NZ TRANSPORT AGENCY
WAKA KOTAHI

Peka Peka to Otaki Expressway
Scheme Assessment Report Addendum
Preliminary Design Philosophy Statement

This report has been prepared for the benefit of the NZ Transport Agency (NZTA). No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fulfil a legal requirement.

Quality Assurance Statement

Project Manager:	Andrew Quinn
Prepared by:	Gareth McKay
Reviewed by:	Tony Coulman
Approved for issue by:	Tony Coulman

Revision Schedule

Rev. No	Date	Description	Prepared by	Reviewed by	Approved by
1	13/6/11	First Draft	G. McKay	T. Coulman	T. Coulman
2	17/6/11	Second Draft	G. McKay	T. Coulman	T. Coulman
3	16/9/11	For Draft SARA	G. McKay	T. Coulman	T. Coulman

NZ Transport Agency

Contents

1. Introduction

This document provides a summary of the design standards, assumptions and departures for the Scheme Design. Along with a number of other documents it describes the scheme design. The related documents include:

- Stormwater Design Philosophy
- Geotechnical Interpretive Report
- Bridge Design Statement
- Urban and Landscape and Design Framework
- Design Flood levels for Waterway Crossings
- Cost Estimate Report
- Basis of Design for KiwiRail, August 2011
- Economic Analysis of Pavement Design Options, August 2011
- Cost Estimate Report
- Value for Money Statement

The relationship between these different documents is discussed through this report.

This is seen as a live document that will continue to be updated through the SARA and subsequent phases of the project.

A number of these design elements have been considered as part of the Basis of Design Assessment (undertaken Feb-May 2011) and the outcomes of that assessment are included in the *Value for Money Statement*.

2. Basis of Design Philosophy

The overall objectives of this project are to:

- Build a modern, high standard four-lane highway between Peka Peka Rd and Taylor's Rd bypassing Otaki Village, and including a new four lane bridge over the Otaki River;
- Provide high quality connections to the realigned SH1 at Otaki Village and maintain connections to local roads at Otaki Gorge, Te Horo and Gear Rd/School Rd
- Achieve the highest standards of design and construction;
- Provide a reliable and resilient route offering superior ride comfort, convenience and journey time savings;
- Contribute to the economic growth and productivity and significantly improve transport links to the lower North Island;
- Enhance the urban and rural landscape where practicable using urban design principles and environmental best practice;
- Mitigate where practicable the social and environmental impact of construction;
- Provide connectivity to local road networks and provide a safe experience for vulnerable road users e.g. cyclists and walkers;
- Ensure efficient, local and stageable interfaces with the adjacent RoNS projects to the North and South.
- Achieve an early start and early delivery as part of the Government's infrastructure package;

In meeting these objectives the scheme will need to provide an integrated urban design outcome with appropriate local road connectivity across the corridor together with environmentally and culturally sensitive treatments.

The philosophy proposed for the design will:

- Develop an integrated solution that achieves an appropriate balance between the functional performance requirements of local and State Highway traffic;
- Achieve a balance between the initial capital investment and long term maintenance by whole of life costs analysis and value engineering techniques;

- Secure statutory approvals as early as possible in the project on conditions that are acceptable to the NZTA and that minimise construction constraints whilst maximising operability of the expressway;

- Address the social, land use and environmental impacts of the project in the context of the aspirations of territorial authorities; and

- Identify and progress opportunities for early physical works that deliver benefits and which are assessed by value for money criteria.

3. Design Standards

The design standards to be used for this project include:

- Roads of National Significance Design Standards and Guidelines;

- Transit Draft State Highway Geometric Design Manual (SHGDM);

- AUSTROADS Guides to Traffic Management and Road Design;

- New Zealand Supplement to the Austroads Guide to Traffic Engineering Practice Part 14: Bicycles

- AUSTROADS Rural Road Design

- AUSTROADS Pavement Design manual and NZ Supplements;

- AUSTROADS Cycling Aspects of Austroads Guides (March 2011)

- Manual of Traffic Signs and Markings (MOTSAM);

- Transit Bridge Manual 2nd Edition (July 2005)

- LTSA – Cycle Network and Route Planning Guide;

- Australian/New Zealand Standard – AS/NZS 1158.0:1997: Road Lighting;

- NZTA Guidelines for Highway Landscaping (SP/M/020);

