Appendix O

Basis of Design for KiwiRail

NZ TRANSPORT AGENCY
WAKA KOTAHI

Peka Peka to Otaki Expressway
Scheme Assessment Report Addendum
KiwiRail Outcomes and Basis of Design

Quality Assurance Statement

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Revision Schedule

Rev. No	Date	Description	Prepared by	Reviewed by	Approved by
1	8 April 11	Draft for Discussion	K Way	G McKay	T Coulman
2	19 August 11	For further KiwiRail Comment	G McKay	T Coulman	T Coulman
3	19 March 12	Final	M Edwards	G McKay	G McKay

NZ Transport Agency

Contents

1. Introduction

Purpose

The purpose of this document is to describe the following:

1. Extent of alterations to the existing KiwiRail network as a consequence of the Peka Peka – North Otaki Expressway Project;
2. Define the safe guarding for future development of the KiwiRail network that the project will consider; and
3. Confirm the basis of design to be adopted for track and civil works which may be required.

This document has been prepared by Opus as a draft for discussion purposes and will continue to evolve through the scheme development process and discussion between NZTA and KiwiRail.

Outcomes, criteria etc are subject to further NZTA and KiwiRail discussion prior to finalising.

Context

This document is focussed on the engineering aspects of the project and should be read in conjunction with the following:

(NZTA/KiwiRail Service Level Agreement)

(NZTA/KiwiRail planning strategy)

Background

NZTA are currently undertaking a scheme assessment study including public consultation which will result in design and construction of an expressway from Peka Peka to North Otaki as part of delivering an expressway from Wellington to Levin. The NIMT railway runs close to the proposed expressway alignment between Te Horo and North Otaki and will cross it at Mary Crest and North Otaki.

2. Summary of Outcomes

The scope of the track and civil works as part of the project generally 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.

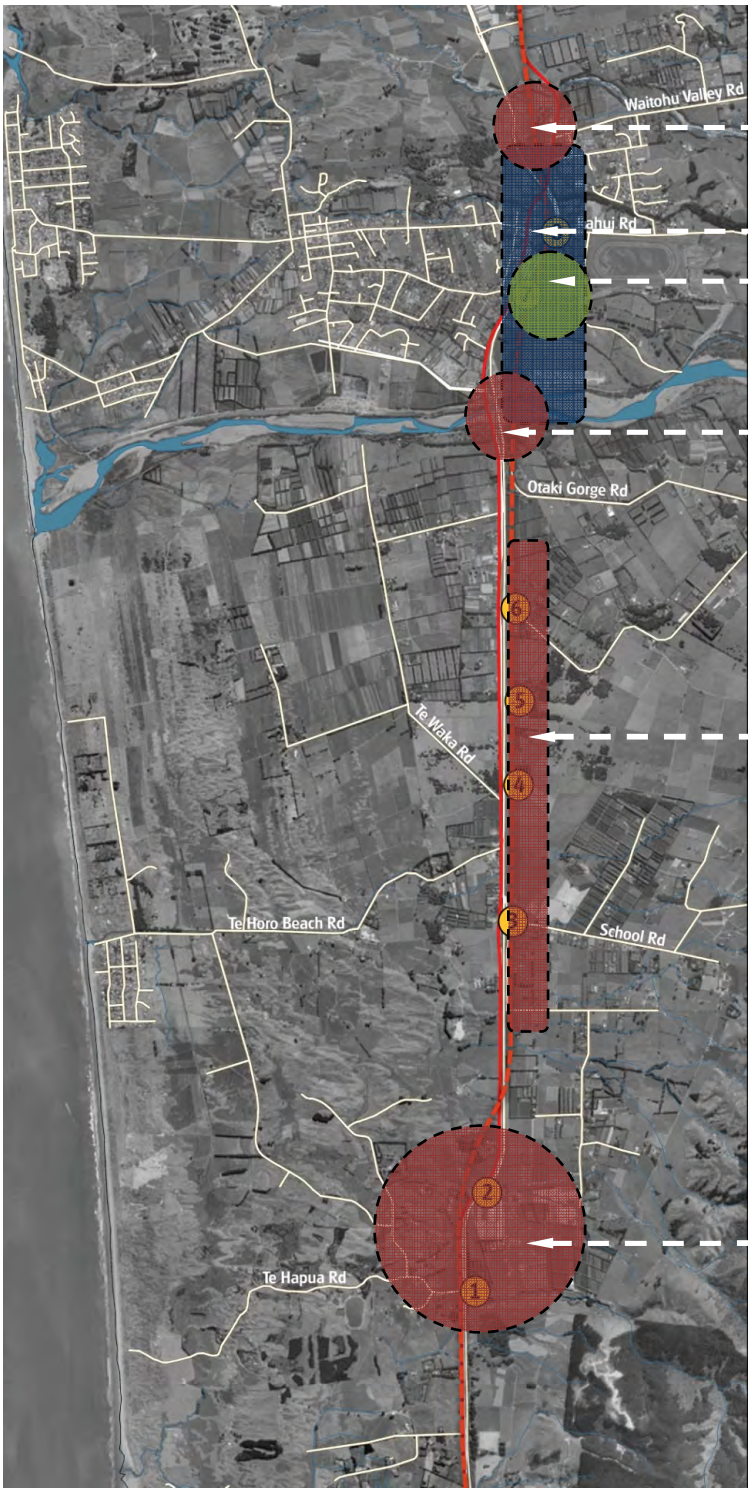
Through the design process NZTA will consider and ensure that their works do not preclude the following:

- 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.

The following sections provide more specific details about each of these items. Section 5 sets out the basis of design for infrastructure relating to KiwiRail.

3. Project Outcomes

This section identifies the specific parameters and requirements for effects on KiwiRail infrastructure along the route. It is divided by location as shown in Figure 3.1 below.



North Otaki – Refer to Section 3.6

Otaki Realignment – Refer to Section 3.5

Otaki Railway Station – Refer to Section 3.4

South Otaki – Refer to Section 3.3

Te Horo – Refer to Section 3.2

Mary Crest – Refer to Section 3.1

Non-specific locations:

Level Crossings (existing locations shown by yellow dots) – Refer to Section 3.7

Structures over KiwiRail Property – Refer to Section 3.8

Figure 3.1. Locations of areas of KiwiRail interest.

3.1 Mary Crest

The expressway crosses the rail in the vicinity of Mary Crest and does not require any rail realignment.

Clearance under expressway structure

Where the expressway crosses the rail corridor the minimum design widths and clearances shown in Figure 3.2 will be adopted. The scheme design is based on Option B which incorporates a local access under the structure.

