3 WATERS PRELIMINARY ASSESSMENT

LAUREL HILLS
Queenstown, New Zealand

Laurel Hills – Proposed Residential Development
6 & 8 Laytons Lane
December 2018

CLARK FORTUNE MCDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT & PLANNING CONSULTANTS

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1 INTRODUCTION

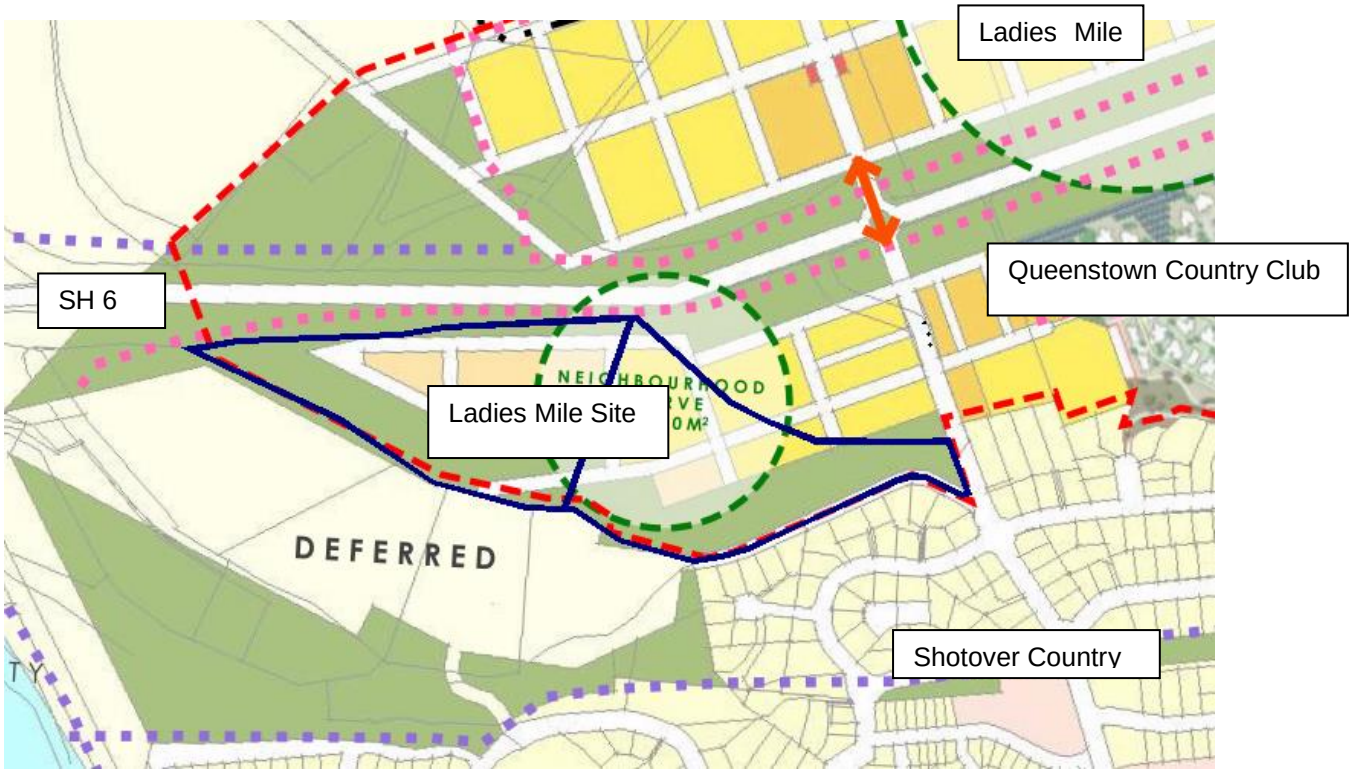
Clark Fortune McDonald & Associates (CFM) has been engaged by Laurel Hills Ltd to assess capacity of existing QLDC 3 water infrastructure for a proposed residential development on land located on the southern side of Ladies Mile between SH6 and Shotover Country.

The property sits within the QLDC proposed Ladies Mile Master Plan included in the Lead Policy for Special Housing Areas.

The proposal seeks to develop low to medium density residential activities.

The site is legally described as Lot 2 D.P. 325561 and Lot 1 D.P.431492. The total site area comprises approx 9.3 ha and is contained in CT's 103217 & 522182.

The site has frontage to Stalker Road, the Frankton Ladies Mile highway (SH6) and a private right of way known as Maxs Way/Layton Lane.



The site comprises river terrace platforms successively cut down by meanders of the Shotover River over the preceding thousands of years. The river terraces decrease in elevation from the northeast to the southwest.

The development area is presently zoned Rural General under the Operative QLDC District Plan (the Plan).

This report is preliminary for initial feasibility. Further information and detailed engineering design will be required as development proceeds.

The report considers infrastructure demands and capacity based on proposed residential activities.

2 SCOPE OF WORK

The scope of work includes examination of existing QLDC as-built records, confirmation of capacity of existing services to determine the adequacy of the existing infrastructure, and recommendation of infrastructure servicing options.

3 DESIGN STANDARDS

Site development standards include, but are not limited to, the following:

- QLDC Land Development and Subdivision Code of Practice adopted June 2018.
- NZS4404:2010
- Drinking-Water Standards for New Zealand 2005 (revised 2008).
- NZS PAS 4509:2008, New Zealand Fire Service Fire-fighting Water Supplies Code of Practice.
- Water for Otago, Otago Regional Council regional water plan.
- Document for New Zealand Building Code Surface Water - Clause E1 / Verification Method 1.

4 PROPOSED DEVELOPMENT PLAN

The Masterplan for the Laurel Hills development proposes a mix of residential activities over the site. The basis of the design considers a possible 156 dwelling equivalent (DE) summarised as follows:

- 6 DE – Compact houses
- 52 DE – Townhouses
- 46 DE – Retain Houses
- 38 DE – Urban houses
- 14 DE – Villas (including existing house)

The Masterplan and the above scope of development is indicative and subject to change.

