

B Engineering Standards

B1 Introduction

This appendix contains standards that apply to subdivision, use and development of land. It is referred to in the rules for each zone. As well as standards, the objectives in this appendix will guide the assessment of resource consents, and conditions may be imposed on consents in regard to any of the matters mentioned throughout the appendix.

B1.1

The standards are performance based with an emphasis on outcomes and effects. They are not a prescription of methods or materials, but are intended to permit flexible and innovative approaches or solutions, to engineering aspects of land development.

B1.2

For people who prefer to rely on prescribed methods and materials, compliance with the Hamilton City Development Manual, which is a separate document from this plan, will be accepted as a means of compliance with this appendix. However, alternative methods will be considered at the time of making an application, and will be evaluated as part of the resource consent assessment process.

Advisory Note:

The Hamilton City Development Manual has been replaced with the Hamilton Infrastructure Technical Specifications. Compliance with the Hamilton Infrastructure Technical Specifications is considered an acceptable alternative method to achieve compliance with this appendix.

B1.3

Design life standards stated below do not apply to private roads, water supplies, or stormwater systems that are used solely to service activities on the site.

B1.4

It is anticipated that for any activity, compliance with the engineering standards will ensure that all adverse effects on the health and wellbeing of the Waikato River and its catchment will be avoided.

B2 Wastewater

B2.1

The wastewater disposal system shall meet these objectives:

- (a) safeguard peoples' health and safety
- (b) safeguard people from loss of amenity due to the presence of unpleasant odours or the accumulation of offensive matter resulting from wastewater and foul water disposal
- (c) safeguard the intrinsic values of ecosystems within the land being subdivided
- (d) ensure that sanitary wastewater is removed from the premises.

B2.2

Drainage systems for the disposal of wastewater shall be constructed to:

- (a) convey foul water to an appropriate treatment and disposal system
- (b) avoid the likelihood of blockage and leakage

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- (c) be supported, jointed, sealed and protected in a way that will avoid the likelihood of penetration of roots, or the entry of groundwater, or surface stormwater
- (d) be provided with reasonable access for maintenance, and clearing of blockages
- (e) be ventilated to avoid the likelihood of foul air and gases accumulating in the drainage system and sewer (provided that vents shall be positioned to avoid nuisances near existing buildings or likely future building sites)
- (f) be constructed to avoid the likelihood of damage from superimposed loads, normal ground movement, or flooding from a 2 per cent probability flood event
- (g) be compatible with any existing network that it is linked to
- (h) not unduly restrict the location of any future buildings
- (i) use materials suitable for the intended use
- (j) be sized to accommodate the foreseeable flows
- (k) have a design life of at least 70 years.

(ka) set back drip lines and effluent disposal fields at least 1.5m from the site boundary.

Despite (k), the design life for systems within the Te Kauwhata Structure Plan area shall be at least 100 years.

B2.3

Every allotment shall be provided with a piped gravity outfall connected to an existing council sewer, where a sewer is available within 500 metres and which has the capacity to carry the potential volume of wastewater likely to emanate from the allotment following subdivision. (The capacity of the sewer means the capacity of the length of the sewer from the allotment to, and including, the treatment facilities).

B2.4

The connection to the sewer shall be made in a manner that avoids damage to the sewer, and that is to the approval of the network utility operator.

B2.5

On-Site Wastewater Disposal

Every allotment that is not connected to a reticulated wastewater system shall be capable of being provided with a means of treating and disposing of sanitary wastewater (within the net area of the allotment) that meets the objectives and relevant construction standards above, and that ensures that there will be no contamination of downstream properties by wastewater effluent. Waste water systems in poorly drained areas should be designed to avoid health risks from the effects of high ground water levels on the proposed effluent disposal field.

On-site wastewater systems shall comply with AS/NZS 1547:2000 or subsequent revisions, and shall comply with the Waikato Regional Council's regional rules for on-site discharges of wastewater.