- Stormwater Treatment Standard for State Highway Infrastructure, NZTA, 2010

- Subdivision and Development Principles and Requirements, KCDC, 2005
- Erosion and Sediment Control Guidelines for the Wellington Region, GWRC, 2006
- NZS 6806:2010 Acoustics – Road-traffic noise – New and altered roads.
- Kapiti Coast Development Management Strategy, KCDC, 2007
- Kapiti Coast Subdivision and Development Guidelines, various titles, KCDC
- KCDC Open Space Strategy, *not yet completed but to be considered once finalised*, KCDC

(Other documents to be added as appropriate)

4. Geometric Design

Expressway Design Standards

The scheme design for the Peka Peka to Otaki Expressway is based on the RoNS Design Standards and Guidelines, (October 2009), which uses the SHGDM as its basis. The key design parameters are as follows:

- Design Speed – Horizontal 100km/h, Vertical 110km/h;
- Desirable minimum curve radius 1100m, minimum curve radius 720m (Scheme design minimum, 820m);
- Desirable superelevation of 4%, maximum superelevation of 6% (Scheme design maximum, 4%);
- Desirable curve length 500m, minimum curve length 300m (Scheme design minimum 300m);
- Gradient limited to 4% and length <600m, maximum gradient 8% and length <300m (Scheme design maximum gradient, 3.2%).

Interchange Design

The layout of merges, diverges, on-ramps and off-ramps to the expressway will be developed in accordance with the RoNS Design Standards and Guidelines, (October 2009). The standards do not specifically address merge and diverge design requirements and therefore the following additional design standards have been used for the scheme design:

- Manual of Traffic Signs and markings (MOTSAM), Part 3, Motorways and Expressways;
- State Highway Geometric Design manual (SHGDM) (Draft);
- Austroads Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings;
- Austroads Guide to Road Design – Part 4c: Interchanges.

Local Road and Access Design Standards

The new sections of Local Arterial are to be designed for a design speed of 100km/h and will be designed using the Austroads Rural Road Design Guideline. Existing sections of SH1 that do not meet a 100km/h design speed will not be upgraded as part of the project. The PP2O scope includes mitigation works to tie in

locations with the local road and removal of passing lanes. Other complimentary works to the Local Arterial will be the subject of the SH Revocation Project.

KCDC are yet to formalise a position on the future operational speed of the Local Arterial and this could range between 80 and 100km/h through the rural sections.

New local access roads will be designed to meet KCDC Subdivision and Development Principles and Requirements, 2005 as well as other KCDC Subdivision Design Guides and Best Practice Documents.

Walking and Cycling Design Standards and Provisions

Cycleways/Walkways will be designed to the relevant Austroads Traffic Management and Road Design Guidelines as well as the KCDC Subdivision and Development Principles and Requirements, 2005.

A 4m off-road facility (2.5m walking/cycling path and 1.5m grassed bridleway) will be provided along the local arterial corridor (as part of the revocation project). This facility will run adjacent to the new Local Arterial with the exact location (east or west side) to be confirmed as part of the SH Revocation Project.

The separation width of this facility from the new local arterial may be minimal at some locations and may require a barrier.

Walking and cycling provision on local road bridges crossing the expressway will vary. On local road bridge connections the kerb side traffic lanes will be widened to 4.2m to provide adequate space for cycling in the traffic lane. Providing a dedicated shoulder (of at least 1.5m) would push the seal width on bridges up towards 10m which is likely to encourage drivers to travel faster. In conjunction with this a 2.5m shared use path will be provided on one side. Where necessary a 1.5m pedestrian path will be provided on the other side.

Based on discussion with KCDC equestrian use across bridge structures assumes that horse riders will either utilise the road shoulders, or dismount and walk horses along the footpaths.

The proposed provision for off-road walking and cycling facilities on local road bridges is as follows:

- Bridges 2&3 (North Otaki): 1.5m (West side – minimised to encourage users to use east side away from on-ramps), 2.5m combined path (East side – higher demand). The provision of a path on the west side of this bridge will need to be tested further with the road safety audit team.

- Bridge 4 (Rahui Rd): 2m path (North), 2.5m path (South – providing more direct connection to rail station).

- Bridges 6&7 (South Otaki): 2.5m path (North side), no path (South side – avoids ramp conflicts)

- Bridge 8 (Te Horo): no path (North side – low demand), 2.5m path (South side).