The following report examines the feasibility of connecting into the existing QLDC infrastructure adjoining the site that currently services Lake Hayes Estate, Shotover Country and Queenstown Country Club developments.

Consideration has also been given to the Ladies Mile HIF Scoping and Concept Design report prepared by WSP OPUS dated June 2018 and addendums.

The demand figures are used in assessing demands for wastewater and water supply in the following sections of the servicing report.

5 WASTEWATER

5.1 Design flows – Laurel Hills Development

Demand based on anticipated activities has been determined in accordance with the development standards:

Refer QLDC Code of Practice.

No of residential units/DE:	156
Average dry weather flow:	250 l / person / day.
Dry weather diurnal peak factor:	2.5.
Infiltration factor:	2.
Occupancy:	3 person / du.
Dry weather average daily flow:	***117 m^3 / day.***
Peak hour flow:	***6.8 l / sec.***

5.2 Existing infrastructure

The Shotover Country subdivision development established a reticulated waste water system to service the allotments.

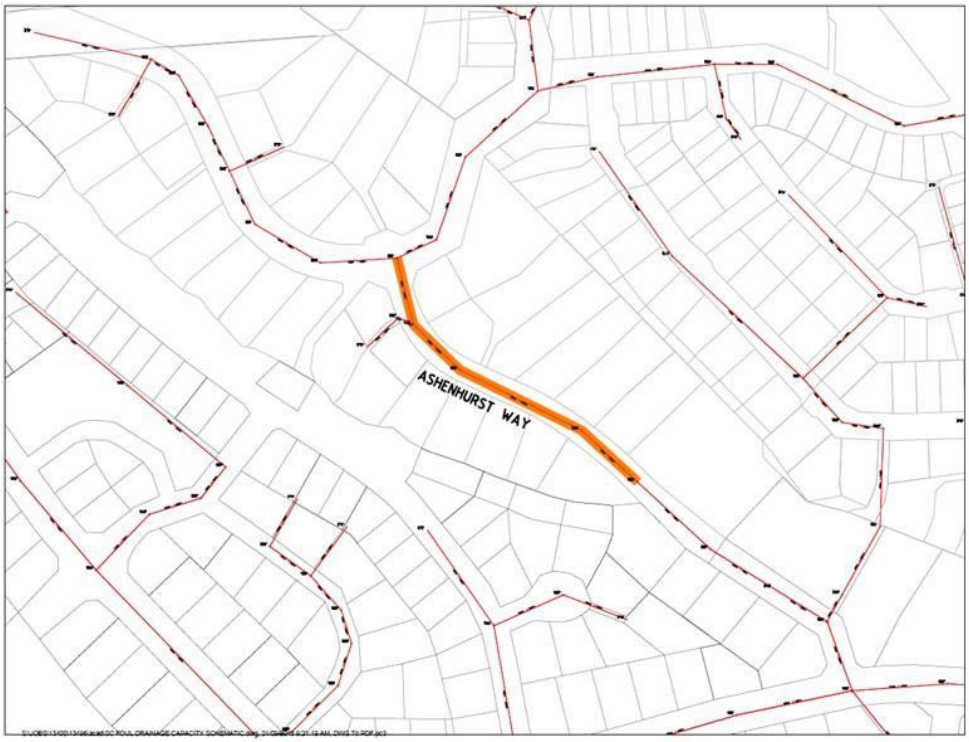
This system is a gravity network that discharges to a Waste Water Pump Station located on Stalker Road.

The nearest point of connection to the existing network is in Stalker Road adjoining the property boundary. The sewer main is 150mm Ø main.

Since the system was designed and installed, changes introduced in the 2018 Code Of Practice has reduced the dry weather average flow per person from 300 to 250 L per person per day, it reduced the number of people per dwelling from 3.5 to 3.

As a result of these amendments there is now spare capacity in the reticulation network for an additional demand.

The network has been analysed and below are the sections of reticulation with the constriction in capacity highlighted.



Magflow meter readings taken in September 2016 from the Shotover Wastewater Pump Station supplied by the maintenance contractor indicate Average Dry Weather Flows of under 500l/day per allotment. CoP design figures require allowance for 750l/day.

Using the measured figures from the WWPS, there is sufficient spare capacity in the pipe network to cater for the proposed development.

Magflo data is set out below. At the time the data was recorded 327 houses were occupied with 126 under construction.

Shotover Country Pump Station # 1

Date	Pump 1 Hrs	Pump 2 Hrs	Magflo	M3 Pumped	Days	Hours	L/S	Ave/day	P1 wk hr	P2 wk hr
29/08/2016	774.58	726.74	54935	1118	7.00	29.87	10.48	159.71	14.38	15.49
5/09/2016	789.03	742.21	56058	1123	7.00	29.92	10.51	160.43	14.45	15.47
12/09/2016	804.5	757	57178	1120	7.00	30.26	10.36	160.00	15.47	14.79

Rainfall data is not available so no allowance has been made for infiltration. It is assumed that this is dry weather flow.

Measured dry weather flow per residential unit is 489 L/day.
CoP dry weather flow per residential unit is 750 L/day - conservative.

We have taken the opportunity to recalculate the pipe capacity in the existing pipe network based on metered flows as follows:

Line 001.O – 001.P
Diameter: 150mm
Grade: 0.70%
Mannings N: 0.011

QCap (Manning): 15.10 L/s
No. dwellings (excluding Laurel Hills): 253
ADWF: 489 L/day
Peak hour flow per residential unit: 0.028 L/s
Peak hour flow total: 7.15 L/s
Spare capacity: 7.95 L/s
Spare 284 residential units

It is noted that New Zealand Standard 4404:2010 recommends between 180 to 250 l/p/d and occupancy of 2.5 to 3.5.

