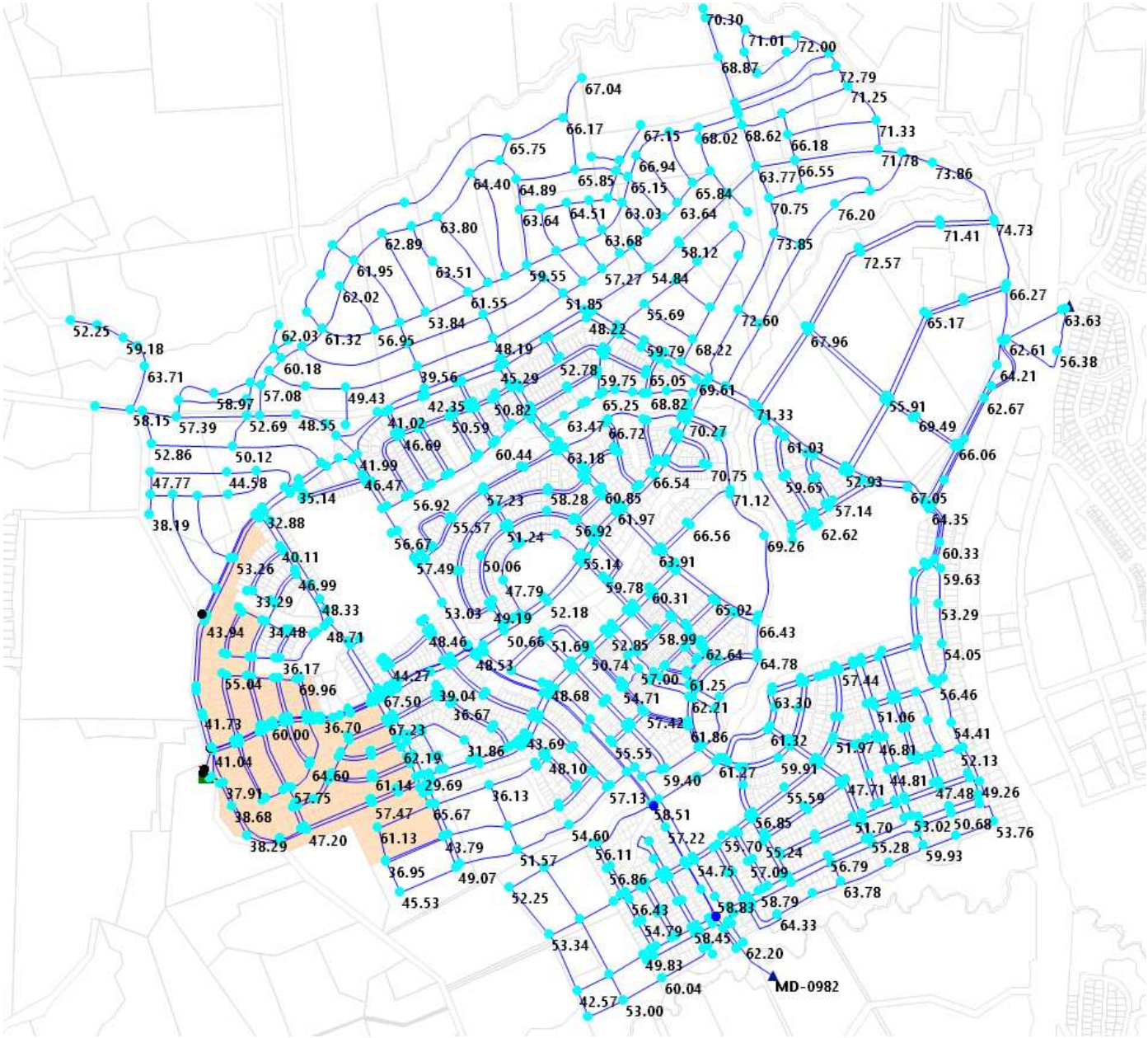
Short term scenario Available fireflow l/s at 10m residual pressure