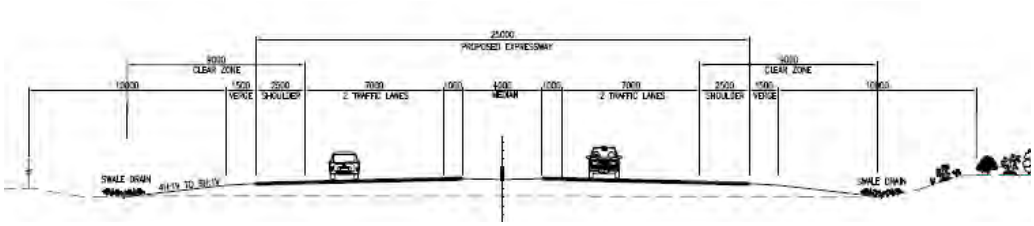
Shoulder provision for walking and cycling on the local arterial will be a minimum of 1.8m, This is consistent with the AUSTROADS standard for an 80km/h posted speed. If the local road posted speed was increased to 100km/h then an increase in shoulder width to 2.0m should be considered. Widening the seal width for the local road is likely to give the road environment a more open feel and potentially lead to higher speeds.

There will be no specific provision for walking and cycling on the expressway, the aim is to promote the local road corridor.

Design Cross Sections

The proposed road cross sections are illustrated in the scheme drawings, and in Figure 2.1 below.

The proposed expressway cross-section includes one variation from the RoNS Design Standards and Guidelines. The target rural median width is 9m (edge line to edge line, and the proposal is to use a median width of 6m. This variation will need to be submitted to the Highways VAC for approval. Opportunities to increase and reduce the median width have been considered. The outcomes of this analysis are summarised within the *Value For Money Statement*.

Expressway Approx width = 47m	 Cross section for 1 direction (repeated both sides of median barrier): • Varies (approx 10m) swale, services or planting strip • 1.5m verge • 2.5m sealed shoulder • Two 3.5m wide traffic lanes • 1m median sealed shoulder • 2m grass median (not on bridges) • Wire rope median barrier (concrete or other form of barrier on river bridges)

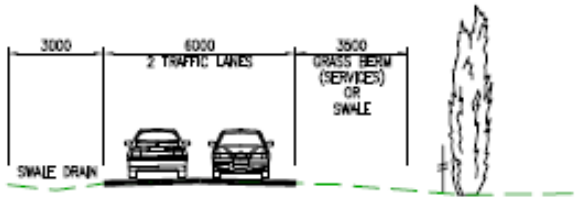
New Local Arterial Approx width = 16.6m	• 3m side swale, services or planting strip • 1.8m wide shoulder • 3.5m wide lanes in each direction • 1.8m wide shoulder • 3m side swale, services or planting strip
Existing SH1, where becomes new Local Arterial	To be confirmed as part of the SH Revocation Project but to include: • Minimum 1.8m wide shoulder • 3.5m wide lanes in each direction • Minimum 1.8m wide shoulder
Property Access Approx width = 12m	 • 6m sealed road • 3m minimum swale/services strip or road corridor on each side.
Off-road cycling facility Total width = 4m	• 2.5m of unsealed walking/cycling path. • 1.5m grassed bridle facility.

Figure 2.1 – Typical Design Cross Sections

Typical cross sections at bridges are summarised in the *Bridge Design Statement*.

At the Value Engineering Review Workshop (August 2011) it was identified by NZTA that the Bridge Manual is to be updated to require median shoulders on bridges to be widened to a minimum of 2m. This change in standards is expected prior to construction and a departure may be required to retain the 1m median shoulder width proposed.

Further details on design cross sections for the rail corridor are provided in the *Basis of Design for KiwiRail* document. At Mary Crest a local property access will be provided under the expressway. The proposed width of this access is shown in Figure 2.2.

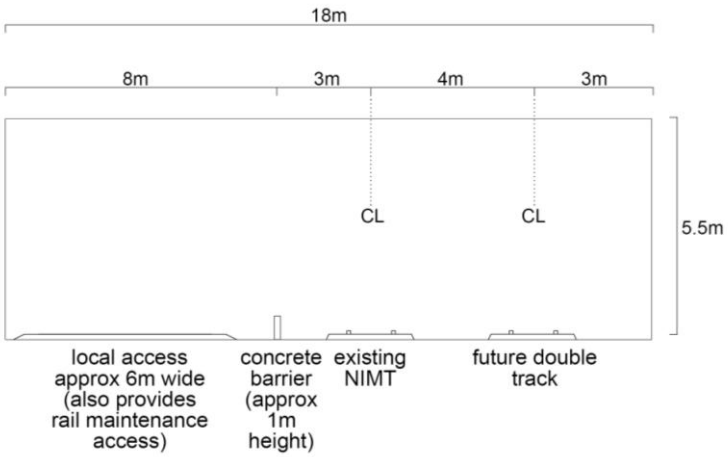


Figure 2.2 –Cross Section under expressway at Mary Crest.

