NZTA P46 Stormwater Specification

[Note to specifier. This Stormwater Specification sets out the design and construction stormwater requirements for all state highway improvement projects. The Specification is applicable as part of the documentation for design & construct projects or with adaption for alliances or PPPs. It is applicable to inform designers undertaking designs for measure & value and lump sum (traditional) tenders. A construction specification will still be necessary for construction requirements].

[This Stormwater Specification focuses on performance requirements and avoids proving guidance on how to undertake the design. The Specification tries to avoid duplication and where the relevant content is covered elsewhere it is referenced e.g. NZTA (2010) Stormwater Treatment Standard for State Highway Infrastructure.

This Specification is anticipated as a starting point and will need to be adapted to address local issues and the scope of the project, which may include deletion of content that is not relevant to the project. Changes to the requirements sort by NZTA must be approved by NZTA.]

[Version control

Version #	**Date**	**Version name**	**Changes**	**NZTA approver**
1	15 April 2016	Stormwater Specification	Approved by NO BUDMT.	Carol Bannock/ Rob Hannaby

]

1 Introduction

1.1 Scope of stormwater specification

This Stormwater Specification (the "Specification") covers the design requirements relating to the proposed stormwater system for the *[Insert name of Project]*. It outlines minimum standards necessary to ensure that NZTA's performance requirements are met.

The scope of the Specification is stormwater surface drainage, collection and conveyance, treatment, cross drainage, erosion and scour protection, existing stormwater systems and operation and maintenance. This Specification does not cover temporary works or sub-soil drainage and relies on other specifications for geometrics, tunnels, bridge waterways, landscaping, pavements, erosion and sediment control, geotechnical and ecology. The Specification does not cover the aspects of a construction specification, such as material quality and testing, which will still need to be covered in a construction specification.

The Specification covers all rural and urban state highways including two lane roads (one in each direction), multi-lane roads such as expressways and motorways, and on/off ramps. The Specification covers local roads where specific standards are required by NZTA, otherwise local roads shall be designed in accordance with the Local Standards.

The stormwater design shall comply with this Specification, all Resource Consents, the designation conditions, property agreements, side agreements etc. Departures from these requirements must be approved by NZTA.

1.2 Project specific consent conditions

The regional and district plan rules and relevant resource consent conditions shall take precedence over the Specification and NZTA shall be informed where there are conflicting requirements. The relevant resource consents include:

[List relevant consents and designations and highlight any key conditions.]

1.3 Standards and guidelines

As a minimum the design and construction of the stormwater system for the Project shall be compliant with, and make reference to, the standards and guidelines listed in Appendix A.

1.4 Background documents

Investigation and design of the stormwater system for the Project shall be informed by the following background documents:

- *[insert relevant Local Authority Catchment Management Plans]*
- Stormwater Management Specimen Design Report, *[insert reference]*
- Stormwater Management Assessment of Effects, *[insert reference]*
- Stormwater Management Design Philosophy Statement, *[insert reference]*
- *[other]*
- *[Insert reference to Utility Company Services plans, including any known future works to allow integration with Utility Company for future assets etc.]*

2 Stormwater management general requirements

The following items set out the requirements to achieve a consistent, high quality, safe and cost effective, minimal impact stormwater management over the short and long term.

Compliance with this Specification will be demonstrated through the design report, drawings, and the Stormwater Operation and Maintenance Plan, which will be approved by NZTA. Key methods/assumptions/parameters used for the design will need to be agreed with NZTA and documented in the design report. *[Specifier to alter as required to reflect project review processes]*

2.1 Whole life consideration

Demonstrate full consideration of stormwater implications throughout the stages of feasibility, planning, design, construction, maintenance, quality assurance, operations, renewal and/or disposal over the life of the asset. Considerations are to include, but not be limited to:

a A robust, transparent evaluation of options for major drainage elements/types is to be undertaken through a value analysis matrix (e.g. weighted multi criteria evaluation).

b Whole of life value must demonstrate holistic value for money and is to be assessed over a 50 year period.

c *[Insert relevant Network operations and maintenance organisations]* are to be engaged to provide robust inputs for whole of life considerations and maintenance requirements.

d Operation and maintenance must be considered in the design. For motorway situations consider Asset Management and Whole of Life Value in the AMA Operation and Maintenance Guidelines (2009). *[include if relevant]*

e Ensure stormwater asset protection and security including consideration of fire, spill hazards, environmental conditions and susceptibility and vulnerability to theft and vandalism.