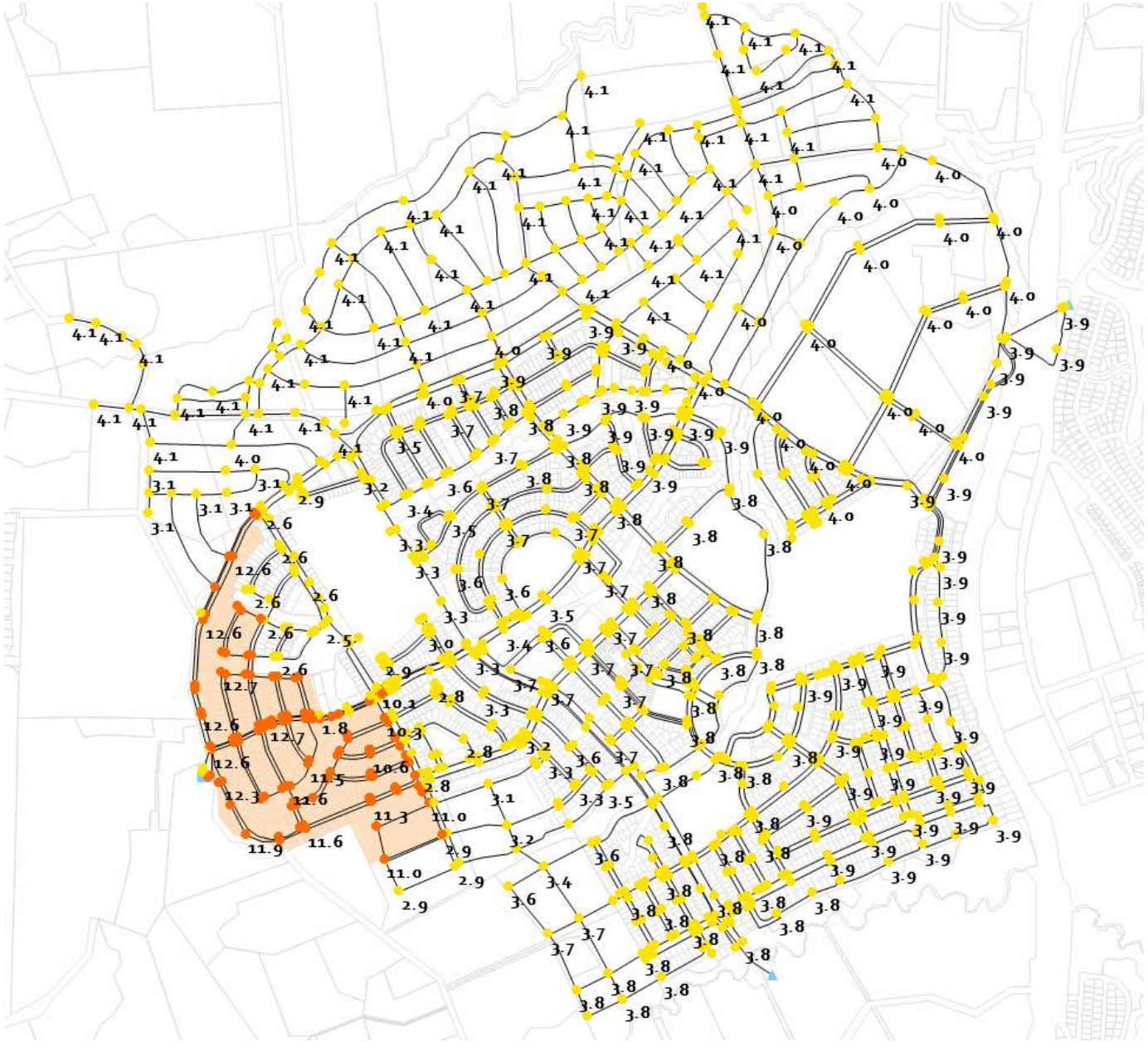
Long term scenario Minimum pressure m



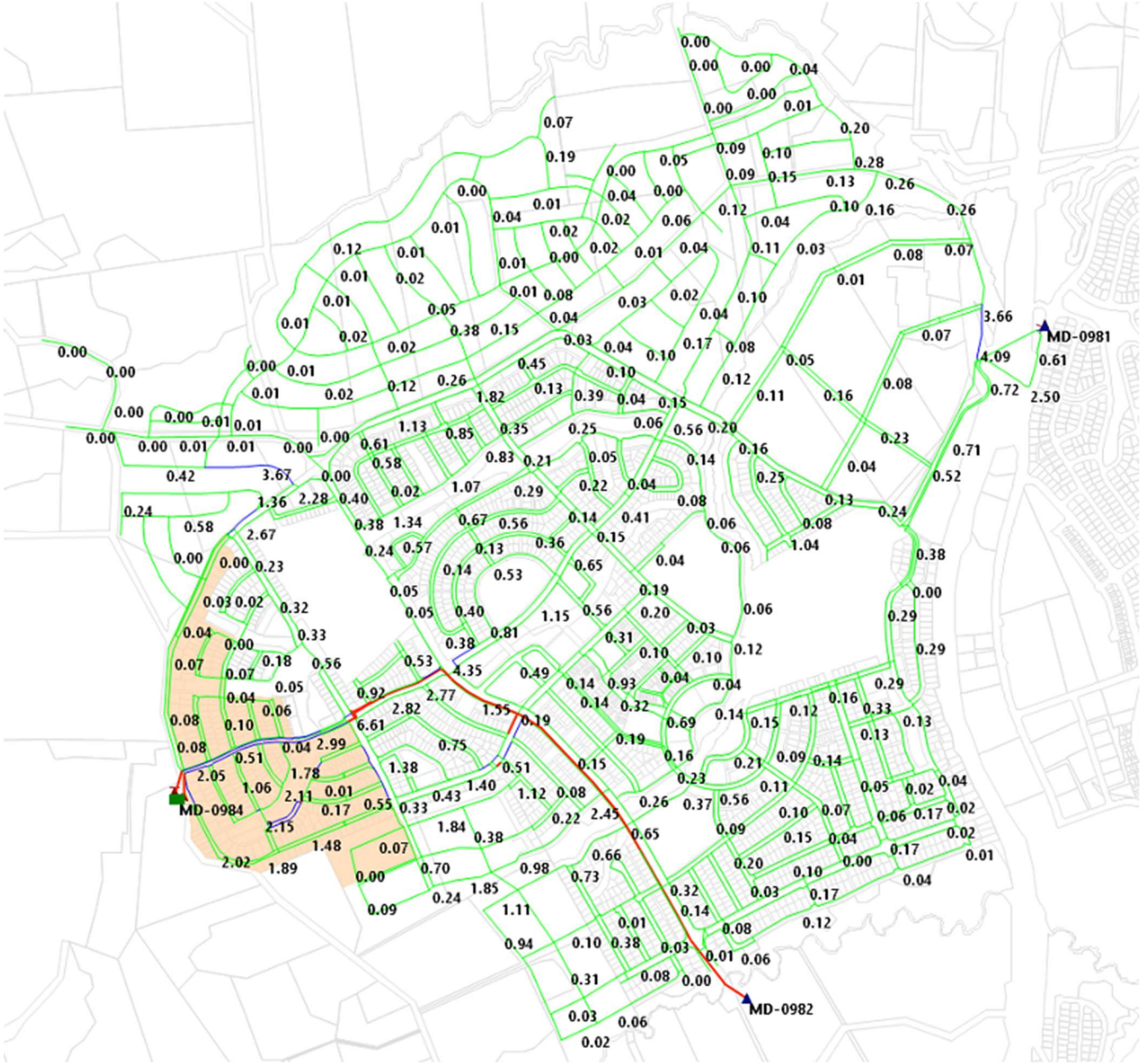
Long term scenario Maximum pressure m



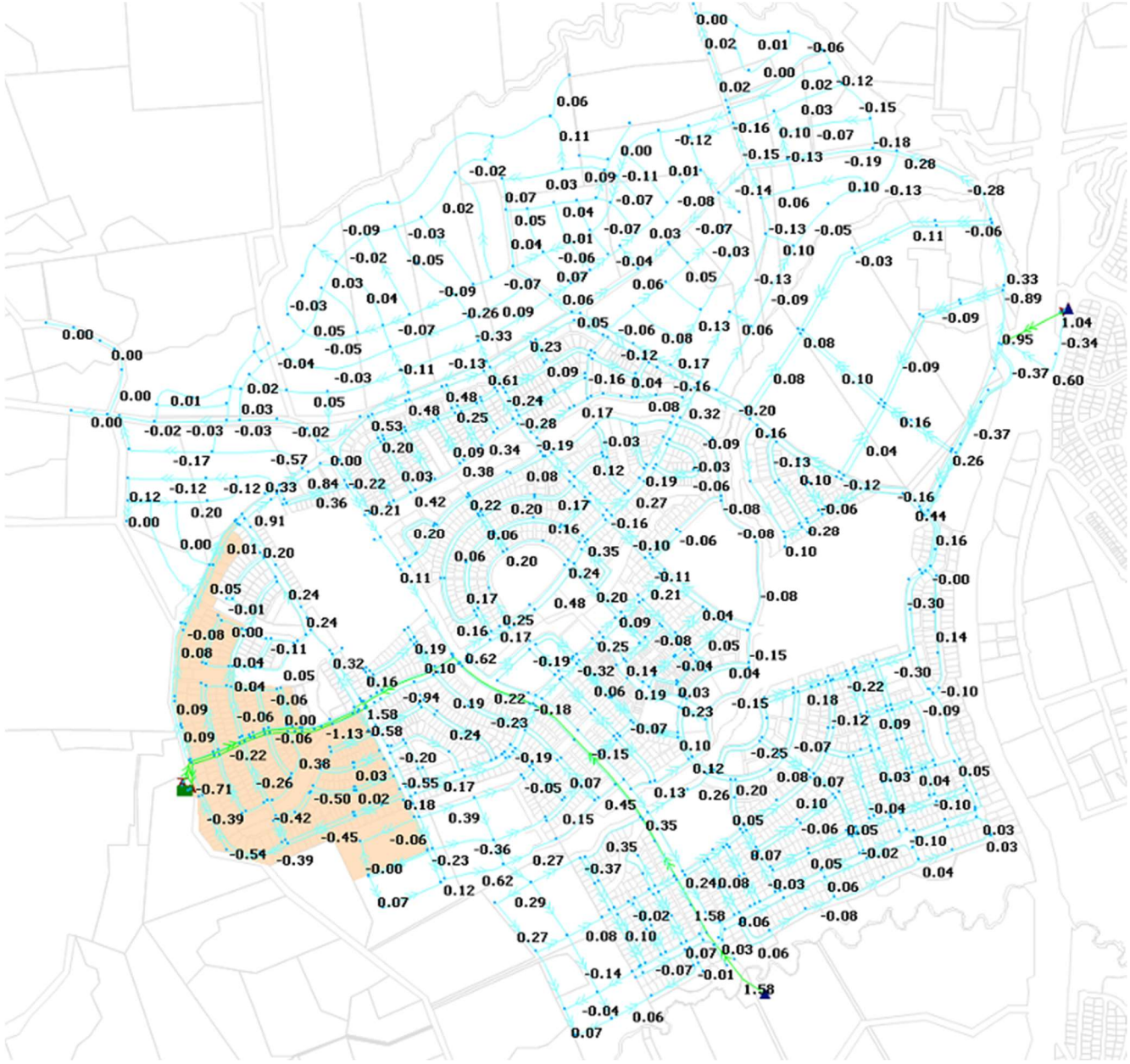
Long term scenario Pressure variation m



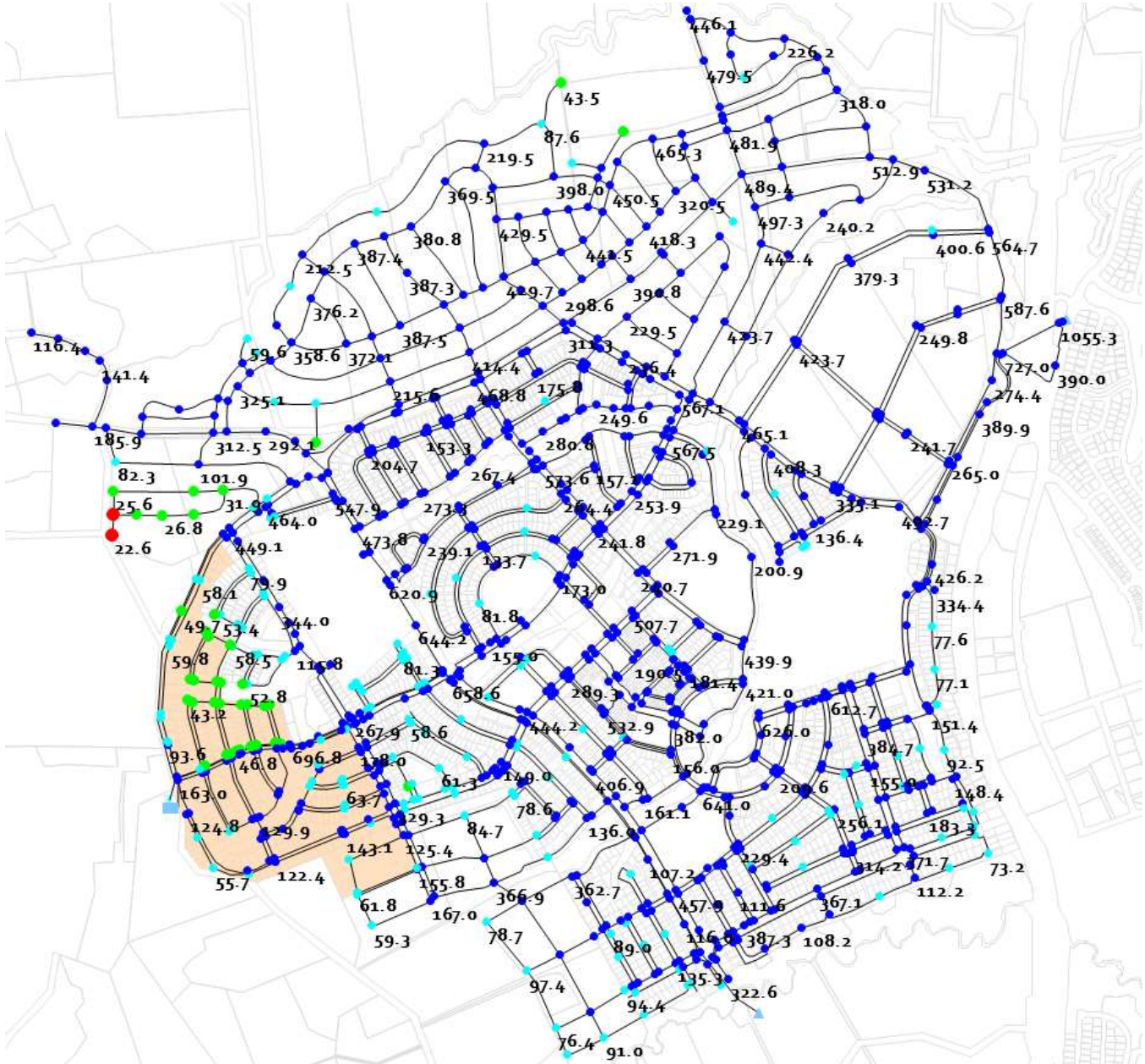
Long term scenario Maximum headloss m/km



Long term scenario Maximum velocity m/s



Long term scenario Available fireflow at 10m residual pressure l/s



Appendix F – Water Booster Pumping Station – Fast Track RC Memo

To	From
Fast Track Consenting Panel	*Woods* *Ben Pain – Principal Engineer* *Reviewer – Marcel Bear*
Cc: Fulton Hogan Land Development Ltd	*W-REF: P24-128* *20 February 2025*

Water Booster Pumping Station – Fast Track RC Memo

Milldale Development, Pine Valley

This memo has been prepared to confirm the requirement and design parameters for the proposed Water Booster Pumping Station at the Milldale Development in Pine Valley, Auckland. These will be used for the detailed design of the station.

Statement of Qualifications and Experience

I am a Principal Engineer at Wood & Partners Consultants Ltd. Woods is multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since October 2009.

I hold the qualification of Bachelor of Engineer (Civil) from the University of Auckland, which I completed in 2007. I am a Chartered member of the Engineering NZ.

I have over 16 years of professional experience in the civil infrastructure and land development industry. My experience includes the design and construction administration of many public and private pumping stations, large scale land development projects and other civil infrastructure.

I confirm that, in my capacity as author of this letter, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Requirement

Woods' 3 Waters team have prepared a report "Milldale Stages 4C, 10, 11, 12 and 13 Water Supply" dated 21st December 2024 which outlines the water supply network modelling undertaken for the development concerned in the fast track consent. For the short to medium term servicing of the zone above RL 50m, this report determined a need for a Water Booster Pumping Station until the supply from Orewa 3 main is available. See Figure 1.

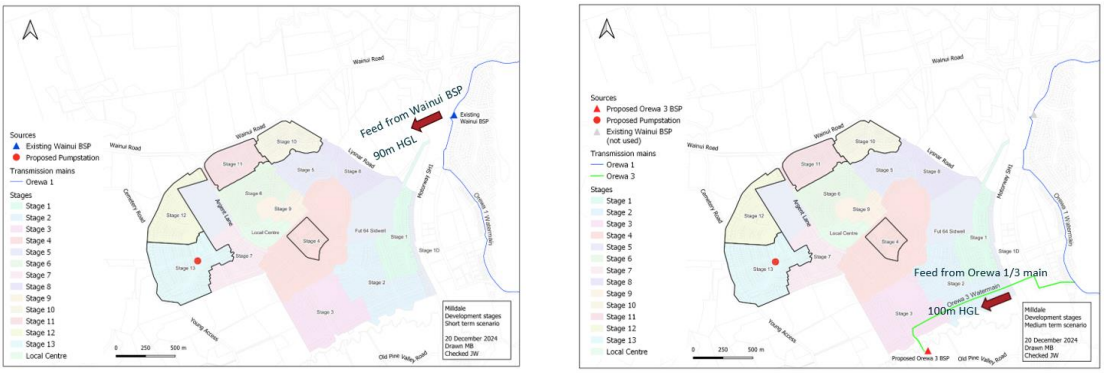


Figure 1: Short- & Medium-term network model maps

Pumpstation duty point

The water supply modelling requires the following pump duties:

- Water Supply boost case of 8.0 l/s @ 23m Head
- Fire Supply boost case of 31.0 l/s @ 10.0m Head

The requirements for the pump station's pipelines are DN150mm connections to and from the pumping station to connect onto the DN300mm main on the street.

Design Standards

The proposed booster pumping station shall be designed in accordance with:

- Watercare Services Ltd's "Standard for Network Water Pump Stations" DP-15 Version 1 (18 June 2020) and "Water pump station drawings for networks" DW04 Version 1 (19/08/2016)
- Watercare Services Ltd's "Code of Practice for Land Development and Subdivision – Water Supply Only" COP-01 Version 2.4 (1 June 2021) for Water Demands
- Watercare Services Ltd's "Architectural Design Guidelines" DP-12 Version 1.0 (8 June 2020)
- New Zealand Fire Service "Firefighting Water Supplies Code of Practice" SNZ PAS 4509:2008

Integration into Open Space

In accordance with WSL's Architectural Design Guidelines, the pump station shall be designed to integrate with the adjacent public open space. A concept urban design assessment will be completed as part of preliminary design and any modifications to the site will be detailed at Engineering Plan Approval Stage.