Overhead Clearances

Table 2.1 sets out the proposed overhead clearances at structures. These clearances are measured from the road surface (or rail level) to the soffit level of the structure.

	Minimum Overhead Clearance
Expressway	6m
Local Arterial	6m desirable, 5.5m minimum
Local Property Access	4.9m minimum
NIMT Rail	5.5m
Access to Stresscrete	4.2m normal access plus 6m desirable over-dimension access.

Table 2.1. Overhead Clearances

Northern Connection (Taylors Road)

The scheme design has been prepared on the assumption that it will tie in to the Taylors Road intersection as proposed by the safety improvements project from Taylors Road to Pukehoe Bridge. This incorporates a right turn bay in to Taylors Road. The design for the proposed solution is shown on the scheme drawings.

The solution shown includes a southbound off-ramp in to Otaki before the new Waitohu River bridge utilising the existing State Highway. This off-ramp is designed to meet SH standards, not full expressway standards as it is not practical to provide an adequate merge length for vehicles entering the SH from Taylors Road. This is considered appropriate as the expressway does not develop until south of this off-ramp to reduce conflicting movements. When the expressway to the north of this project is constructed the off-ramp will need to be re-

constructed in conjunction with the provision of a grade separated solution for Taylors Road to connect back to Otaki.

It has been agreed with the Otaki to Levin expressway team that they will provide a layout for the ultimate design and designation at Taylors Road (given the inter-relationship between the expressway and local road). This design would be required to feed in to the property purchase process to ensure that negotiations with land owners made allowance for future designation requirements. The future work will also allow for culvert provision associated with the Waitohu Stream overland flow in the vicinity of Taylors Rd (the PP2O project will retain the existing SH1 levels in the vicinity of Taylors Rd together with the existing flood risk, while addressing flood risk to the south). Further discussion on the flood risk considerations are included in the *Hydraulic Assessment Report*.

The scheme design in this area has been developed following the Feb 2010 Public Consultation and to incorporate feedback from the Road Safety Review (Feb 2010). An item that has been added to the project is improvements to the southbound forward visibility approaching Taylors Road. This will involve adjustments to the vertical profile through this section of road.

Southern Connection (Peka Peka)

This project finishes north of the proposed Peka Peka interchange with the project interface defined as the northern extents of the interchanges north facing ramps (Te Kowhai Road). The proposed Peka Peka interchange (Option E5_01, as at 19th May 2011, as supplied by the M2PP Alliance) has been included in the scheme drawings.

The M2PP Expressway uses a 4m median width at this location and it will therefore be necessary to transition the median out to a width of 6m, at the southern extent of the project.

Due to the existing topography immediately north of Te Hapua Road it is expected that stormwater collected in this area will need to be attenuated and treated within the M2PP project area. This will be discussed and agreed with the M2PP Alliance.

5. Signs and Markings

A preliminary layout for information/directional signage has been prepared for the route. The proposed signage will need to be coordinated with the MacKays to Peka Peka Expressway project and discussions on this have commenced. NZTA have indicated a desire to not have any tourist signage along the expressway and instead include this on the local arterial once a decision has been made to leave the expressway. Further discussion on the route signage is required with KCDC and GWRC.

The proposed layout indicates the assumptions for Variable Message Signs and traffic cameras placed prior to interchanges. In addition to the proposed signs and cameras 3 x 100mm communications ducts will be provided along the length of the expressway. This allocation has been proposed based on preliminary discussions with the NZTA network operations team.

The more detailed regulatory signage and road markings will be completed as part of the detailed design. All road signage and markings will comply with the , Manual of Traffic Signs and Markings (MOTSAM).

6. Traffic Analysis

Intersection designs have been checked using the SIDRA modelling package using outputs from the Kapiti Traffic Model. The intersection design has been based on a design year of 2026. All movements at intersections provide adequate capacity for the design flows. The target in terms of Level of Service for links and intersections will be C. All aspects of the scheme design are operating at Level of Service A or B. A summary of the intersection performance will be included in the project Traffic Impact Assessment (TIA).