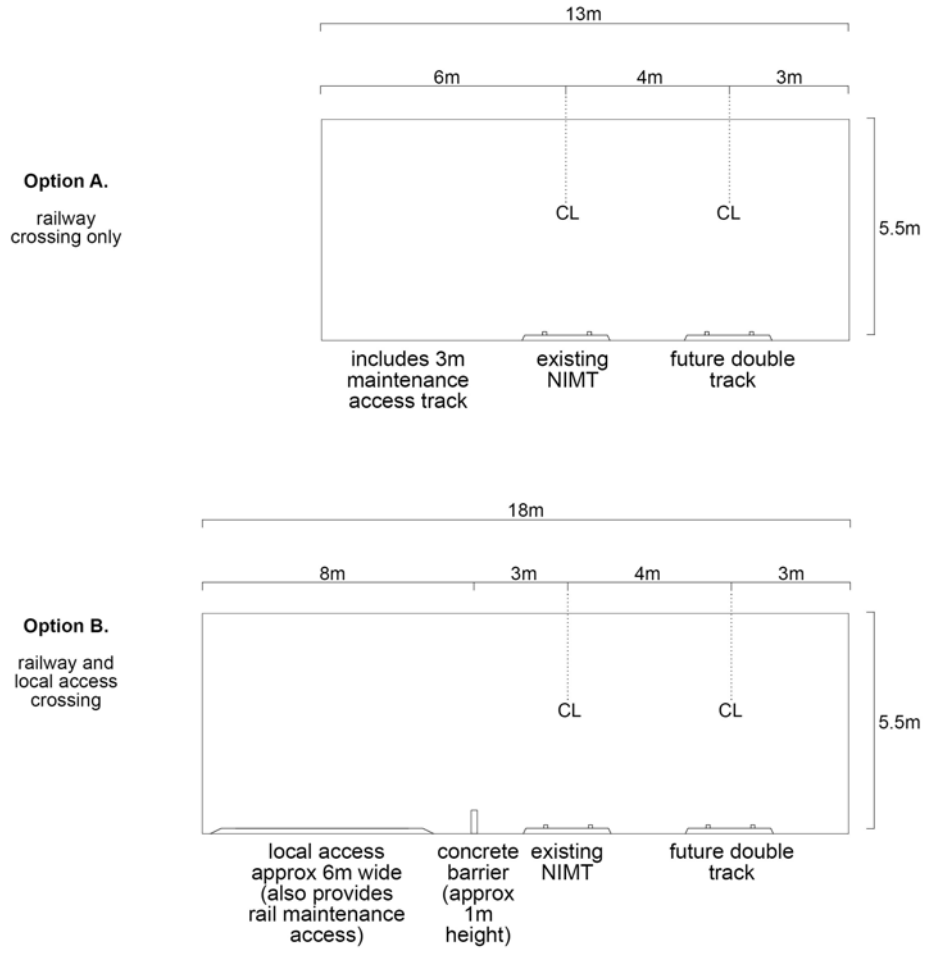


Figure 3.2. Minimum clearances under structure at Mary Crest.

Note: Clearance above the rail corridor to be adequate to allow for cant of track.

Potential for Future Realignment

Currently KiwiRail do not have any proposal to realign the track at Mary Crest but have requested that the expressway design does not preclude any future straightening of the track. Through development of the scheme design the expressway alignment has been adjusted which changes the methodology for straightening

of the rail alignment at Mary Crest. The preliminary design of a possible KiwiRail alignment is shown below in Figure 3.3.

Figure 3.3. Possible future NIMT alignment at Mary Crest (shown as dashed yellow line, concept only).

The expressway proposals also maintain two property accesses and at-grade rail crossings in this vicinity as shown by the white dashed line in Figure 3.3. As part of future upgrades to the rail alignment it will be possible to remove these level crossings.

3.2 Te Horo

The existing rail corridor south of Otaki Gorge Road and through Te Horo is generally 30m wide. At Te Horo the corridor widens marking a historic provision for a future station.

Based on preliminary discussions NZTA would like to explore the possibility of utilising some of the land for infrastructure (or earthworks, clear zones, landscaping) associated with the expressway. This will minimise the overall footprint of the transportation corridor, while protecting for future double tracking and a future platform at Te Horo.

Impact on KiwiRail Property

A narrowing of the rail corridor is proposed. This would require an alteration to the current rail designation or other agreement to enable NZTA to maintain any infrastructure. The minimum width of rail corridor to be retained by KiwiRail will be 20m.

This space within the existing designation will be utilised for drainage swales or environmental mitigation if required. It is not anticipated that the expressway footprint will be within this area. A typical cross section is shown in Figure 3.4 below

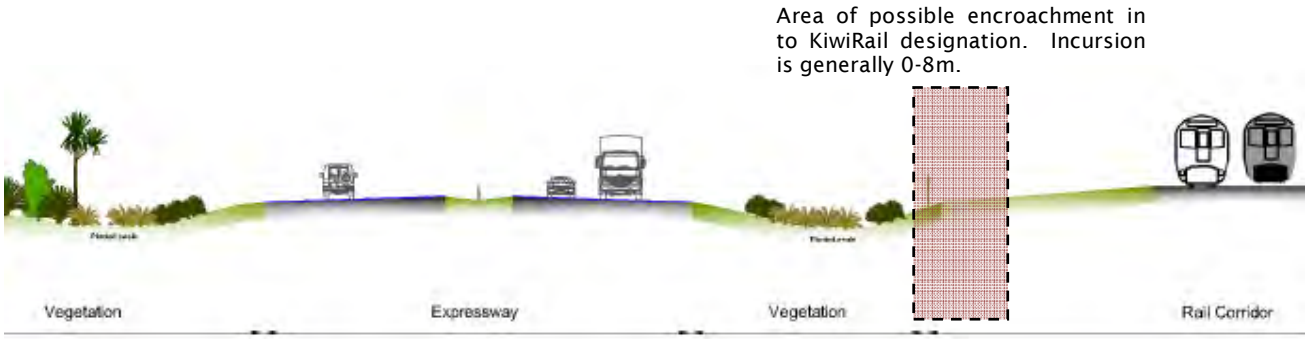


Figure 3.4. Typical Cross Section north of Te Horo

A preliminary assessment has indicated that the land required within the existing KiwiRail designation (south of the Otaki river) may be in the order of 15,000-35,000m^2. The large range in value reflects that the land requirement plans are yet to be produced. The width of incursion in to the rail corridor generally varies from nothing in some places to8m. The incursion may be slightly more (up to 15m) at the Te Horo station location and at the approach to the Mary Crest bridge. As land requirement plans are developed then this figure will be agreed between KiwiRail and NZTA. Through Otaki (north of the river) the exact extent of the new designation will need to be agreed with KiwiRail based on the extent of earthworks.

Provision for Future Station at Te Horo

The requirement to provide additional width at Te Horo for a possible future rail station has been discussed at stakeholder workshops. It has been identified that the designation can be rationalised at this location. It is proposed that the station provision as proposed for Otaki (see Figure 3.5 below) is retained, enabling some reduction in the existing rail designation and hence reducing the impacts on adjacent residential properties.

3.3 South Otaki

At early stages of the project there was some discussion regarding the curve to the north of the Otaki River Rail Bridge (Bridge No.5) and potential tightening the radius of this curve. These options have now been discarded but it had been discussed that a reduction may be possible providing it meets the following criteria:

- Design speed = 80 km/h (refer meeting notes 2 September 2010, Item 4)

- Horizontal radius = 475m to 500m (refer meeting notes 2 September 2010, Item 4)

The existing radius at this point is approximately 600m and the current scheme design proposal retains this existing radius.

