

Rail Electrification Extension

Glossary

Auckland Council	(AC)
Auckland Electrification Project (KiwiRail)	(AEP)
Auckland Plan	(AP)
Auckland Transport	(AT)
Benefit Cost Ratio	(BCR)
City Centre Future Access Study	(CCFAS)
Diesel Multiple Unit	(DMU)
Electric Multiple Unit	(EMU)
KiwiRail Group	(KRG)
Long Term Plan	(LTP)
New Zealand Transport Agency	(NZTA)
North Island Main Trunk	(NIMT)
Rapid Transit Network	(RTN)

Executive Summary

Electrification of the Auckland rail network to Papakura is due for completion in August 2013. Extension of electrification to Pukekohe is a named project in the AP and is identified for implementation in the first decade, which would effectively allow diesel rolling stock to be completely removed from the Auckland commuter rail network.

The business case for the electrification extension to Pukekohe project has now been completed, identifying a project priority profile of HHM (high for strategic fit, high for effectiveness, and medium for efficiency) and recommending inclusion in the AT capital portfolio.

AT has now completed work on the CCFAS and this indicates significant population growth between Drury and Pukekohe and this has been taken into account in the business case.

At the time AT presented input into the AC LTP, the business case for rail electrification had not yet been completed and as such this was not a named project. Now that the business case has been finalised and the project priority profile identified it can be included within the AT capital portfolio at its determined level of priority should this be approved by the Board as a valid transport project. The implication of including any new project into the portfolio is that either additional funding needs to be secured or lower priority projects will need to be reprogrammed out in time to ensure the fiscal envelope is not exceeded taking into account the business funding sources. This reprogramming will generally need to be undertaken within the same category of funding as the newly included project to satisfy both AC and NZTA funding rules and in this case the project is in the PT Infrastructure Category.

A number of options have been examined and Option C has been determined as the preferred, which has a capital cost estimate to AT of \$102.3m. Approximately 90% of the benefits arise from increased patronage, with most of the balance coming from a reduction in operating costs.

This paper recommends to the AT Board that a project to extend the rail electrification to Pukekohe be included in the AT capital portfolio at its identified prioritisation profile of HHM. Further work will be required to determine NZTA subsidy implication and programming of lower priority projects. Once this work has been completed a recommendation to the AT Board regarding inclusion in the LTP can be progressed.

Recommendations

It is recommended that the Board:

- i). Receive the report
- ii). Approves including the extension of rail electrification to Pukekohe as a project within the AT capital portfolio at an identified priority profile of HHM
- iii). Notes that additional work is required to determine NZTA subsidy implications, project timing, funding sources or reprogramming of lower priority projects. This will be brought back to the Board in early 2013 with a recommendation with respect to inclusion into the LTP.

Strategic Context

The AP identifies Pukekohe as one of the eight growth areas that are a priority for planning and investment in the short term. Pukekohe is classified as a Satellite Town which is an urban settlement that is significant in servicing a wide rural catchment. Satellite Towns are identified as the focus for growth in the rural areas.

The AP also identifies the RTN extending along the existing NIMT line as far as Pukekohe indicating that a higher frequency train service is planned for Pukekohe in the future. Electrification of rail to Pukekohe is a named project in the AP to occur within this decade (2011 to 2020).

Projected population growth in the Drury to Pukekohe area as noted in the ART3 multi-modal PT model to 2041, is estimated to be over 4% p.a. up to 2041 and effective RTN services need to be in place to accommodate this. Table 1 identifies the projected population and employment forecasts to 2041.

Table 1: Population & Employment Forecasts, Drury to Pukekohe

	2011	2021	2031	2041
Population	23,500	35,100	52,400	78,300
Employment	19,700	25,900	34,200	45,100

Background

Currently shuttle services are planned to run from Papakura to Pukekohe using DMUs post implementation of the AEP and commissioning of EMUs. By extending electrification to Pukekohe a rail service to and from Britomart can be provided to Pukekohe passengers using the new EMU fleet. The preferred solution will provide regular 20 minute services at peak times to Pukekohe and 30 minutes inter-peak.