Key Design Parameters

The key design parameters for the proposed booster pumping station shall be as follows:

PARAMETER	VALUE
Pump Station Site Requirements	
- Access	24 Hours access with parking, manoeuvrability, and access to all components within lot area.
- Building	An acoustically rated building to house the pump set and control cabinet complete with doors suitable for maintenance access, lighting, ventilation, equipment storage and emergency lighting.
- Electrical Requirements	Dedicated underground mains supply from link pillar, external lighting, earthing and provisions for a temporary on-site generator.
- Landscaping	Integration with Open Space / Place in accordance with WSL Architectural Standards. Fencing to be provided between residential properties on boundary or on top of retaining walls.
- Earthworks Requirements	Level aspect with boundary and contamination free site located min 500mm above 100 year flood level.
Pump Requirements	
- Boost Range	Water Supply boost case of 8.0 l/s @ 23m Head Fire Supply boost case of 31.0 l/s @ 10.0m Head
- Velocity Range	0.5 to 2.0 m/s
- Arrangement	Duty / Assist (if required) / Standby / Fire
- Pump Selection	Multi pump set as open system to cope with variable demand selected with: - Combined efficiency at BEP at 80% or higher - Pump selection within 5% of BEP - 10% inaccuracy factor for friction losses (ie selected at 45 Hz)
- Noise & Vibration	Acoustic considerations in building and ventilation with vibration isolation provided at pump set feet.
Other Station Requirements	
- Meters	Magflow meters on incoming and outgoing pipelines
- Water sampling	Water sampling within pump house
- Service connections	Connections for SW, WW, Power & Comms
- SCADA Connection	Antenna on Building to connect to SCADA. Signal testing to occur as part of detailed design.
- Bypass System	Pipework configuration to allow for bypass of pump station
- Maintenance	Portable lifting equipment on site rated to pump weight.
- Lot Ownership	Agreed lease as pump station is a temporary requirement (circa 10 years)

Approval Process

This memo forms part of the WSL's Standards (DP-15) design process (Section 5) for Network Water Supply Booster Pumping Stations, which a draft approval is sought from WSL. Once this is received as part of this Resource Consent, detailed design shall commence, and an Engineering Plan Approval (EPA) application shall be the pumping station.

Yours sincerely

Ben Pain

Principal Engineer

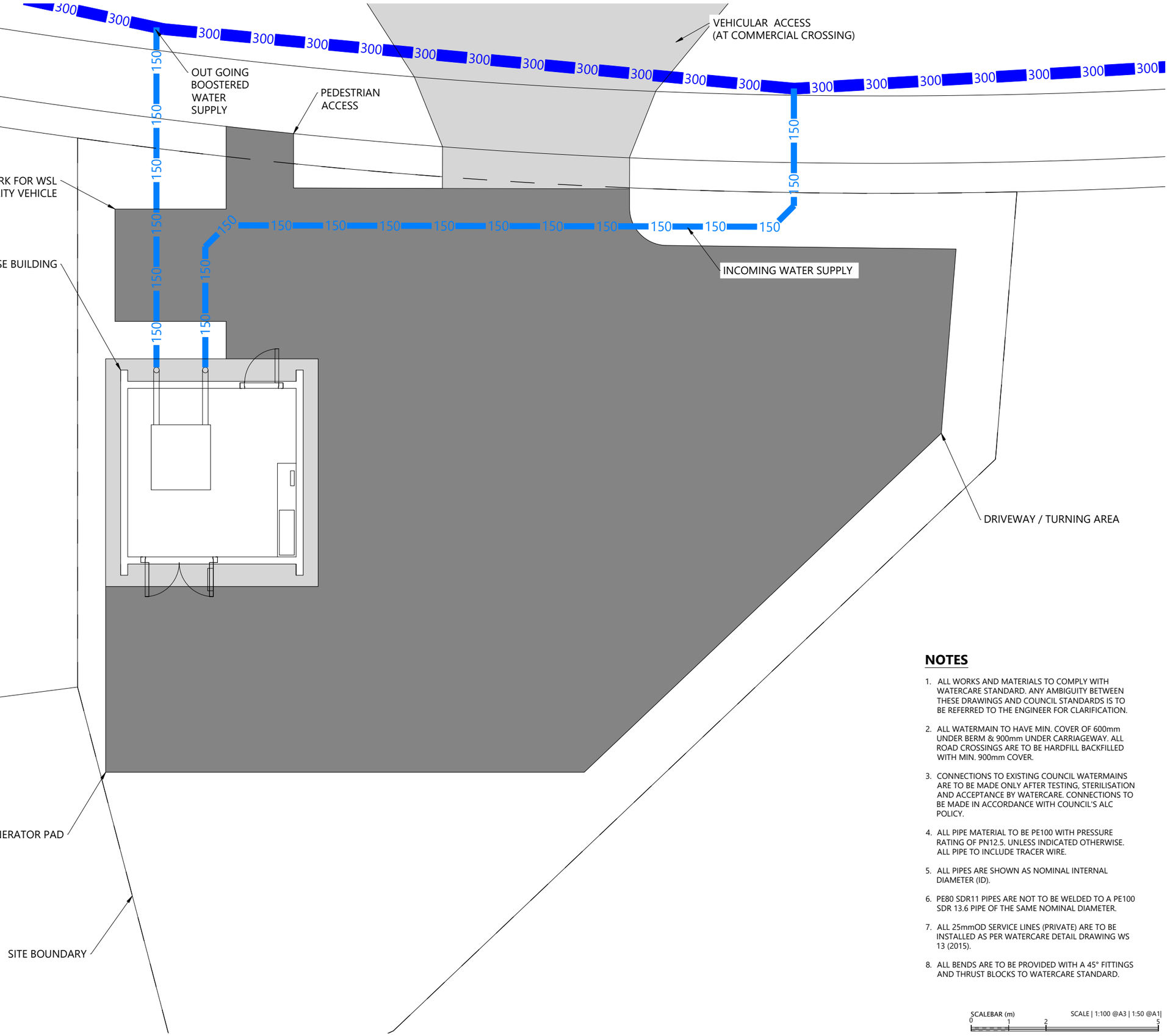
Ed Ryan

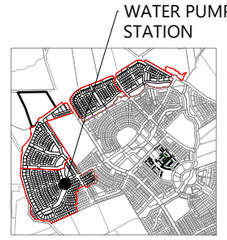
Senior Mechanical Engineer

Attachments:

1) RC Plans
2) Preliminary Pump Selections

Attachment 1 – RC Plans





LOCALITY PLAN
N.T.S

NOTES

1. ALL WORKS AND MATERIALS TO COMPLY WITH WATERCARE STANDARD. ANY AMBIGUITY BETWEEN THESE DRAWINGS AND COUNCIL STANDARDS IS TO BE REFERRED TO THE ENGINEER FOR CLARIFICATION.
2. ALL WATERMAIN TO HAVE MIN. COVER OF 600mm UNDER BERM & 900mm UNDER CARRIAGEWAY. ALL ROAD CROSSINGS ARE TO BE HARDFILL BACKFILLED WITH MIN. 900mm COVER.
3. CONNECTIONS TO EXISTING COUNCIL WATERMAINS ARE TO BE MADE ONLY AFTER TESTING, STERILISATION AND ACCEPTANCE BY WATERCARE. CONNECTIONS TO BE MADE IN ACCORDANCE WITH COUNCIL'S ALC POLICY.
4. ALL PIPE MATERIAL TO BE PE100 WITH PRESSURE RATING OF PN12.5. UNLESS INDICATED OTHERWISE. ALL PIPE TO INCLUDE TRACER WIRE.
5. ALL PIPES ARE SHOWN AS NOMINAL INTERNAL DIAMETER (ID).
6. PE80 SDR11 PIPES ARE NOT TO BE WELDED TO A PE100 SDR 13.6 PIPE OF THE SAME NOMINAL DIAMETER.
7. ALL 25mmOD SERVICE LINES (PRIVATE) ARE TO BE INSTALLED AS PER WATERCARE DETAIL DRAWING WS 13 (2015).
8. ALL BENDS ARE TO BE PROVIDED WITH A 45° FITTINGS AND THRUST BLOCKS TO WATERCARE STANDARD.

SCALEBAR (m) 0 1 2 5
SCALE | 1:100 @A3 | 1:50 @A1|

REVISION DETAILS		BY	DATE
1	ISSUED FOR CONSENT	BP	JAN 25

SURVEYED	WOODS	SIDWELL ROAD WAINUI AUCKLAND
DESIGNED	WOODS	
DRAWN	BP	
CHECKED	ER	
APPROVED	JW	WOODS.CO.NZ

MILLDALE
Connecting Lifestyles

MILLDALE FAST TRACK STAGES 10 - 13

WATER BOOSTER PUMPING STATION LAYOUT PLAN

STATUS	ISSUED FOR CONSENT	REV
SCALE	1:100 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-00-5500-WR	

Plot Date: 11:13:41 am,11 February 2025, BENP

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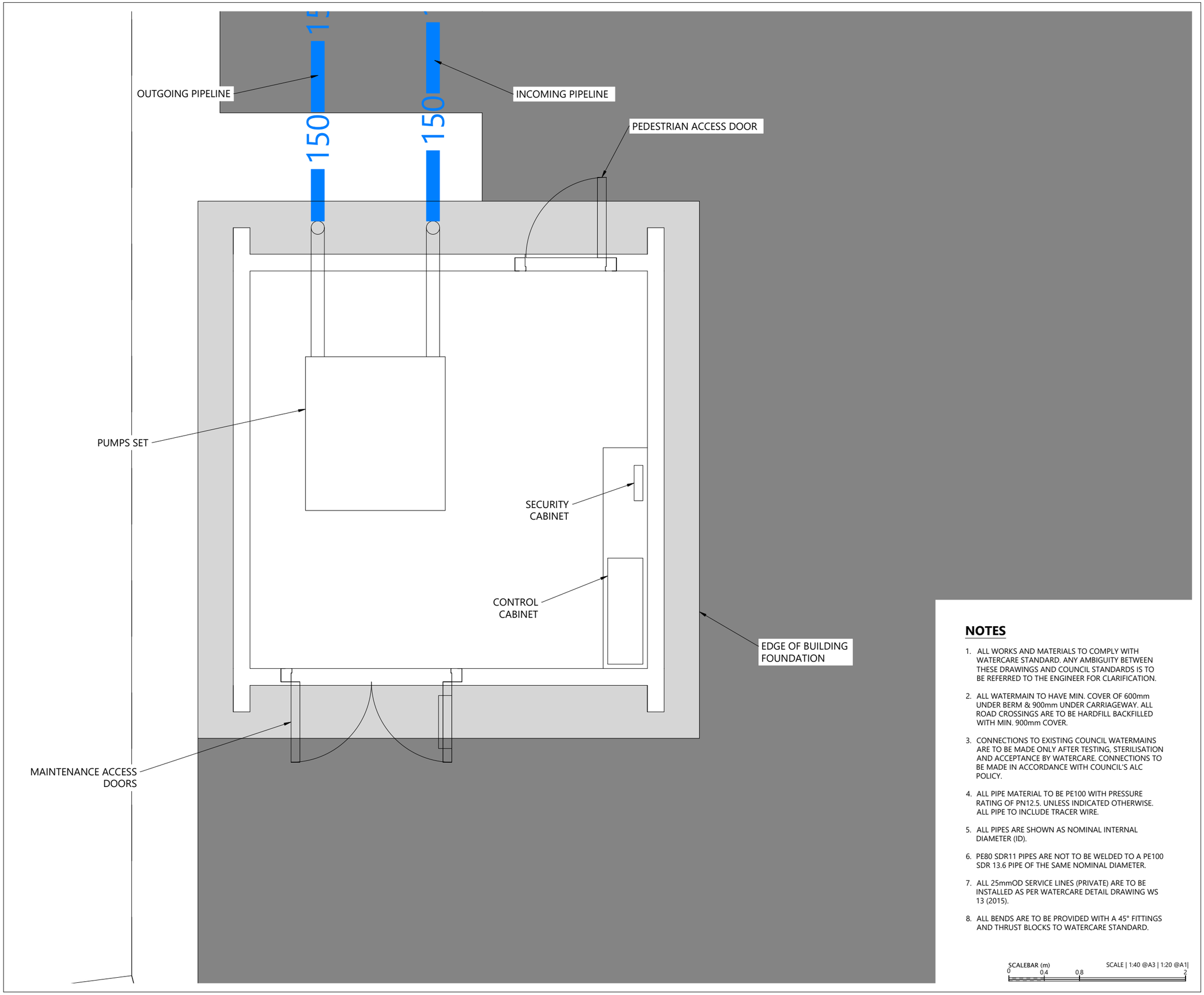