2.2 Safety in Design

Safety in Design (SiD) issues are to be assessed and mitigated as part of the design of the stormwater assets. These include safety hazards that may present themselves during the installation/construction, operation/maintenance, future modifications or demolition phases. Considerations are to include, but not be limited to:

a An integrated design incorporating a safe system approach (e.g. NZTA TM 2503 and Austroads Part 6 (Roadside Design, Safety and Barriers).

b Allow safe, convenient and 24/7 all-weather vehicle access and working areas for inspection and maintenance (particularly for treatment devices), without the need for temporary traffic control, other than short duration mobile operations.

c Minimise the need to enter below ground structures for operational monitoring and maintenance activities.

d Protection from falling as per the New Zealand Building Code.

e Public safety around stormwater systems.

Safety in Design shall be informed by NZTA document "Safety in Design Minimum Standard for Road Projects" October 2013.

2.3 Landscaping

In addition to the requirements of the landscape specifications *[ref]*, landscaping associated with, or adjacent to, stormwater management measures shall achieve the following outcomes:

a Planting that achieves/supports treatment of stormwater.

b Plant species best suited to the operational function of the stormwater management devices and environmental outcomes.

c Landscaping that does not block stormwater management devices.

Landscaping of stormwater facilities shall be informed by the AMA Operation and Maintenance Guidelines (2009) and the NZTA Landscape Guidelines (Final Draft, September 2014). *[include if relevant]*

2.4 Materials and durability

The materials and durability of the stormwater system shall have the following general requirements:

a Culverts, pipelines, manholes and other hydraulic structures shall be constructed to have a design life and durability performance of not less than 100 years with no major maintenance requirement (e.g. structural or foundation repair).

b Existing culverts, pipelines, manholes and other hydraulic structures that are to be retained shall have a durability performance of not less than 100 years with no major maintenance requirements during this 100 year period. [*This requirement is to be considered on a project and asset basis, and implemented when the performance of an existing asset (e.g culvert) is critical to the performance of the proposed stormwater infrastructure. NZTA may approve less durability for existing assets,]*

c All treatment/attenuation devices shall be designed with a minimum design life of 50 years with planned maintenance that provides the lowest whole of life cost.

d Swales, open channels and overland flow paths shall have a 50 year design life with planned maintenance that provides the lowest whole of life cost.

e All stormwater assets subject to vehicle loads shall be designed to withstand HN-HO-72 (NZTA, Bridge Manual, 2014). The Highway Structures Design Guideline shall be also consulted for structural loads.

f All stormwater assets are to be designed for expected construction loads.

g Pipe materials shall meet the requirements of NZTA F3: 2010.

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3 Hydrological and hydraulic criteria

The following criteria are to be used to determine stormwater flows for the Project. The flows will be used for the design of runoff collection and conveyance system, stormwater treatment, major waterway and network crossing assets and erosion protection design.

[only one of a and b or c below is required, delete the other]

a Rainfall depths/intensities for Project area for various return periods shall derived from HIRDS V3 (**http://hirds.niwa.co.nz/**). *[or from local or regional standards or data sources]*

b The rainfall shall be adjusted for climate change based on a predicted mid-range temperature increase that is extrapolated for 100 years. The rainfall increases shall be based on Ministry for the Environment "Climate Change Effects and Impact Assessment; A Guidance Manual for Local Government in New Zealand" (2nd Edition, May 2008) or subsequent estimates published by. Ministry for the Environment.

c The design rainfall depths with climate change (as derived from *[insert local council rainfall depths/intensities method e.g. Auckland Council TP108 methods or 10 min durations if the table is going to be applied to the road surface drainage]* to be used for this Project are provided below:

Average Recurrence Interval (ARI)	Design Rainfall Depths (including climate change)		
	Duration 10 mins	*Duration ??mins*	*Duration 24 hours*
Water quality	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
Extended detention	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
2 year	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
10 year	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
20 year	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
50 year	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*
100 year	*[insert depth (mm)]*	*[insert depth (mm)]*	*[insert depth (mm)]*

d Where applicable, all flow calculations from catchments contributing to stormwater runoff are to be based on the maximum probable development (MPD) scenario as detailed in the *[insert local council]* planning requirements.

e Runoff factors are to be based on local guidance *[insert guidance]* and the underlying geology as defined on the geological map for the *[insert local region]* and confirmed by site inspections and the land use anticipated for the maximum probable development.

f Rainfall runoff flows are to be calculated using the following methods:

- For the road surface drainage the flows may be determined using the Rational method with the average rainfall intensity for the design Average Recurrence Interval (ARI) event based on a 10 minute time of concentration.
- For larger catchments the hydrological models/calculations developed to generate stormwater runoff flows for the Project catchments are to be based on *[insert method as recommended by local authority or specifying engineer]* and use the time of concentration appropriate for the specific stormwater asset.
- Flow data sources should be used provided the data is of sufficient quality/duration.

g The permanent stormwater system must consider a range of potential tailwater levels. For coastal discharges the tailwater levels for the 100 year ARI rainfall event shall be based on Mean High Water Spring (MHWS) including climate change adjustments for 100 years. The design of coastal discharges shall also consider the 10 year ARI rainfall event in combination with the 10 year extreme sea level including climate change adjustment for 100 years.

h The invert levels of all stormwater drainage structures must be above the *[insert MHWS + 0.5 m for sea level rise or alternative that is practicable for situation]*. Where this is not possible alternative solutions must be approved by NZTA

i Adaption strategies for climate change may be accepted by NZTA based on consideration of whole of life aspects. Where there is a high risk from flooding/inundation, the effects of a high emissions climate change scenario and/or the upper bound standard errors from statistically derived rainfall depth shall be considered.

