NORTH THREE PARKS

Ballantyne Road and SH84, Wanaka
Infrastructure Assessment

Queenstown Lakes District Council

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1.0 EXECUTIVE SUMMARY

Paterson Pitts Wanaka (PPW) were engaged by Ballantyne Investment Ltd to prepare an infrastructure and servicing report for the planned North Three Parks Development, Wanaka. This report will form part of the Section 32 documentation supporting this plan change.

This assessment demonstrates that the existing infrastructure together with planned upgrades can cope with the potential increase in demand on services. Supporting reports were obtained from

- Rationale for wastewater
- Tonkin and Taylor for water
- Tonkin and Taylor for geotechnical investigation
- Traffic Design Group for traffic assessment
- Delta Utility Service Ltd for power
- Telecom New Zealand for telecommunications

No system limitations have been identified by any of the network operators that would limit the development of North Three Parks apart from possible staged upgrades required on the Wanaka Water supply. However it is noted that the final determination of what and when any upgrades to the Wanaka water supply would be required is yet to be confirmed and further modelling at the time of subdivision consent and detailed infrastructure design will be necessary.

Land Stability and Earthworks
The Tonkin and Taylor Geotechnical Investigation dated June 2010 did not identify any areas of concern regarding site stability nor identify any special soils, which would require further geotechnical assessment during development.

Based on the Geotechnical Investigation the site is considered suitable for residential development given its soil structure, gentle ground slope, stability and ability to dispose of stormwater to ground.

Roading
The proposed main land use of North Three Parks will be predominantly live and play land use defined by the mixture of low density suburban and medium density urban areas combined with the proposed Wanaka Sport Fields. There is a small pocket of shop and trade area in a strip of business zone located along the southern boundary of the site adjacent to Ballantyne Road.

Within North Three Parks the proposed road widths are based on the new NZS 4404 2010 which specifies a range of roading widths designed to service suburban (low density residential area) and Urban (medium density areas). The roading hierarchy can be summarized into three main types of roads

- one central primary collector road through the site linking Ballantyne Road and Three Parks.
- local collector roads to provide access to adjacent suburban and urban areas.
- smaller local roads designed for suburban and urban resident use only.

Additionally parts of the main collector and local collector roads are proposed to be enhanced as Boulevard style roads to provide increased usability for pedestrians and cyclists thereby providing better connectivity to the proposed sports ground from the surrounding openspace network.

Traffic Design Group traffic assessment report dated October 2011 confirms that the existing roading network can accommodate the expected demands from the proposed plan change and that proposal is consistent with the regional and local transport planning strategies. The proposed plan change gives effect to the Wanaka Structure Plan and therefore the proposed plan change can be supported from a transportation perspective.

Stormwater
PPW investigated the options of fully disposing of stormwater to ground as a result of uncertainties expressed about the capacity of the existing Cardrona River stormwater by-pass in the Aurecon Southern Wanaka Growth Zone Stormwater Review dated 3 February 2010.

A stormwater concept design (Appendix B) proposes a “Treatment Train” approach whereby all stormwater from the three main post development catchments are directed firstly via gross pollutant traps (GPTs), then further treated by stormwater water quality treatment ponds before being discharged to soakage fields for infiltration to ground. This is then backup by an emergency overflow into the Cardrona bypass via the adjacent Three Parks development.

In order to provide for emergency overflow from any stormwater soakage disposal area there is a need to ensure that the developer of the adjacent Three Parks site allows for appropriate sized pipes to service the upstream catchment of North Three Parks.

Further analysis and modelling of the stormwater catchment serviced by the Cardrona bypass pipeline should be undertaken at the time of subdivision consent and detailed engineering design to reconfirm the capacity of the bypass line.

Wastewater
The Rationale Modelling Report (Appendix D) confirms that it is acceptable for the proposed development to be connected to Councils existing wastewater infrastructure.

The point of connection would be via the existing foul sewer trunkmain that bisects the adjacent Three Parks site. There is a need to ensure that the developer of the adjacent Three Parks site allows for appropriate sized pipes to service the upstream catchment of North Three Parks.

Water Supply
The Tonkin and Taylor water modelling report (Appendix E) confirms that water supply can be made available to North Three Parks via the Albert Town ring main. There is a need to ensure that the size of the duplicate watermain along Anderson Road is sized appropriately to cater for both the North Three Parks and the adjacent Three Parks developments.

The report also identifies that there is a need for additional upgrades to the wider Wanaka Water supply required as a result of the increased development. These upgrades can be staged and would only be required once full development within North Three Parks occurs.

Further modelling will therefore be required to ascertain the type of upgrades required and the timing for these upgrades when development proceeds to the implementation phase for the both the North Three Parks and the adjacent Three Park site. At the time of detailed infrastructure design and detailed modelling analysis, confirmation of appropriate development staging can be confirmed.

Power, Telecommunications, Gas
Aurora Energy, Telecom New Zealand and Rockgas limited have confirmed that power, telecommunications and gas supplies can be made available to the proposed development site.

Aurora Energy has confirmed that the existing sub station location along Ballantyne Road is intended to remain in place for the foreseeable future.

There is a need for further consideration of the existing 66kva supply to the sub station that crosses the North Three Parks site. The location of the high voltage power supply as an overhead supply through a residential area as an above ground supply is considered inappropriate. Further consultation is required to investigate the undergrounding of this supply or its relocation along Ballantyne Road during development of the site. Additional consultation during the overall master development plan phase will be required to define and or protect a corridor for the undergrounding of the powerlines.

2.0 LAND STABILITY AND EARTHWORKS

2.1 Geology

Tonkin and Taylor have carried out a geotechnical investigation of the North Three Parks Site. This investigation and subsequent addendum of December 2010 is contained in Appendix G.

The conclusions and recommendations of this report are

- *The proposed plan change area exhibits hummocky fluvio-glacial (kame and kettle) topography to the NE of Ballantyne Rd, This changes to gently terraced glacial outwash channels about midway across the Wanaka Highway.*
- *Subsurface soils comprise topsoil, typically underlain by outwash gravels. Thin loess and colluvium may sometimes be present, and glacial till underlies the outwash at two localities.*
- *No adverse ground water conditions are expected within the plan change area, with the water table inferred to lie at 15-20m.*
- *The risk of flooding is considered low and erosion very low.*
- *There is no evidence of slope instability and the risk is considered low.*
- *The active Cardrona Fault is inferred to lie about 1km east, but due to the long (7500year) reoccurrence interval the risk to the site area in the next 50 years is considered low. The main seismic risk is strong shaking from an Alpine earthquake, with high probability in the next 50 years.*
- *The seismic liquefaction risk is considered very low due to the deep water table and material properties.*
- *Foundations should be extended below topsoil and loess to bear on competent outwash gravels.*
- *Placement of fill (if required for building platforms) should be undertaken in accordance with NZS 4431:1989.*
- *The highly permeable outwash gravels are suitable for stormwater disposal by infiltration.*

2.2 Ground Soakage

Of specific relevance is the high soakage rate of the existing ground. The permeable gravels, which underlie the site, are anticipated to have high infiltration rates. A mean permeability of 4 x 10-4m/s has been found on adjacent sites, which contain similar terrain along Ballantyne Road. This equates to a hydraulic conductivity of 34 m/day. This compares to the geotechnical assessment carried out by Opus Consultants for the adjacent Three Parks plan change, which identifies a high hydraulic conductivity ranging from 50 to 70m/day.