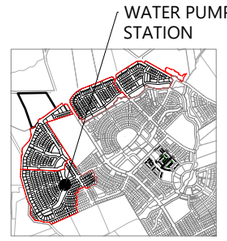

LOCALITY PLAN
N.T.S

WOODS
Est.1970

NOTES

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SCALEBAR (m) 0 0.4 0.8 2
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REVISION DETAILS		BY	DATE
1	ISSUED FOR CONSENT	BP	JAN 25

SURVEYED	WOODS	SIDWELL ROAD WAINUI AUCKLAND
DESIGNED	WOODS	
DRAWN	BP	
CHECKED	ER	
APPROVED	JW	WOODS.CO.NZ

MILLDALE
Connecting Lifestyles

MILLDALE FAST TRACK STAGES 10 - 13

WATER BOOSTER PUMPING STATION BUILDING LAYOUT PLAN

STATUS	ISSUED FOR CONSENT	REV
SCALE	1:40 @ A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-00-5501-WR	

Plot Date: 11:13:42 am,11 February 2025, BENP

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Attachment 2 – Preliminary Pump Selections

Brown Brothers Engineers Ltd

QUOTATION

To: Woods **Date:** 24/01/25

Att: Ed Ryan **Reference:** AJS250124122141 V1

Subject: Milldale Bulk Water Pumpset

Hi Ed, please see below our selection based on the estimated duty from our discussion-as noted the actual Fire pump duty head would be determined by the pipe size & distance to the Hydrants from the pump so there is spare capacity built into our selection.

1. Cold Water Booster Pumpset + Firepump
Retic Estimated Duty: 8 lps @ 23m
Firepump Estimated Duty: 31 lps @ 10m
Model 15SVX05F055T-Duplex HydroPac + 92SV02G150T Firepump
Set includes the following:

- 2 x Lowara 15SVX05F055T vertical multistage pumps, complete with 5.5kW, 2900 rpm, motors.
- 2 x HydrovarX variable speed pump controllers mounted directly on the pump motors.
- 1 x 92SV02G150T variable speed controlled Firepump set to start on pressure drop when flow exceeds Retic
- 3 x pressure transducers connected to the Hydrovar's to ensure a constant pump discharge pressure.
- 3 x 40 litre pressure tanks, mounted on discharge manifold.
- 150mm Stainless steel pump manifolds with pressure gauge, isolating & check valves all mounted on a pressed stainless-steel base.
- Electrical panel with run/fault lights & VFC for BMS.
- Fully wired, programmed & tested before shipping from our factory.

[redacted]

Delivery: 10 weeks, subject to confirmation at time of order.

Warranty: 24 months against parts and workmanship deemed faulty at time of manufacture. Both Brown Brothers and our suppliers standard warranty policies apply. Warranty period commences from date of delivery.

Quotation Validity: 30 Days from date of this quotation.

Terms and conditions: Brown Brothers Engineers Ltd terms and conditions of sale apply to this quotation. For a copy of BBE standard terms and conditions please contact our office.

We trust this quotation meets your immediate needs. Feel free to contact us if you require anything further.

Kind Regards,

Adam Souness
BROWN BROTHERS ENGINEERS LTD

LOWARA
a xylem brand

GHV20/15SVX05F055/4

Technical data

Company name
Contact
Phone number
e-mail address

Operating data

1	Pumpe type	Single-/Multi-pump set		Fluid	Water, pure		
2	No. of pumps		2	Operating temperature t A		°C	4
3	Nominal flow	l/s	8	pH-value at t A			7
4	Nominal head	m	23	Density at t A		kg/m³	1000
5	Static head	m	0	Vapor pressure at t A		kPa	100
6	Inlet pressure	kPa	0	Kin. viscosity at t A		mm²/s	1.569
7	Environmental temperature	°C	20	Altitude			0
8	Available system NPSH	m	0				

Pump data

9	Product version		[X] - Hydrovar X+
10	Operating speed		2040 rpm
11	Stages		5
12	Max. working pressure	kPa	1060.2
13	Head H(Q=0)	m	110
14	Power input P1(max)	kW	12.4
15	Total weight	kg	230.0
16	Power input	kW	1.6
17	Overall efficiency	%	57.4
18	Shaft power	kW	1.3
19	Pump efficiency	%	67.1
20	NPSH 3%	m	1.27
21			

Materials

	Pump		Options		
22					
23	Manifolds	Stainless steel, 1.4301, AISI 304	GHV Non-return valve		Non return valve in delivery side
24	On-off valves ball type	Nickel-plated brass	Additional Card		No card
25	Non-return valves	Brass	Analog Device		Standard
26	Pressure switches	Galvanized steel/AISI 301	Condensation Resistance		Standard
27	Pressure trasmitters	AISI 304L & AISI 316L	Control Devices Oversized		Standard
28	Caps/plugs	AISI 304 or superior	Control Panel		Standard
29	Sliding/Blind flanges	Galvanized steel	Control Panel cloud connection		Standard without
30	Welded flanges	Stainless steel, 1.4301, AISI 304	Control Panel Position		Standard position
31	Fittings	Stainless steel, 1.4401, AISI 316	Control Panel Protection Degree		Standard
32	Bracket	Galvanized steel/painted steel	DACH - Control Panel mounted on		Standard
33	Base	Painted steel	DACH - Optical sensor for lack/presence of water		None
34			Control Panel Options		Standard
35			Delivery Side		Standard delivery
36			Double Pressure Transmitter		Standard
37			Electric Pump Special Seals		Standard
38			Emergency		Standard
39			High Pressure Protection		Without high pressure protection on delivery
40			N.A.		
41			N.A.		

Motor data

42	Manufacturer	Lowara e-XM			Phase Missing		Standard
43	Specific design	IE5 Three phase motor			N.A.		
44	Type	EXM132B5/4.055BH2			Protection Against Dry Running		Without protection against dry running
45	Rated power	5.5 kW	Rated current	11.4 A	Pump Test		Set without certified pumps
46	Nominal speed	3600 rpm	Rated voltage	380 V	Suction Side		Standard suction
47	Frame size	132	Motor efficiency %	90.6	Timer		Standard
48	Weight kg	37.2	Power factor	0.8			

Remarks

49	
50	
50	
52	

LOWARA
a xylem brand

GHV20/15SVX05F055/4

Performance curve

Company name
Contact
Phone number
e-mail address

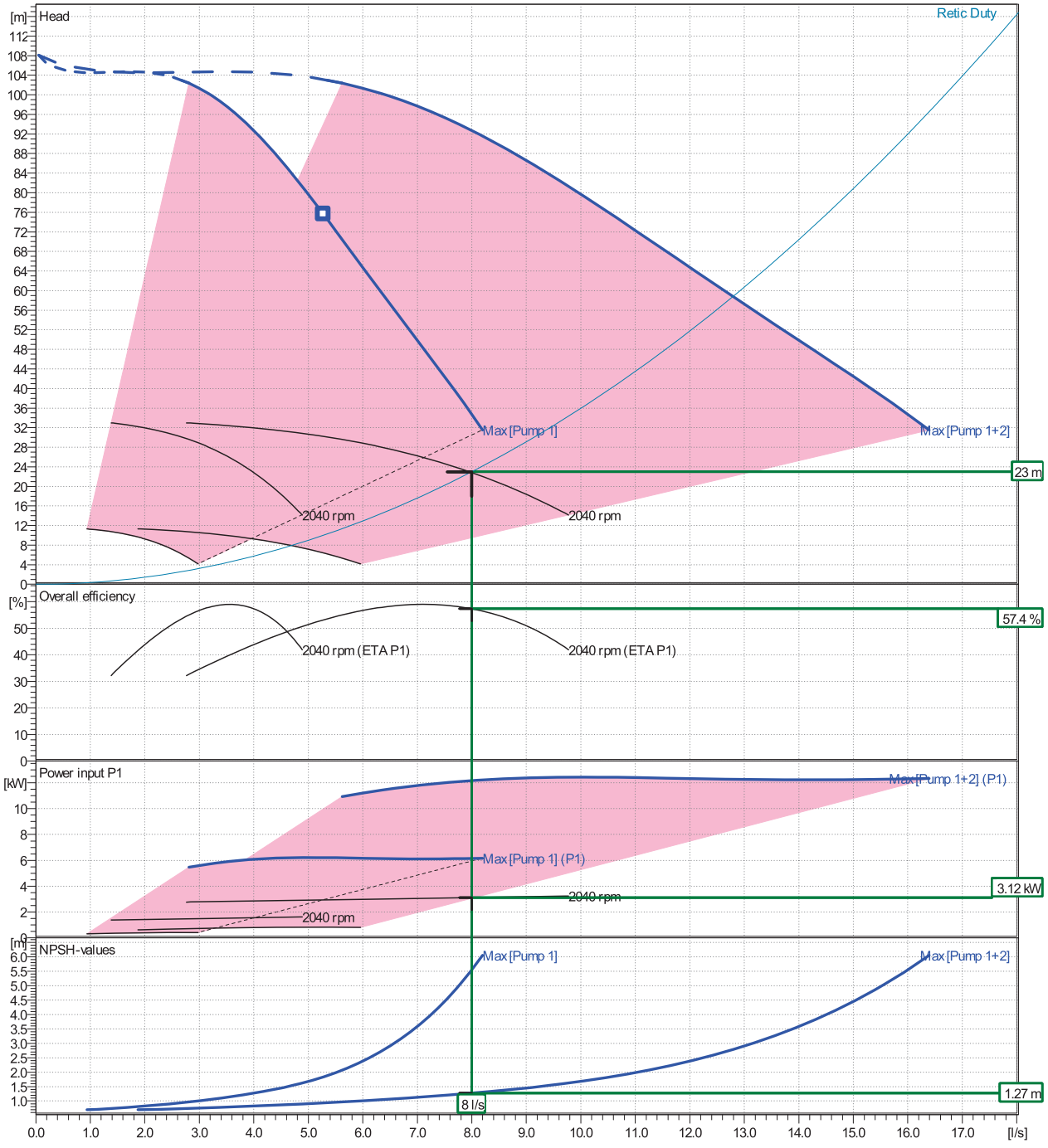
Ø	Pump capacity Operating range Min. l/s	Max. l/s	η Max. l/s	Pump head H(Q=0) m	η Max. m
Max.	2.81	8.2	5.28	108	75.6

Frequency	Hz	50/60
Operating speed	rpm	2040
Nominal flow	l/s	8
Nominal head	m	23
Inlet pressure	kPa	0
Static head	m	0

hydr. Performance acceptance acc. To EN ISO 9906 Class 2B

Power datas refered to:

Water, pure [100%] ; 4°C; 1000kg/m³; 1.57mm²/s



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Program version: 75.0 - 06/11/2024 (Build 274)
Data version: 18/01/2025 09:55
User group(s): Xylem:Products - Grindex, New Zealand - EXT