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4 Surface drainage

The surface drainage for the traffic lanes must adhere to the following requirements. The ability to meet these requirements is dependent on the geometric and pavement design as well as the design of the stormwater runoff collection and conveyance systems. Non-compliant designs must be approved by NZTA. The optimal design that balances geometric and drainage requirements with vehicle safety and whole of life costs is sought by NZTA. *[These design criteria are based on importance level 3 and 4 routes. The specifier may consider reducing these for importance level 1 and 2 routes]*.

a The maximum water surface depth at any point on the traffic lanes shall be calculated in accordance with, and meet the requirements of, NZTA TM2502 during a 2 year ARI 10 min duration rainfall event. This includes median areas that can be trafficked, gore areas, ramps and all merge and diverge areas and intersections. The maximum surface water depth shall not be greater than 4mm above the top of the surface texturing.

b For all traffic lanes in a 10 year ARI, 10 minute rainfall event, shoulder flow must not encroach on traffic lanes (including shoulder priority lanes).

c For multi-lane sections of state highway, channel flow may cover one lane (including priority lanes) at a maximum water depth of 100mm within the lane in a 100 year ARI, 10 minute rainfall event.

d For two-lane state highways, ramps and local roads in a 100 year ARI, 10 minute rainfall event, at least 3.0m of live traffic lane must be free of stormwater with a maximum water depth of 100mm in the covered lane.

e No surface runoff from unpaved areas is permitted to flow onto or across a traffic lane surface.

f On median divided roads of four or more lanes total, surface water is not permitted to flow from one side to the other. This includes preventing water from crossing gore areas and crossing the median in super elevated sections of state highway.

g The pavement surfacing design must prevent runoff concentrating along any surfacing lip on the high side (for example along the edge of the OGPA lip) and overflowing across the live traffic lane.

h No gutters, dish channels or longitudinal drainage grates shall be permitted within the live traffic lanes.

5 Stormwater collection and conveyance systems

This section considers the infrastructure for the safe collection and conveyance of stormwater from the road surface to treatment or discharge locations. *[These design criteria are based on importance level 3 and 4 routes. The specifier may consider reducing these for importance level 1 and 2 routes]*

5.1 General

a All stormwater systems are to be gravity operated.

b Primary systems to be designed for the 10 year ARI rainfall event [*confirmation by specifier as there may be situations where the primary system need only convey the water quality event or as much as the 100 year ARI event]* with secondary or overflow systems designed for the 100 year ARI rainfall event.

c All stormwater assets shall comply with NZTA Safe Systems approaches. Stormwater assets shall be located outside of trafficable lanes and preferably behind barriers. Stormwater assets not behind barriers must be traversable and designed for applied traffic loading without springing up or dislodging under hydraulic pressure or traffic loading, and must offer a smooth ride.

5.2 Open drains

Open drains include swales, roadside (table) drains and diversion drains. Swales provide a treatment function and are covered in Section 6.2. Roadside drains convey runoff from the road and/or adjacent land, but are not specifically designed to provide treatment. Roadside drains also collect and convey water from the subgrade and pavement and the requirements for this are set out in the pavement specifications *[specified to check this link].* Diversion drains are located to divert runoff away from the road corridor or to culverts associated with the Project.

a Open drains are the preferred method for the collection and conveyance of stormwater where space and other design limitations do not limit their application.

b Open drains and flow paths shall be reinforced, lined, stabilised, or otherwise treated to ensure that the 20 year ARI storm does not cause erosion or scour. If there is a risk that erosion or scour could cause a catastrophic failure, a 100 year ARI design standard for erosion and scour protection shall be adopted.