B2.6

In addition, all effluent disposal systems in the Tamahere Country Living Zone and the Tamahere Village Business Zone shall be designed, installed and managed to meet the following minimum

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objectives:

- (a) provides a means of treating and disposing of sanitary wastewater to ensure that there is no detectable increase in effluent discharge across the boundary of the site, except where a cross boundary effluent disposal system is agreed between the owner/s of the Tamahere Village Business Zone and Waikato District Council,
- (b) reflects the nature of the site conditions and constraints associated with the property and building development, demonstrating that the soil and ground water conditions have been considered in the design,
- (c) meets the Australian/New Zealand standard for Onsite Domestic Wastewater Management AS/NZS 1547:2012,
- (d) demonstrates that ground water and surface water quality is not degraded as a result of the discharge or in combination with other discharges.

B3 Trade Waste

Measures shall be put in place to minimise the generation of trade wastes from all commercial premises. A specific trade waste agreement will be required prior to the discharge of any trade wastes to the Council's wastewater networks.

B3.1

A trade waste disposal system shall meet these objectives:

- (a) safeguard people's health and safety, in regard to injury or illness caused by infection or contamination resulting from trade waste
- (b) safeguard people from loss of amenity due to the presence of unpleasant odours or the accumulation of offensive matter resulting from trade waste disposal
- (c) safeguard the intrinsic values of ecosystems within the land being subdivided
- (d) ensure that sanitary and industrial wastewater is removed from premises.

B3.2

Allotments that are likely to be used for activities generating trade waste shall be provided with adequate facilities for the safe and hygienic collection, holding, treatment and disposal of the waste.

B3.3

Facilities for the storage, treatment and disposal of industrial liquid waste shall be constructed:

- (a) to dispose of wastes from allotments safely and hygienically
- (b) to avoid the likelihood of blockage and leakage
- (c) to avoid the likelihood of foul air and gases entering current buildings, or likely future building sites
- (d) to provide reasonable access for clearing of blockages
- (e) with adequate capacity for the volume of waste and the frequency of disposal
- (f) to provide adequate vehicle access for collection if required
- (g) to avoid the likelihood of contamination of any potable water supply
- (h) to avoid the likelihood of contamination of soils, ground water and water bodies except as permitted under a resource consent
- (i) from materials that are impervious both to the waste for which disposal is required, and to water

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- (j) to avoid the likelihood of foul air and gases accumulating within or entering into buildings
- (k) to avoid the likelihood of unauthorised access by people
- (l) to permit easy cleaning and maintenance
- (m) to have a design life of at least 70 years
- (n) from materials suitable for the intended use
- (o) be compatible with any existing network that it is linked to
- (p) to ensure safety in operation.

B4 Water

B4.1

The water supply system shall meet these objectives:

- (a) safeguard people from illness caused by infection from contaminated water or food
- (b) safeguard against injury or property damage arising from the operation of the system
- (c) safeguard people from loss of amenity arising from a water supply that is offensive in appearance or odour
- (d) provide adequate supply of potable water for the reasonably foreseeable consumption, health and hygiene needs of people using each allotment
- (e) conserve water by avoiding leaks and, where practicable, the use of water saving fixtures, such as low flow shower heads and rain tanks will be encouraged
- (f) provide adequate water supply for fire fighting in urban areas.
 - (fa) new buildings shall incorporate water saving fixtures where practicable, such as low flow shower heads and rain tanks.

B4.2

Every allotment shall be provided with a potable water supply sufficient for the likely use of the land following subdivision.