3.4 Otaki Railway Station

General

The rail track will be realigned through the existing station. The station building will be rotated to align with the new track profile and the platform will also be reconstructed. It will also be necessary to provide temporary platform facilities during the station and platform works.

The design proposals for the track allow for future duplication of the track and platform.

The line speed for the design of new track work is 100 km/h except for the curve north of the Otaki River Bridge (Bridge No.5) which is discussed in the previous section.

The works must provide for a designed transition between the existing and new track that is acceptable to all stakeholders. The design should optimise the vertical and horizontal alignment and take into account the following:

- Realigned platform

- Allowance for future eastern platform to proposed widths shown in Figure 3.5 below. These dimensions are based on designs used at Waikanae Station (2010).

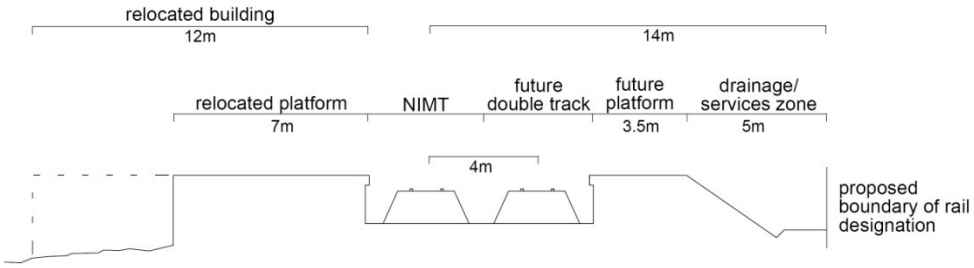


Figure 3.5. Provision for Otaki Station and future double tracking

- Allowance for a future stabling area – up to 200m long to be located to the south of the Station

- Provision of a parallel length of crossing loop track through the station to replicate what currently exists. The proposed length of this crossing loop is 900m. This is greater than what currently exists at the station. It is noted that during discussions KiwiRail expressed a desire for this loop to start and finish on a straight section of track. This would require doubling of the existing facility so is not currently proposed.

These provisions are indicated in the concept realignment drawings included in Appendix B.

Design Parameters

The design parameters as detailed in Section 5 shall apply with the addition of:-

- Desirable horizontal radius through station = 820m (refer meeting notes 16 June 2011, Item 1)

3.5 Otaki Realignment

The north island main trunk line (NIMT) will be realigned and regraded from north of the Otaki river to south of the Waitohu Stream. This work will tie in to the new KiwiRail bridge crossing of the Waitohu Stream.

Design Parameters

The design parameters as detailed in Section 5 shall apply with the only amendments being those mentioned in the previous sections.

Preliminary alignment drawings are attached as Appendix B. These are subject to further development through the design process.

3.6 North Otaki

Access to Waitohu Stream Bridge

The expressway proposals will include for maintenance access to the KiwiRail NIMT bridge crossing the Waitohu Stream. This access currently extends from the existing State Highway and will be severed by construction of the expressway. The proposal is to provide access along or adjacent to the new rail corridor. This will provide a connection from the Otaki rail station. This route is shown in Figure 3.6.

This access is expected to occur within the constructed formation width of 13m which potentially includes a duplicated rail line in the future. Formation width would be as for Option A in Figure 3.2.

Figure 3.6. Proposed access route to Waitohu rail bridge along rail corridor

3.7 Level Crossings

General

There are a number of existing access points on to the existing SH that cross the NIMT line. Through the project a number of these will be removed or altered. The existing crossing locations are indicated in Figure 3.7.

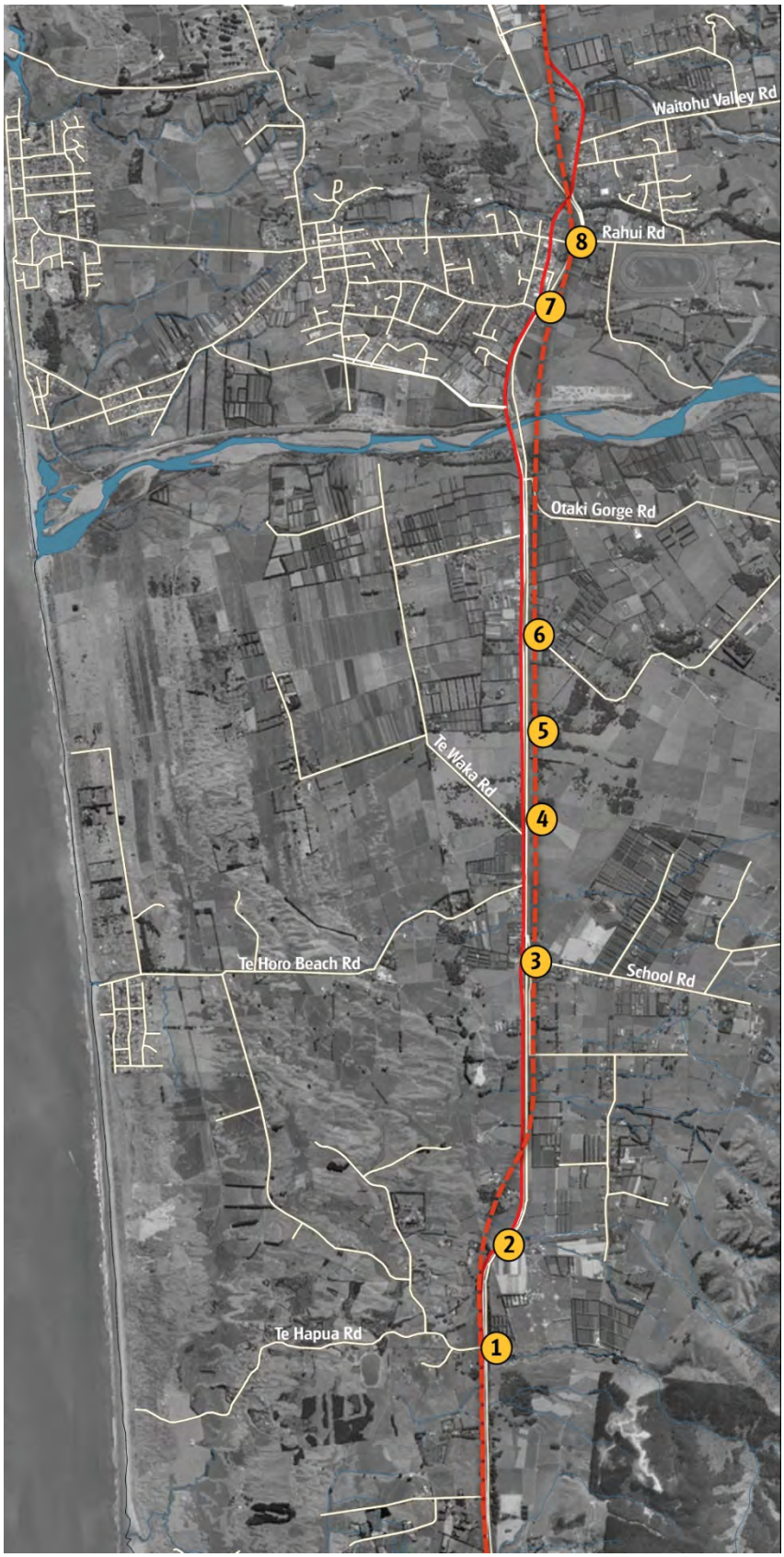


Figure 3.7. Locations of existing level crossings in project area.