This provide opportunities for a green approach to the disposal of stormwater with disposal of stormwater to ground and subsequent infiltration. The disposal of stormwater is covered in detail under Section 4. The mean permeability rate of 4 x 10-4m/s has been used for infiltration calculations associated with a preliminary soakage disposal and stormwater design.

2.3 Earthworks

Large scale bulk earthworks will be required to form roads and flatten terrain suitable for medium and low density housing.

The extent and volume of earthworks is likely to be significant given the undulating terrain and need to construct appropriate sized residential blocks suitable for locating medium density housing. The existing kame and kettle terrain and undulating nature of the site comprising various hollows and bumps needs to be completely reshaped in order to remove the hollows and shape the ground. This is required so that the watershed from each residential block can sheet flow out to the roading network, thereby avoiding ponding on residential sections through out the site.

2.3.1 <u>Areas and Volumes</u>

Earthworks volumes upwards of several thousand cubic metres will be involved to suitably reshape the site.

Preliminary estimates are topsoil stripping volume of 100,000m^3 and cut to fill volume of 250,000m^3

2.3.2 <u>Staging of Earthworks</u>

The earthworks could be carried out as several smaller stages matched with the installation of roading and other services or as one stage to create and establish the general roading pattern and water shed ahead of roading and other infrastructure. The complete shaping and forming of earthworks across the whole site would provide opportunities to establish green networks and openspace ahead of residential development and provide time for reestablishment of vegetation.

2.4 Erosion & Sediment Controls

Given the undulating nature of the site it is anticipated that earthworks will be undertaken on the bulk of the site.

Given the high rate of permeability of the underlying soils the control of runoff will be straight forward and able to be fully contained within the confines of the site.

The control of erosion and silt-laden water can easily be achieved by the use of standard erosion and sediment controls such as sediment traps or settlement ponds, cut off drains to divert clean water around site works, cut off drains to divert silt laden water to settlement ponds and silt fences along external boundaries as appropriate to prevent any silt or sediment from leaving the site during development.

2.5 Dust control

Control of dust would be a vital aspect of any development of the North Three Parks site given its over burden of fine loess material and alluvial gravel which if left exposed will give rise to wind blown dust.

The Wanaka region is subject to strong to gale force northwest winds associated with frontal systems from September through to early January. It is also common for strong winds to extend through to March with sporadic periods of strong wind during April and May.

Appropriate controls measures such a k-line irrigation, limiting exposed surfaces, use of water carts, stabilisation of exposed areas will be necessary to effectively control dust and allow development to occur with minimal disruption.

2.6 Potential Ground Contamination

The QLDC Hazard register identifies all of 37 Ballantyne Road (Lot 2 DP 304423) as being potentially contaminated (RDUC 3). Subsequent to this Paterson Pitts has undertaken further investigations to determine any potential contamination onsite.

The origins of this notation have been further investigated as a result of additional material becoming available from the Otago Regional Council on 17 June 2010. This information indicated that the Otago Regional Council's "Database of Selected Landuses" shows that there were no contaminated sites associated with the above site. This correspondence notes "*there may have been a wool hide merchants located on the property as well as a sheep dip.*"

Investigations and discussions with long-term residents have revealed that there has been no wool/hide merchant located on this site.

There was a tannery located on the southern side of Ballantyne Road. There appears to be no link between the former tannery and the subject site. A former operator of the tannery has indicated that wastes from the tannery processes were disposed of to the former wastewater treatment ponds on Ballantyne Road and not disposed of on the subject site. When the tannery ceased operating and the site was remediated the wastes were transported to the Wanaka Landfill Site and buried in a polythene liner.

A previous owner and farmer of the site, with a long family association with this area, has indicated that this site never contained a sheep dip.

On the basis of the above discussions with people previously associated with the site, and surrounding activities, it is concluded that the site did not contain a wool/hide merchant or a sheep dip, and therefore the RDUC 3 notation on Council's Hazard Register is based on "*unchecked data, including anecdotal information, inferences and speculation.*" The inference that the site is potentially contaminated appears to have been based on speculation and not checked. Correspondence from the Otago Regional Council indicates that their records have now been updated (See Appendix H for confirmation).

2.7 Suitability of Site for Development

The Tonkin and Taylor report did not identify any areas of concern regarding site stability nor identify any special soils, which would require further geotechnical assessment during development.

Based on the geotechnical assessment the overall site is considered very suitable for residential development given its soil structure, gentle ground slope, stability and ability to dispose of stormwater to ground.

3.0 TRAFFIC & ROAD DESIGN

3.1 Place & Context

The main landuse characteristic of North Three Parks is predominantly live and play landuse defined by the mixture of low density suburban and medium density urban areas combined with the proposed Wanaka Sport Fields. There is a small pocket of shop and trade area provided by the strip of business zone located in the south eastern corner of the site.

3.2 Road Layout Features

The key roading layout features of the North Three Parks are

- Shared entry with the adjacent Three Parks site off State Highway 84 via a three way two laned round about.
- Central collector road providing high amenity and access through the middle of the development and to Ballantyne Road.
- Central collector provides direct and logical access to the proposed sport fields
- Grid based roading pattern providing high level of connectivity.
- Incorporation of additional boulevard style road and green linkages to openspace areas along State Highway and alongside the golf course.
- Use of narrower local roads to restrict access to the suburban and urban areas to resident only traffic.
- A high amenity pedestrian and cycle network within the reserve that follows the western boundary, separate from the road network, and providing a shorter route to Wanaka Town Centre and direct connection to Mt Iron.

3.3 Road Dimensions

The following road dimensions are proposed within the North Three Parks site.

Collector – the collector road provides access from the Three Parks main street and commercial core along the northern edge of the proposed sports fields into the adjacent suburban and urban residential areas through to Ballantyne Road. Legal road width of 21m with a 7m carriageway and cycleway. Parking is provided in indented parking bays on both sides of the carriageway and defined by street tree planting.