Post AEP completion, the proposed rail network will use DMU shuttles operating from Papakura to Pukekohe. Operation of a small DMU fleet is sub-optimal and poor value for money. There are also operational issues involved in running a parallel EMU/DMU service that would be overcome with electrification. These include the increased travel time from Pukekohe to Britomart and an EMU/DMU interchange at Papakura. A net saving of \$2m per year can be achieved should DMU services be replaced with EMU services on this section of the rail network and if all passenger trains are EMU services, further cost savings could result.

Options Analysed

A scheme assessment report has been prepared based on NZTA's Economic Evaluation Manual to determine the BCR of extending the electrified rail network to Pukekohe. Options have been refined from the preliminary business case with input from KRG and consultation across AT and are as follows:

- **Do Minimum** – Electrification terminates at Papakura and DMU shuttles run between Papakura and Pukekohe (existing plan – a DMU shuttle every 20min peak, 30min non-peak)
- **Option A** – Electrification to Pukekohe (no new stations)
- **Option B** – Electrification to Pukekohe and build Drury station
- **Option C** – Electrification to Pukekohe and build Drury & Paerata stations

The proposed upgrade of Pukekohe is included as part of this proposed scope of works. The station upgrade at Pukekohe includes dedicated Park & Ride, cycle parking and bus interchange facilities.

Benefits / Cost Analysis

Note: if the decision is to proceed, it would be necessary to undertake a more detailed assessment of the capital requirements. This should include confirming any potential funding contributions from third parties who may have ownership of some of the assets, and hence benefit from any improvements made to the assets as part of this project.

OPTION	DESCRIPTION	COST (\$m)*	BCR
Do Minimum	Diesel Shuttles to Papakura, minor upgrade to Pukekohe station	5.43	n/a
A	Electrify to Pukekohe	94.3	0.9
B	Electrify to Pukekohe plus Drury station	99.3	1.3
C	Electrify to Pukekohe plus Drury & Paerata stations	102.3	2.1

The preferred option is **Option C** with BCR of 2.1.

The total estimated Capex is \$113.3m less assumed third party contributions of \$11.0m giving a project cost of \$102.3m, which is used in the BCR analysis.

The present value benefits are \$168.1m, which are driven by patronage growth that can only be achieved with new Park & Ride facilities and stations at Paerata and Drury in addition to a major station upgrade at Pukekohe.

Funding Options

This project is not currently listed in the AT LTP and funding is not allocated for the \$113.3m estimated total cost. Station upgrades do have some LTP funding (\$18.6m), and it has been assumed that funding will be available from KRG and NZTA for improvements to infrastructure (\$11.0m). The remaining \$83.6m would be required to be funded by AC and although NZTA subsidy would be sought, it is unlikely to be provided.

Funding summary:

Total cost to deliver	\$113.3m
Less anticipated third party contributions	-\$11.0m
Less funding in LTP	-\$18.67
Total additional funding required from AC and NZTA	\$83.63m

Programme Impacts

This project has an identified priority profile of HHM based on the AT funding prioritization process which means that it has a higher priority than other PT Capex projects in the LTP. However, this project is not currently in the LTP.

If this project is to proceed the funding options are:

- a) the \$83.6m additional budget must be funded from within the current PT Capex programme and other lower priority projects will have to be deferred. Consideration will need to be given to whether this project will be able to qualify for NZTA subsidy and whether or not deferred projects would have qualified for NZTA subsidy thus impacting the overall fiscal envelope;

or

- b) the \$83.6 of additional budget has to be allocated by AC and or NZTA specifically for this project, which is over and above the current Capex allocation to AT.

Next Steps

- Further investigation to secure enhanced confidence in major cost elements.
- Investigate funding options including a detailed NZTA funding evaluation
- Assess the possibility of attracting additional funding
- Assess the likely program based on the potential reprogramming of lower priority PT infrastructure projects.
- Assess the funding implications (NZTA and AC) of any reprogramming of lower priority projects
- Report funding back to the Board in early 2013 with a recommendation on inclusion into the LTP.