Outcomes from PP20 Project

A summary of the proposed outcomes at each crossing location are described in Table 3.1.

Ref.	Description	KiwiRail Reference	Proposed Outcome
1	Sampson Property Access		Existing situation retained.
2	Mary Crest	62.690	Existing situation retained.
3	School Road	65.110	Closed. NZTA proposal provides grade separation.
4	Property Access opposite Te Waka Road	65.950	Closed. NZTA provides alternative access.
5	Stevens Property Access	66.700	Closed. NZTA provides alternative access.
6	Old Hautere Road	67.550	Closed. NZTA provides alternative access.
	Winstones Crossing		To be retained for oversize loads as per existing situation.
7	South of Waerenga Road	69.550	Already closed.
8	Rahui Road		Closed. NZTA proposal provides grade separation

Table 3.1. Proposed adjustments to Level Crossings

There have been discussions with KiwiRail regarding options for providing alternative access to the Mary Crest properties (location Ref. 1 and 2). This has included meeting with property owners in the area to discuss potential solutions. The current scheme proposals retain this crossing but during NZTA property negotiations further consideration may be given to obtaining some of the property required to provide an alternative access to Sutton Road.

3.8 Structures over KiwiRail Corridor

A number of bridge structures are to be constructed over the KiwiRail corridor. These structures will be located at:

- North Otaki – current proposals show this structure located immediately north of the existing state highway bridge over the rail corridor. This location is subject to change.
- Rahui Road – There is the potential for either a road link or pedestrian link over the expressway at this location.
- Otaki Gorge Road – current proposals show this structure located immediately north of the existing state highway bridge over the rail corridor. This location is subject to change.
- Te Horo – A new local road access will be constructed over the expressway, rail corridor and existing state highway. The location of this crossing is still to be confirmed.
- Mary Crest – Expressway to cross rail corridor as discussed previously in Section 3.1.

These structures will be constructed to the clearances specified in the Basis of Design section of this document (Section 4)

4. Basis of track and civil design

The following sections set out the basis of design to be used in the development of design aspects affecting KiwiRail. They are somewhat generic and reflect that design is at a preliminary stage. Throughout the design process NZTA will work with KiwiRail to develop these principles for the specific solutions required.

4.1 Regulations

Works shall comply with all relevant regulations of government and semi-government authorities.

4.2 Published Standards

Where a New Zealand Standard or Code of Practice exists it will be adopted as the desirable standard for materials, design, construction, operation and maintenance of all components of the works. Design standards for narrow gauge railway will comply in general with the ONTRACK T:200 Infrastructure Engineering Handbook and Infrastructure Group Supplements.

In particular, the proposed works shall comply with the provisions of current editions of the following codes, regulations and standards. Where a conflict of requirement arises it shall be referred to KiwiRail for resolution:

- Building Act 2004 (New Zealand)
- New Zealand Building Regulations and Code
- Historic Places Act
- Health and Safety in Employment Act
- AS/NZS1170 Structural Design Actions
- NZS3101 Concrete Structures
- NZS3404 Steel Structures
- Transit Bridge Manual
- Bridge Design Code, Supplement CSW/0201 and rating CSW 0202
- AREMA Manual for Railway Engineering
- NZS4121 Design for Access and Mobility
- ONTRACK Railnet Codes.

Reference to Standards or Codes of Practice shall mean the latest issue and the specifications, rules, codes, supplements and amendments associated with such Standards or Codes. Where no New Zealand Standard or Code of Practice exists the advice of ONTRACK shall be sought.

4.3 Design Criteria: Track Works

General

The Basis of Design is principally based on ONTRACK's T:200 Infrastructure Engineering Handbook and Infrastructure Group Supplements, referred to as T200 and CSP/xx respectively.

The design requirements for the track allow for future duplication.

The works must provide for a designed transition between any existing and new track that is acceptable to all stakeholders. The design should optimise the vertical and horizontal alignment and take into account the following:

- clearances from structures
- operating parameters
- tie-in points for the existing tracks
- minimising disruption to KiwiRail passenger and freight operations during the works
- protection of existing services, particularly drainage
- environmental constraints.

The design parameters forming the basis of design are attached as Appendix A.

Horizontal clearance

The works shall comply with the clearance requirements as depicted in Figure 4.1 and Item 344 of T200.

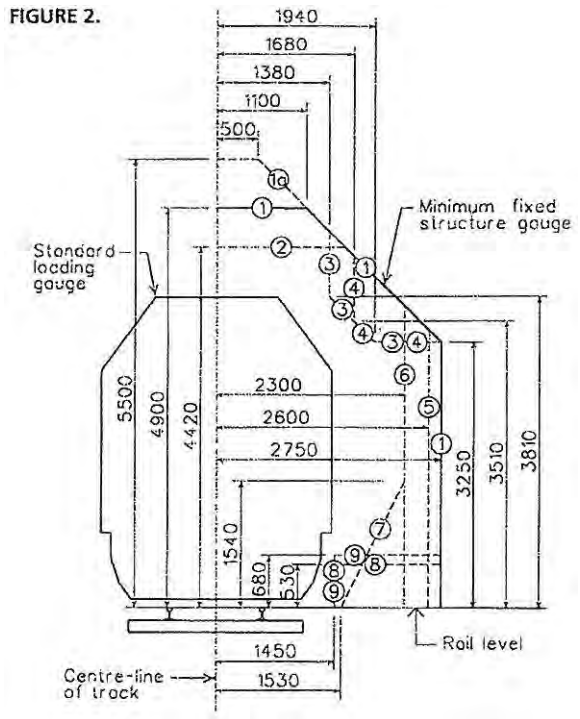


Figure 4.1. Figure 2 of T200

Track centre clearances (minimum):

- Structure or fence to track: 3.00 m.
- Isolated obstructions up to 2 m long: 2.75 m, e.g. signal masts, traction power poles and columns, 2.6 m is an absolute clearance and would be considered on a case by case basis only if significant physical constraints exist.
- Main line track to platform coping: 1.45 m.
- Main line track to main line track, within station limits: 4.00 m and outside station limits: 4.00 m where practical for side mounted traction power poles and within station limits: 6.00 m and outside station limits: 5.5 m for centrally mounted traction power poles.
- Main line track to siding: 4.00 m for side mounted traction power poles and 5.5 m for centrally mounted traction power poles.

For the purpose of this Design Basis Report it is assumed that side mounted traction poles will be used in the majority of locations. In areas where side mounted poles are deemed inappropriate alternative designed poles will be considered with respect to the overall project delivery (eg. under structures).

All horizontal clearances given are for tangent track and will be increased for curve and cant effects for all curves.