5.3 Catchpits

Specific criteria relating to the design of catchpits shall meet the following as a minimum:

a Grated inlets connected to piped stormwater systems must have either a bypass that enables the inlet to remain effective should the grate become clogged with debris, or a secondary flow path that prevents stormwater encroaching on the running lanes in the event of a blockage of the inlet.

b Standard NZTA approved 675mm x 450mm catchpits with a minimum of sump depth of 450 mm shall be used in state highways [substitute regional preferences for catchpit where these exist].

c Catchpit manholes may be used when these provide the best whole of life and safety performance. Sumps are not required in catchpit manholes.

d Catchpits within local roads shall be in accordance with local Council requirements.

e Additional catchpit and pipe capacity is required at low points on the main traffic lane alignment and at low points on all ramps. These shall be designed to capture and convey the design events assuming standard catchpits upstream of the low points are operating with 50% blockage of open areas.

f Approved catchpit grates shall be orientated to be cycle friendly when installed within traffic lanes used by cyclists, within local roads and on the shared user paths. In all other cases, catchpit grates shall be orientated in the direction of channel flow to maximise inlet efficiency and reduce the risk of blockage.

g Field catchpit grates shall be surrounded by a flush concrete apron for erosion protection.

h All catchpits shall be recessed behind the kerb line when the shoulder width is 1m or less with an appropriate splay and apron gradient appropriate to flow and velocity. If this is not practicable then back entry catchpits without grates are to be used.

5.4 Pipe systems

a The design capacity of new and existing pipe [project specific] systems associated with this project must convey the primary design flow without surcharging closer than 500mm from the road surface level. In the locations where there is no secondary overland flow path available that leads stormwater away from the traffic lane or if 100 year ARI attenuation is required the pipe system must be designed to convey the 100 year ARI peak flow without surcharging closer than 200 mm from the road surface level.

b The minimum pipe diameter must be 300mm, except for pipes crossing the live lanes, in which case a minimum diameter of 375mm is required.

c All pipe systems require specific design, including attention to bedding and support requirements, hydraulic and structural allowance for settlement and consolidation, and structural design for cover and expected loadings in accordance with AS/NZS 3725. *[Specifier to add AS/NZS 2566 for Buried Flexible Pipelines if these are expected to be used]*

d The minimum pipe cover under traffic lanes is 1.2m. Where this cannot be achieved, a reduced cover of no less than 0.6m may be approved by NZTA where it can be demonstrated with specific design that adequate structural capacity and design life is achieved.

e The minimum pipe cover in un-trafficked landscape areas (covered by topsoil and grass seed/vegetation) is 0.9m. Where this cannot be achieved, a reduced cover of no less than 0.6m may be approved by NZTA where it can be demonstrated with specific design that adequate structural capacity and design life is achieved.

f Catchpit leads must connect directly into a manhole chamber from the catchpit.

g All new pipes longitudinal to the alignment are to be located clear of the live traffic lane, and also clear of the shoulder where practicable.

h All new pipelines crossing the state highway shall be at an angle greater than 45° to the state highway alignment.

i The acceptable minimum flow velocities for all pipes for the 2 year ARI flow are an absolute minimum of 0.6 m/s and desired minimum of 1.0 m/s.

5.5 Manholes

a Manholes are to be provided at all changes of direction, gradient and pipe size, and junctions.

b The minimum diameter of manholes is 1050mm.

c All manholes lids shall have a 600mm diameter clear opening. All manholes located in the local road reserve are to be designed and installed in accordance with the *[insert local transport authority code of practice e.g. Auckland Transport Code of Practice]*

d Lock on lids shall be provided for any manholes where surcharging could occur in storm events up to 100 year ARI.

e Manholes shall be spaced at maximum intervals of 100m.

f Manholes shall be placed outside of traffic lanes bus lane shoulders and on/off ramps and shoulders of all state highways. Where it is identified that manholes are unable to be located outside of the traffic lane, and it can be demonstrated to the satisfaction of NZTA that a reasonable alternative is not practical, the manholes are to be buried in accordance with the Auckland Motorway Alliance's O&M Guidelines. Where it is identified that manholes are unable to be located outside of the shoulder, the manhole lids shall be hinged in the direction of traffic flow and have a friction coating.

g All existing manholes located within lanes or shoulders of the state highway and ramps shall be relocated, unless it can be demonstrated to the satisfaction of NZTA that a reasonable alternative is not practical, in which case the requirements of 5(f) shall be followed.

h The lid level of all new and existing manholes shall be made to match the new ground levels.

i 600mm diameter manholes may be used as inspection points to (swale) under-drainage, in which case the maximum depth shall be limited to 1m.

j Structures located off the traffic lane shall have sufficient strength to support maintenance vehicles and errant vehicles.

k Manholes shall have rungs for access and the maximum height from the manhole lid to the first manhole rung shall be 600mm.

5.6 Bridge and underpass surface drainage

a Bridge and underpass drainage design shall be informed by Section 4.12.3 of NZTA's Bridge Manual SP/M/022 Third edition 2013 for bridge drainage criteria.

b Where not covered in the Bridge Manual, bridge deck drainage shall be designed as per surface drainage in Section 4 of this document and collection and conveyance within a bridge or underpass shall be designed as per Section 5 of this document. Alternative material (PE, PVC) and catchpit, pipe sizes may be required on bridges.

c Where applicable, bridge surface drainage shall be captured before the structure's expansion joint(s) and not pass over or through the joint(s).

d Avoid the installation of systems and elements that require specialist access for maintenance.

e Cleanout plugs and elbows should be conveniently accessible without the need for specialised plant, or tools for safe operations.