Given the variables in assessing the wastewater flows, the most robust way to check and confirm capacity would be to monitor and meter actual flows in the network.

It is recommended that more recent flow readings are analysed to determine actual demands generated for the development.

The Shotover Country Waste Water Pump Station is currently servicing a consented design capacity of approx. 970 dwelling equivalents within the Shotover Country catchment. This figure would not include residential flats.

The WWPS has a combination of on site and in-line storage and emergency back up generation to ensure security of operation.

The addition of the further wastewater flows may require the need for further storage upgrades to the WWPS. It is suggested that this may take the form of a further on-site storage tank to buffer flows.

If the conservative ADWF values are used, emergency storage for 156 dwellings would be 39m³ based on 8 hours storage. Emergency storage would be needed in the event that the rising main was compromised.

An additional 60m³ storage tank to match the two existing 60m³ tanks could be added in series if required to mitigate the additional demand. No upgrades to the pumps or rising mains are considered necessary.

60m³ of additional storage is anticipated to cost in the order of $150 - $200K based on the cost of the last 60m³ tank install in December 2016.

It is noted that the WSP OPUS HIF report has proposed a new WWPS be constructed to service the area labelled 3.2 where the subject development sits. The Rough Order of Costs (ROC) indicates budgets of $550K for pump station plus $100K for rising mains and $200K for storage excluding P + G, professional fees and contingencies.

The proposed location of the pump station is on adjoining land and is not subject to this application. It is noted that the location of the proposed pump station is on a terrace above the elevation of the existing Shotover Country WWPS. It is therefore possible to gravity reticulate to the existing WWPS.

Cost analysis on upgrades to the existing WWPS should be undertaken prior to making a decision on which option will result in the lowest whole of life cost to the network owner.

WSP OPUS have also recommended further modelling on the performance of the existing DN300 main to confirm capacity.

One possible benefit of additional storage will be to buffer discharges to mains in Ladies Mile that discharge at the Shotover Treatment Plant.

It may also be required to examine the storage capacities at each of the contributing pump stations and synchronise the discharges to ensure all pumps are not discharging simultaneously to ensure capacities of the existing mains can be maximised.

The WSP OPUS report confirms that the Shotover Treatment Plant has sufficient capacity to treat the demand generated in the Ladies Mile master plan catchment.

5.3 Proposed Servicing for the Laurel Hills Development

It is proposed that new gravity sewer reticulation will be constructed internally to service the development. This would likely by 150mm – 225mm diameter mains depending on minimum grade requirements. The full development site can be reticulated by gravity to connect to the existing network.

5.4 Required upgrades

Any effects on the QLDC's wider infrastructure being the Shotover Waste Water Treatment Plant will be mitigated by the imposition of headworks fees at the time of connection to Council's service. It is assumed that the Laurel Hills Development would be levied the figures stipulated in the Ladies Mile category under the 2018/2019 Development Contribution policy. The current figure being levied is $3,500 per residential unit. The additional 156 residential units under the current levy would net Council 156 x $3,500 = $546,000.00 ex GST which is expected to be sufficient to cover the costs of either contribution to a new WWPS or storage upgrades to the existing WWPS and the cost of treatment at the Shotover Treatment Plant.

Upgrades to the Shotover Waste Water Treatment Plant are currently under construction.

6 STORMWATER

The development of the site area will increase stormwater runoff and introduce contaminants into the receiving aquatic environment.

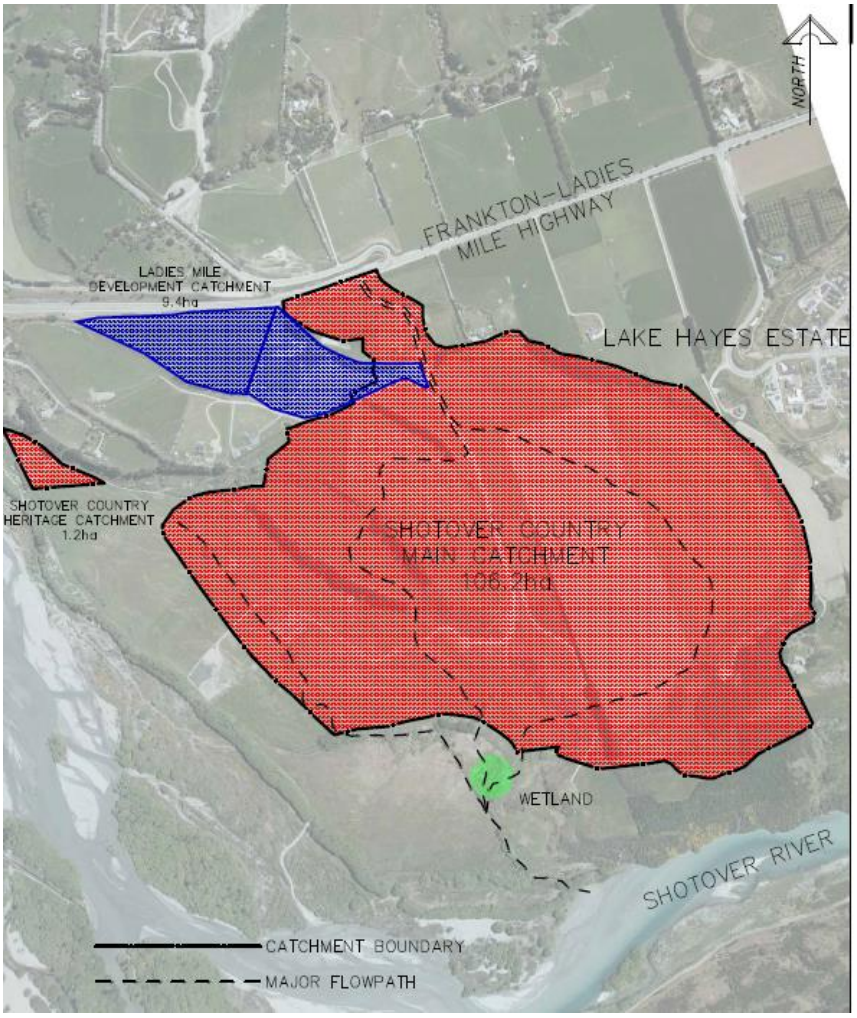
6.1 Stormwater Catchment Management Plan (SCMP)