Local Connector – narrower through roads providing access to suburban and urban areas with parking in recessed parking bays carriageway encouraging a residents only street. Legal road width of 18m with a movement lane width of 5.0m.

Homezones – narrower local roads providing access to residential uses and acting as living streets. Narrow carriageway 3-5m shared with cyclists provides for slow speed living environments with attractive landscaped edges.

3.4 Network Connectivity

A high level of network connectivity is proposed within North Three Parks. The combination of a central collector road and local roads is essentially a grid format, which provides the highest number of alternative routes for all users. The maximum distances to the collector from within the suburban and urban areas ranges from 150 metres to 250 metres.

3.5 Traffic Assessment

Traffic Design Group have carried out a detailed traffic assessment of the proposed zone plan change and their report concludes that the existing roading network can accommodate the expected demands from the proposed plan change and that proposal is consistent with the regional and local transport planning strategies. The proposed plan change gives effect to the Wanaka Structure Plan and therefore the proposed plan change can be supported from a transportation perspective. The traffic assessments are contained in Appendix I.

4.0 STORMWATER

4.1 Objective

There are two objectives of the stormwater assessment.

Objective one is to determine whether pipe asset upgrades to the existing Wanaka stormwater network allowing for QLDC proposed upgrades scheduled under the LTCCP would be required to service the planned North Three Parks Development.

Objective two is to setout the possible catchment wide requirements for treatment and disposal of stormwater from the North Three Parks site to the existing Wanaka stormwater network.

4.2 Predevelopment Analysis

North Three Parks is a greenfield site with no existing stormwater drainage service. The site is undulating mixture of deposited glacial and fluvio-glacial landforms.

4.2.1 Description of Runoff

Existing runoff from North Three Parks is derived from the following catchments (refer Appendix B for the catchment plan).

Catchment 1 totals 2.8ha and drains to a closed depression located adjacent Ballantyne Road 70m south of the intersection of Ballantyne Road and Golf Course Road.

There are two sub-catchments outside the development site, which also drain into Catchment 1. This comprises Catchment 1a, an area of 9.1ha of rural residential housing and catchment 1b, an area of 0.41ha, which is a small catchment draining from the golf course into catchment 1.

Catchment 2 totals 4.75ha and drains to the northwest and discharges as overland flow into the golf course.

Catchment 3 totals 3.05ha and drains to the northwest and discharges as overland flow into the golf course.

Catchment 4 totals 26.8ha and is the largest catchment onsite. This drains to the north and northeast and discharges as overland flow onto the adjacent Three Parks site.

Catchment 5 totals 0.97ha and drains to the east into the adjacent Three Parks site as overland flow.

Catchment 6 totals 6.5ha and drains to the east into the adjacent Three Parks site as overland flow.

Catchment 7 totals 4.75ha and drains to the east into the adjacent Three Parks site as overland flow.

Catchment 8 totals 3.01ha and drains to the northeast into the adjacent Three Parks site as overland flow.

4.2.2 Existing Drainage Surrounding Site

The Cardrona bypass stormwater trunkmain passes the northern most point of the site. This line has been designed to take stormwater flows from the majority of Three Parks and North Three Parks site for the standard 5year return period storm events specified under NZS 4404. This is based on the infrastructure report prepared by MWH for the rezoning of the adjacent Three Parks site.

There is some concern about the capacity of the bypass line as identified by the Aurecon report entitled "Southern Wanaka Growth Zone, Stormwater Review" dated 3 February 2010. In this report questions are raised about the capacity of the by pass line. From this report on page 3 paragraph 5 the following has been identified

Flows and existing network capacitates have been derived and compared. Significant discrepancies have been noted and clarification requested on these items. Specifically calculations appear to indicate that the capacity of the Cardrona by-pass seems insufficient to accept design inflows from the Three Parks development. ……. It is identified that a flow restriction exists on the upstream catchments such that a maximum inflow of 0.55m3/s can be achieved. This would need to be clarified

Other drainage adjacent to the site is located along Ballantyne Road. However this is shallow and provides no opportunity for connection to.

4.2.3 Existing Overland Flowpaths

Existing overland flow paths are detailed on the plan in Appendix B. The majority of the site comprising catchments 4,5,6,7 and 8 discharges overland flow into the adjacent Three Parks Site. Catchments 2 and 3 discharge into the golf course. Catchment 1, 1a and 1b discharge to a closed depression located onsite, immediately to the east of the intersection of Ballantyne Road and Golf Course Road.

4.3 Possible Stormwater Disposal for North Three Parks

Given uncertainties concerning the Cardrona River by-pass this report has investigated the option of fully disposing of stormwater to ground within the confines of the site.

The following principals have also been applied to the proposed stormwater disposal. These principals are those submitted by the Otago Regional Council during the first round of informal submission made on the proposal to rezone North Three Parks and are taken from ORC's submission letter dated 16 July 2010.

- The rate of stormwater discharge shall remain equal to or less than that of predevelopment up to the 1 in 100 year recurrence interval event; and
- The quality of stormwater discharge shall remain equal to or better than that of pre-development.
- That the disposal of stormwater is managed to avoid erosion, land stability and property damage.

Infiltration to ground is considered a green approach as opposed to piping runoff flows to a single discharge point offsite.

For this report we have proposed a "Treatment Train" approach whereby all stormwater from the three main post development catchments are directed firstly via gross pollutant traps (GPTs), then further treated by stormwater water quality treatment ponds before being discharged to soakage fields for infiltration to ground. The proposed "Treatment Train" is considered to meet the principals suggested by ORC in their informal submission.

4.3.1 Proposed Stormwater Design

The Post developed site will contain three main catchments.

Catchment 1 will comprise the land owned by Spencer-Bower located in the western corner of the site. This catchment will be fully discharged to ground as per the existing situation.

Catchment 2 comprising the bulk of the site currently owned by Ballantyne Investments Limited will be collected and piped to one treatment and discharge point located in the northeast corner of the site.

Catchment 3 comprising the land owned by Robertson and Gordon-Moseby will be collected and piped to a treatment and discharge point located near the northern most boundary of the site immediately adjacent to the state highway.

Each catchment will contain the following "Treatment Train".