6 Stormwater treatment

This section considers the stormwater treatment requirements for the project.

6.1 General

a Runoff from the state highway shall be collected and passed through stormwater treatment devices prior to discharge to the receiving environment in accordance with the consent conditions. *[Specifier to confirm and list the key water treatment requirements. These may be in addition to the consent conditions, such as when there are permitted activity controls or when NZTA seeks stormwater treatment that is over and above the local/regional requirements].*

b All stormwater devices shall be designed in accordance with NZTA's Stormwater Treatment Standard for State Highway Infrastructure (May 2010), unless a regional standard prescribes a higher standard, in which case the regional standard shall apply. This section of the specification notes some requirements that are additional to the Stormwater Treatment Standard. *[Specifier to replace with regional guidelines if that is the preferred design method].*

c Wherever proprietary items are proposed as part of the design, the suitability of the device shall be demonstrated and submitted to NZTA for approval. Approval may also be required from the local authority if they become the ultimate owner of the device(s) or if the device must achieve the requirements of a resource consent condition.

d Low flow outlets from treatment devices must be designed to ensure that their intake is drowned and/or baffled so that debris, gross pollutants, floating hydrocarbons and warm surface layers are contained within the device.

e Clean stormwater runoff from permeable surfaces (e.g. batters etc.) is to be diverted away from treatment devices where practicable (and allowed by the Resource Consent) to minimise stormwater volumes requiring treatment.

f All proposed stormwater treatment devices (e.g. wetlands, proprietary treatment devices) throughout the Project are to include mechanisms that provide an isolation capacity of 20 m^3 for spills. *[Note: specifier to consider practicalities of achieving this volume when ponds are not provided]*

g Provision shall be made to convey excess flows, greater than the requirements for the treatment device, arising from larger storms to a suitable surface discharge point without erosion of either the swale drains or receiving drain.

6.2 Swales

Grass swales are open channels that are designed for the purpose of stormwater treatment. They differ from roadside (table) drains and diversion drains used for other purposes.

a If the swale gradient is less than 2%, a smooth bore perforated subsoil pipe shall be provided in accordance with NZTA Specification F2:2003.

b Rodding points shall be provided for the subsoil pipe at minimum 100m intervals along all subsoil drains under swales for maintenance purposes and marker posts shall be provided at all rodding points and outlets.

6.4 Infiltration

a Infiltration devices can be used primarily for groundwater recharge and retention of stormwater quantity, but only where there has been careful consideration of soil permeability, risk of blockage/blinding, impact on adjacent structures/geotechnical requirements and high groundwater.

b Infiltration devices must have overflow systems.

6.5 Stormwater wetlands/ponds

a *[Outline Project specific requirements such as lining, site constraints etc.]*

7 Cross drainage

This section outlines the requirements for conveying stormwater runoff generated outside the designation and within the designation where it is conveyed beneath the state highway.

Stormwater runoff from contributing catchments outside the designation is to be conveyed under the state highway in accordance with consent conditions, while maintaining the operational performance of the state highway.

Bridges, and culverts with a cross sectional area greater than 3.4 m^2 are to be designed in accordance with NZTA Bridge Manual (3rd Edition).

The requirements for culverts are also covered in Section 5.4.

7.1 Culvert crossings

a Culvert crossings shall maintain the existing natural drainage patterns of the contributing catchment where possible (i.e. must not concentrate several watercourses into one discharge point) such that existing flood prone areas are not exacerbated or new flooding issues created.

b Culverts shall be designed and specified in accordance with NZTA F3 (2010) Specification for Pipe Culvert Construction.

c All culverts and pipe crossings (existing and new) that cross the state highway must satisfy the following hydraulic conditions *[These are based on importance level 3 and 4 routes, as per the Bridge Manual. The specifier may reduce these for importance level 1 and 2 routes]*:

- Convey the 10 year ARI storm event flow without surcharge of the pipe for the MPD scenario; and
- Convey the 100 year ARI storm event flow without surcharge of the pipe more than 2m above the pipe soffit, whilst ensuring a minimum 500mm freeboard is provided from the peak water level to the outer edge line level for the MPD scenario. *[insert if applicable "Flood risk to upstream properties shall be considered and mitigated in accordance with the relevant Resource Consent Conditions;"]*

d All new culvert structures and pipe crossings under local roads shall be designed in accordance with the *[insert local transport authority code of practice e.g. Auckland Transport Code of Practice]* or otherwise agreed with *[insert local council]* and NZTA in advance.

e All new culverts crossings shall be at an angle greater than 45° to the state highway alignment.

f Precast or in-situ concrete inlet and outlet structures shall be installed on all pipes with a diameter of 375mm or greater.