Provision for Emergency Services

The project team has had ongoing discussions with the Kapiti Emergency Services group. Through these discussions it has been agreed that the project will look at locations to provide the following:

- Turn-around facilities on the expressway. Locations where the wire rope barrier can be dropped and a hard surface provided to allow turning movements in the event of an emergency.

- Access on and off the expressway for Emergency Service Vehicles at Te Horo from either Gear or School Road. Based on discussions with Emergency Services emergency access across the rail corridor is not required. These facilities would not be open to the public, are likely to be barrier controlled and could be integrated with speed enforcement facilities.

These facilities will be specified through the detailed design process and agreed with the Kapiti Emergency Services group and KCDC.

7. Geotechnical

The *Geotechnical Interpretive Report* sets out the assumptions and proposed design criteria based on desktop and site investigations. The key earthworks criteria that have been used to develop the scheme design include:

Criteria	Design Basis
Cut Slope Angle	1V:2.5H (22°) or less. In alluvium material south of the Otaki River then can be steepened to 1V:1.2H Benches are likely to be required in cuts over 15m in height.
Fill Embankment Angle	2H:1V (26°)

Table 5.1 – Earthworks Design Criteria

Liquefaction Risk

According to the Regional Liquefaction Hazard Map (Wellington Regional Council, 1993), the majority of the proposed expressway is situated in areas which are not susceptible to liquefaction. Results of the site investigations confirm that there are areas with localised sand and silt layers within the site and the liquefiable layers are generally thin. Liquefaction of the layers could possibly cause limited subsidence (less than 100 mm) of the state highway. We consider the risk to the expressway is relatively low, as the limited subsidence will not cause closure of the road for access, and can be readily reinstated after large earthquake events.

At bridges abutments and potentially for high embankments the liquefiable material will either be removed and replaced of improved using the most effective solution for the site (eg. vibro-compaction, vibro-replacement, stone columns, dewatering using wick drains).

Treatment of Peat Areas

The locations where peat is likely to be encountered is limited to the south end of the project. The proposal at present is to excavate and replace the unsuitable material. Peat treatment trials currently being undertaken by the M2PP Alliance are being monitored and will be considered as a potential solution depending on the outcome of the trials.

8. Pavements and Surfacing

The scheme pavement design is described in the *Economic Analysis of Pavement Design Options* report which is included as an Appendix to the SARA. The proposed pavement design for the expressway is an unbound granular construction with a cement stabilised basecourse which is illustrated in Figure 8.1.

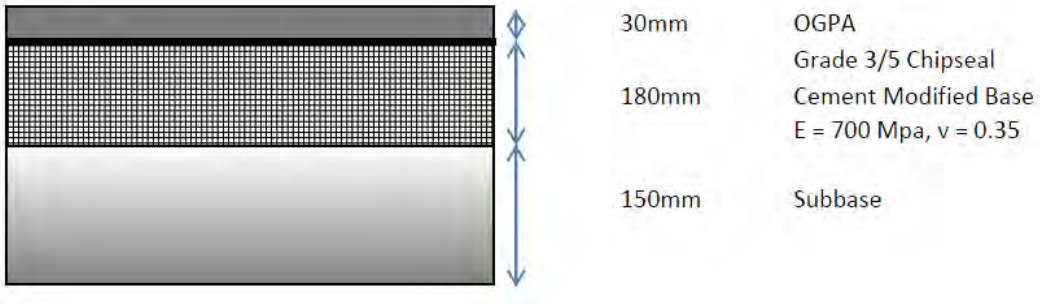


Figure 8.1. Proposed expressway pavement design.

The use of cement modification has been considered and has been recommended on a whole of life risk based basis.

The OGPA surfacing is only to be added where required for noise mitigation, based on assessments undertaken using NZS 6806:2010 Acoustics – Road-traffic noise – New and altered roads. Where it is required it will be necessary for the OGPA to be added at least 3 months after the road is initially opened. The scheme design proposal for the extent of low noise surfacing has been assessed as part of the noise assessment process and will be confirmed through mitigation workshops held through the AEE stages of the project. The current assessment suggests that OGPA is likely to be provided on the expressway through Otaki (between the railway station and Waitohu Valley Road) and possibly through Te Horo.