B4.3

Water supply systems shall be constructed to:

- (a) ensure compliance with the NZ Drinking Water Standards 2000 or subsequent revisions, where the system serves more than one dwelling or property
- (b) avoid the likelihood of potable water contamination within both the system and the water main
- (c) provide water at flow rates that are adequate for the likely future land use on each allotment under normal conditions (the minimum requirement shall be the flow rates required for a typical household containing 4 persons), and to withstand anticipated pressures and loads
- (d) avoid the likelihood of leakage
- (e) allow reasonable access for maintenance of mechanical components
- (f) allow the system and any backflow prevention devices to be isolated for testing and maintenance
- (g) provide adequately for fire fighting, with accessible water supplies in public places, in all zones other than the Rural and Country Living Zones

- (h) be compatible with any existing network it is linked to
- (i) have a design life of at least 70 years
- (j) use materials suitable for the intended use
- (k) be clearly identified as such, if carrying non-potable water.

Note – urban type activities that establish in the Rural, Coastal and Country Living Zones may be required under resource consent conditions to provide for fire fighting, as the Council will not supply water in these areas at sufficient pressure or flow for fire fighting.

B4.3A

Every allotment less than 6ha in an area serviced by the existing infrastructure of an urban or rural water supply scheme is connected to that scheme.

B4.4

Every allotment connected to the Council water supply system shall be equipped with an approved water connection and meter backflow preventer where applicable. For allotments fronting a public road, the connection shall be located on the road side of a road boundary at a point where it is clear of vehicle and traffic movements and readily accessible for meter reading. The installation of a rain tank for secondary use, e.g. watering gardens, washing boats, is encouraged.

B5 Stormwater

B5.1

The stormwater disposal system shall meet these objectives:

- (a) safeguard people from injury or illness from damage caused by surface water
- (b) avoid adverse effects caused by surface water on other properties
- (c) protect the environment from accelerated erosion or sedimentation
- (d) protect the environment from the effects of heavy metals and other contaminants in stormwater discharges
- (e) protect the outfalls of drainage systems.
 - (ea) provide adequate drainage within each allotment

B5.2

Buildings and site works shall be constructed in a way that protects people and property from the adverse effects of surface water.

B5.3

Surface water, resulting from a storm having a 10per cent probability of occurring annually and which is collected or concentrated by buildings or site work, shall be disposed of to a suitable outlet in a way that meets the objectives in B5.1 and avoids the likelihood of damage or nuisance within the allotment or to other property. Secondary flow paths shall be provided for surface water flows exceeding the 10per cent storm flow.

In the Te Kauwhata Structure Plan area, secondary flow paths shall have capacity to convey the 1 per cent average recurrence interval storm flow.

B5.4

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Drainage systems for the disposal of surface water shall be constructed to:

- (a) convey surface water to an appropriate outfall using gravity
- (b) avoid the likelihood of blockages, leakages, or penetration by roots, where pipes, manholes or lined channels are used
- (c) provide reasonable and safe access for maintenance, and clearing of blockages
- (d) avoid the likelihood of damage to any outfall, in a manner acceptable to the network utility operator
- (e) avoid the likelihood of damage from superimposed loads or normal ground movements
- (f) deal with surface water in the catchment in which it falls
- (g) adequately service each allotment, road area or other land area falling to the point of entry into the drainage system
- (h) be compatible with any existing drainage network it is linked to
- (i) use materials suitable for the intended use
- (j) have a design life of at least 70 years
- (k) not unduly restrict the location of any future building
- (l) avoid the discharge of stormwater to any wastewater sewer network
- (m) avoid an increase in the peak flow rate off the land in Living, Pa, Business, Industrial (particularly in Raglan) and Country Living Zones. Within the Tamahere Country Living Zone any measures designed under this rule shall ensure that existing low flows in gully streams are preserved.
- (n) minimise discharge of contaminants.
- (o) ensure that stormwater disposal areas are adequately separated from effluent disposal areas to safeguard the functioning of both systems. In areas of poorly drained soils either the stormwater is to be directed to areas with higher infiltration, or infiltration systems are to be constructed.
- (p) ensure that residual stormwater (after mitigation) discharged to a gully is piped down the gully sides with appropriate erosion protection measures, e.g. rip rap at the outlet to the gully floor.