Curve effects are calculated by:- Centre throw (mm) = $(C^2/8R) \times 1000$
End throw (mm) = $((L^2-C^2)/8R) \times 1000$
where C=bogie dist (m), L= wagon length (m) and R=curve radius (m)

KiwiRail to advise design vehicle dimensions (length ad bogie spacing) during detailed design.

$$\text{Cant effect (mm)} = \frac{\text{3810 (rolling stock height) x cant (mm)}}{\text{1068 (track gauge)}}$$

Vertical clearances

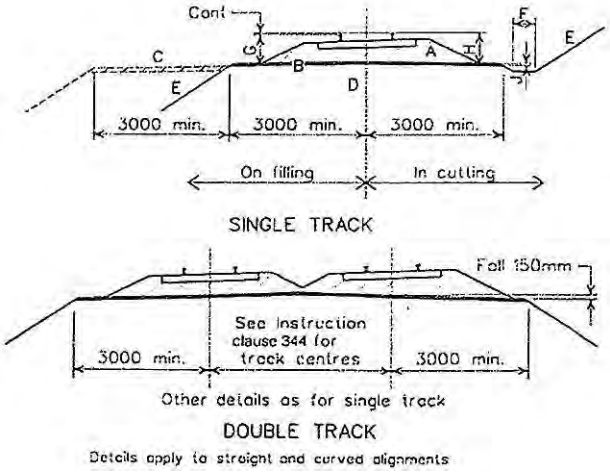
For new structures over proposed tracks the minimum vertical clearance shall be 5.5 m as shown in Figure 4.1. The same clearance shall be provided from existing structures. Any existing structure with a clearance less than 5.5 m shall be referred to KiwiRail's Manager, Traction Engineering.

The vertical clearance from top of rail to top of platform coping shall be 680 mm.

Structure gauge

The works shall be in accordance with the minimum fixed structure gauge as depicted in Figure 4.1 Infrastructure Engineering Handbook unless otherwise noted in this report.

Track structure

Rail	The rail shall be 50 kg continuously welded rail. The rail will act as track circuit and power conductor and the traction rail is separately bonded.
Sleepers	Sleepers shall be pre-stressed concrete to ONTRACK's material specifications.
Ballast depth	A minimum depth of 300 mm of clean ballast shall be provided under the nearest point of the capping to the base of the sleeper as shown in Figure 4 of T200.
Ballast shoulder	The ballast shoulder shall be at least 350 mm wide as shown in Figure 4 of T200. On curves less than 600 m radius, the ballast shoulder shall be at least 400 mm wide to improve track stability.
Formation width	Formation will conform to Figure 1 of T200:  **Figure 4.2. Figure 1 of T200** Single track formation to edge of sub ballast shall be 6 m wide, 3 m either side of the centre line. Dual track formation to edge of sub ballast shall have 3 m either side of the track centre line, and the track spacing and clearances shall be in accordance with Figure 4.1. In cuts open drains shall be provided as shown in Figure 4.2. Formation cross fall shall be 1:33 and new track shall fall away from existing adjacent track. This varies from the double track fall shown in Figure 1 of T200 but is intended to provide an

	adequate cross slope whilst minimising the amount of ballast required and has been used in previous projects following agreement with KiwiRail.

Table 4.1. Proposed track structure design basis

Sleeper spacing

Sleepers are typically spaced at 700 mm. On curves less than 400 m radius, they are spaced at 600 mm, as shown in Figure 5 of T200.

Points and crossings

Turnouts and crossovers from the main line desirably shall be 1 in 18; with 1 in 12 adopted where significant physical constraints occur.

Turnout geometry shall comply with CSP/63.

Gauge

As given in Table 1 of T200 gauge shall be 1068 mm measured at right angles to the track and 16 mm below the top of the rail head. On curves less than 250 m radius the gauge shall be increased to 1074 mm and consideration given to use of a check rail.

Geometric alignment

New sections of track shall be designed for a line speed of 110 km/h in accordance with the track parameters (Appendix A) and signalling requirements.

4.4 Design Criteria: Civil Works

Earthworks

All earthworks shall be finished to smooth and uniform surfaces and conform to the lines, levels and cross falls shown in the drawings.

New track formation

The requirements for track formation are depicted in Figure 4.2 and Appendix A.

Formation cross fall shall be 1 in 33.

The track formation including capping (sub-ballast) shall provide for a minimum design life of 50 years and a maximum differential settlement of 20mm see Appendix A.

Batter slopes will be 2H:1V or as recommended by the geotechnical engineer.

Drainage

The rail formation and reserve must be drained to prevent scouring, wash away or saturation of the upper layers of the formation.

Cut-off drains are to be provided at the top of all cuttings where land slopes towards the rail line to prevent run-off from entering the cutting.

In locations where there is insufficient room for table drains, drainage of the formation must be provided by lined or pipe drains.

Run-off from one track must be prevented from reaching another track.

Cess drains shall be incorporated in cuts and low fills wherever possible. The flat section of the drain shall be a minimum of 0.5 m wide and the minimum depth shall be 200 mm below the bottom of the capping.

Minimum grade on open drains shall be 1:300 typically, 1:500 absolute.

Return periods for drainage design will be as follows:

- Longitudinal: 1 in 10 years
- Cross (transverse): 1 in 50 years
- Bridges: 1 in 100 years.

The water level shall, for the nominated return period, not be higher than the outside top edge of capping for longitudinal and cross drainage. Bridges shall provide a minimum of 600 mm freeboard below soffit level.

All drainage shall be designed in accordance with the recommendations contained within the KiwiRail document: ONTRACK DRAFT Drainage Design Guidelines January 2008.

Existing cross drainage will be maintained and extended as required. No upgrading will occur even if the existing drainage has insufficient capacity to meet current design standards. Any such drainage shall be brought to the attention of KiwiRail.

Kapiti Coast District Council (KCDC) will need to be consulted as part of this process in order to establish culverts that form part of their overall Flood Hazard Strategy. Where they have identified culverts that are substandard under the existing track; these will be brought to KiwiRail's attention, and Opus design will provide for the correct culvert beneath any new construction.

Structures

All under track structures shall be designed for 25 tonne axle loadings.

Cable Routes

Ducts and cables shall be located clear of the formation and drains. Design shall conform to the KiwiRail Specification for Constructed Cable Routes on the Rail Corridor.

Fencing

Fencing shall conform to the KiwiRail Rail Corridor Fencing Standard.