g Road users shall be protected from the hazard presented by culvert inlet and outlet structures in accordance with the requirements of the Austroads Guide to road design part 6 and TM4006.

h Final levels of culverts shall not vary by more than ?? mm *[Specifier to insert tolerance with consideration to likely slopes and consequences of settlement*] from the design levels due to embankment settlement.

i Cross culverts in wooded or urban catchments shall be checked for blockage risk in accordance with the Australian Rainfall & Runoff (2015), Blockage of Hydraulic Structures – Blockage Guidelines or approved alternative methodology. Where the debris potential is determined to be medium or high, debris countermeasures shall be designed in accordance with the Blockage Guidelines. In addition, secondary inlets shall be provided where it is necessary to maintain the culvert headwater requirements. Where a risk of blockage remains and/or the consequences are high, works shall be included to divert overflows that might occur so they remain within the road reserve until entering another watercourse.

j The Building Act requirements for large dams may be triggered when the culvert and associated embankment are designed with the intention of detention of water. Notwithstanding the classification of the embankment as a dam, the design must include consideration of storm event scour, overtopping, embankment stability (including rapid drawdown conditions) and the potential for piping failure.

k Culverts shall allow for the continuity of sediment transport processes that naturally occur in the watercourse.

7.2 Stream diversions

Relocation or works within stream channels or waterways shall be avoided other than as allowed for in resource consents. Some minor channel realignments at culverts to match up and downstream channel direction may be acceptable, and temporary stream diversions may also be necessary, to facilitate culvert construction, but also subject to resource consent requirements.

Should any permanent drain diversion become necessary the following requirements will apply:

a Where not specified in consent conditions, design shall be in accordance with [insert regional guidelines].

b Stream diversions, consisting of the channel and wider floodway, shall be designed for the 100 year ARI flood with MPD. The main channel should be sized for at least the 2 year ARI flow and for low flows for fish habitat and passage.

c Channel form should mimic the stream environment being replaced by replicating or improving channel substrate, gradient, sinuosity, bed form, morphology and habitat features.

d Grade control structures shall be utilised as deemed necessary (eg weirs, etc) where stable grades are not achievable.

e Where proposed diversion streams are situated adjacent to embankments, the design shall address embankment stability and scour.

7.3 Overland flows

[*These requirement are to be considered on a project and asset basis. There may be occasion when overland flow paths or floodways are decided to be acceptable by NZTA, but this should be on a by exception basis]*

a Overland flow paths (OFPs) are to be identified on and adjacent to the designation. Where an existing OFP is to be intercepted by temporary or permanent works then the overland flow path shall be collected and conveyed to provide continuation of the flow.

b Preservation of OFP is preferred, but when these need to be piped or bridged then sufficient inlet capacity shall be provided to collect and transmit overland flow to the downstream stormwater management system or receiving environment, refer to culvert requirements.

c Local roads may form part of the overland flow system. Where overland flow is to be conveyed along local roads approval shall be sought from NZTA and the local authority.

d OFPs shall be provided where there are un-mitigated risks such as from culvert or catchpit blockage.

7.4 Flooding

a The design shall allow for regional/catchment scale flood issues, consent requirements and not create unacceptable adverse effects on the upstream and downstream properties outside the designation or land owned by NZTA for events up to the 100 year ARI flood. *[Specifier to check versus consent requirements or local practise and confirm this requirement]*

b The hydraulic hazard from flood water to pedestrians and vehicles in public areas shall be assessed with consideration of velocity and depth.

7.5 Fish passage

a The requirements for fish passage shall be in accordance with resource consent requirements, local council guidelines, Freshwater Fisheries Regulation (1983) *[insert local council guidelines if exist for fish passage]* and the NZTA (2013) Fish Passage Guidance for State Highways.

b NZTA requires that the successful migration of fish species is not disrupted by its network, through the appropriate design of new culverts, and the retrofit of existing culverts in the project area to allow for fish passage. Departures from these requirements must be approved by NZTA.

8 Stormwater discharges

This section outlines the requirements to manage the erosive effects of stormwater discharges from the conveyance system (Section 5), stormwater treatment devices (Section 6) and cross culvert(s) (Section 7) into the receiving environment. It also covers discharge by soakage to ground.

8.1 Erosion protection

a To mitigate scour at the interface between culvert and stormwater discharge to natural or man-made waterways, appropriate energy dissipation and erosion control measures shall be incorporated.

b Erosion and scour control measures shall be sized for at least the 20 year ARI storm event. However, if there is a risk that erosion or scour could cause a serious failure with environmental, social or economic consequences, or where access for future maintenance is difficult, a 100 year ARI design standard for erosion protection is to be adopted. *[Specifier may need to replace these requirements based on the relevant Resource Consent Conditions if applicable, or insert local erosion protection standards e.g. Auckland Council TP10 and TR2013/018]*

c All culvert outlets shall be positioned within the designation.

d Culvert outlets shall match the alignment of the downstream channel, where practicable.

e Flap gates or other suitable device shall be fitted to the outfall pipes or wingwalls that discharge to the sea to prevent a backflow into the pipe at the outlet. The device and specific fixing details to precast headwalls or pipe ends shall be approved by NZTA.