- Standard storm water collection pits, which incorporate a reverse "Y" siphon
- Gross Pollutant Traps
- Stormwater quality treatment ponds
- Stormwater soakage disposal fields
- Emergency overflow connection to the Cardrona bypass line.
- Ability to attenuate volume of stormwater runoff

4.3.1.1 Storm water collection pits (mudtanks)

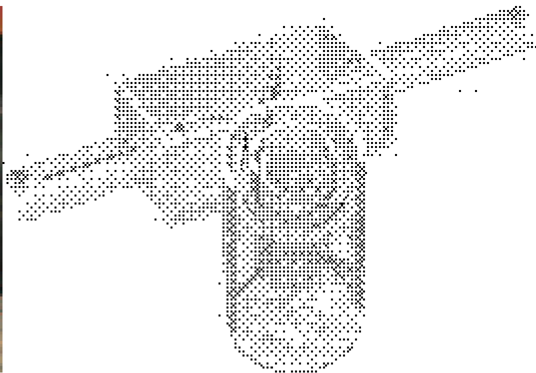
Each roadside mudtank will incorporate a reverse "Y" siphon system on the outlet to the piped stormwater network. This provides for a higher level of collection of roadside grit, rubbish, oils etc within each mudtank.

4.3.1.2 Gross Pollutant Traps (GPT)

Immediately prior to each stormwater quality pond a Gross Pollutant Trap (GPT) sized accordingly to the inflow from each catchment will be installed. GPTs are designed to capture and retain gross pollutants, litter, grit, sediments and associated oils. The Humes GPT unit is endorsed by the Auckland Regional Council (ARC) as a pre-treatment device that achieves 65% Total Suspended Solids (TSS) removal.

Such devices are located underground and are able to be cleaned out by sucker truck at specified maintenance periods such as 6 monthly intervals. The use of GPT is considered a better solution than using pond forebays, which require a higher level of maintenance and are visually unappealing.

Once the runoff has been directed via a GPT it is discharged to a stormwater quality pond where the finer particles are treated and removed.

Typical GPT plus schematic diagram of how it works.

4.3.1.3 *Water Quality*

In order to maintain water quality the use of water quality treatment ponds planted with suitable vegetation is the preferred method. Such ponds can be used as passive open space and landscaped areas and incorporated into a green network within a green field subdivision.

Given the permeable soils which underlying the site the use of a dry pond is the most suitable method. The dry pond would be a highly landscaped pond located between the GPT and the soakage field.

The treatment pond should be designed to treat first flush or smaller storm events, which contain the highest level of contaminants. Typically the required water quality volume is designed to be one third of the 2 year ARI 24 hour storm event.

The low flow from one-third of the 2 year ARI storm event is best directed through a treatment system which is not exposed to higher flood flows which can re-suspend contaminants before they are trapped or absorbed into the vegetation. This would be achieved through the use of a diversion manhole upstream from the pond inlet. Low flow from small storms events would be passed through the treatment pond and then discharged to an adjoining soakage field. Higher flood flows would bypass the treatment system and be discharged directly to the soakage field.

The treatment rates for removal of contaminants from water quality ponds is around 75%. This when combined with the use of GPT pre treatment device results in an overall removal rate of around 91%

Recent water treatment pond installed at Peninsula Bay, Wanaka

4.3.1.4 Soakage Field

Following treatment via the GPT and water quality pond it is proposed to discharge the runoff to an open soakage field. The use of an open soakage field consisting of an exposed stone bed is one possible method for achieving a high rate of infiltration into the existing ground.

The exposed stone bed would be excavated down in to the highly permeable gravels that underlie the site and the bed backfilled with stone rubble. For visual appearance the soakage pond would be landscaped with differing sized stones and suitable planting such as flaxes and other natives, thereby providing additional benefit in the form of passive open space. Walkways through and or over the dry bed could be incorporated into a green network through the site.

Recent soakage field installed at Cromwell

4.3.1.5 *Emergency overflow to Cardrona Bypass Stormwater Trunkmain*

For catchments 2 and 3 the provision of emergency overflow connections to the Cardrona bypass would provide an additional level of security should either of these soakage fields become over whelmed by an extreme event.

The post development catchment plan in Appendix B, details two points of connection required for connecting the soakage fields to the Cardrona bypass. Catchment 2 would connect via a future road link within the adjacent Three Parks development. Catchment 3 would connect directly to the Cardrona Bypass line located immediately adjacent the northern boundary just within the State Highway.

Further investigation at the time of development and setting of minimum floor levels in relation to water quality pond and soakage field will be required for catchment 1 given it is a closed depression that has no overland flowpath.

4.3.1.6 *Possible Stormwater Attenuation.*

Provision of additional attenuation of stormwater utilising openspace reserves and or parts of the proposed Wanaka Sports grounds is possible should additional attenuation be required following Councils finalisation of its Stormwater Catchment Management Plan for the Wanaka area.

4.3.2 *Other Stormwater Management Methods*

Other methods for management of stormwater such as swale drains and pervious pavements should also be considered during the preparation of an overall development master plan for the site. The use of swale drains within road carriageways and the disposal of individual residential runoff to ground would result in reduced use of traditional stormwater piped drainage reticulation and a reduction in size of the suggested treatment devices above. The use of pervious pavement in low traffic areas such as car parks can provide additional benefit in reducing the amount of runoff.

4.3.3 Overland Flow Paths

The post development overland flow paths have been identified on the catchment plans in Appendix B.

The pre development flowpaths that affected the Golf Course would be redirected as a result of the proposed roading network and collection of stormwater by a piped network within the subdivision.

The control of overland flow within the majority of the site would be achieved via the new roading network, which would be designed to convey overland flow into the three proposed soakage fields.

Given the proposed use of the soakage fields it is envisaged that no downstream overland flowpaths will affect the adjacent Three Parks site up to and including the 100-year event.

4.3.4 Maintenance

Roadside Mudtanks
Maintenance of the standard roadside mudtanks would be as per normal maintenance currently carried out by Council's Roading maintenance contractor involving twice yearly clean out of the mudtanks by sucker truck. There is also the ability to incorporate additional catchpit screen filters within the roadside mudtanks to capture additional contaminants. However these require more regular maintenance of between 2 – 4 months.

Gross Pollutant Traps
These require maintenance cleaning frequency of 6 to 12 months and are either cleaned out by sucker trucks in a similar fashion to the roadside mudtanks or the GPT contains a removable basket that facilitates cleanout. Given the proposal to use only 3 GPT across the proposed development the additional maintenance is considered minimal given the cleanout frequency and ease of cleanout.

Water Quality Pond
Maintenance of dry ponds has two components

- Aesthetic maintenance
- Functional maintenance

The aesthetic maintenance of the dry pond given its wider use of grass and vegetative planting is considered similar to a Council reserve such as Lismore Park. Maintenance would involve the periodic removal of litter, mowing of grass and control of weeds.

The functional maintenance would involve both preventative and corrective maintenance of various parts of the dry ponds such as

- grass mowing and grass maintenance
- vegetative cover maintenance
- removal of trash and debris
- sediment removal and disposal

Given the proposed use of roadside mudtanks with the reverse "Y" siphon and the gross pollutant traps the sediment trapped within the water quality ponds will be fine silts. Therefore it is expected that the cleanout timeframes for removal of sediment will be significantly longer than normal sediment ponds that have a pond forebays with clean out upwards of 15 to 20 years.