Appendix A – Design Parameters

(NZTA 440 PN Rail Design Parameters (1st Draft)

TRACK AND CIVIL DESIGN PARAMETERS SUMMARY

Parameter	Desirable (to be adopted where practical)	Absolute (to be adopted where required by site constraints)	Source	Comment
Corridor width	30 m	20 m	Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 1 November 2010, Item 1	As agreed with Kiwi Rail the expressway could infringe on the rail corridor.
Design Speed	110 km/h	Aim for 110 km/h where practical otherwise as high as practical		80 km/h curve north of Otaki River Rail Bridge.
Cant (maximum)	70 mm	70 mm	ONTRACK T200 CSP/33	0 cant on tangent track. Minimise applied cant to achieve desired speed.
Cant (maximum) at stations	0 mm	50 mm	ONTRACK T200 Item 329(2)	Stations to be on straights with zero cant if practical.
Cant ramp rate (maximum)	1:1000	1:500	ONTRACK CSP/33	
Cant deficiency	60 mm	60 mm	ONTRACK CSP/33	
Excess Cant V≤25kph V>25kph	 0 mm 0 mm	 0 mm 0 mm		
Horizontal geometry				
Minimum radius (mainline)	750 m	140 m	ONTRACK CSP/33	Largest practical radius curves should be used.
Minimum curve length	20 m	20 m	ONTRACK CSP/33	
Minimum transition length	20 m	20 m	ONTRACK CSP/33	Transition lengths vary based on applied cant and curve speed, refer to Table 1 T200.
Minimum length of straight between reverse and compound curves	=V/2	20 m	ONTRACK CSP/33	Distance is between ST and TS points of adjacent curves
Maximum permitted bend (angle change without a curve) in track	0	0		
Horizontal clearances				
Static rolling stock outline	T200 Fig 2	T200 Fig 2	ONTRACK T200 Fig 2 and CSP/37	
Structure clearance outline	3.00 m	Considered on a case by case basis	Email KiwiRail (Stephen Curry) 20 September 2010 to Opus (Gareth McKay)	Plus curve and cant effects on all curves. (Varies from ONTRACK T200 Fig 2)
Structure clearance to isolated items e.g. poles, masts etc	2.75 m	2.60 m	ONTRACK T200 Fig 2	Plus curve and cant effects on all curves.
New track centres - mainlines outside station limits	4.0 m 5.5 m	3.8 m 5.5. m	ONTRACK T200 Item 344	Traction power poles on side. Traction power poles central. Plus curve and cant effects on all curves.
New track centres - mainlines inside station limits	4.0 m 6.0 m	4.0 m 6.0 m	ONTRACK T200 Item 344	Traction power poles on side. Traction power poles central. Plus curve and cant effects on all curves.
Mainline to siding	4.0 m 5.5 m	4.0 m 5.5 m	ONTRACK T200 Item 344	Traction power poles on side. Traction power poles central. Plus curve and cant effects on all curves.
Mainline to platform coping	1.45 m	1.45 m	ONTRACK T200 Fig 2	Plus curve and cant effects on all curves.
Existing tracks	See comment			To be maintained where no work performed. To above standards if work required.
Vertical geometry				
Minimum radius	$=V^2/1.271$ m	6000 m	ONTRACK CSP/33	Largest radius curves practical to be adopted.
Vertical acceleration (maximum)	.01g	.01g	ONTRACK CSP/33	
Minimum length	40 m	15 m	ONTRACK CSP/33 Ref 8.2	
Maximum grade change not requiring vertical curve	0.00%	Governed by vertical acceleration	ONTRACK CSP/33	
Maximum grade (compensated)	Ruling grade for section	Ruling grade for section		Will generally match existing grade, reduce if possible. Grade should never be greater than 1:32 even for temporary works.
Maximum grade in yards and sidings	1 in 200 (0.5%)	1 in 200 (0.5%)	ONTRACK T200 Item 323	Ideally will fall away from the mainline
Grade compensation	n=1.65R		Westrail 3.5.5.	Where n = 1 in "n", R is curve radius in m.
Top of rail to platform coping	0.68 m	0.68 m	ONTRACK T200 Fig 2	
Overbridge clearances	5.5 m	Clearance less than 5.5 m requires the approval of the Manager, Traction Engineering	ONTRACK T200 Fig 2	
Drainage Design life	50 years		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Lateral Drainage	3% cross fall		ONTRACK DRAFT Drainage Design Guidelines January 2008	Cross stormwater only required to percolate through ballast of one set of tracks.

TRACK AND CIVIL DESIGN PARAMETERS SUMMARY

Parameter	Desirable	Absolute	Source	Comment
Stormwater outside of Rail Corridor				
Primary Systems	20% AEP or 1 in 5 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	If flow is piped, KCDC approval is required **
Building	No inundation for 1% AEP		ONTRACK DRAFT Drainage Design Guidelines January 2008	
Stormwater inside of Rail Corridor				
Primary Systems	10% AEP or 1:10 year return with no surcharging		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC require higher levels of service.
Secondary Systems	1% AEP or 1:100 year return		ONTRACK DRAFT Drainage Design Guidelines January 2008	Piped flow only if no viable alternative.**
Longitudinal (outside underground)	1% AEP or 1:100 year return with minimum 300mm freeboard from rail track Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	To be swale drains with catchpits or turnouts as appropriate. Swales to have side slopes < 1.5h:1.0v and may be flatter where insitu soil dictates**
Longitudinal (underground)	1% AEP or 1:100 year return with minimum 600mm freeboard from rail track - Match existing if already present.		ONTRACK DRAFT Drainage Design Guidelines January 2008	Unless KCDC requirements are more onerous.**
Manholes	60m centres		ONTRACK DRAFT Drainage Design Guidelines January 2008	At all changes in grade, horizontal alignment or max crs 60m
Cross Stormwater	10% AEP or 1:10 year return with no surcharging and 1% AEP with min 600mm freeboard to rail tracks		ONTRACK DRAFT Drainage Design Guidelines January 2008	Match existing waterways if in close proximity
Open drains				
Longitudinal gradient (minimum)	1 in 300 (0.33%)	1 in 500 (0.20%)		
Invert width (minimum)	500 mm	300 mm		
Depth below underside of capping (minimum)	300 mm	200 mm		
Track and track structure				
Track weight for new work	50 kg/m		As agreed	
Axle load for infrastructure	22.5 t	22.5 t	As agreed	
Axle load for structural design	25 t	25 t	As agreed	Existing bridges to be retained as-is.
Ballast depth under sleeper (minimum)	300 mm	300 mm	ONTRACK T200 Fig 4	150 mm at sidings.
Ballast shoulder	350 mm	300 mm	ONTRACK T200 Fig 4	*400 mm on curves < 600 m R. *Refer to 4.1.5 Ballast shoulder for discussion on this addition to ONTRACK standard
Track structure (new work)	Concrete sleepers on ballasted track			Except for turnouts, bridges and level crossings.
Turnouts	1 in 18	1 in 12	ONTRACK CSP/63	Mainlines only. Sidings on a case by case basis.
Half formation width (CL to formation edge) straight track and curves ≥ 8000 m radius	3.00 m	Considered on a case by case basis.	ONTRACK T200 Fig 1	Width to edge of sub-ballast. Drain required in cuts.
Formation cross slope	1 in 33	1 in 20	ONTRACK T200 Fig1 # As agreed in discussions with ONTRACK.	New track to fall away from existing. *Refer '4.1.5 Formation width for discussion on variance from ONTRACK standard
Sub-ballast (capping)	50 mm	50 mm	ONTRACK T200 Fig 4	
Formation fill batter slope	2H : 1V	1H : 1.5V		As recommended by the geotechnical engineer and agreed with KiwiRail
Cut batter slope				As recommended by the geotechnical engineer and agreed with KiwiRail
Formation- sub-grade strength	15-20% CBR		ONTRACK - As agreed	
Rail seat	1 in 20 inward tilt	1 in 20 inward tilt	ONTRACK material specification	Vertical for turnouts.
Sleeper spacing	700 mm typical; 600 mm on curves less than 400 m radius	700 mm typical; 600 mm on curves less than 400 m radius	ONTRACK T200 Fig 5	Otherwise in accordance with Fig 5 of ONTRACK T200.
Track gauge	1068 mm (narrow gauge)	1068 mm (narrow gauge)	ONTRACK T200 Item 302	Note 1074 gauge for curve radius <250m. Check rail to be considered in these cases.
Crossing Loop				
Length	1104 m			Ontrack Sketch "Waikanae Stabling and Crossing Loop" (17 November 2009)
Clearance - Mainline to crossing track	4.00 m			
Turnout	1 in 12		CCE 97579	
Radius - turnout to crossing track	565 m			
Settlement Criteria				
Longitudinal deviation (top fault)	14 mm for a 10 m chord at any time		As agreed	
Cross deviation (twist)	10 mm for a chord of 10 m		As agreed	
Maximum differential settlement	20 mm		As agreed	