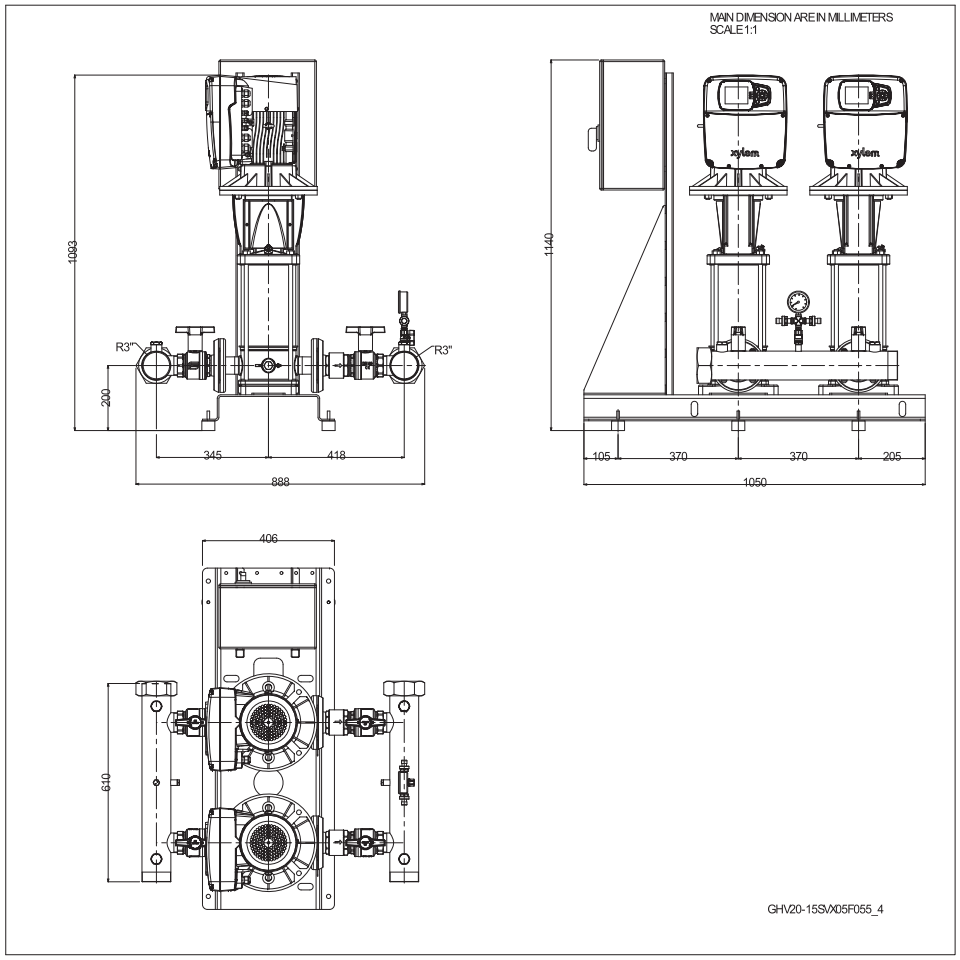
LOWARA
a xylem brand

GHV20/15SVX05F055/4

Dimensions

Company name
Contact
Phone number
e-mail address

[X] - Hydrovar X+
EXM132B5/4.055BH2



Dimensions and weight without obligation

Project	**Xylect-20083341**	**Created by**	**Adam Souness**	**Last update**	**1/22/2025**
Block	**GHV20/15SVX05F055/4**	**Created on**	**1/22/2025**		

LOWARA
a xylem brand

92SV2G150T/D

Technical data

Company name
Contact
Phone number
e-mail address

Operating data

Pumpe type	Single head pump		Fluid		Water, pure
Available system NPSH	m	0	Operating temperature t A	°C	4
Nominal flow	l/s	31	pH-value at t A		7
Nominal head	m	25	Density at t A	kg/m³	1000
Static head	m	0	Kin. viscosity at t A	mm²/s	1.569
Inlet pressure	kPa	0	Vapor pressure at t A	kPa	100
Environmental temperature	°C	20	Solids		0
			Altitude	m	0

Pump data

Make	Lowara				Nominal	l/s	( )
Speed		rpm 2900	Flow		Max-	l/s 33.3	
Number of stages		2			Min-	l/s	
Max. casing pressure		kPa			Nominal	m	
Max. working pressure		kPa 665	Head		at Qmax	m 29.6	
Head H(Q=0)		m 68			at Qmin	m 67.8	
Weight		kg 183	Shaft power			kW	( )
	Max.	mm 146	Max. shaft power			kW 14.8	
Impeller R	designed	mm 146	Efficiency			%	
	Min.	mm 146	NPSH 3%			m	

Pump Materials

Pump body	Cast iron
Lower support	Cast iron
Impeller	Stainless steel / AISI 316L
Diffuser	Stainless steel / AISI 304
Outer sleeve	Stainless steel / AISI 304
Shaft	Stainless steel / AISI 431
Adapter	Cast iron
Wear ring	Technopolymer PPS
Coupling	Cast iron
Upper head	Cast iron
SEAL HOUSING	Cast iron
Coupling protection	Stainless steel / AISI 304
Shaft sleeve and bushing	Tungsten carbide
Bushing for diffuser	Carbon
Fill / drain plugs	Stainless steel / AISI 316

Shaft Seal

e-SV Mechanical seal	Roten
e-SV - Uniten (-30 / +120 °C)	
1 - Rotating part	Silicon Carbide
2 - Stationary part	Resin impregnated carbon
3 - Elastomers	EPDM
4 - Springs	AISI 316
5 - Other components	AISI 316

Motor data

Manufacturer	Lowara	Electric voltage	400 V	Speed	2940 rpm	Insulation class	F
Specific design	IE3 3ph Flange Motor - Premium Efficiency			Frame size	160 M	Colour	RAL 5010
Type	PLM-3MAS 160 B5 15 kW						
Rated power	15 kW	Degree of protection	IP55				
Electric current	26.6 A						

Remarks:

LOWARA
a xylem brand

92SV2G150T/D

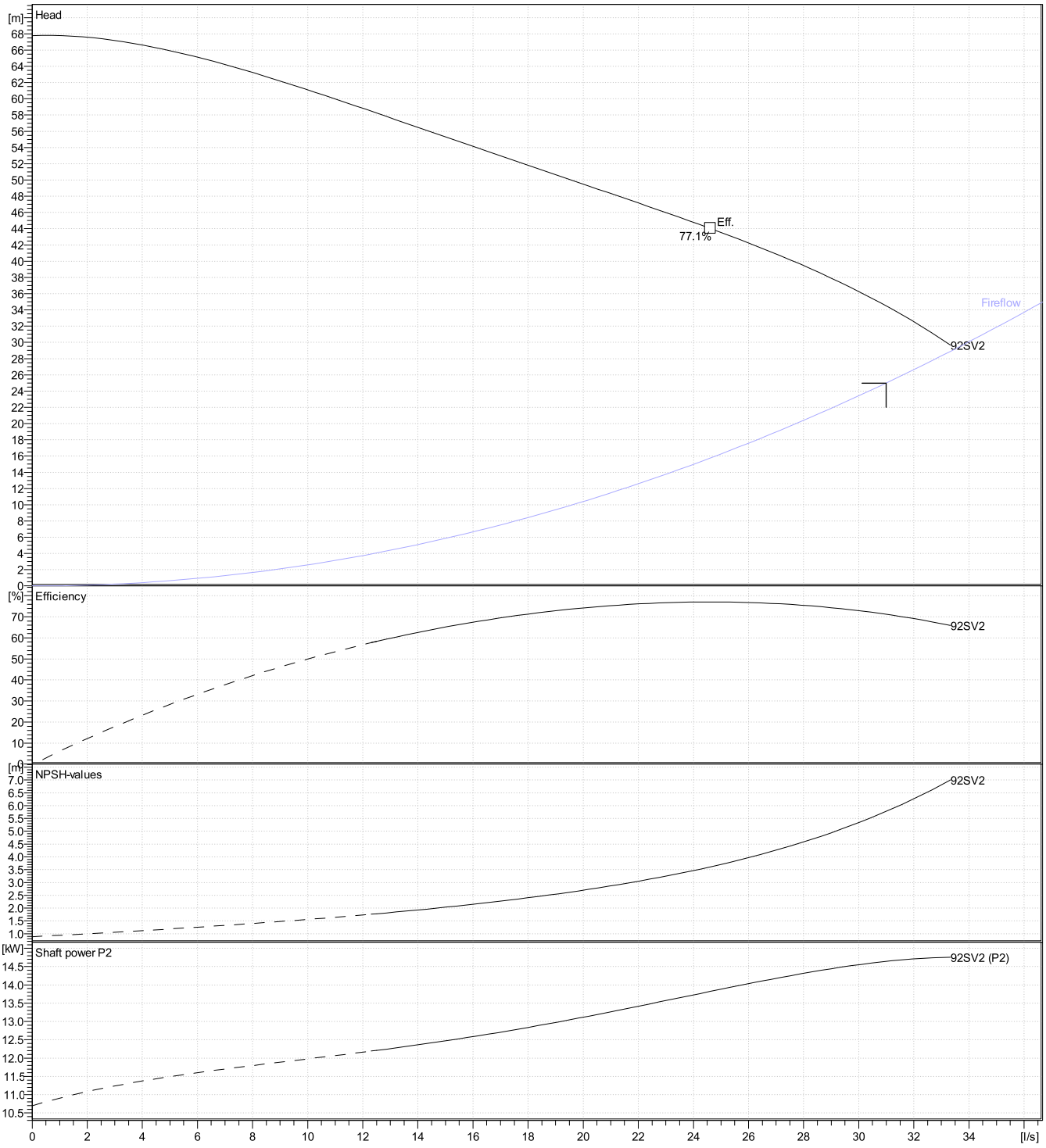
Performance curve

Company name
Contact
Phone number
e-mail address

Hydraulic data

Operating Data Specification		Hydraulic data (duty point)		Impeller design	
Flow	31 l/s	Flow		Impeller R	146 mm
Head	25 m	Head		Frequency	50 Hz
Static head	0 m	MEI >=0,7		Speed	2900 rpm

Power datas refered to:
Water, pure [100%] ; 4°C; 1000kg/m³; 1.57mm²/s
Performance according to ISO 9906:2012 – Grade 3B