In addition to the above, in the Te Kauwhata Structure Plan area drainage systems for the disposal of surface water shall be constructed to:

- (q) minimise the amount of stormwater entering the piped drainage system
- (r) facilitate groundwater recharge where soil characteristics and winter groundwater conditions indicate that infiltration systems are a viable engineering solution.
- (s) cover the immediate needs as well as those of foreseeable future developments
- (t) have a design life of not less than 100 years
- (u) build infrastructure that minimises lifecycle costs
- (v) meet the requirements of any catchment management plan, where applicable
- (w) ensure that the infrastructure vested in Council is of sufficient capacity to cope with total unmanaged design flows assuming there are no functioning private LIUDD's within the catchment.

Note: Clause (t) supersedes clause (j) | the structure plan area.

B5.5

Every allotment shall be provided with a piped gravity outfall connected to a council stormwater drain where one exists and where it has the capacity to carry the potential volume of stormwater likely to

emanate from the allotment following subdivision. (The capacity of the drain means the capacity of the length of the drain from the allotment to, and including, its outfall to a water body or coastal water).

B5.6

All systems shall be designed to accept the flow from upstream of the subdivision, and shall be of sufficient capacity to provide for maximum flows from possible future development areas, to the extent of development allowed as a permitted activity in the relevant zone.

B5.7

In the Tamahere Country Living Zone and the Lorenzen Bay Structure Plan Area and the Te Kauwhata Structure Plan area, all systems shall incorporate appropriate low impact design features such as these described in the New Zealand Water Environment Research Foundation (NZWERF) "On-Site Stormwater Management Guideline (2004)" including, but not necessarily limited to

- rain tanks
- swale/filter strips
- filters
- infiltration trenches
- rain gardens
- stormwater planters
- wetlands/ponds
- roof gardens
- roof gutters
- permeable pavements.

In the Living and Business Zones in the Te Kauwhata Structure Plan Area, rain tanks shall be specifically designed for urban use, shall be located adjacent to the building and not extend more than 2m horizontally from the external wall, shall not be visible from the road, and the controlled outlet and overflow shall be connected to the Council's reticulated system at all times.

B5.8

In the Lorenzen Bay Structure Plan Area, all systems shall incorporate appropriate design features in terms of location and sizing of culverts and creation of stormwater attenuation ponds to comply with the intent of [Figure B1](#) and [Table B1](#), drainage plan and technical specifications for the structure plan area.

B5.9

In the Tamahere Village Business Zone, the stormwater management system shall be capable of providing a means of managing, treating and disposing of stormwater that:

- (a) incorporates low impact design features,
- (b) provides storage capacity for a 10%AEP critical storm event (including climate change increases),
- (c) attenuates stormwater discharge to pre-development levels,
- (d) manages stormwater runoff to ensure natural water bodies are not degraded and ecological values

are protected,

- (e) has no additional impact on adjacent properties,
- (f) can be maintained as required to ensure its ongoing effective and efficient operation.

B5.10

In the Tamahere Country Living Zone, a Stormwater Management Plan shall be prepared by a suitably qualified engineer that:

- (a) can demonstrate that development (including earthworks) does not obstruct any primary overland flowpaths,
- (b) can demonstrate that development provides appropriate mitigation measures for the adverse effects of stormwater resulting from a 1% annual exceedance probability (i.e. 1 in 100 years) storm event*,
- (c) assesses the flow volumes for the 2-year, 10-year and 100-year return period storms, and times of concentration from the subject area, under pre-development conditions,
- (d) recommends appropriate systems to mitigate post-development flows, volumes and times of concentration to pre-development levels,
- (e) maintains the overall hydrological characteristics of the area including maintaining surface groundwater flow regimes, ponding and drainage patterns.

* Note: All rainfall events are required to be adjusted for climate change as per best practice.