TRACK AND CIVIL DESIGN PARAMETERS SUMMARY

Parameter	Desirable	Absolute	Source	Comment
SPECIFIC SITE PARAMETERS (These parameters replace or are in addition to those in the summary above)				
Mary Crest				
Te Horo				
Future Station			Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 2 September 2010, Item 3	Discussion KiwiRail/NZTA/GWRC/OPUS
South Otaki				
Horizontal geometry				
Minimum radius (mainline)	500 m	475 m	Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 2 September 2010, Item 4	Provides for 80km/h curve
Otaki Railway Station				
Horizontal geometry				
Minimum radius (mainline)	901 m		Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 1 November 2010, Item 3	
Platform width				KiwiRail to advise
Future Station			Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 2 September 2010, Item 3	Subject to KiwiRail confirmation
				Locate south of the railway station subject to KiwiRail confirmation
Stabling				
Length	200 m	150 m	Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 1 November 2010, Item 3	Locate south of the railway station subject to KiwiRail confirmation
Turnout	1 in 9	1 in 9	ONTRACK CCE97579	Waikanae stabling and crossover
Horizontal clearances				
Mainline to siding	5.6 m		Ontrack Sketch "Waikanae Stabling and Crossing Loop" (17 November 2009)	
Ballast Pit				Locate south of the railway station subject to KiwiRail confirmation
North Otaki				
Realign rail from south of Otaki Station to south of the Waitohu Bridge.			Peka Peka to North Otaki Meeting Notes. NZTA 440/442PN KiwiRail Technical Meeting 2 September 2010, Item 2	Expressway may sever KiwiRail maintenance access. Discuss options with KiwiRail.

* indicates variance from ONTRACK standard

** Where necessary to pipe drainage, pipes to have min dia. 300mm and laid to min grade 1%. Where pipes cross track shall be min Z* class reinforced rubber ring jointed with min

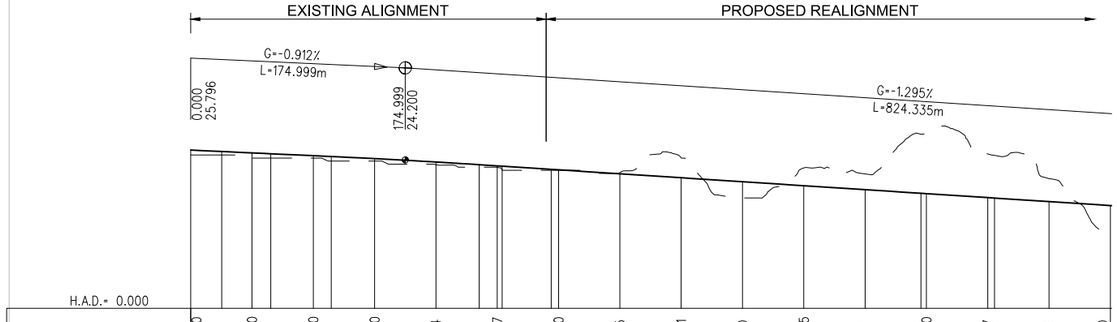
"CoP" Is the Code of Practice for the Defined Interstate Rail Network (Australia)

"Westrail' is the Westrail Narrow Gauge Code of Practice (Western Australia)

"ONTRACK T200" is the ONTRACK T200 Infrastructure Engineering Handbook

P:\projects\5-C1814.00 Peka Peka to North Otaki 440PN\500 Technical\515 Rail\Basis of Design\[Design Parameters 1st draft.xls]Parameters

Appendix B – KiwiRail Preliminary Design Drawings



H.A.D.= 0.000

EXISTING LEVEL	25.000	24.500	24.500	24.000	23.414	22.977	22.500	22.125	24.531	18.000	22.885	21.917	28.550	25.177	21.143	12.000		
FINISHED LEVEL	25.796	25.565	25.340	25.200	24.884	24.750	24.408	23.856	23.419	23.229	23.177	22.659	22.581	21.934	21.286	20.639	19.991	19.344	18.754	18.696	18.049	17.977	17.401	16.754
STATION	0.000	25.300	50.000	65.300	100.000	114.677	150.000	200.000	235.322	250.000	253.979	293.979	300.000	350.000	400.000	450.000	500.000	550.000	595.547	600.000	650.000	655.547	700.000	750.000
HORIZONTAL DATA	D	CL	R=-805.000 L=188.680						CL	D=301.567								CL						
VERTICAL DATA	P=-0.912%		L=114.677	R=-31500.000 L=120.644					P=-1.295% L=548.607															