Attachment

Attachment 1 – Scheme Assessment Report

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Papakura to Pukekohe Rail Electrification

Scheme Assessment Report

Prepared by:

Major Projects Rail Improvements



An Auckland Council Organisation

Document Information

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1	First Draft	John Drillien			03/09/2012
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3	Third Draft	John Drillien			21/09/2012
4	Fourth Draft	John Drillien			28/09/2012
5	Fifth Draft	John Drillien			09/11/2012

Glossary

Auckland Council	(AC)
Auckland Plan	(AP)
Auckland Transport	(AT)
Auckland Electrified Area	(AEA)
Auckland Electrification Programme (KiwiRail)	(AEP)
Construcciones y Auxiliar de Ferrocarriles	(CAF)
Diesel Multiple Unit	(DMU)
Electric Multiple Unit	(EMU)
KiwiRail Group	(KRG)
New Zealand Transport Agency	(NZTA)
Rapid Transit Network	(RTN)
Regional Land Transport Programme	(RLTP)
Road User Benefits	(RUB)
Public Transport User Benefits	(PTUB)
Auckland Tourism Events and Economic Development	(ATEED)

Executive Summary

This scheme assessment report presents a business case for extending the electrified rail passenger network currently under construction, from Papakura to Pukekohe.

The report has been prepared in consultation with Auckland Transport Operations and KiwiRail.

The Do Minimum option for operating the Papakura – Pukekohe rail passenger network post the completion of the Auckland Electrification Project is to utilise upgraded DMU shuttles, transferring passengers to the new EMUs at Papakura. This option includes an upgrade of Pukekohe station, but no park and ride or bus interchange facilities. It assumes a 20 min peak and 30 min non-peak service frequency for the shuttles. The capital cost of the do minimum option is estimated to be \$7.80m.

The business case builds on a preliminary business case completed in February 2012. This business case has refined future options, and updated costs and benefits of each option.

The preferred option extends the electrification of the rail network from Papakura to Pukekohe and is estimated to cost \$102.30m. In addition to the do minimum option, it includes:

- rail electrification and signal upgrades
- purchase of two additional 3 car EMUs
- raising of three bridges and track lowering in one location
- construction of new stations incorporating park and ride facilities at Paerata and Drury
- a significant upgrade of Pukekohe station incorporating park and ride, and bus interchange facilities

The BCR for this option is 2.1. Additional benefits are that it:

- delivers the most patronage growth, and the corresponding benefits
- creates a complete electrification of the Auckland rail passenger network, removing legacy DMUs from the Southern Line and providing a consistent and high quality service to all rail passengers.
- delivers air quality and environmental benefits
- provides an important piece of public transport infrastructure in one of the few areas of Auckland where there is considerable land available to support urban and residential growth

The recommendation of this report is to implement the preferred option (Option C). The project is not currently listed in the AT LTP and therefore has no funding for the bulk of the required capital expenditure. Given the similar economic evaluation results between 'Option C' and 'Option C Staged', AT has the choice to either:

- complete the work by the end of 2015, to align with the completion of the rollout of EMU services under the Auckland Electrification Project or,
- stage the work over a 6 year period with completion in 2019, should more flexibility be required for funding the project over a longer timeframe.