B6 Earthworks

B6.1

Earthworks shall meet these objectives:

- (a) safeguard people, property and the environment from the adverse effects of unstable land
- (b) improve land utilisation
- (c) avoid accelerated erosion or sedimentation
- (d) be sympathetic to surrounding cultural and landscape values
- (e) avoid, remedy or mitigate any adverse effects on the environment
- (f) within the Te Kauwhata Structure Plan area, compliance with the Urban Design Guide.

B6.2

Earthworks shall be constructed to:

- (a) remain safe and stable for the duration of the intended land use
- (b) be geotechnically sound
- (c) provide safe, stable and accessible building sites
- (d) withstand and remain stable under anticipated loads
- (e) provide for the adequate control of stormwater, and cater for the natural groundwater flows
- (f) minimise sediment loss from the site through implementation and maintenance of sediment controls
 - (fa) within the Te Kauwhata Structure Plan area, meet the requirements of Environment Waikato Erosion and Sediment Control Guidelines for Soil Disturbing Activities.
- (g) avoid adverse effects on other land from changes to natural water flows and established drainage

paths.

(ga) avoid sites of significance to Maaori.

B7 Road Standards

B7.1

Roads shall meet these objectives:

- (a) ensure safe and efficient movement of people, vehicles and goods, with minimum adverse effects on the environment
- (b) provide for network utilities, subject to objective (a).

B7.2

Roads shall be constructed to:

- (a) provide adequate vehicular access to each allotment, taking into account the potential number of residential units or other development on each allotment (refer B7.7)
- (b) link and be compatible with the current road network.
- (c) provide for the safe movement of both vehicular and non-vehicular traffic
- (d) provide adequate access for emergency vehicles
- (e) have a design life of at least 25 years based on equivalent design axle (EDA) or equivalent design methods
- (f) withstand the anticipated loads for the design life of the road
- (g) transfer applied loads so as not to adversely affect the underlying subgrade or services
- (h) contain materials suitable for the intended use
- (i) maintain adequate surface smoothness
- (j) provide for safe cycle access and thoroughfare where two-lane roundabouts are constructed
- (k) protect the road, road users and adjoining land from the adverse effects of surface and ground water, as set out in B7.3.

B7.3

The road surface and ground water control system associated with any road surface shall:

- (a) have a service life of at least 80 years unless an activity serviced by the road has a term of operation less than 80 years
- (b) adequately convey water to an approved discharge point
- (c) avoid the likelihood of leakage and infiltration and the penetration of roots
- (d) avoid the likelihood of blockages
- (e) provide reasonable access for maintenance

B7.4

All services in roads should avoid crossing intersections and extend to property boundaries in a manner that will ensure the efficient use and development of any adjoining land, having regard to the provisions of this plan.

B7.5

Road, carriageway, footpath widths and standards shall be sufficient to ensure the efficient use and development of any adjoining land, having regard to the provisions of this plan.

B7.6

Sufficient additional road reserve width shall be provided to:

- (a) accommodate any retaining structure or slope necessary to support the road or adjacent property
- (b) achieve a complying horizontal alignment
- (c) accommodate any turning area required by this plan within the Te Kauwhata Structure Plan area, accommodate low impact stormwater systems such as roadside drainage swales.

B7.7

In residential areas the number of potential residential units shall be based on the minimum allotment size allowed as a controlled activity in the relevant subdivision rules, or the actual number of residential units proposed, whichever is the greater.

B7.8

Passing bays shall be constructed on any single lane access, where necessary, having regard to topography of land, sight distances and usage.

B7.9

An area shall be formed at the end of a cul-de-sac to allow a 90 percentile two-axle heavy goods vehicle to undertake a three-point turn (refer to [Appendix A, Figure 3](#) Tracking Curve Minimum Radius).