The pavement design is based on a CBR of 10. In areas where a CBR of 10 is not achieved then the pavement thickness can either be increased or undercutting and replacement used. Provision for these treatments will be included in the cost estimate based on available geotechnical data. For a lower CBR 5 an approximate increase of 150mm granular subbase or undercut is expected.

9. Stormwater Design Philosophy

The *Stormwater Design Philosophy* defines the proposed standards, assumptions and outlines the background behind the stormwater design concept. That document should be referred to for more detail. The following table is taken from that report and summarises the proposed standards:

	New sections of local and connecting roads	**New sections of expressway and junctions**
Climate change	As the midrange of the MfE guidance to the year 2090. This is an additional 16% for flows or rainfall	
Primary road drainage	Designed to convey the 10% AEP[1] storm event flows	Designed to convey the 10% AEP storm event and to keep these flows a maximum of 4mm deep at the edge of the trafficked lane[2]
Secondary road drainage	Assuming no median barrier exists: Minimum of 2m width in centre of road to be passable[3] in a 1% AEP[1] storm event	Assuming a median barrier exists: Minimum of one lane in each direction to be passable[3] in a 1% AEP[1] storm event
Treatment of road runoff	We propose to treat a road surface area, equivalent to the increase in impermeable road surface. This may be a new or existing road surface. Treatment to NZTA requirements (which are an evolution of the TP10[4] treatment requirements as referred to in KCDC's subdivision requirements1). This is a Best Practicable Option approach. NZTA treatment requirements are further defined in their stormwater standard[5]. From the NZTA stormwater standard, the water quality event is defend as 19mm[6] over 24hours (before allowing for climate change)	
Stream channel erosion control	No standards proposed	Provision of extended detention volumes where the 50% AEP velocities are erosive for catchment with foreseeable imperviousness of greater than 3%
Attenuation – (Storm peak discharge control)	For the critical duration storm event for the whole catchment: post road construction 50%, 10% and 1% flows are to be attenuated to 100% of pre road construction flows. Climate change provision in the form of additional land to enlarge the stormwater devices in the future if necessary. There is the opportunity to establish the case that increases in flow is no more than minor for several of the larger catchments. These catchments are the Otaki River, the Mangaone Stream and the Waitohu Stream. At this stage, we are confident to predict that attenuation will not be needed for sections of road surface discharging to the Otaki river.	

[1] Subdivision and Development Principles and Requirements, KCDC, 2005
[2] Highway surface Drainage, NZTA, 1977
[3] "Passable" is defined as 100mm of water depth (NZTA 1977) with a velocity not exceed 2m/s.
[4] TP10, Stormwater Management Devices: Design Guidelines, Auckland Regional Council (ARC), 2003
[5] Stormwater Treatment Standard for State Highway Infrastructure, NZTA, May 2010
[6] The NZTA stormwater guidance document defines the Water quality event as the 90th percentile rainfall event. From appendix A of the NZTA stormwater guidance document the 90th percentile rainfall event along the project length varies between 17.5 and 20mm over 24 hours; we have adopted 19mm throughout (not including climate change)

	New sections of local and connecting roads	New sections of expressway and junctions
Minor Waterway crossings[7]	To convey 10% AEP storm flows, typically but 1% if appropriate (to be assessed on case by case basis) 1 With 300mm freeboard from road white edge line.	To convey 1% AEP storm flows, with a minimum 500mm freeboard from road white edge line and a maximum of 2m heading up from the culvert soffit.
	Hydraulic exceptions are culvert providing a throttling action and flood protection to downstream properties. Design flows to include for climate change. Fish passage provided to GWRC guidelines[8].	
Erosion and Sediment Control	T o comply with GWRC Guidelines.	

Table 9.1 – Proposed Stormwater Design Standards (to be confirmed following discussions with NZTA, GWRC and KCDC)

Culvert Design

Following discussion with the ecology team it has been decided that apart from the major river crossings (Waiothu and Otaki River) all other watercourse crossings will be culverted. This includes the expressway and local roads.

More specific details on culvert design will be available through the preliminary design process. The assessment at that stage will define the locations where fish passage will be provided.

[7] Minor waterway crossings refers to all waterway crossings with the exception of the four major crossings (Otaki, Waitohu, Mangaone, Mangapouri). For information on the major crossings refer to the hydraulics and modeling report.
[8] Fish-friendly culverts and rock ramps in small streams, GWRC, 2003

10. Flood Management Philosophy

The *Hydraulic Assessment Report* provides details on the flood modelling work undertaken. This section sets out the key considerations affecting the design outcomes without detailing any potential effects of the project.