LONGITUDINAL SECTION

HORIZONTAL SCALE 1:2500
VERTICAL SCALE 1:500

1:2500 @ A1 — 0 40 80 120 160 200 240 m

Revision	Amendment	Approved	Revision Date
R1	RAIL REALIGNMENT MODIFIED		

NZ TRANSPORT AGENCY WAKA KOTAHI

OPUS URS

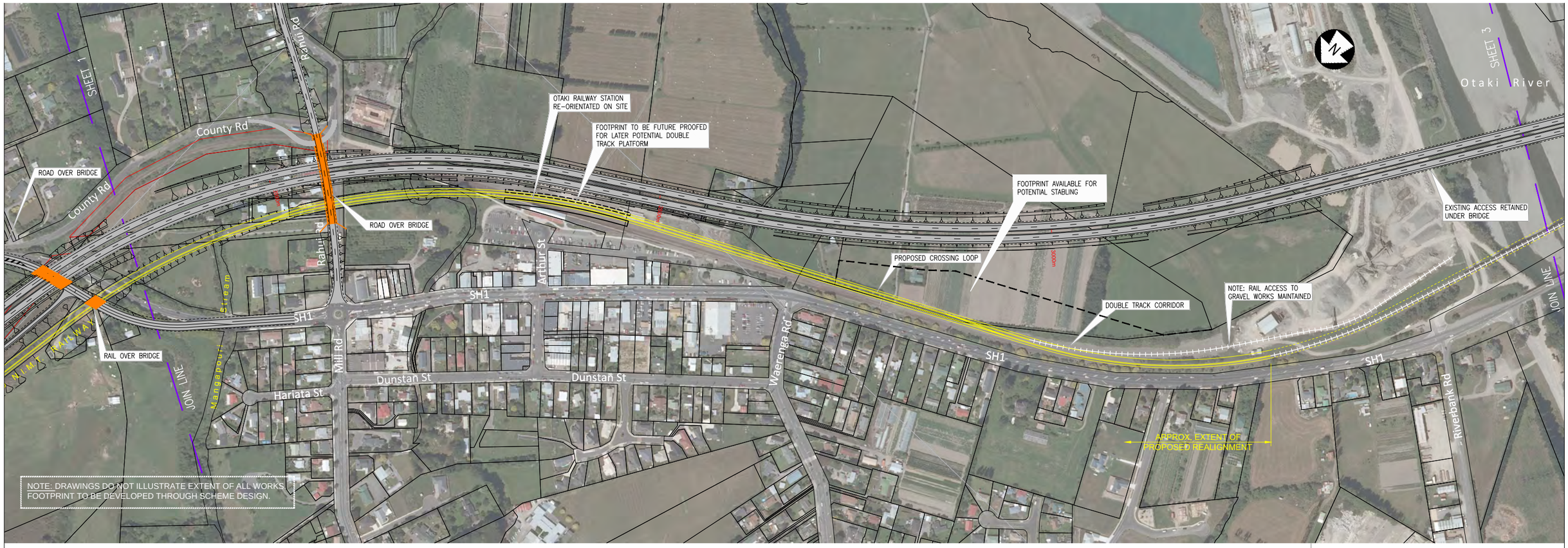
Drawn	Designed	Approved	Revision Date
B.R.C.	B.R.C.	A.J.COULMAN	18-08-11

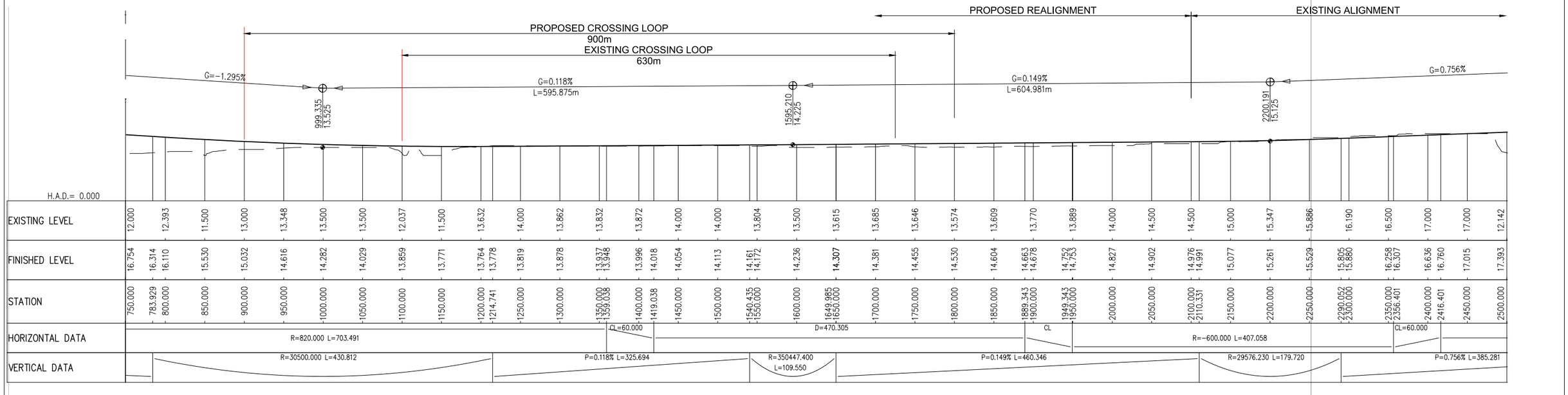
Project
NEW ZEALAND TRANSPORT AGENCY
PEKA PEKA TO NORTH OTAKI EXPRESSWAY
SCOPING STUDY

Sheet
RAIL REALIGNMENT - PRELIMINARY DESIGN
SHEET 1 OF 2

Project No.	Scale	Drawing No.	Sheet. No.	Revision
5C1814.00	1:2500(A1), 1:5000(A3)	5/2664/1/5504	751	R1

Original Sheet Size A1 [841x594] Plot Date 19/08/11 @ 08:35 p:\projects\5-c1814.00 peka peka to north otaki 440pn\900 drawings\910 cad\5504_scoping study\rail realignment\5_2664_1_5504_751-752.dwg





STATION	EXISTING LEVEL	FINISHED LEVEL
750.000	12.000	16.754
783.929	12.393	16.314
800.000	11.500	16.110
850.000	13.000	15.530
900.000	13.348	15.032
950.000	13.500	14.616
1000.000	13.500	14.282
1050.000	12.037	14.029
1100.000	11.500	13.859
1150.000	13.632	13.771
1200.000	14.000	13.764
1214.741	13.862	13.778
1250.000	13.832	13.819
1300.000	13.872	13.878
1350.000	14.000	13.937
1359.038	14.000	13.948
1400.000	13.804	13.996
1419.038	13.500	14.018
1450.000	13.615	14.054
1500.000	13.685	14.113
1540.435	13.646	14.161
1550.000	13.574	14.172
1600.000	13.609	14.236
1649.985	13.770	14.307
1650.000	13.889	14.307
1700.000	14.000	14.381
1750.000	14.500	14.455
1800.000	14.500	14.530
1850.000	15.000	14.604
1889.343	15.347	14.663
1900.000	15.886	14.678
1949.343	16.190	14.752
1950.000	16.500	14.753
2000.000	17.000	14.827
2050.000	17.000	14.902
2100.000	12.142	14.976
2110.331		14.991
2150.000		15.077
2200.000		15.261
2250.000		15.529
2290.052		15.805
2300.000		15.880
2350.000		16.258
2356.401		16.307
2400.000		16.636
2416.401		16.760
2450.000		17.015
2500.000		17.393

1:2500 @ A1
0 40 80 120 160 200 240 m

Revision	Amendment	Approved	Revision Date
R1			
R2	RAIL REALIGNMENT MODIFIED		
R3	STABLING AREA ADDED	MAE	03/2012

NZ TRANSPORT AGENCY
WAKA KOTAHI

OPUS URS

Drawn	Designed	Approved	Revision Date
B.R.C.	B.R.C.	A.J.COULMAN	18-08-11

Project No.	Scale
5C1814.00	1:2500(A1), 1:5000(A3)

Project
NEW ZEALAND TRANSPORT AGENCY
PEKA PEKA TO NORTH OTAKI EXPRESSWAY
SCOPING STUDY

Sheet
RAIL REALIGNMENT - PRELIMINARY DESIGN
SHEET 2 OF 2

Drawing No.	Sheet. No.	Revision
5/2664/1/5504	752	R3

Original Sheet Size A1 (841x594) Plot Date 19/08/11 @ 08:35 p:\projects\5c1814.00 peka peka to north otaki 440pn\900 drawings\910 cad\5504_scoping study\rail realignment\5_2664_1_5504_751-752.dwg