8.2 Soakage

a Treatment of road runoff prior to disposal by soakage is to be provided in accordance with this Specification.

b Soakage devices shall be designed and constructed in accordance with *[insert local authority guidelines. i.e. if in Auckland Region insert "the Auckland Council Technical Report TR2013-040],*

c Permeability testing is to be conducted in order to determine the size and spacing of soakage devices. Soakage designs are to be based on appropriate soakage rates, including allowance for any reduction in soakage rate due to error margins in testing methods, saturation in longer duration storms, long term clogging of the underlying soils, and taking into account seasonal and high groundwater levels.

d The combination of soakage and overflow systems must have capacity for the 100 year ARI rainfall event.

9 Existing stormwater systems

This section outlines the requirements for all works to existing or redundant infrastructure affected by the Project.

9.1 Connecting to existing infrastructure

a Where parts of existing stage highway network stormwater systems will be replaced by the new works, the remnant upstream infrastructure in catchments, which drains into the Project stormwater system must be connected to the new system.

b It shall be demonstrated that the capacity of the downstream stormwater system will not be exceeded by the additional flow generated by the *Project [Specifier to adjust to reflect the requirements of the downstream asset owner]*. Where the existing stormwater system does not have sufficient capacity, options shall be explored with NZTA and the local authority.

c Existing culverts and pipe crossings passing beneath the state highway shall be replaced to comply with this Specification. *[This requirement may be reconsidered if the cost-benefit does not warrant this expenditure]*

9.2 Redundant infrastructure

a All redundant manholes, catchpits, inlet and outlet structures, head walls, wing walls etc must be removed completely.

b All redundant pipes/culverts with a depth of less than 1m to pipe soffit must be removed.

c All redundant pipes/culverts with a depth of 1m or more to soffit that are under or within 5m of the traffic lanes of a state highway (or within a local road) must either be removed or filled with 5 MPa flowable fill.

d All redundant pipes/culverts with a depth of 1m or more to soffit that are greater than 5m from the state highway (or outside a local road) must either be removed, filled with 5 MPa flowable fill, or be end capped and abandoned.

e Trench excavations of all removed pipe/culverts must be backfilled to the same standard as new pipelines (with similar approved material).

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10 Handover requirements

This section outlines the requirements at the handover stage of the Project.

a At Practical Completion and again at Final Completion all treatment devices must be in "as new" condition and cleaned out of all sediment.

b At Practical Completion and at Final Completion, any damage caused to new and existing stormwater infrastructure as a result of construction works shall be remediated.

c Provide as-built information and certification in accordance with any Resource Consent conditions or local authority requirements.

d As-built drawings shall be as accurate and to a similar extent to the construction drawings.

e Key supplier/manufacturer documentation that is relevant to the operation, maintenance and resupply of aspects of the stormwater system should be included with as-built information.

f As-built certification forms as set out in the NZTA (2010), Stormwater Treatment Standard for State Highway Infrastructure, should be used or replaced with agreed alternative.

g RAMM data is to be submitted to NZTA in the prescribed format.

h The Contractor must provide a CCTV survey of both the existing and new stormwater infrastructure at Practical Completion of the stormwater works and again at the end of the Defects Liability Period. *[Specifier to consider whether this clause is best moved to construction specification and whether sample CCTV surveys are adequate for their project]*

11 Operation and maintenance

This section outlines the requirements for operation and maintenance.

11.1 Operation and maintenance requirements

The following specific requirements shall be considered in conjunction with the Project requirements for each component of the stormwater system.

a Accessways required for stormwater maintenance access shall have a heavy duty commercial vehicle crossing at the entrance.

b Accessways directly off the state highway shall have a recessed level area of sufficient length to allow vehicles using the accessway to stop 1.5m clear of the edge white line while any gate is being opened or closed.

c Stormwater assets within the median shall be located where possible so that access for maintenance only requires temporary traffic management on one side of the state highway.

d All grass swales should provide a discrete trafficable section to enable maintenance vehicles to safely traverse across the swale without causing damage to the profile of the invert.

e Culvert inlet and outlet structures are to be designed with a level of access that is commensurate with the operation and maintenance that is predicted for the structure.

f All wetlands and ponds must have an all-weather access track. Access must be designed and constructed to all wetland/pond forebays to enable heavy vehicles to cart out sediment from the ponds including the forebay. The access must be suitable for all year round access for two wheel drive maintenance vehicles, must be metalled to a minimum depth of 300mm and a minimum width of 3.0m, and provide an appropriate turning facility.

g All wetlands and ponds (forebay and main pond elements) shall have dewatering facilities (i.e. to incrementally draw down the water levels to pond base level for the purpose of maintenance operations).

h Stormwater management devices shall have a measuring staff for the convenient monitoring measurement of accumulated sediments (e.g. at pond forebays and main ponds).