Expressway Road Design Levels

The road level has been designed based on a number of factors:

- To ensure the road is a lifeline route during flood events, based on flood information provided in the *Hydraulic Assessment Report*.
- If possible to achieve an earthworks balance within the project.
- To minimise the visual impact and other effects of the expressway and interchanges.

The Hydraulic Assessment Report summarises the modelling work that has been undertaken to confirm predicted flooding levels and guide the design road level.

Location	Flood Level[9] (NZ Vertical Datum (2009))	Freeboard	Structure depth	Minimum Road Design Level[10] (NZ Vertical Datum (2009))
Waitohu Stream Bridge	25.31m	1.2m	1.6m	26.51m
Mangapouri Stream	14.4	0.3m[11]	-	14.7m
North of Chrystalls Stop Bank[12]	14.76m	0.3m[13]	-	15.06m
Chrystalls Stop Bank	15.56	0.6m	-	16.16m
Otaki River Bridge	15.46m	1.2m	1.6m	18.26m
Mangaone Stream	20.21m	0.5m	-	20.5m

Table 10.1 – Minimum Road Design Levels at points of hydraulic assessment

The bridge structure depth provision at river crossings (Waitohu and Otaki) is 1.6m (soffit to road surface). This is based on an anticipated bridge structure utilising Super-T beams with a span of 25-35m.

[9] For further details including return period events and climate change allowance refer to Hydraulic Assessment Report.
[10] Road design level is measured to the white edge line.
[11] Reduced freeboard at the Mangapouri stream is a result of desire to reduce height of Rahui Road connection. Freeboard provision results in white edge line being set at a level of the predicted 1 in 500 year flood.
[12] Applies to first 500m north of stopbank and from this flood level reduces.
[13] 0.3m freeboard is consistent with Mangapouri Stream and reflects that flooding in this area is dependent on overtopping of stopbank and resulting body of water will be relatively still.

There are also minimum road level requirements at a number of smaller culvert crossings along the route. These levels are set by the existing stream bed level, size of culvert required and provision of a minimum 0.5m free board for 1 in 100 year events. These parameters are discussed in Section 9 and specified within the *Stormwater Design Philosophy*.

Local Road Design Levels

The level of service design standard for local roads with respect to flooding is to set the road above the flood level for a 5% AEP event including climate change. The road will remain passable in a 1%AEP event as defined above in Table 9.1.

Flood Inundation Areas

The introduction of the expressway in to existing flood plains may increase upstream water levels. Hydraulic modelling is being undertaken to confirm where this could occur. In these situations the design shall ensure that there is no increased effect on existing buildings or residences outside the project footprint. It is not proposed to provide compensatory storage in any of these situations. At the Mangaone stream it may be necessary to consider additional property purchase or covenants over of affected areas of pasture.

11. Structures

All bridge and retaining wall solutions will be developed to conform with the Transit New Zealand Bridge Manual (Transit, 2003). Full details of the design philosophy for structures is included in the *Bridge Design Statement*.

Urban design guidelines for bridge structures have been agreed with the M2PP Alliance for the Coastal RoNS. These guidelines are also incorporated in the Urban Landscape and Design Framework (ULDF). The proposed bridge structures will comply with these guidelines wherever possible and any exceptions will be clearly stated.

12. Urban and Landscape Design

The design principles for urban design are discussed within the *Urban and Landscape Design Framework*.

An Urban and Landscape design workshop (10 June 2011) was held to shape the scheme design enabling urban design to influence the outcome of the project at an early stage.

13. Street Lighting

Street lighting will be required at interchanges (north and south of Otaki) on the expressway. It is not expected that the expressway will be lit in other locations. Local road lighting will be reinstated where it currently exists and new lighting will be required at new intersections on the local road network, eg. at the junction of Otaki Gorge Road and the new local arterial.

All street lighting will be designed to comply with Australian/New Zealand Standard – AS/NZS 1158.0:1997: Road Lighting.