Open Soakage Field
Maintenance of the open soakage field would also involve the same two components as for the dry pond.

- Aesthetic maintenance
- Functional maintenance

The aesthetic maintenance of the open soakage field will involve the periodic removal of litter, control of weeds.

The functional maintenance of the open soakage field will involve the periodic checking for contaminant and removal of any sediment build up that would affect the soakage performance.

4.3.5 Stormwater Management Plan

It is understood the Queenstown Lakes District Council is part way through preparation of a catchment wide stormwater management plan for the Wanaka Township. The proposed stormwater controls and methods of disposal of stormwater from the North Three Parks can be adopted into the proposed Stormwater Management Plan. Alternatively given the proposal for all stormwater from within the North Three Parks to be disposed of fully to ground, a separate Stormwater Management Plan specific to the North Three Parks can be prepared in detailed at the time of specific engineering design of the development infrastructure.

4.3.6 Summary of Proposed Stormwater Design

The suggested urban stormwater design would involve the following

?? Gross Pollutant Traps (GPT)
- pre treatment prior to the water quality ponds
- designed to capture and retain gross pollutants, litter, grit, sediments and associated oils.
- the CDS GPT unit is endorsed by the Auckland Regional Council (ARC) as a pre-treatment device that achieves 65% TSS removal.
- Straight forward to maintain using sucker trucks.

?? Water Quality Pond
- dry pond
- maximum depth of 400mm
- landscaped with native vegetation
- provides passive open space as part of a green network
- removal of 75% of remaining TSS following pre-treatment by GPT achieves overall total of 91% TSS removal.

?? Soakage Field
- open soakage field incorporating varying sized stones interspaced with pockets of native vegetation
- contain and discharge the 100 year runoff event
- emergency discharge to existing Cardrona by-pass
- provides passive open space as part of a green network

?? Other Stormwater Methods
- consider use of swales and other stormwater methods in the ODMP design.
- swales, rain gardens and permeable pavements would reduce size of main treatment devices (GPT, stormwater quality ponds and soakage fields)

- ?? Flowpaths
  - designed to follow the roading network
  - formation of appropriate low points in roading network so that 100-year flowpaths are disposed to the proposed soakage fields.

4.4 Effects on Receiving Environment

Based on the proposed treatment and discharge to ground it is considered that there are no effects on the receiving environment. The following potential effects have been considered

- ?? Water quality
- ?? Balancing pre and post development flows and downstream effects
- ?? Capacity issues with Cardrona by-pass

4.4.1 Water Quality

The use of gross pollutant traps and water quality treatment ponds is calculated to remove upwards of 91% of suspended contaminants. Further treatment of the remaining pollutants would be achieved via ground infiltration.

As the depth to the underlying water table is likely to be in excess of 15 to 20m any remaining contaminants discharged to ground are unlikely to come in contact with ground water.

Therefore it is considered there will be no effects on water quality given the proposed "Treatment Train" proposed by the use of GPT, water quality ponds and soakage fields.

4.4.2 Balancing Pre and Post Development flows

Given the proposed discharge to ground for all storm events including the 100-year event all runoff is able to be contained within the site. Therefore the post- development runoff leaving the site will actually end up being less than the pre-development runoff situation

This provides beneficial effects by reducing runoff that currently affects the golf course and results in no downstream effects on the adjacent Three Parks site.

4.4.3 Capacity Issue with Cardrona Stormwater By-pass

Given the proposal to fully discharge stormwater to ground within the site there is no need to investigate further any capacities issue with the Cardrona River stormwater by-pass. Therefore there are no effects on the existing infrastructure based on the proposed method of stormwater treatment and infiltration.

However during final preparation of the ODMP, should the size of the proposed soakage fields be reduced then additional investigation would be required to determine the capacity of the Cardrona by-pass line.

4.5 Stormwater Modelling

4.5.1 Available Design Guidelines

There are no suitable guidelines produced by either the ORC or QLDC on stormwater management practices. Therefore design guidelines for the water quality ponds have been adopted from Auckland Regional Council's Technical Publication "Stormwater Management Devices: Design Guidelines Manual" (TP10). The modelling of the stormwater runoff for a storm event has been based on Auckland Regional Councils "Stormwater Runoff Modelling Manual" (TP108).

4.5.2 *Catchments*

Preliminary calculations have only been carried out for the post development situation as the proposed stormwater design fully disposes of stormwater within the site and therefore no comparison with the existing runoff situation is necessary.

4.5.3 *Rain Fall Depths*

The estimate of the 24hour rainfall depth has been obtained from NIWA's *"High Intensity Rainfall Design System (HIRDS)"* version 3 online program.

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	3.2	4.7	5.9	8.7	12.9	24.0	35.6	52.8	63.2	70.2
2.00	0.500	3.6	5.2	6.5	9.5	14.1	25.9	38.1	56.1	67.2	74.7
5.00	0.200	4.6	6.9	8.6	12.7	18.4	33.1	48.0	69.4	83.3	92.7
10.00	0.100	5.7	8.3	10.4	15.4	22.0	39.0	55.8	80.1	96.5	107.3
20.00	0.050	6.7	10.0	12.5	18.3	26.2	45.6	64.7	92.0	110.9	123.7
30.00	0.033	7.4	11.0	13.8	20.4	28.9	50.1	70.8	100.0	120.5	134.3
40.00	0.025	8.0	11.8	14.8	21.9	31.0	53.1	74.7	105.1	126.8	141.5
50.00	0.020	8.5	12.5	15.7	23.2	32.6	55.6	78.0	109.2	132.0	147.4
60.00	0.017	8.8	13.1	16.5	24.2	34.0	57.7	80.6	112.6	136.2	152.1
80.00	0.012	9.5	14.0	17.6	26.1	36.3	61.1	85.0	118.3	143.0	159.7
100.00	0.010	10.0	14.8	18.7	27.6	38.2	64.0	88.7	123.0	148.6	166.0

Figure 2. HIRDS Version 3.0 Rainfall Depths Wanaka: Northing 5604868, Easting 2205092

Note the above figures have allowed for potential climate change temperature increase of 2 degrees. This temperature increase is based on the recommendations in the "Climate Change Effects and Impacts Assessment: A guidance manual for Local Government in New Zealand: 2nd Edition" (Ministry for the Environment, 2008). This guideline predicts an expected temperature increase of 2°C in Otago by 2090 and recommends designing stormwater infrastructure for an 8% increase in rainfall intensity per 1°C for a 1% AEP storm event.