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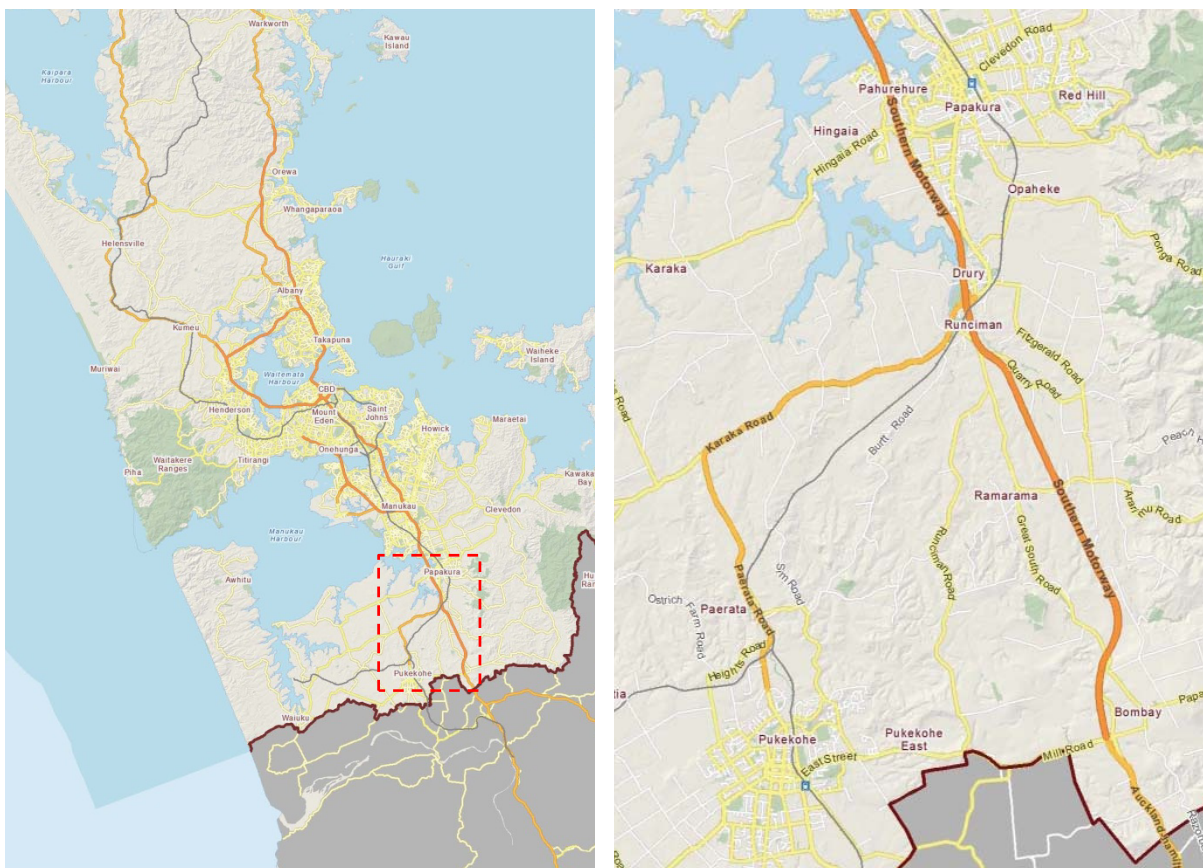
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Background

The purpose of this report is to develop a business case for extending the electrified rail passenger network from Papakura to Pukekohe. The business case builds on a preliminary business case completed in February 2012. Included in this business case are options that include construction of new stations and park and ride facilities at Drury and Paerata, and an upgrade to the existing station Pukekohe, including park and ride and bus interchange facilities.

The Local Area

Figure 01 & 02: Greater Auckland Region (Left) & Papakura to Pukekohe Region (Right)