14. Rail Corridor

The project has a number of interactions with the North Island Main Trunk (NIMT) rail corridor. Discussions with KiwiRail on these aspects of the scheme are ongoing and are summarised in the document, *KiwiRail Basis of Design*. This document will be included as an Appendix to the SARA and updated as the project progresses. The scope of the track and civil works proposed includes (or may include) the following:

- Realign and re-grade the track through Otaki to facilitate the proposed expressway works (from south of Otaki Station to the Waitohu Stream), including construction of earthworks for potential double tracking;
- Re-orientate Otaki Station and reconstruct the platform;
- Provide an equivalent crossing loop facility at Otaki Station to replace the one that currently exists;
- Ensure adequate space is available for a second platform and potential stabling facilities at Otaki;
- Maintain access to the existing gravel works north of the Otaki river;
- Alteration or protection of services and utilities that cross or are within the rail corridor on which the expressway has an impact;
- Extension or alteration of culverts adjacent to the KiwiRail network (where rail realignment occurs);
- Closure of a number of level crossings through the project area by providing alternative access;
- Amendments to the existing rail designation between Otaki and Te Horo to utilise some of the existing designation for infrastructure or clear zones associated with the expressway; and
- Ensure maintenance access to the KiwiRail bridge over the Waitohu stream is maintained.

Through the design process NZTA will consider and ensure that their works do not preclude the following:

- Future double tracking through the project area.
- Future provision of a second platform at Otaki Station as part of double tracking.
- Future provision of additional stabling associated with upgrades to the Otaki Station.

- Future provision for a station platform at Te Horo.

- Future rail curve easing at Mary Crest.

- Rail curve easing south of the Otaki Rail bridge, potentially under the bridge connecting to Otaki Gorge road.

15. Services and Utilities

Information on utilities within the study area was supplied by the utility owners. The nature of the study area and intersecting roads is rural and hence coverage of some utilities is limited. As the investigations progress a better understanding of the utilities in the area and extent of impact will be gained. Detailed discussions with utility owners are ongoing. A summary of known services are;

Road	OH Power	UG Power	Comms	Water	Sewer	Storm Water[1]	Gas
SH1	✓	✓	✓			✓	✓
County	✓	✓	✓	✓	✓	✓	
Rahui	✓	✓	✓	✓	✓	✓	✓
Otaki Gorge	✓	✓	✓	✓			
Addington	✓	✓	✓				
Old Hautere	✓	✓	✓	✓			
Te Waka	✓	✓	✓				
Te Horo Beach	✓	✓	✓	✓			✓
School	✓	✓	✓	✓			
Gear	✓	✓	✓	✓			
Te Hapua	✓	✓	✓				
Te Kowhai	✓	✓	✓				

Table 15.1. Existing Services and Utilities along route

Note: Excludes swales, box drains and culverts

The existing services are shown on the plan set included with the scheme drawings.

No specific provision for a services strip has been provided along the expressway. This decision is based on a number of factors:

- Throughout the length of the route the expressway is located in close proximity to the new local arterial. It is proposed that using the local arterial as a services corridor is more practical given that it is linked to other local roads and will limit disruption to expressway traffic during installation and maintenance.

- In addition the provision of an off-road cycle facility adjacent to the local road provides space for a possible services corridor.

Electrical and communication cables associated with street lighting and ATMS can be run along the shoulder of the expressway.

16. Construction Methodology

The Cost Estimate Report includes a construction methodology, current assumptions and a proposed construction programme. The document includes the following:

- Project risk profile
- Earthworks Methodology – Consideration of earthworks staging for north and south of Otaki river.
- Methodology for peat treatment
- Temporary Traffic Management
- Fill material sources

Possible staging of Otaki bypass and Te Horo expressway

Previous versions of this document included possible arrangements for temporary tie-ins for an Otaki Bypass to the existing SH1 at south Otaki. Such an arrangement may enable some early use of this route prior to completion of the Te Horo section of the expressway.

Due to the lowering of the expressway at south Otaki (to provide additional cut material and reduced visual impact of interchange structures) it is now more of a challenge to provide a temporary connection at south Otaki. Staging is likely to require additional width on proposed or new structures for this to be considered and would result in significant additional costs.

17. Identified Departures from Standards

Table 17.1 identifies departures from standards that are expected to be included as part of the scheme. This table will be developed further through the scheme design phase.

Departure	Reasoning
Flood event freeboard reduced to 0.3m north of Chrystalls Bend Stopbank through Otaki Township	• Bodies of water are expected to be still and unlikely to be susceptible to wave action. • Reduced height of expressway at Rahui Road reduces the effects from the local road bridge. • The freeboard provision at Rahui Road sets the white edge line at the predicted 500 year ARI flood level.

Table 17.1. Identified Departures from Standards