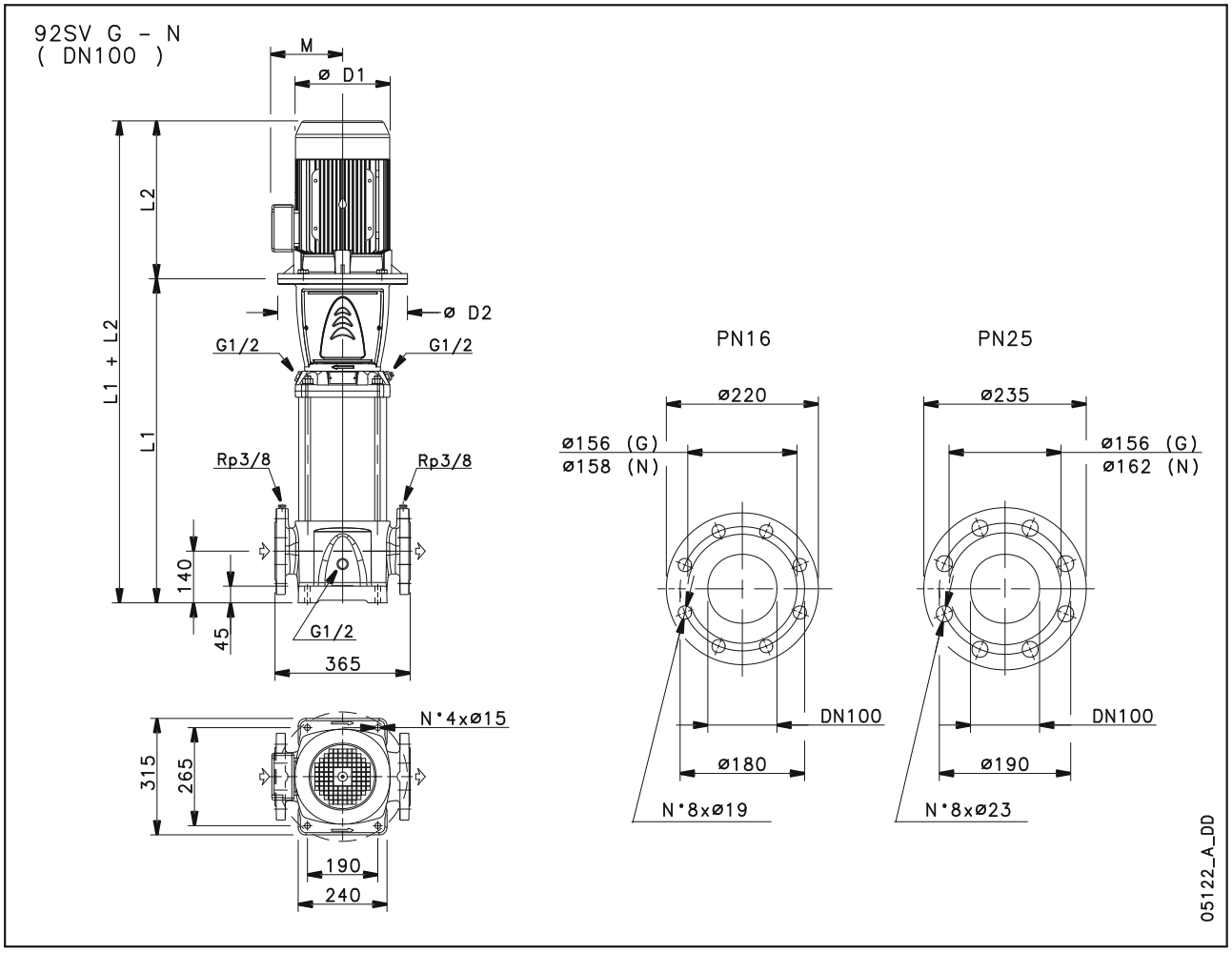
LOWARA
a xylem brand

92SV2G150T/D

Dimensions

Company name
Contact
Phone number
e-mail address

Drawing



Dimensions mm

Electrical and dimensional data refer to IE3 motor

D1 D2 L1 L2 M	313 350 699 494 240					Weight 200 kg

Project	**Xylect-20095088**	**Created by**	**Adam Souness**	**Last update**	**1/24/2025**
Block	**92SV2G150T/D**	**Created on**	**1/24/2025**		

Program version
75.0 - 06/11/2024 (Build 274)

Data version
18/01/2025 09:55

User group(s)
Xylem:Products - Grindex, New Zealand - EXT

8.7 Electrical specifications

See the motor data plate.

Permitted tolerances for the supply voltage

Frequency Hz	Phase ~	No. of conductors + earth	UN, V ± %
50	1	2 + 1	220÷240 ± 6
	3	3 + 1	230/400 ± 10, 400/690 ± 10
60	1	2 + 1	220÷230 ± 6
	3	3 + 1	220/380 ± 5, 380/660 ± 10

8.8 Sound pressure

Measured in free field at a distance of one metre from the unit, with standard motor operating without load.

50 Hz motors

Table 2: Sound pressure level LpA, dB ± 2

Power, kW (hp)	2 poles	4 poles
0.25 (0,33)	-	<70
0.37 (0.5) – 0.55 (0.7) – 0.75 (1) – 1 (1,3) – 1.5 (2) – 2.2 (2.9) 3 (4) – 4 (5.4) – 5.5 (7.4) – 7.5 (10)	<70	<70
11 (14.8)	73	-
15 (20) – 18.5 (25) – 22 (30)	75	-
30 (40) – 37 (50)	74	-
45 (60)	78	-
55 (74)	84*	-

* Sound pressure level LwA: 95 dB ± 2

60 Hz motors

Table 3: Sound pressure level LpA, dB ± 2

Power, kW (hp)	2 poles	4 poles
0.25 (0.33)	-	< 70
0.37 (0.5) – 0.55 (0.7) – 0.75 (1) – 1 (1.3) – 1.5 (2) – 2.2 (2.9) 3 (4) – 4 (5.4) – 5.5 (7.4)	< 70	< 70
7.5 (10) - 11 (14.8) - 15 (20)	71	< 70
18.5 (25)	73	-
22 (30)	70	-
30 (40) – 37 (50)	76	-
45 (60) - 55 (74)	79	-

8.9 Materials in contact with the liquid

Model	Materials
1, 3, 5, 10, 15, 22	Stainless steel
33, 46, 66, 92, 125	Stainless steel, cast iron

Appendix G – Milldale Boster Pump Station - Architectural Concept

MILLDALE WATER BOOSTER PUMP STATION

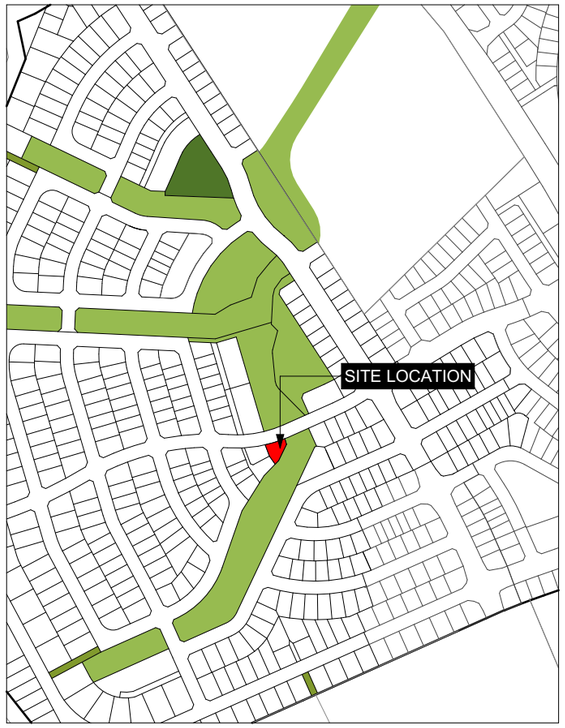
PROJECT ADDRESS

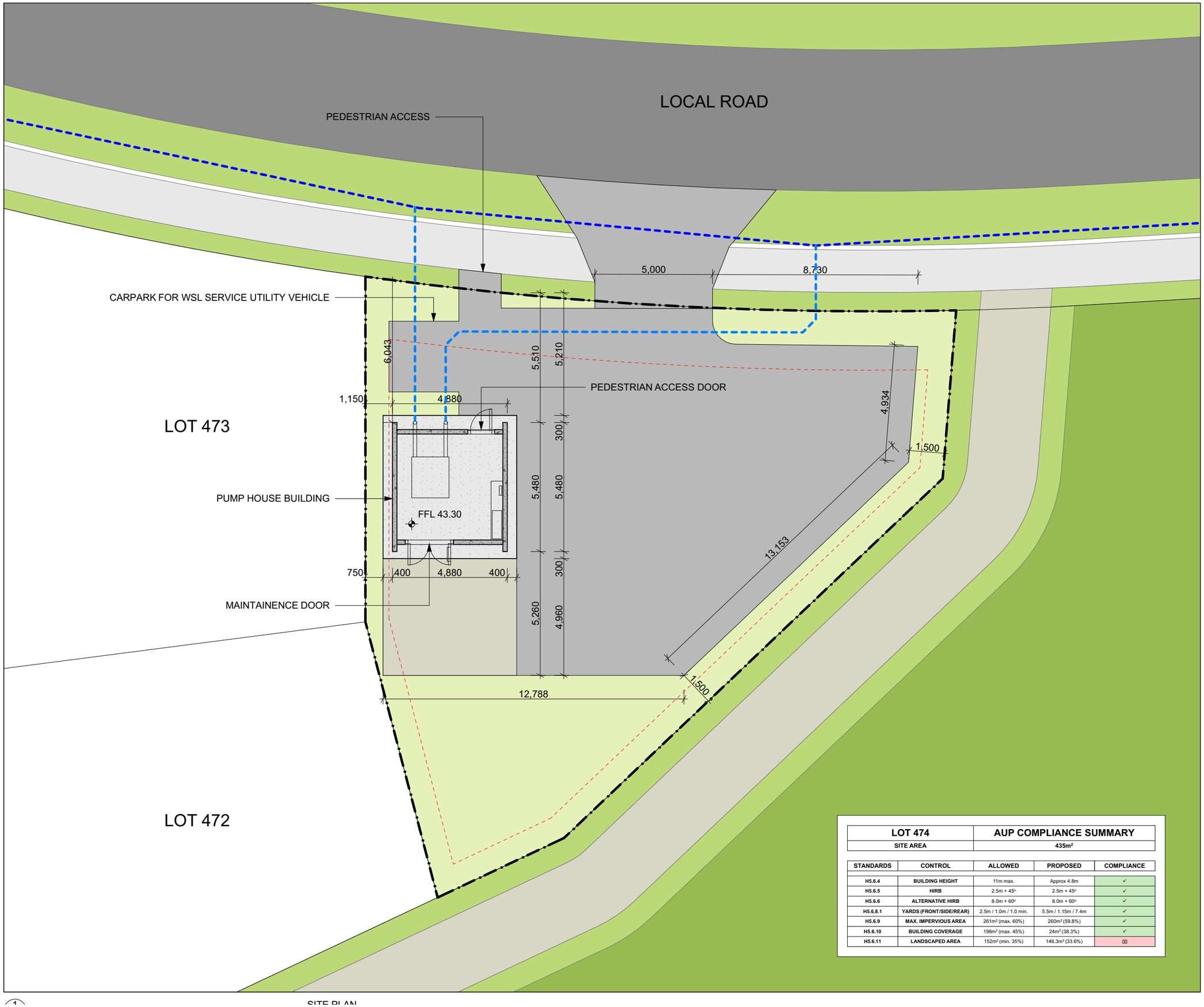
MILLDALE, AUCKLAND

PROJECT STATUS

FAST TRACK APPLICATION

PROJECT NO.	ISSUED DATE	REV
P24-128	FEB 2025	1





LOT 474	AUP COMPLIANCE SUMMARY
SITE AREA	435m²

STANDARDS	CONTROL	ALLOWED	PROPOSED	COMPLIANCE
H5.6.4	BUILDING HEIGHT	11m max.	Approx 4.8m	✓
H5.6.5	HIRB	2.5m + 45°	2.5m + 45°	✓
H5.6.6	ALTERNATIVE HIRB	8.0m + 60°	8.0m + 60°	✓
H5.6.8.1	YARDS (FRONT/SIDE/REAR)	2.5m / 1.0m / 1.0 min.	5.5m / 1.15m / 7.4m	✓
H5.6.9	MAX. IMPERVIOUS AREA	261m² (max. 60%)	260m² (59.8%)	✓
H5.6.10	BUILDING COVERAGE	196m² (max. 45%)	24m² (38.3%)	✓
H5.6.11	LANDSCAPED AREA	152m² (min. 35%)	146.3m² (33.6%)	☒

1 SITE PLAN

WOODS
EST.1970

NOTES

REFER TO ENGINEER'S DRAWING FOR FURTHER DETAIL ON BUILDING LAYOUT.