From modelling undertaken for various storm durations the 24 hour storm has been identified as the critical storm event for peak volume runoff and the 20 min storm has been identified as the critical storm for peak runoff flow.

4.5.4 *Modelling Program*

The stormwater runoff has been modelled using a stormwater modelling program called HydroCAD. The program models stormwater runoff over a chosen time duration using a rainfall distribution pattern and an estimate of the design rainfall depth for various storm return periods.

The modelling program uses the SCS unit hydrograph method (developed by the US Soil Conservation Service) for determining runoff from catchments with allowance for time of concentration, travel time, different soil types and infiltration.

4.5.5 Rainfall Distribution Pattern

A rainfall distribution indicates how the storm depth will be distributed over time.

For the Wanaka region we have determined our own rainfall distribution pattern for three time periods being 12, 24 and 36 hours, from assessing the hourly rainfall records from the automatic rain gauge located at the Wanaka Airport.

The rain gauge information has been obtained from NIWA. The rainfall distribution pattern has been determined by analysis of 1-hour storm depths from large storm events of more than 20mm and durations from 10 to 72 hours.

The analysis of the available hourly rainfall data from NIWA for the Wanaka Airport automatic rain gauge indicates that the distribution pattern detailed below is typical of the Wanaka area for a 24 hour storm event.

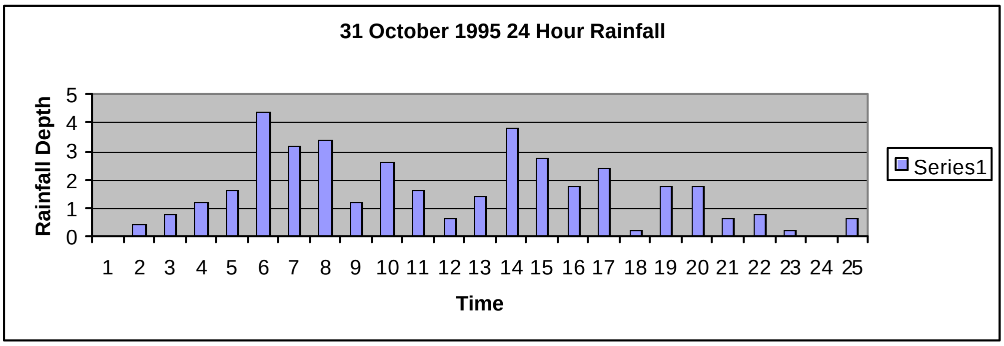


Figure 3. Typical 24 hour rainfall pattern for Wanaka derived from NIWA hourly rainfall data from Wanaka Airport automatic rain gauge.

The above rainfall depths have been converted to accumulative rainfall versus time to determine the required storm distribution pattern curve used in the modelling program.

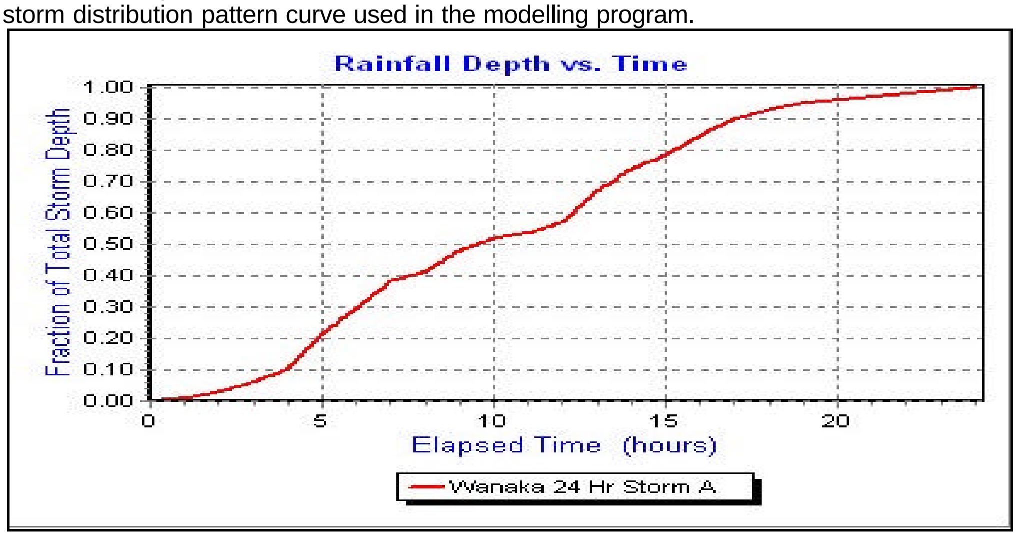


Figure 4. HydroCad rainfall distribution chart derived from rainfall depths in Figure 3.

4.5.6 Soil Type

Soils are classified into hydrologic soil groups to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve number.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate - the rate at which the water moves through the soil. This rate is controlled by the soil profile. The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands and gravels, and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted, and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted, and consist chiefly of soils with a layer that impedes downward movement of water, and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted, and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

4.5.7 Runoff Curve Number (CN)and average percent impervious area

The curve number, or CN, is determined according to the soil type and ground cover. A high CN (such as 98 for pavement) indicates minimum retention, while a low CN (such as 30 for certain wooded areas) indicates a large retention capability.

The average percentage of impervious used to determine the expectant coverage of imperious and pervious ground cover is based on Table 2-2a-Runoff curve numbers for urban areas from ARC's TP108 Guidelines for Stormwater Runoff Modelling. The following has been used

Urban commercial and business = 85% impervious
Residential 500m² section or less (medium density housing) = 65% impervious
1,000m² section (low density housing) = 38% impervious

Other assumptions used are that impervious areas are directly connected to the drainage system and all impervious areas have a CN of 98 and pervious areas are considered equivalent to open space in good hydrological condition and use a CN of 39 (based on HGS A).

4.5.8 Return Storm Events

The following storms have been modelled for determining the peak discharge, water quality pond sizing and the soakage field area.

- ?? 100-Year Return 20 minute Storm Event
- ?? 100-Year Return 24 hour Storm Event

The following storm has been modelled for determining the peak discharge rate of runoff to the existing wetland and the required water volume necessary to achieve suitable water quality in accordance with TP10.

?? One third 2-Year Return Storm Event

4.6 Stormwater Modelling Results

As the developed urban area would contain significant amounts of impervious areas discharging directly to a piped network it is considered to be heterogeneous. Therefore each catchment is modelled separately connected by a hydraulic element (i.e. pipe or channel).