It is proposed that the Laurel Hills development submit to QLDC an updated SCMP to be approved by QLDC prior to development of the site. This would be an amendment to the existing SCMP adopted by QLDC in October 2012 for the development of the Shotover Country Special Zone. A copy of the existing SCMP is attached in the appendix.

6.2 Stormwater Catchments

The topography of the development site is terraced. The lowest elevation of the subject site is where it adjoins Stalker Road. It would be possible to drain the site by gravity to this point.

Below is the SCMP catchment overview with the subject site hatched in blue.
The stormwater run-off from the site could contribute to the Shotover Country main catchment. This would represent an increase in the main catchment area by approx. 9%.



6.3 Existing Reticulation

The Shotover Country reticulation was not designed to service other development areas as they were not zoned for development. The stormwater reticulation therefore will only have sufficient capacity to drain the land if the discharge enters the network after the peak flow from the Shotover Country main catchment has passed.

6.4 Hydrological analysis

Runoff has been considered using the Rational Method. The development area is 9.4 ha and presently consists mainly of pasture and some trees. The soil drainage is good and the development area is quite flat, so a slope correction of -0.05 can been applied to the runoff coefficient for each surface type. Runoff coefficients have been obtained from Approved Document for New Zealand Building Code, Surface Water, Clause E1. Rainfall intensity has been determined from NIWA HIRDS V4 (http://hirds.niwa.co.nz/).

Post development peak runoff has been calculated using HIRDS v4 rainfall figures and shortened time of concentration to allow for the effects of a) increased impervious area, b) channelling surface flows, and c) piping flows. The QLDC has instructed that the RCP8.5 period 2081-2100 scenario is to be used for estimating stormwater runoff.

20 year ARI peak runoff would be of the following magnitude:
A: 9.4ha
C: 0.60
Tc: 15 min
ARI: 20 years
i: 48.0 L/s
Qpeak: 753 L/s

100 year ARI peak runoff would be of the following magnitude:
A: 9.4ha
C: 0.60
Tc: 15 min
ARI: 100 years
i: 74 L/s
Qpeak: 1160 L/s

20 year ARI runoff would range from 645m³ for a 15 minute duration storm to 4,405m³ for a 12 hour storm.

100 year ARI runoff would range from 987m³ for a 15 minute duration storm to 6,091m³ for a 12 hour duration storm.

The runoff coefficient for the residential area of 0.60 has been used in the post development calculations. This is specified in the Approved Document for New Zealand Building Code, Surface Water, Clause E1, as being appropriate for townhouse developments.

Storage capacity could be provided for the 20-year ARI storm on site.
It is noted that it would be permitted to discharge the pre-development flows downstream.

Therefore the chamber could have a 100mmØ outlet to allow an average discharge of 20l/s to the existing Shotover Country network which is equal or less than the pre-development flow.

The chamber will also utilise infiltration and the infiltration rates have been tested by Geosolve and their recommendation depending on the location of the gallery would allow a maximum volume of water to be discharged to ground of between 540 – 800 l/m² applying factored soakage rates.

Using 800l/m² a 20 year ARI infiltration would range from 164m³ for a 15 minute duration storm to 7,782m³ for a 12 hour storm.

Using the same rates for 100 year ARI infiltration would range from 235m³ for a 15 minute duration storm to 11,280m³ for a 12 hour duration storm.

A 60 minute storm duration would require a gallery volume of 810m³ for a 20 year ARI event or a 20m x 30m x 1.5m deep gallery.

The chamber(s) sizing allowing for infiltration to ground of the stored stormwater will be subject to detailed design.

An alternative may be to install individual on-site soakage devices such as the Cirtex smart soak or similar. These can be installed at the time of dwellings being constructed.

The packaged systems range in size from 3.5m³ - 10m³. If buildings are to constructed comprehensively a shared system between adjoining dwellings might be more cost effective.

This system also allows for the possible re-use of stormwater for irrigation. The indicative supply cost is between $2,500 - $5,600 per unit.

WSP Opus have also considered installing a new stormwater main from Area 3.2 to the Shotover River. This pipe has been proposed to be installed in the State Highway Corridor and that discussions with NZTA be initiated. The ROC for the construction of this pipe is in the order of $259K including a stilling basin at the discharge point excluding P + G, professional fees and contingencies.

The subject property could connect to the stormwater infrastructure if considered the best long-term solution.

A contribution to the capital cost of this infrastructure would then be made by the applicant proportional to their demand on this asset.

Either on-site stormwater or connection to a reticulated network are feasible options for this site.

6.5 Runoff quality

Stormwater can contain a number of contaminants which may adversely affect the receiving environment. Studies in New Zealand and abroad have identified urban development as a major contributor to the declining quality of aquatic environments. It is estimated that

upwards of 40% of the contaminant content of this runoff can be attributed to run-off from roads.

At this site stormwater will be generated by run-off from the following:

- Roofs of residential buildings;
- Urban roadways;
- Footpaths; and
- Other hard-standing areas.

Based on available information it is expected that stormwater from the above-named developed surfaces could contain the following contaminants:

- Suspended solids;
- Oxygen demanding substances;
- Pathogens; and
- Dissolved contaminants.