FINAL FINISHED FLOOR LEVEL (FFL) IS TO BE CONFIRMED AT DETAIL DESIGN STAGE

SITE LEGEND

- WATER BOOSTER PUMP STATION SITE BOUNDARY
- CONCRETE SLAB
- CONCRETE VEHICLE CROSSING / MAINTENANCE VEHICLE PARKING AREA
- PERMEABLE PAVING
- LANDSCAPING
- DRAINAGE RESERVE
- DRAINAGE RESERVE
- DN300 WATERMAIN
- DN150 WATERMAIN

PLANNING CONTROL

YARDS	MINIMUM DEPTH
FRONT YARD	2.5m
SIDE YARD	1.0m
REAR YARD	1.0m

REVISION DETAILS		BY	DATE
1	FAST TRACK APPLICATION	SW	FEB 2025

DESIGNED	WOODS	MILLDALE, AUCKLAND
DRAWN	SW	
CHECKED	SW	
APPROVED		WOODS.CO.NZ

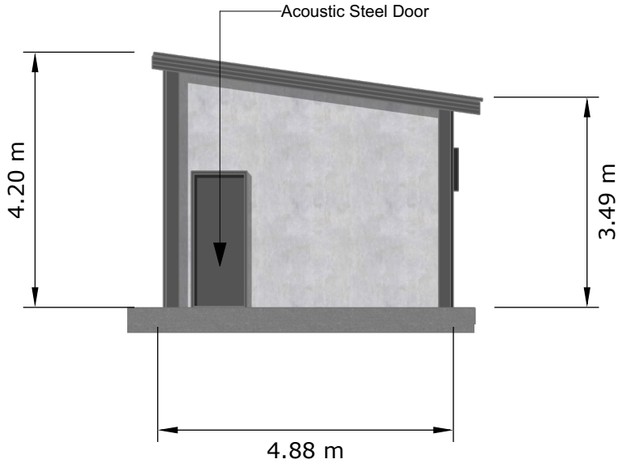
N

MILLDALE
Connecting Lifestyles

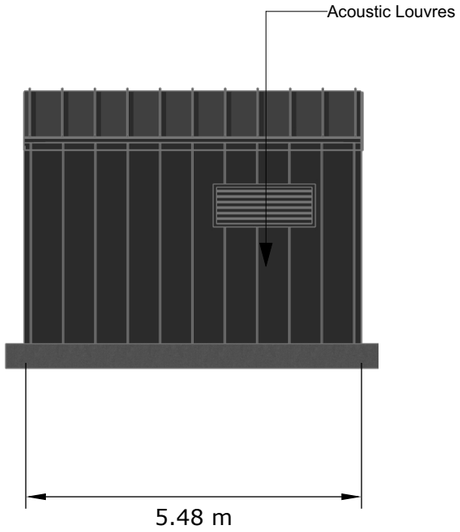
MILLDALE STAGE 10 -13

WATER BOOSTER PUMP STATION - SITE PLAN

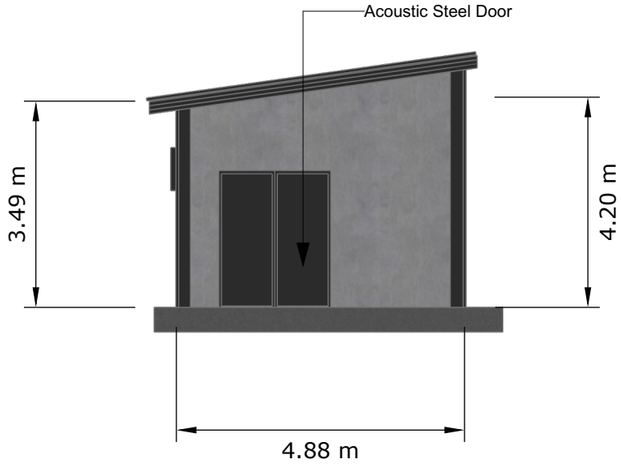
STATUS	FAST TRACK APPLICATION	REV
SCALE	1:150, 1:350 @A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-UD202	



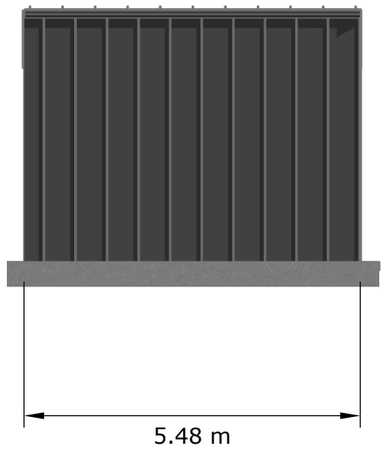
NORTH ELEVATION



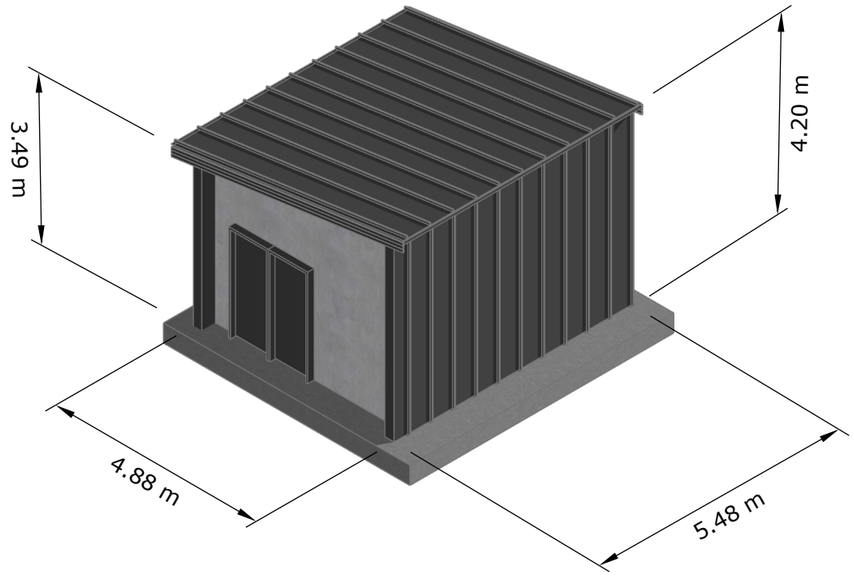
WEST ELEVATION



NORTH ELEVATION



EAST ELEVATION



OVERALL DIMENSION

WOODS
EST.1970

CLADDING PROFILE

	METALCRAFT ESPAN 470 VERTICAL CLADDING
	190mm PRECAST CONCRETE WALL PANELS WITH ANTI-GRAFFITI SEALER.

ROOFING PROFILE

	METALCRAFT ESPAN 470 ROOFING

SERVICES

FASCIA	METALCRAFT FASCIA 155
SPOUTING	BOX GUTTER 125
DOWNPIPE	METALCRAFT RP80mm DOWNPIPE

REVISION DETAILS		BY	DATE
1	FAST TRACK APPLICATION	SW	FEB 2025

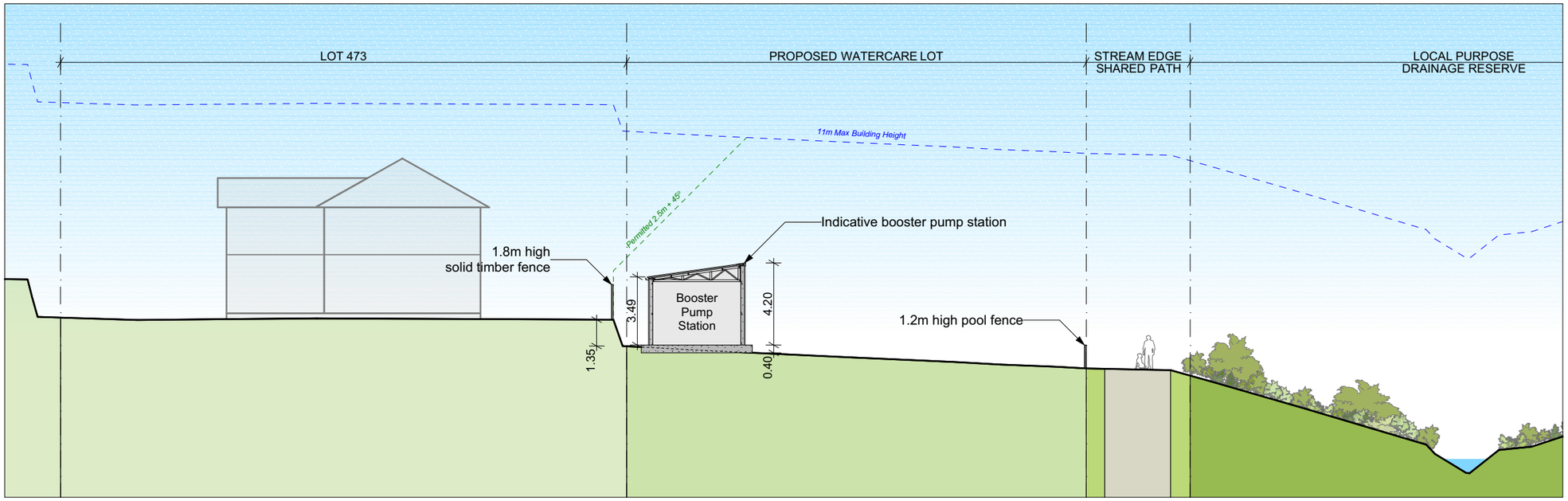
DESIGNED	WOODS	MILLDALE, AUCKLAND
DRAWN	SW	
CHECKED	SW	
APPROVED		WOODS.CO.NZ

MILLDALE
Connecting Lifestyles

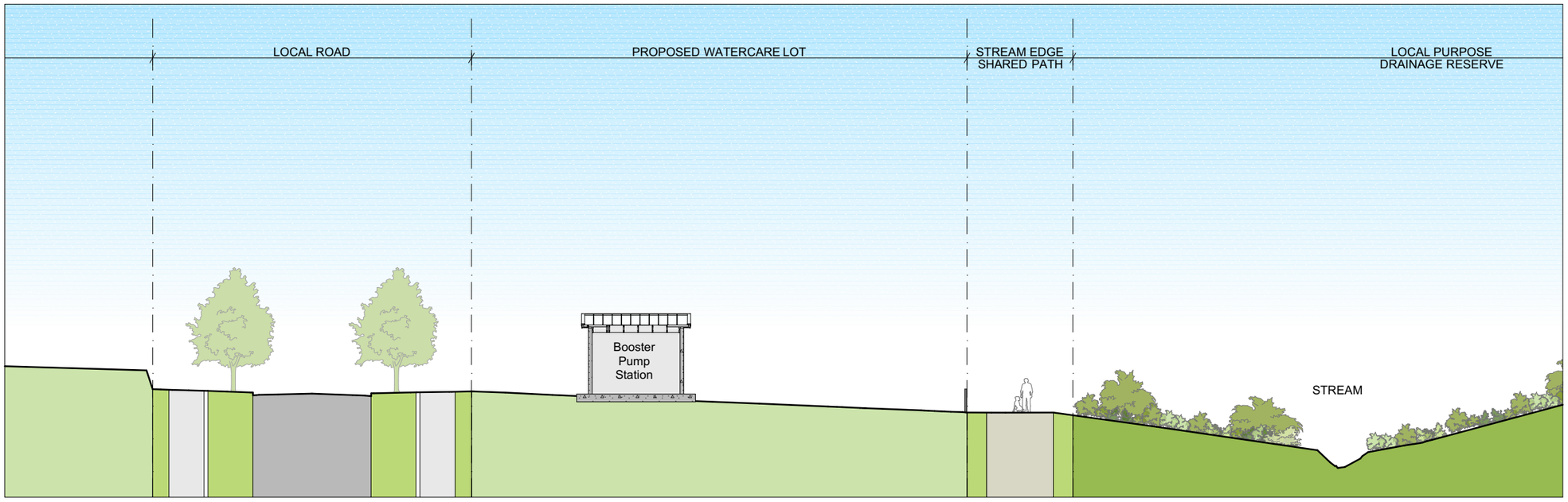
MILLDALE STAGE 10 -13

ELEVATIONS

STATUS	FAST TRACK APPLICATION	REV
SCALE	@A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-UD203	



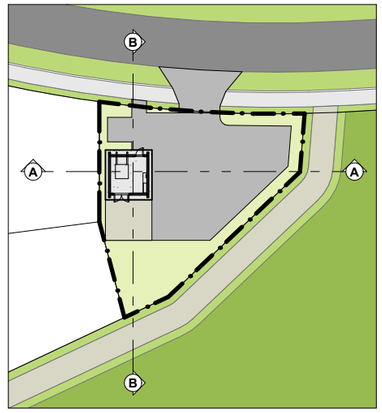
1 - SECTION AA
1:250



2 - SECTION BB
1:250

WOODS
EST.1970

SECTION REFERENCE PLAN



REVISION DETAILS		BY	DATE
1	FAST TRACK APPLICATION	SW	FEB 2025

DESIGNED	WOODS	MILLDALE, AUCKLAND
DRAWN	SW	
CHECKED	SW	
APPROVED		WOODS.CO.NZ

MILLDALE
Connecting Lifestyles

MILLDALE STAGE 10 -13

WATER BOOSTER PUMP STATION - SECTIONS

STATUS	FAST TRACK APPLICATION	REV
SCALE	1:250 @A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-UD204	

REVISION DETAILS		BY	DATE
1	FAST TRACK APPLICATION	SW	FEB 2025

DESIGNED	WOODS	MILLDALE, AUCKLAND
DRAWN	SW	
CHECKED	SW	
APPROVED		WOODS.CO.NZ

MILLDALE STAGE 10 -13

ARTIST'S IMPRESSION

STATUS	FAST TRACK APPLICATION	REV
SCALE	@A3	1
COUNCIL	AUCKLAND COUNCIL	
DWG NO	P24-128-UD205	

Appendix H – Milldale Stages 10 to 13 – Transportation Assessment
(bound separately)

Appendix I – Milldale Construction Management Plan Requirements

Milldale Construction Management Plan Requirements (CMP)

Date: 26 March 2025

Status: Draft - Subject to Contractor Construction Methodology

This document provides and preliminary outline of the content expected within CMPs required as preconstruction conditions to each season of earthworks or stage of subdivision works with the Milldale Fast Track works.