11.2 Operation and maintenance documentation

A 'Stormwater Operational and Maintenance Plan' shall be prepared and submitted for the constructed stormwater system during the detailed design phase for review and approval by NZTA and the network operator *[specifier to add local Council if this is a requirement]*. As a minimum, this document is to set out the monitoring and maintenance procedures for the stormwater infrastructure as required by the [*relevant network maintenance organisations]* and any Resource Consent conditions. This is to include as a minimum:

- Location map and access arrangements;
- Inspection and maintenance requirements and frequency;
- Safety requirements;
- Project risk items where they continue to be relevant for the operation phase;
- Traffic Management (TM) requirements;
- Monitoring and reporting requirements of consent conditions (resource consents should be appended);
- Contingency plan;
- Routine and emergency contacts; and
- As-built drawings and stormwater system information (refer Section 10).

Appendix A

The following standards and guidelines apply to this Project. Where there are inconsistencies, the document hierarchy of precedence shall be this Specification, other Transport Agency publications, New Zealand standards, other New Zealand publications, current Austroads publications followed by other documents.

[Delete or add to list as appropriate]

National

NZTA (2016), Highway Structures Design Guide.

NZTA (2014), Technical Memorandum 2502: Preferred method for calculating road surface water runoff in New Zealand.

NZTA (September 2014), Landscape Guidelines (Final Draft).

NZTA (2013), Technical Memorandum 2503: Guidelines for Edge Protection and Medians on Dual Carriageway Roads, incorporating a Safe System Philosophy.

NZTA (2013), Bridge Manual, 3rd Edition (SP/M/022).

NZTA (2013), Fish Passage Guidance for State Highways.

NZTA (2013), Safety in Design Minimum Standard for Road Projects.

NZTA (2013), F/2 Specification for Pipe Subsoil Drain Construction.

NZTA (2010), Stormwater Treatment Standard for State Highway Infrastructure.

NZTA (2010), F3 Specification for Pipe Culvert Construction.

NZTA (2008), Technical Memorandum 4006: Traversable and mountable grates for precast concrete headwalls.

NZTA (2008), Highways and Network Operations Technical Memorandum No. TM 4006.

TNZ (2003), F/6 Specification for Fabric Wrapped Aggregate Subsoil Drain Construction.

TNZ (2003), F/7 Specification for Geotextiles.

Ministry of Works and Development (1977), Highway Surface Drainage Design Guide for Highways with a Positive Collection System.

AS 3996-(2006), Access covers and grates.

NZS 3101 (2006), Concrete Structures Standard.

The New Zealand Building Code.

MBIE, Acceptable solutions and verification methods for New Zealand building code clause E1 Surface water.

Australian Rainfall & Runoff (2015), Blockage of Hydraulic Structures – Blockage Guidelines.

Austroads (2013), Guide to Road Design - Part 6: Roadside Design, Safety and Barriers.

Austroads (2013), Guide to Road Design – Part 5: Drainage – General and Hydrology, Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface and Part 5B: Drainage – Open Channels, Culverts and Floodways.

Concrete Pipe Association of Australia (CPAA), (2012), Hydraulics of Precast Concrete Conduits, CPAA Design Manual.

Hydraulic Engineering Circular No.9 (HEC-9), Debris Control Structure Evaluation and Countermeasures (3rd Edition), FHWA.

Hydraulic Engineering Circular No.14 (HEC-14), Hydraulic Design of Energy Dissipators for Culverts and Channels (3rd Edition), FHWA.

Ministry for the Environment (2008), Climate Change Effects and Impacts Assessment - A Guidance Manual for Local Government in New Zealand, Second edition, used for recommended climate change temperature increase.

Regional *[select those applicable from the list below and/or add other references as required]*

Christchurch City Council (2013), Waterways, Wetlands and Drainage Guide.

Auckland Council (2013), Stormwater Disposal via Soakage in the Auckland Region, Technical Report 2013/040.

Auckland Regional Council (2003), Guidelines for Stormwater Treatment Devices, Technical Publication No. 10 (ARC TP10).

Auckland Motorway Alliance (2009), Operations and Maintenance Guidelines for Planning, Design, Construction and Handover of Capital Projects in the Auckland South Area Motorway Network.

Auckland Regional Council (1999), Guidelines for Stormwater Runoff Modelling in the Auckland Region, Technical Publication No. 108 (ARC TP108).

[insert relevant local/regional council plans]

[insert relevant local/regional technical publications]

[insert relevant local/regional council guidelines]