The dissolved stormwater contaminants of concern at this site can cause an aquatic risk to the ecology of the receiving environment. The parameters of concern are as follows:

(1) Hydrocarbons and Oils

These are associated with vehicle use, although there is potential for spillages of hydrocarbon products to occur. They may be in solution or absorbed into sediments. Routine stormwater discharges are likely to have low concentrations ranging between 1 and 5g/m^3 total hydrocarbons over each storm event.

(2) Toxic Metals

A variety of persistent trace-metal compounds are carried in stormwater in both solid and dissolved forms. The most commonly measured metals of concern are zinc, copper, and chromium (mostly associated with vehicles and roads).

(3) Nutrients

Fertiliser application and animal waste associated with the current agricultural use of the site have the potential to generate high levels of nutrients such as phosphorus and nitrogen within stormwater runoff. High nutrient levels are not anticipated within the post-development stormwater runoff as, agricultural activities, such as grazing in particular, will cease.

6.5.1 Expected Contaminant Levels

Ranges of contaminant levels area provided by both the Auckland Regional Council (TP 10 and 53) and NIWA (Williamson 1993). This data can be used to predict the likely contaminant loading levels associated with changes in land use. Contaminant levels anticipated for this development have been estimated from TP10 and are included in Table 1 below.

Table 1 – Estimated Contaminant Loading Ranges for Land Use Types (kg/ha/year)

Land Use	Total	Total	Total	BOD	Lead	Zinc	Copper

	Susp. Solids	Phosph.	Nitrogen		(median)		
Road	281-723	0.59-1.5	1.3-1.5	20-33	0.49-1.10	0.18-0.45	0.03-0.09
Residential	60-340	0.46-0.64	3.4-4.7	12-20	0.03-0.09	0.07-0.20	0.09-0.27
Pasture	103-583	0.01-0.25	1.2-7.1	NA	0.004-0.015	0.02-0.17	0.02-0.04
Grass	80-588	0.01-0.25	1.2-7.1	NA	0.03-0.10	0.02-0.17	0.02-0.04

6.5.2 Construction-Stage Stormwater

Construction stage stormwater has the greatest potential to cause discharge of sediment laden runoff to the receiving environment. The applicant will provide details of the proposed stormwater management plan as part of the engineering design phase of the project.

Any detention ponds will be designed generally in accordance with Auckland Regional Council TP10. Each pond will have a fore-bay and will be suitably vegetated. The detention ponds will provide stormwater treatment before it is discharged to ground. The primary contaminant removal mechanism of all pond systems is settling or sedimentation.

6.6 Stormwater Management Objectives

The following draft overall objectives should be recognised while assessing stormwater management options for the development area:

- Primary protection for 20 year ARI storms;
- Secondary protection (overland flowpaths) for 100 year ARI storms;
- Regulatory Compliance;
- Avoidance of increases in downstream peak flows resulting from the increase in developed surface areas;
- Sustainable management of the effects of the proposed development;
- Minimisation of pollution of receiving waterways through the reduction of stormwater contaminants from roadways;
- Erosion protection in the stormwater discharge zone;
- Construction and maintenance costs.

6.7 Stormwater Management Approaches

This Section of the report introduces options available for Laurel Hills Development stormwater management, in particular traditional design (big pipe), Low Impact Design (LID) or Sustainable Urban Drainage (SUD) approaches.

6.7.1 Traditional Approaches (Big Pipe)

The traditional approach to stormwater management has been to direct all runoff from residential allotments and roadways to a pipe network which discharges to the nearest receiving water body, with minimal effort made to replicate the pre-development hydrological regime.
Arguably the big pipe approach has one advantage over LID and SUD approaches: lower construction and maintenance costs.

6.7.2 LID / SUD Approaches

Some LID options are presented below. These have been sourced from the *Low Impact Design Manual* for the Auckland Region TP124 (Shaver et al. 2000), the *On-Site Stormwater Management Guideline* (NZWERF, 2004) and *Waterways, Wetlands and Drainage Guide* (CCC, 2003).

- Clustering and alternative allotment configuration. Fewer, smaller allotments, with more open space. This approach is less economic for the Developer and is also at odds with some of the principals of modern urban design.
- Reduction in setbacks. Reduction in the front setback reduces the length of driveway required. Correspondingly, the total amount of impervious area within the development is reduced. This approach presents some compliance issues with QLDC District Plan rules.
- Reduction in developed surfaces. This approach applies mainly to transport related aspects of residential developments such as reduced carriageway widths, use of grassed swales as opposed to kerb & channel, and alternative turning head design.
- Vegetated filter strips and swales. Stormwater from roadways is directed through a densely vegetated strip, and then into a road-side swale. Swales are generally used for conveyance of stormwater however they do have contaminant removal properties such as sediment removal efficiency of 20 – 40% (Waterways, Wetlands and Drainage Guide, CCC 2003). Stormwater velocity is reduced so this approach is beneficial in reducing peak flows.
- Infiltration Trench. Infiltration trenches can be constructed in place of swales if natural soils are sufficiently free draining. This is applicable to sites with limited available open space. Infiltration trenches also have the ability to store stormwater. Infiltration trenches can reduce peak flows however they present maintenance issues.
- Infiltration Basin. The suitability of this option is reliant upon free draining natural soils, adequate depth to groundwater, and sufficient open space to construct.
- Soakage chambers. These allow direct discharge of stormwater to groundwater or free drainage soils. Soakage chambers require clean, pre-treated stormwater.
- Permeable paving. This option allows stormwater to permeate directly into pavement layers, and is applicable for low traffic areas with low ground water levels and free draining non-cohesive soils. Construction and maintenance costs for this option are high.
- Detention Ponds. These are used to reduce peak discharges to pre-development levels. They allow for settlement of suspended solids by vegetation. They require sufficient open space to construct.