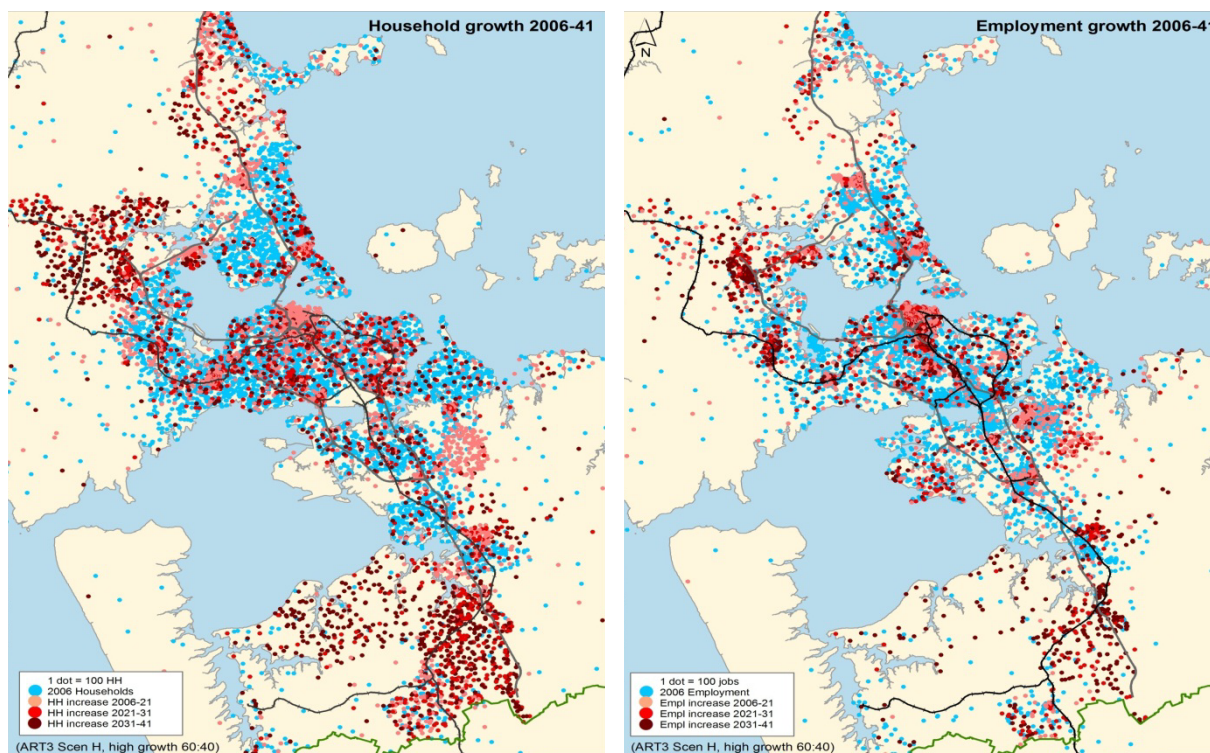


Pukekohe is the present Southern terminus of suburban rail passenger services and is approximately 18km south of Papakura and 13km south of Drury (fig. 01 & 02). Pukekohe is classified as one of only two satellite towns in the Auckland Region (the other being Warkworth). A satellite town is an urban settlement that is significant in servicing a wide rural catchment. The Pukekohe area is experiencing rapid growth and the Franklin District Growth Strategy projected the population to grow from 15,400 (2004) to 24,800 (2021), a growth rate close to 4.0% per annum.

Figure 03a: Development Strategy Map – Auckland Wide



Figure 03b: The Auckland Plan Development Strategy – Household and Employment growth



The Strategic Context

The Auckland Plan (AP) identifies Pukekohe as one of the 8 areas prioritised for growth in the first 3 years of the life of the plan. Land surrounding Pukekohe and Drury has been identified as potential greenfield area for development (see fig. 03a). Additionally, the AP Development Strategy shows significant household and employment growth planned for the Pukekohe area over the next 30 years (see fig 03b). Projected population and employment growth in the Drury to Pukekohe area as noted in the ART3 multi-modal PT model to 2041, are forecasted to be 4.1% pa, and 2.8% pa respectively (see fig 04). Further breakdown of the population numbers can be found in the Appendix.

Figure 04: ART Household & Employment Population Forecasts

Population	2011	2021	2031	2041
Household	23,500	35,100	52,400	78,300
Employment	19,700	25,900	34,200	45,100

The AP also identifies the Rapid Transit Network extending along the existing railway line as far as Pukekohe in the future. Transport projects for the next 3 decades are listed in the AP and include electrification of rail to Pukekohe as a named project in the 1st decade (to 2021).

Once the Auckland Electrification Project (AEP) is completed in 2013, and the rollout of new electric multiple units (EMUs) is completed in 2015, the current intention is that diesel powered (DMU) shuttles will operate between Papakura and Pukekohe, with a platform interchange at Papakura.

Auckland Transport is currently considering a series of options on the future of train services from Swanson to Waitakere (beyond the limit of electrification on the western Line). One option being considered is to replace train services with enhanced bus services. Should this option proceed, the only diesel powered services planned to remain in the passenger network would be on the line between Papakura and Pukekohe.

Existing Services & Stations

Diesel powered passenger train services currently operate between Pukekohe and Britomart. The headway of the existing diesel services is outlined on the table below.

Figure 05: Existing Headway to Britomart (minutes)

	Papakura	Pukekohe
Peak	10	20
Non-Peak	15	60-75

Services have grown from 2/day to 40/day over the past 10 years, making a significant contribution to patronage growth (see fig. 06 below).

The existing station at Pukekohe is in poor condition and will require an upgrade irrespective of whether electrification to Pukekohe proceeds. The upgrade of Pukekohe station is scheduled to be completed as part of the current Long Term Plan (LTP) by 2015/16.