4.6.1 Urban Residential Runoff Calculations

For the preliminary modelling undertaken for this report the following assumptions have been made

- Impervious area = roof, driveways, road seal, footpath CN = 98
- Pervious area =open space grass, gardens, grass road berms etc CN = 39
- Soil type = HSG A. This has a high rate of permeability. Previous experience from other developments within the surrounding area from developments involving ground soakage indicate that the mean permeability rate is 4×10^{-4} m/sec.

The following catchments have been determined to represent the likely urban residential runoff.

Catchment #	Area (hectares)	CN
1per	9.52	39
1imp	4.1	98
2per	15	39
2imp	22.4	98
3per	2.4	39
3imp	2.7	98

Figure 9. Urban Residential – catchment parameters. Per = pervious, Imp = impervious

4.6.2 Urban Residential Runoff Via Soakage Field

Each of the 3-post development catchment requires separate soakage fields to dispose of stormwater runoff to the permeable gravels under the site. The following preliminary soakage field sizes and rates of discharge have been determined.

Post Development Catchment 1

Soakage Pond Results for Post Development Catchment 1

Soakage Field 1	**Basic Dimensions**	
Surface Area	300m²	
Base Level	310.00	
Upper Level	312.00	
Modelling Results	**100year 20 min ARI**	**100year 24 hour**
Peak inflow (m^3/s)	0.2894	0.1288
Volume Disposed to Ground (m^3)	254	4759
Peak Elevation	0.3	0.05
Peak Soakage Rate (m^3/s)	0.120	0.120

The above results identify that a soakage field of 300m2 has the ability to handle both the 100 year 20 minute storm and the 100 year 24 hour storm event. The depth of water is estimated to range from a maximum of 0.31m during the 20minute storm to 0.05m during the 24-hour event.

Post Development Catchment 2

Soakage Pond Results for Post Development Catchment 2

Soakage Field 2	**Basic Dimensions**	
Surface Area	1500m²	
Base Level	316.00	
Upper Level	318.00	
Modelling Results	**100year 20 min ARI**	**100year 24 hour**
Peak inflow (m^3/s)	0.2176	0.8243
Volume Disposed to Ground (m^3)	2317	26600
Peak Elevation	0.89	0.61
Peak Soakage Rate (m^3/s)	0.6	0.6

The above results identify that a soakage field of 1500m^2 has the ability to handle both the 100 year 20 minute storm and the 100 year 24 hour storm event. The depth of water is estimated to range from a maximum of 0.89m during the 20minute storm to 0.61m during the 24-hour event.

Post Development Catchment 3

Soakage Pond Results for Post Development Catchment 3

Soakage Field 3	**Basic Dimensions**	
Surface Area	200m²	
Base Level	313.00	
Upper Level	315.00	
Modelling Results	**100year 20 min ARI**	**100year 24 hour**
Peak inflow (m^3/s)	0.2952	0.0995
Volume Disposed to Ground (m^3)	275	3231
Peak Elevation	0.78	0.31
Peak Soakage Rate (m^3/s)	0.08	0.08

The results above identify that a soakage field of 200m^2 has the ability to handle both the 100 year 20 minute storm and the 100 year 24 hour storm event. The depth of water is estimated to range from a maximum of 0.78m during the 20-minute storm to 0.31m during the 24-hour event.

4.6.3 Urban Residential Water Quality Calculations

The sizing of the water quality treatment pond has been determined as per the procedures in TP10. The necessary volume specified in TP10 for maintaining water quality is equal to the volume of runoff generated by one-third of a 2-year storm event.

4.6.3.1 Required Volumes & Area

The following preliminary water quality volumes and areas have been calculated for the three catchments.

Catchment	Water Quality Volume m^3	Land required to be set aside for Water quality Pond	Soakage Area	Total Area
1	312	600	300	900
2	2910	4000	1500	5500
3	351	600	200	800

4.7 Water Table

The existing water table has been identified as being 15m to 20m or more below the surface and would not be exposed during development of the site.

4.8 Integration with the Adjacent Three Parks Development

Should additional capacity in the Cardrona Stormwater By Pass be identified by Council there is a need to ensure that the developer of the adjacent Three Parks allows for appropriate sized and located stormwater pipes to service the upstream catchment of North Three Parks.

Any work undertaken in the adjacent Three Park development required to service North Three Parks would be undertake by either the Developer of Three Parks or by the Developer of North Three Parks (dependent on agreement between both developers). Council's role will be to ensure that appropriate infrastructure is ultimately installed by either developer in accordance with NZS 4404 and Council's amendments to NZS 4404.

4.9 Recommendations

The following recommendations are considered one solution to the treatment and disposal of stormwater for the North Three Parks site.

- Stormwater from the three main post development catchments are directed firstly via gross pollutant traps (GPTs), and then further treated by stormwater water quality treatment ponds before being discharged to soakage fields for infiltration to ground.
- If of benefit to the discharge of stormwater to ground use other stormwater management methods such as swale drains and pervious pavements when preparing a detailed development layout.
- If of benefit to the discharge of stormwater to ground use additional attenuation, which could be achieved by utilising the new sports grounds for temporary storage of excess stormwater.
- Undertake additional modelling of the existing stormwater trunkmain in the Three Parks site as part of Council's wider stormwater catchment plan for Wanaka to specifically check for spare capacity so as to reduce reliance on dispersal to ground within North Three Parks which will allow for additional residential use of land which otherwise would have to be set aside for stormwater soakage areas.

5.0 WASTE WATER

5.1 Existing Waste Water Reticulation

Wastewater reticulation exists along Ballantyne Road and through the northeast corner of the adjacent Three Parks site.

The existing water line along Ballantyne road consists of a 150-diameter line that ultimately discharges to the Riverbank Road pump station.

The existing Three Parks trunkmain consists of a 300-diameter sewer main that also discharges to the Riverbank Road pump station.

5.2 Proposed Disposal of Wastewater

The development of North Three parks will result in three distinct catchments, which match the stormwater catchments. These are

Catchment A will comprise the land owned by Spencer-Bower located in the Western corner of the site.

Catchment B comprising the bulk of the site currently owned by Ballantyne Investments Limited.

Catchment C comprising the land owned by Robertson and Gordon-Moseby.

Two possible scenarios have been modelled for the disposal of wastewater from the North Three Parks site.

<u>Scenario 1</u>

?? Catchment A – pumping to an existing manhole in Ballantyne Road.
?? Catchment B – discharge by gravity via a new wastewater main to existing reticulation located in the adjacent Three Parks Commercial Core.
?? Catchment C – pumping to an existing manhole located along side the Wanaka – Luggate highway.

<u>Scenario 2</u>

?? Catchment A – pumping to Catchment B reticulation
?? Catchment B – discharge by gravity via a new wastewater main to existing reticulation located in the adjacent Three Parks Commercial Core.
?? Catchment C – pumping to Catchment B reticulation

Further investigation is required for Catchment C to determine if it can be service by gravity sewer by a second connection point from Three Parks.