6.8 Management Options

Many options are available to avoid, remedy or mitigate the adverse effects associated with residential development on receiving environments.

For the Laurel Hills Development project, the recommended stormwater management strategy is to provide an integrated treatment train approach to water management, which is premised on providing control at the catchment wide level, the allotment level, and the extent feasible in conveyance followed by end of pipe controls. This combination of controls provides a satisfactory means of meeting the criteria for water quality, volume of discharge, erosion and flood control (if required).

Table 2 – Recommendations

	Recommendations	Remarks
Collection	Combinations of LID/SUD measures, kerb & channel, swales, open channels and pipes.	(1) Where allotment density allows direct roadway runoff to grass swales (primary treatment) – also for secondary overland flow during flood events. (2) Where natural soils allow incorporate infiltration measures. (3) Kerb & channel & pipework to provide primary protection.
Treatment	Combinations of swales, detention ponds and end of pipe structures (gross pollution traps and filters).	(1) Pipework to discharge to detention / infiltration ponds. (2) End of pipe structures and fore bay bunds to provide pre-treatment of stormwater before infiltration to ground water.
Disposal	Use attenuation prior to discharging to watercourses.	(1) Sufficient space is available to construct detention ponds. (2) Where natural soils allow incorporate infiltration ponds. (3) Post development discharge not to exceed pre-development levels.

6.9 Stormwater Concept Design

Runoff from undeveloped areas shall be directed around the developed areas via grass swales, and then discharged to ground. This will replicate the pre-development runoff scenario for the undeveloped areas. The developed areas will be serviced using a hybrid LID/SUD/Big Pipe design. This will incorporate a combination of grass swales, kerbs, pipework and detention areas.

The development area can be broken into smaller sub-catchments: Separate pipe networks are then proposed - one for each catchment. Each network will discharge either to its own disposal area adjacent the southern boundary of the site or a single combined storage area. Secondary overflow paths will be provided for in swales or road ways. Overflows will discharge to the same locations as the pre-development scenario.

7 WATER RETICULATION

7.1 Water supply design

To assess the demand and supply requirements for the proposed Laurel Hills development the following aspects have been considered:

- Water demands
- Water availability
- Existing infrastructure
- Storage requirements
- Irrigation requirements

7.2 Design flows – Laurel Hills Development – QLDC

Demand based on the anticipated activities for the Laurel Hills Development have been determined in accordance with the development standards:

Refer QLDC code of practice 6.3.5.6.

No of residential units:	156.
Average daily demand:	700 l / person / day.
Occupancy:	3.0 person / du.
Peak Day factor:	6.6.
Average Daily demand:	***327 m^3 / day.***
Peak day demand:	***25.0 l/ sec.***

QLDC Code of practice also allows for a lower demand when supported by metering data approved by QLDC. Shotover Country completed a 12-month metering trial on 50 randomly selected houses. The results of the trial indicate demands far closer to 4404:2010 have been found in the order of 250l/person/day.
The WSP Opus HIF report has assessed and agreed water demands of 1,000l/day with QLDC dated 4 May 2018.

7.3 Design flows – Laurel Hills Development – Recommended

Demand based on medium density residential activities has been determined as a middle ground between QLDC standards and 4404:2010:

No of residential units:	156.
Average daily demand:	333 l / person / day. (1,000l/day per DE)
Occupancy:	3.0 person / du.
Peak day factor:	5.0.
Average Daily demand:	***156 m^3 / day.***
Peak hour demand:	***9.0 l / sec.***

One significant consideration for the Average Daily Demand for the QLDC code of practice is irrigation demand. Irrigation for private use varies greatly and is generally uncontrolled.

The irrigation demand for reserves, streetscapes and open spaces is anticipated to be managed by QLDC once these assets vest.

It is noted that this property is connected to the Arrow Irrigation scheme and can be supplied with a connection for irrigating the open spaces in the development.

The main race is piped from the inlet of the Shotover syphon around the side of Slopehill. The irrigation water runs in a series of races and flumes to Spence Road where it crosses the state highway by syphon to the top of the subject site. The system also supplies amenity ponds on adjoining properties.

7.4 Required Fire fighting demand

The design of the new water infrastructure will need to meet the requirements of SNZ PAS 4509 – NZ Fire Service Firefighting Water Supplies Code of Practice.

7.4.1 Residential fire fighting demand – reticulated supply - non sprinklered

Water supply classification:	FW2.
Required water flow within 135m:	12.5 l / sec
Additional water flow within 270m:	12.5 l / sec.
Max No. of hydrants to provide flow:	2.
Minimum pressure	100kPa.