After each contract is awarded for the various stages of earthworks and subdivision construction works, the awarded contractor shall prepare a site specific CMP.

These CMPs shall include but not be limited to the following information:

1. Project Description

Details of the Project Description will to be provided for each earthworks construction season and each sub-stage of civil construction.

Project Description will be contract and stage specific and include the following details:

a) Site location
b) General scope of works
c) Specific construction elements to be undertaken, ie Earthworks, drainage works, retaining, landscaping, etc.
d) Project deliverable, ie completed subdivision, Stage number.
e) Timeframes for key stages of works

2. Project Management

Details of Project Manager(s) to be provided for each earthworks construction season and each sub-stage of civil construction.

Project Manager(s) will be contract and stage specific. The CMP shall include the following details:

a) Site Supervisor – name and contact information
b) Project Engineer – name and contact information
c) Project Manager - name and contact information
d) Project Director - name and contact information

3. Health and Safety Plan

Health and Safety Plans shall be prepared specifically for each earthworks construction season and each sub-stage of civil construction.

The contractor shall take responsibility for preparing an appropriately detailed Health and Safety Report and implement the Health and Safety Plan for the duration of the works.

The Health and Safety plan shall include but not be limited to the following information:

a) Site specific health and safety managers and contact details. Identify roles and responsibilities
b) Site specific health and safety risks
c) Identification of hazards and risks specific to the project
d) Risk Assessment and management controls
e) Procedures for undertaking High Risk Activities
f) Site layout of Health and Safety inventory on site
g) Sign in procedures for visitor management
h) Emergency management response
i) Health and Wellbeing procedures
j) Incident Reporting and investigation procedures
k) Required Personal Protective Equipment (PPE)
l) Monitoring and review procedures

4. Working Hours

The hours of construction work are to be identified in the plan and are to be in accordance with the approved Resource Consent conditions. The proposed condition in the application is:

All construction works authorised by this consent must only take place between 7.00am and 6.00pm, Monday to Saturday, with no works undertaken at any time on Sundays, or on public holidays. Heavy plant must not be operated within 130m of any occupied building before 7.30am.

5. Site Access

Details of Site Access will to be provided for each earthworks construction season and each sub-stage of civil construction.

Site Access will be contract and stage specific and include the following details:

a) A plan showing the stage of works, including street / road names
b) Site ingress and egress locations
c) Site compound and site office locations.
d) Location of signage and hazard boards.
e) Extent of security fencing
f) Location of wash down facilities at egress locations
g) Location of first aid and health and safety equipment.

6. Construction Traffic Management Plan

Construction Traffic Management Plan (CTMP) outlines measures to ensure the safe and efficient movement of vehicles, pedestrians, and cyclists in and around the construction site. The plan shall include details around the access to the site to comply with the Code of Practice for Temporary Traffic Management (CoPTTM) and all relevant local and national regulations.

Details of Construction Traffic Management will to be provided for each earthworks construction season and each sub-stage of civil construction.

Within Milldale Construction Traffic will be managed in a way to minimise any distribution to residents within the development and to users on the surrounding road network.

Construction Traffic Management will be contract and stage specific and include the following details:

a) Provide a parking management plan for construction traffic.
b) Address the transportation and parking of oversize vehicles (if any).
c) Provide appropriate loading / working areas to minimise disruption to traffic.
d) Provide cleaning facilities within the site to thoroughly clean all vehicles prior to exit to prevent mud or other excavated material from being dropped on the road. In the event that material is dropped on the road, resources should be on hand to clean-up as soon as possible.
e) Provide traffic management plans in compliance with the latest edition of the NZTA "Code of Practice for Temporary Traffic Management" (COPTTM) document.
f) Ensure the site access point shall be clearly signposted.
g) Include measures that are to be adopted to ensure that pedestrian access on the adjacent public footpaths in the vicinity of the site is safe during construction works.
h) Detail how the works will be undertaken to maintain access to properties adjacent to the work site during construction and address the duration time frame for sites with no-vehicle access during the works.
i) Identify proposed numbers and timing of heavy vehicle movements throughout the day.
j) Identify the location of vehicle and construction machinery access during the period of site works.
k) Identify the storage and loading areas for materials and vehicles.
l) For each construction phase, identify the location and duration of any road or lane closures, division of road closures into segments, duration of works in each closure, indication of detour routes for each closure and assessment of the effects on the Auckland Transport Road network of any road closures and a plan to mitigate these effects.
m) Detail how communication with drivers that they should divert, be done and how it would be monitored to ensure that the expected level of diversion is achieved.
n) Identify the relevant Auckland Transport approvals.

It is the responsibility of the applicant to apply for the Traffic Management Plan from Auckland Transport.

7. Site Notice Board

A large and visible notice board will be located at the entrance points on site and be clearly visible to any construction traffic prior to entering the site. The notice board will include site hazards along with contact details for the Site Manager. Example of the site notice boards;

450mm x 600mm

450mm x 600mm

DINES **THINK SAFETY**

HEAD PROTECTION · HIGH VIZ CLOTHING · SAFETY FOOTWEAR
Personal protective equipment must be worn on this site

HAZARD	CONTROL	DATE ADDED	PERSON RESPONSIBLE

8. Environmental Management

Details of Environmental Management shall be provided for each season of earthworks or stage of subdivision works.

Environment plans prepared within the CMP shall be in accordance with the requirements of the resource consent conditions.

9. Sediment and Erosion Control Plan

Prior to the commencement of each earthworks construction season and each sub-stage of civil construction on the subject site, finalised Erosion and Sediment Control Plans must be prepared in general accordance with the application documents referenced in condition 1 and in general accordance with Auckland Council Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016, Incorporating Amendment 2 (GD05), and submitted to the Council. No earthworks activity on the subject site must commence until the Council has confirmed that that the ESCP(s) satisfactorily meets the requirements of GD05. The plans must contain sufficient details to address the following matters:

a) specific erosion and sediment control measures for the earthworks stages (location, dimensions, capacity) including the location of any sediment retention ponds and decanting earth bunds, super silt fences, clean and dirty water diversion bunds and stabilised construction entrances, in general accordance with GD05;
b) supporting calculations and design drawings as necessary;
c) details of construction methods;
d) monitoring and maintenance requirements;
e) catchment boundaries and contour information as necessary;

f) confirmation of any erosion and sediment control measures associated with construction of pedestrian bridges and culvert installation; and
g) details relating to the management of exposed areas (e.g. grassing, mulching).
h) Outline conformance measures to ensure compliance with the approved Adaptive Management Plan (AMP)
i) Site inspection procedures including timings for regular inspections and specific inspections for rainfall trigger events as detailed in the AMP.
j) Streamworks management and detailed methodologies for in stream works, such as culvert installation

10. Chemical Treatment Management Plan

Prior to the commencement of earthworks activity on the subject site, a Chemical Treatment Management Plan (ChTMP) must be prepared in general accordance with Auckland Council Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016, Incorporating Amendment 2 (GD05), and submitted to the Council. No earthwork activities must commence until confirmation is provided by the Council that the ChTMP, meets the requirements of GD05, and the measures referred to in that plan for the sediment retention ponds and / or decanting earth bunds have been put in place. The plan must include as a minimum:

a) Specific design details of a chemical treatment system based on a rainfall activated methodology for the site's sediment retention ponds, decanting earth bunds or any other approved impoundment devices;
b) Monitoring, maintenance (including post storm) and contingency programme (including a record sheet);
c) Details of optimum dosage (including assumptions);
d) Results of initial chemical treatment trial;
e) A spill contingency plan; and
f) Details of the person or bodies that will hold responsibility for long term operation and maintenance of the chemical treatment system and the organisational structure which will support this system.

11. Dust Management Plan

The Contractor will need to prepare a site specific Dust Management Plan (DMP) for each new season of earthworks and submit this as part of their pre-construction documentation prior to works commencing. This plan will identify appropriate dust mitigation strategies for the site.

The site specific DMP will have an allowance for a dedicated water cart resource, dust fences and daily management strategies to avoid dust nuisance to neighbouring properties.

While the Contractor's Dust Management Plan will ultimately provide the management regime for dust nuisance mitigation, the following measures will be expected as part of an effective dust mitigation strategy for this site. Allowance will be made in the construction contract for implementation of these dust control measures.

- The Contractor shall prepare a site specific DMP in accordance with Southern Skies, Milldale Dust Management Plan (included in Appendix D of the Earthworks Methodology Report)

- The Contractor is to monitor dust emissions daily and implement appropriate measures as necessary;
- The Contractor shall provide sufficient water carts and / or sprinklers that are capable to ensure that the exposed areas of the site are appropriately moistened to avoid dust nuisance towards neighbouring properties. Particular attention shall be given to those sensitive receivers identified in the Southern Skies DMP;
- On site traffic management, including specific traffic control measures in areas that are sensitive to dust generation;
- The site is to be watered at the end of each working day when it is considered that a dust nuisance may exist following the close of works for that day. (unless there is sufficient rain or showers, falling or forecasted);
- The site is to be watered if strong winds are forecast, and these coincide with dry ground conditions to avoid dust nuisance towards neighbouring properties;
- Adjoining owners will be informed with a pre-construction communication which will include a 24-hour contact telephone number to call the site Contractor for dust and other complaints;
- The Contractor is to promptly implement additional dust control measures when a complaint is received, and they are to note the complaint, outcomes, and actions;
- A record of dust events and complaints are to be recorded in weekly site meetings;
- Earthworks on site are to be staged to allow for progressive stabilisation. Once areas of works are completed to finished ground, progressive revegetation to pasture is to be undertaken over these areas. Monitoring of this revegetation is to be undertaken to ensure good uptake until stabilisation is achieved;
- A 3m high dust fence can be erected along the boundary of a neighbouring property where an actual dust nuisance has arisen;
- Stockpiles to be stabilised if not in use;
- When loading / unloading trucks, materials are to be dropped from as low a height as practicable;
- Removal of sediment or dust generating materials from the access roads, haul roads, and public roads with a suction sweeper; and
- Use of a wheel wash facility that also has capabilities to wash dust from vehicles.
- Dust monitoring procedures in accordance with the Southern Skies DMP;
- Complaint response procedures in accordance with the Southern Skies DMP.

12. Construction Staging Methodology

For each earthworks construction season and each sub-stage of civil construction, a site specific construction staging will be necessary to enable the site to be constructed in a methodical, safe and timely manner.

A Construction Staging Methodology Plan shall include the following items:

- Site Establishment
- Sediment and Erosion Control implementation
- Spatial staging of works across the site
- Detailed programme of the construction works tasks
    - Earthworks
    - Geotechnical works

    - Streamworks
    - Retaining works
    - Drainage works
    - Roading works
    - Services
    - Landscaping
- Stabilisation of the site
- Removal of Sediment and Erosion Control devices
- Demobilisation and site presentation
- Final walkovers and site certifications