In the Do Minimum option the upgrade would include general repairs to the buildings and overbridge to Station Road, raising the old platform, and installation of new signage.

A conceptual design has been prepared for a more major upgrade of this station, including park and ride and bus interchange facilities, and this is included in Options A-C.

There are currently no operating stations at Drury and Paerata, though plans and cost estimates have been prepared to establish stations at both locations.

Patronage

There has been massive rail patronage growth throughout the Auckland Region over the past decade, with growth spread across most stations in the network.

The table below highlights significant patronage growth at Pukekohe, exceeding that of any station on the Auckland network that has been operating for the entire period. Pukekohe is now a significant station on the Southern Rail Line.

Figure 06: Southern Rail Line - Patronage by Station: Total Weekday Boardings and Alightings

	2003	2004	2005	2006	2007	2008	2009	2010	2011	% Increase
Britomart (Auckland)	2,702	5,047	7,014	8,456	9,605	12,333	13,558	14,121	17,878	562%
Newmarket	1,135	1,408	1,125	1,560	1,815	1,762	1,602	2,025	3,274	188%
Remuera	217	308	218	296	455	418	393	407	485	124%
Greenlane	109	183	197	352	400	468	517	489	633	481%
Ellerslie	413	732	712	1,351	1,086	1,302	1,264	1,449	1,933	368%
Penrose	222	288	296	438	517	568	475	565	591	166%
Penrose Plt 3									247	
Te Papapa									304	
Onehunga									770	
Orakei	137	236	244	393	478	705	793	886	983	618%
Meadowbank	93	217	271	526	592	607	728	812	687	639%
Glen Innes	396	798	1,366	1,804	1,901	1,712	1,983	2,318	2,705	583%
Panmure	158	261	361	513	902	967	1,447	1,476	1,628	930%
Sylvia Park	0	0	0	0	0	916	1,048	1,564	1,679	83%
Westfield	114	229	143	185	208	248	394	268	354	211%
Otahuhu	202	243	483	497	619	644	724	830	954	372%
Mangere	398	481	374	231	231	185	264	208	245	-38%
Middlemore	1,072	1,317	1,103	1,893	1,838	2,137	2,246	2,269	3,055	185%
Papatoetoe	956	1,242	1,160	1,781	1,949	2,155	2,432	2,983	3,074	222%
Puhinui	266	295	285	385	392	424	749	577	676	154%
Homai	683	806	732	1,044	1,234	1,215	1,275	1,617	1,707	150%
Manurewa	1,196	1,588	1,386	1,973	2,171	2,532	3,083	3,404	3,532	195%
Te Mahia	312	291	233	303	284	290	336	342	350	12%
Takanini	545	634	410	687	743	736	885	967	1,062	95%
Papakura	1,908	2,418	2,729	2,583	2,955	2,636	3,333	3,241	3,854	102%
Pukekohe	74	203	296	262	218	1,443*	636	928	1,052	1322%
Totals	13,564	19,459	21,138	27,513	30,593	36,403	40,165	43,746	53,712	296%