7.5 Existing Infrastructure

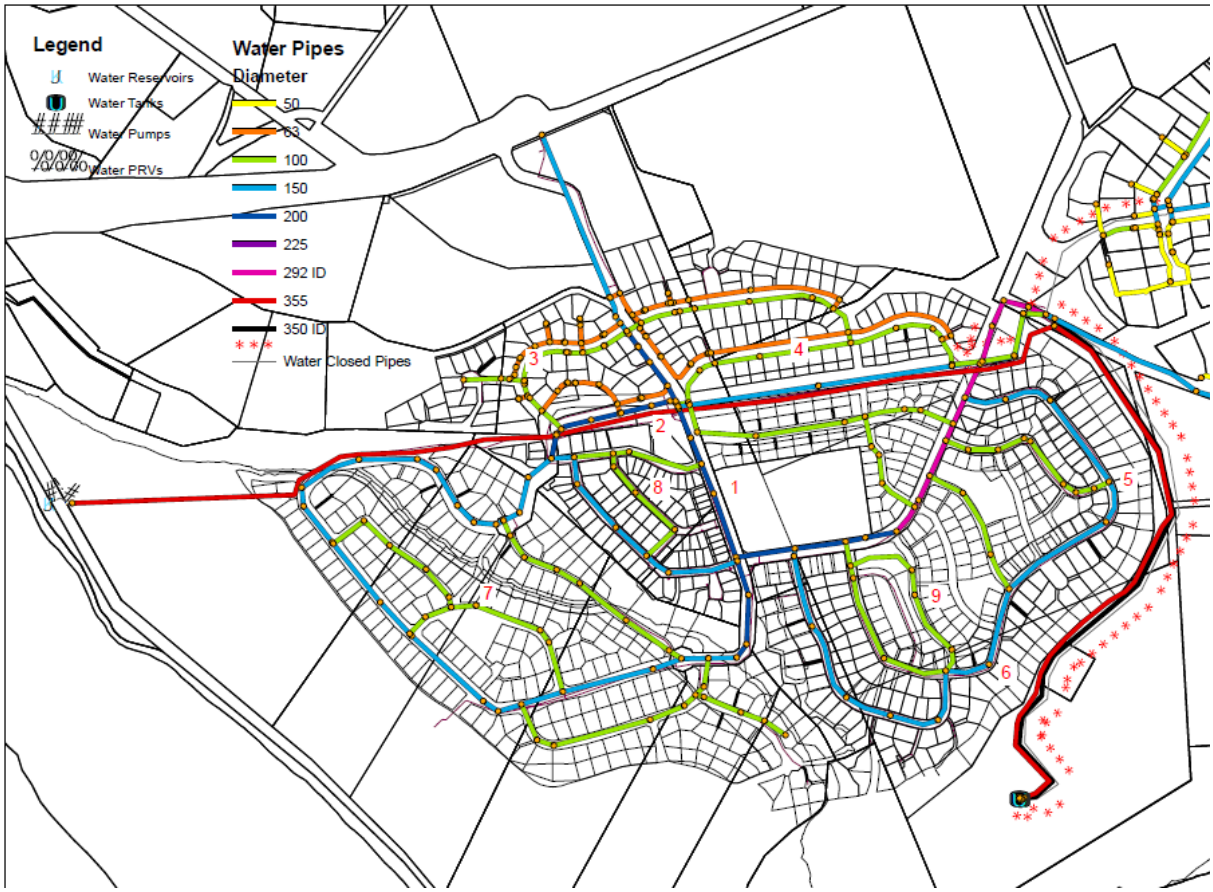
Shotover Country has developed a new 300mm water bore adjoining the Shotover River. Upgrades to the existing Water Treatment Plant at Lake Hayes Estate have also been undertaken.

Shotover Country and QLDC have jointly constructed a new 1,000m³ water storage reservoir on Jones' Hill. The reservoir and associated rising/falling mains were commissioned in August 2014.

This water supply system is now capable of delivering 70l/s for 16 hours per day. This equates to 4,032m³ of potable water per day.

The System is connected to the existing Lake Hayes water supply scheme which provides a level of redundancy and security of supply.

The rising and falling mains as well as the domestic reticulation constructed for the Shotover Country subdivision have been modelled and sized by Tonkin and Taylor Ltd. Pipe work has been sized for the fully built zone to meet QLDC's levels of service.



A 150mm water main was extended to the Stalker Road roundabout and across the highway in early 2016. This main exists in stalker Road adjoining the subject site. The static water pressure in the pipe varies from approx. 350kPa at the Oxfordshire Intersection down to 150kPa at the State Highway intersection given its relative elevation to the Shotover Country water reservoir.

QLDC are currently designing an upgrade to this water supply scheme which involves the construction of a bore field with several new bores capable of taking 395 l/s (subject to consent). This new “on-demand” system will also include a new water treatment plant that will treat the water at the source and be pumped to areas of future development including the Frankton Flats. Works on the first stage of the water upgrade a proposed to commence from October – December 2018.

7.6 Concept Design

To service the proposed development, treated water from the QLDC/Shotover Country scheme would be utilised. It is anticipated that approx. 9.0/s would be required. The connection point would be the existing 150mmØ water main in Stalker Road.

Given the elevation of the site is lower than the State Highway intersection and 150kPa is available at that location, it can be deduced that the entire site will have a static pressure of greater than the minimum required 100kPa can therefore expect to have adequate fire fighting pressures. It is noted however that the elevations are too high to achieve minimum

domestic pressures of 300KpA. Therefore, either a pressure booster pump station is needed or water to be pumped to a higher-level reservoir.

The WSP Opus report includes a water supply concept consisting of 2 x 1,000m³ water reservoirs to be located at an elevation of 423m. These reservoirs will service the Ladies Mile Area.