B7.10

Street lighting shall be provided where necessary to ensure the safety of road users and pedestrians. All new and replacement street and highway lighting fixtures shall be designed, installed and maintained to minimise glare, uplight and light spill onto adjoining properties. Preference should be given to the use of fully shielded or full cut-off light fixtures. Energy-efficient lamps shall be used for street lighting.

B7.11

Within the Tamahere Country Living Zone, all roads and vehicle accesses shall be constructed to no greater than the minimum widths specified in Appendix A Table 4, and shall have swale drains on either side of the carriageway capable of collecting all road runoff and overland flow towards the road or right of way from 5-year ARI (Average Recurrence Interval) event. In areas of poorly drained soils either the stormwater is to be directed to areas with higher infiltration, or infiltration systems are to be constructed.

B7.12

Within the Te Kauwhata Structure Plan area, all roads and vehicle accesses shall be constructed in accordance with typical cross-sections and vehicle entrance drawings specified in [Appendix A: Traffic](#). Stormwater collection should typically be through grassed swales prior to reaching reticulated systems.

B7.13

Within the Rangitahi Peninsula Structure Plan Area, all roads and vehicle accesses shall be constructed in accordance with typical cross-sections and vehicle access design standards specified in [Appendix A: Traffic](#) unless otherwise approved through a Comprehensive Development Plan resource consent.

B8 Other Utilities

B8.1

Other utilities (e.g. telecommunications, energy) shall meet these objectives:

- (a) safeguard health and safety
- (b) provide an adequate supply of the service or commodity to each allotment
- (c) not conflict with the operation or maintenance of the services mentioned above.

B8.2

The layout of any utility reticulation network shall be constructed to:

- (a) adequately service each allotment, development or road area
- (b) be compatible with any existing network that it is linked to
- (c) be compatible with other utility systems
- (d) avoid the likelihood of contamination or leakage
- (e) accommodate the anticipated demand, and withstand the anticipated pressures and loads in its locality
- (f) be made from materials suitable for the intended use
- (g) be clearly identified and accurately recorded on as-built drawings
- (h) ensure safety in operation
- (i) not be visually intrusive
- (j) be located, if the utility is on a road, in accordance with the road controlling authority's requirements
- (k) ensure safety and full reinstatement of road openings, with minimum public disruption. (Compliance with the Waikato District Council's Road Opening Code will be accepted as compliance with this provision.)

B8A Structure plans - Te Kauwhata and Ohinewai Country Living Zones

B8A.1

Every subdivision in the Country Living Zone at Te Kauwhata or Ohinewai (other than a boundary adjustment) must conform to a structure plan produced by the subdivider, for the land being subdivided and adjoining land, containing:

- (a) an indicative road pattern that ensures a safe, efficient and sustainable road network by limiting additional vehicle entrances onto existing roads, taking into account any indicative roads shown on the planning map, and
- (b) corridors to provide options for future infrastructure including water supply, stormwater and wastewater interceptors, pumps and networks, and
- (c) conditions, including building standards, to avoid, remedy or mitigate significant adverse effects on residential amenity from incompatible activities, including expressway noise, industrial and business

activities, and **intensive farming**, and

- (d) methods to manage natural hazards risks.

B8A.2

Every subdivision in the Te Kauwhata Structure Plan area must conform to the structure plan and accommodate:

- (a) the indicative road pattern, and
- (b) corridors to provide options for future infrastructure including water supply, stormwater and wastewater interceptors, pump stations and networks, and
- (c) conditions, including building standards, to avoid, remedy or mitigate significant adverse effects on residential amenity from incompatible activities such as industrial and business activities, and
- (d) methods to manage natural hazards risks
- (e) rail corridor reverse sensitivity effects.

B9 System Development

B9.1

This section applies to assessment of the effects of any activity or subdivision on council stormwater, wastewater, and water supply systems, arising from the proposed means of management of stormwater, wastewater disposal or water supply at the site.