5.3 Rationale Ltd Wastewater Reticulation modelling

Rationale Ltd were commissioned to model the discharging of wastewater generated by the proposed North Three Park development into the Council reticulated network. This report is contained in Appendix D.

The conclusions of this modelling are that North Three Parks be allowed to connect to Council's existing reticulation.

5.4 Integration with the Adjacent Three Parks Development

There is a need to ensure that the developer of the adjacent Three Parks site installs appropriate sized and located foul sewer pipes to service the upstream catchment of North Three Parks. The location for the required connections is detailed in Appendix C.

Any work undertaken in the adjacent Three Park development required to service North Three Parks would be undertake by either the Developer of Three Parks or by the Developer of North Three Parks (dependent on agreement between both developers). Council's role will be to ensure that appropriate infrastructure is ultimately installed by either developer in accordance with NZS 4404 and Council's amendments to NZS 4404.

Further investigation and consideration how Catchment C is to be serviced whether by foul sewer pumping to Catchment B or by gravity sewer through Three Parks is also necessary when further details of the infrastructure layout within the adjacent Three Parks site is confirmed.

6.0 WATER SUPPLY

6.1 Water Modelling

Tonkin and Taylor have carried out a water modelling investigation of the North Three Parks Site. A copy of this report is contained in Appendix E.

The modelling results are:

- Modelling shows that, during the design peak hour demand scenario, the residual pressures in the development will be at least 300 kPa. Hence, the Queenstown Lakes District Council (QLDC) requirement for minimum pressures being = 300 kPa is met within the proposed development.

- Modelling also shows that in the commercial area in the south, a minimum of Class FW3 fire flow can be achieved during the design peak day demand scenario, as required for an unsprinklered commercial/business development. All hydrants can deliver at least 50 l/sec within 270 m, and at least 25 l/sec within 135 m.

- Additionally, modelling shows that for the remainder of the development a minimum of Class FW2 fighting can be achieved during the design peak day demand scenario, as required for an unsprinklered residential development. All hydrants can deliver at least 25 l/sec within 270 m, and at least 12.5 l/sec within 135 m.

6.2 Effects of connection on network capacity

Modelling shows that connection of this development would reduce the minimum pressures in the Cardrona Valley Road area by 120 kPa, during the 2009 design peak hour scenario. This results in West Meadows development and properties on Stone Street, Niger Street and Orchard Road receiving pressures less than 300 kPa (a minimum pressure of 210 kPa occurs at the western end of West Meadow Drive). Hence, QLDC minimum residual pressure requirements would not be met in the other areas of the network with connection of the Ballantyne Investments development, without upgrades to the network.

It is possible that in the short to medium term the development with a lower level of demand and a connection to Ballantyne Road may increase pressures slightly to the Cardrona Valley Road area (due to improved connectivity). However, this connection would reduce pressures to the Cardrona Valley Road area once demand increased within Ballantyne Investments development.

Modelling shows that connection of this development has minimal negative effect on the fire flows in the remainder of the network, provided that a PRV is installed between the proposed development and Ballantyne Road. This connection would improve fire flows to Ballantyne Road and some parts of Cardrona Valley Road.

6.3 Integration with the Three Parks Development

Water supply is currently proposed for the Three Parks area (between Ballantyne Rd and SH84) via the proposed 300 mm NB Albert Town ring main. This ring main is to join to Andersons Rd in the west and Aubrey Rd in the north (both part of the Beacon Point pressure zone). Indicative main sizes have been supplied to QLDC based on projected future populations in the area.

We understand that ultimate supply to the Albert Town ring main may be from the proposed Hawthenden Reservoir in the south of Wanaka, or by the existing Beacon Point Reservoir via new duplicate mains along Anderson Rd. The ultimate source of water to this area of the Wanaka water supply network will determine what network upgrades are required (i.e. additional trunk mains down Anderson Rd), and govern how development in the Ballantyne Rd area is integrated into the overall network upgrade and management strategy.

The connection of the proposed North Three Parks development may require a larger diameter main for the section of the Albert Town ring main between Anderson Rd and the connection point for the development. The further section of main to supply the Three Parks area is expected to be (currently sized at) a 300 mm NB main.

The effects on current network capacity by connection of the proposed North Three Parks development are minimised by not immediately connecting to the Ballantyne Rd trunk main. Modelling shows that connection to the Ballantyne Rd main would result in increased headloss through the McPherson St trunk main reducing the pressures in the Cardrona Valley Rd area. Future network upgrades would dictate when connection to Ballantyne Rd is appropriate.

Any work undertaken in the adjacent Three Park development required to service North Three Parks would be undertake by either the Developer of Three Parks or by the Developer of North Three Parks (dependent on agreement between both developers). Council's role will be to ensure that appropriate infrastructure is ultimately installed by either developer in accordance with NZS 4404 and Council's amendments to NZS 4404.

6.4 Further modeling at the Master Development Stage

Additional modelling would be carried out during the master development stage in conjunction with Council to address ongoing water supply issues with the wider Wanaka water supply network. Initial discussions with Council have indicated a preference for ensuring multiple redundancies are incorporated into the North Three Parks water supply with the ultimate goal of providing additional pressure to the Ballantyne Road area via 2 to 3 larger trunkmains of 200mm to 250mm diameter across the North Three Parks site and also the adjacent Three Parks site. Therefore the current modelling which shows a 300mm diameter main running in the north south direction through North Three Parks would possibly be split into two 200mm diameters mains in order to provi de for greater redundancies with one or both of these mains connected to the existing Ballantyne water at the appropriate time when water pressure issues with the Cardrona Valley Road area are addressed.

7.0 POWER, TELECOMMUNICATIONS, GAS

Confirmation of serviceability of North Three Parks for power, telecommunications and gas were obtained from the suppliers of these services based on the draft structure plan and the possible number of residential units anticipated by the zoning and densities indicated by the Three Parks zoning rules intended to be applied to North Three Parks.

All contacted suppliers confirmed the serviceability of the network with regards to their respective network. Their written confirmations are contained in Appendix F

7.1 Telecommunications Supply

Telecom NZ Limited confirmed by letter 14 July 2010 that they could make a telecommunications supply available for North Three Parks based on the draft structure plan and indicative number of residential units possible.

7.2 Power Supply

Delta Utility Services Limited confirmed by letter dated 28 June 2010 that they could make a power supply available for North Three Parks based on the draft structure plan and indicative number of residential units possible.

7.3 Gas Supply

Rock Gas Limit confirmed by letter dated 6 September 2010 that they could make a gas supply available to North Three Parks.