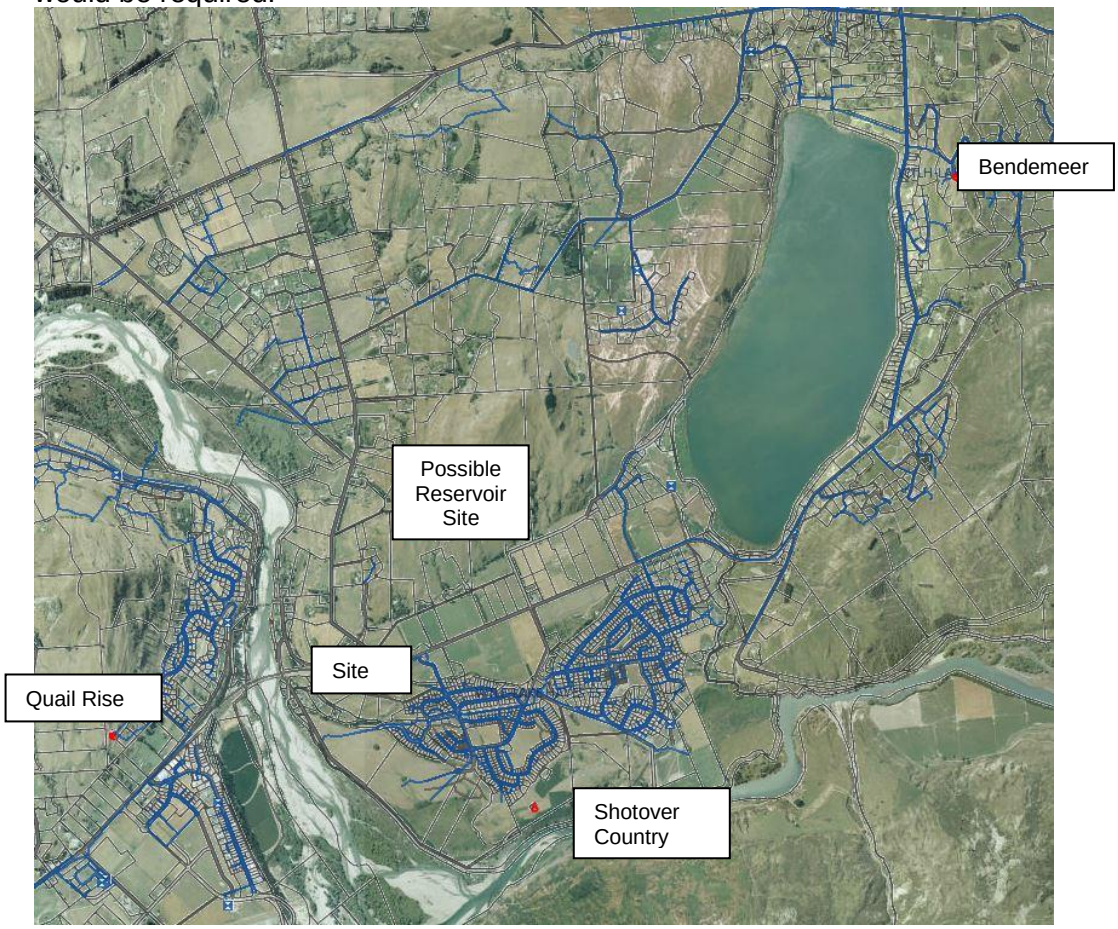
Reservoirs at this elevation will provide for between 570 – 710 kPa static pressures for the development site. This is within the range of 300 – 900 kPa specified in QLDC COP.

It is understood that the business case has been approved by the Government and design work is to proceed on the new storage reservoirs as soon as October-December 2018.

Conceptually the WSP Opus report illustrates that treated water will be pumped from the Shotover Country Bore Field to the new reservoir up Stalker Road.

From the reservoir, gravity falling main reticulation would be installed to connect the subject site for domestic and firefighting supply. The falling main indicated on the WSP OPUS concept is shown at the Stalker Road Roundabout. A line from the roundabout to the subject site would need installed; a distance of approx. 260m.

Internal reticulation would be sized accordingly but is anticipated that mains of 150mmØ would be required.



Sizing of the reservoir has been considered by WPS OPUS and it appears this will help eliminate peaks in the demand. This would then allow for a lower peak flow of water to be taken from the existing QLDC system.

All new infrastructure constructed for this development would then be vested in Council ownership.

It is also proposed to utilise the existing Arrow Irrigation network to irrigate streetscapes, reserves and open spaces. By utilising the Arrow water would see a reduction to the overall demand on QLDC potable water supply.

The further design and modelling of the infrastructure would need to be undertaken closely with the QLDC to confirm availability of supply. It is anticipated that QLDC water modelling consultants Mott MacDonald may be need to carry out this modelling at the next phase of design.

7.7 Required upgrades

Any effects on the QLDC's wider infrastructure being the Shotover Country Bore Field and Water Treatment Plant and new Ladies Mile infrastructure will be mitigated by the imposition of headworks fees at the time of connection to Council's service. It is assumed that the Laurel Hills Development would be levied under the 2018/2019 Development Contribution policy under the Ladies Mile category. The current figure being levied is $5,683 per residential unit. The additional 156 residential units under the current levy would net Council 156 x $5,683 = $886,548.00 ex GST.

8 POWER, TELECOMMUNICATIONS AND GAS

Both local electrical networks, Aurora Energy and Powernet have high voltage network adjoining the subject site. Either network could supply suitable underground electrical supply to the proposed development.

Chorus fibre optic telecommunications cables exist in the north side of the road corridor of State Highway 6. It is anticipated that connection to the network can be made and that the new development would be serviced with fibre to the door.

Contact/Rockgas have a 50t buried gas tank located off Jones Ave. The Shotover Country subdivision has full reticulation. A 110mm main runs in Stalker Road past the property boundary. Gas reticulation would then be available at the discretion of the developer.

All infrastructure is underground. All necessary mains will be extended to service the development area as development proceeds. Confirmation from the network owners will be obtained at each stage of development prior to proceeding.

It is not anticipated that there will be any supply or capacity issues for these services and connection will be made available from existing infrastructure at the time of development in accordance with the relevant service provider's specifications.

9 CONCLUSION

The inclusion of the Laurel Hills Development is not considered to have significant impacts on the infrastructure network. New infrastructure already exists that can be augmented as required to cater for additional demand.

The infrastructure will be constructed and paid for the by the applicant as the development proceeds. It is anticipated that new infrastructure required would be constructed at little or no cost to QLDC. It is possible that the construction of new infrastructure required for this development could also have a wider network or community benefit by augmenting or providing additional security to existing infrastructure.

The development will utilise existing QLDC infrastructure namely the Shotover Waste Water Treatment Plant, Shotover Country water bore field and treatment plant and possibly Ladies Mile water reservoir. Appropriate headworks fees can be levied to mitigate the effects of the additional demand.

Stormwater would be managed for the development by a combination of onsite treatment and discharge to existing network and is not expected to have effects on existing infrastructure.

Other non-Council infrastructure and network utilities exist and have capacity to supply this development.