B9.2

Where this section applies, stormwater, wastewater disposal or water supply proposals shall be assessed by the following criteria, in addition to the other provisions of this plan.

- (a) Effects on adjacent sites, including development potential.
- (b) The relationship of the proposed new works to the pattern and timing of development of the district as a whole.
- (c) Any economies of scale available from alternative designs that would cater for greater or lesser areas of land, either within or outside the site.
- (d) The capacity, availability and accessibility of the existing council service and the effects of any new system linking to it.
- (e) The effects of any stand-alone system, including effects on the long-term development potential, efficiency and cost effectiveness of a current or future council system.
- (f) The effects of any temporary system, where the capacity of any council service is not adequate, but is programmed by the Council for upgrading in the future.
- (g) The long-term maintenance and operating costs of the proposed system.

B9.3

Where the method proposed to manage stormwater, wastewater disposal or water supply complies with, or is consistent with, any strategic plan or long-term strategy published by the Council for the development of the district, the effects on the Council stormwater, wastewater disposal or water supply system will be acceptable for the purposes of this section.

B10 Construction Monitoring

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B10.1

Construction of utilities and services referred to in this appendix must be monitored under this section. The objective of monitoring construction is to provide verification that the construction has been carried out and completed in accordance with the design, and to achieve the environmental results set out above.

B10.2

The functional requirement of construction monitoring is to provide a level of monitoring appropriate to the nature of the project, an independent assessment of the compliance of the construction with the design, and to ensure that any adverse effects on the environment are minimised or remedied.

B10.3

The performance criteria are that the monitoring of construction shall:

- (a) be undertaken by a suitably experienced and qualified person
- (b) be appropriate to the size, importance and complexity of the project
- (c) be appropriate to the potential adverse effects on the environment of the project
- (d) be appropriate to the experience, in the class or classes of work, of the contractor or person directly in charge of the project.

Reasons and explanations are stated in [Chapter 29](#).

Table B1 Lorenzen Bay Structure Plan Drainage Technical Specifications

Table A: Open Channel Flows

Channel Reference Number	Flow (m ³ /s)	Grade (%)	Scour Protection
C1	0.3	4	N
C2	1.2	2.5	N
C3	0.8	3	N
C4	0.3	3	N
C5	0.1	10	Y
C6	0.1	10	Y
C7	TO BE INFILLED		
C8	1.4	1	N
C9	0.1	10	N
C10	0.1	10	N
C11	0.1	10	N
C12	0.7	5	N
C13	TO BE INFILLED		
C14	NATURAL FLOW ACROSS EXISTING DEVELOPMENTS		
C15	2.4		
C16	DIVERTED		
C17	3.3	3	N
C18	3.2	3	N
C19	6.5	2	Y
C20	NATURAL FLOW ACROSS EXISTING DEVELOPMENTS		
C21	0.8	6	N

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C22	TO BE INFILLED
C23	TO BE INFILLED

Table B: Culvert Flows

Channel Reference Number	Flow (m3/s)	Diameter (mm)	Scour Protection
S1	1.4	750	N
S2	0.7	675	N
S3	0.7	675	N
S4	1.0	450	N
S5	1.1	750	N
S6	0.2	300*	N
S7	0.3	450	N
S8	0.1	300	N
S9	0.2	375	N
S10	1.2	750	N
S11	0.1	375	N
S12	3.9	1200	N
S13	2.4	825	N
S14	3.3	750	N

*Existing culvert to remain

Table C: Confluence Ponds and Wetland areas

Channel Reference Number	Surface area (m2)	Type
P1	300	Confluence Pond
P2	200	Confluence Pond
P3	450	Confluence Pond
P4	450	Confluence Pond
P5	450	Confluence Pond
P6	450	Confluence Pond
W1	1350	Wetland
W2	630	Wetland

Figure B1 Lorenzen Bay Structure Plan Drainage Plan