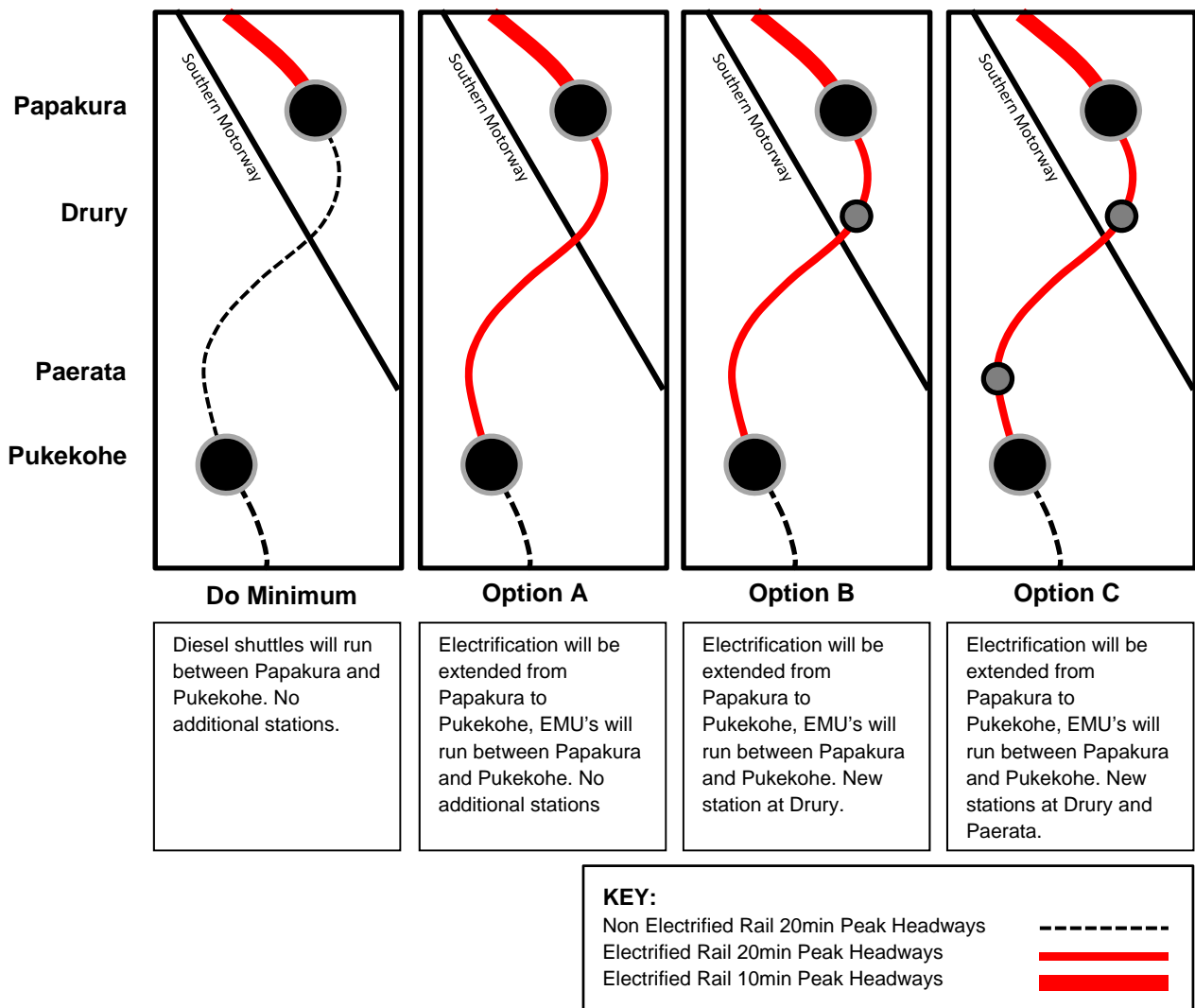
*data unreliable

Defining the Options

There are many potential options based on the key variables of headway, traction type and possible stations. The options selected for evaluation are based on the results of the Preliminary Business Case, with input from key stakeholders at Auckland Transport and KiwiRail. The headways selected are designed to link in with those at Papakura.

A summary of the options is presented below:

Figure 07: Papakura to Pukekohe Rail Options



All options including the Do Minimum maintain 20 minute peak headways. From 2016, non-peak headway is assumed to be 30 min in all options including the Do Minimum, given the growth in patronage from Pukekohe, and the desire to provide regular off-peak services.

The Do Minimum has DMU shuttles operating between Pukekohe and Papakura, with a platform transfer at Papakura, to EMU services to and from Britomart. Do Minimum includes

an upgrade to the Pukekohe station with general repairs to the buildings and overbridge to Station Road, raising the old platform, and installation of new signage.

Option A replaces the DMU shuttles with EMU services between Pukekohe and Papakura. Every second service to Papakura from Britomart carries on to Pukekohe, and every second service leaving Papakura for Britomart starts from Pukekohe. Also included is a significant upgrade to Pukekohe station including a new overbridge, park and ride and bus interchange facilities.

Option B is the same as Option A, with the addition of a new station at Drury. Previous studies have identified the potential of a station at Drury, given the local population (3,600, 2006 census), and its proximity to the Southern Motorway and the potential for park and ride facilities.

Option C is the same as Option A, with the addition of stations at both Drury and Paerata. Paerata is a small settlement 5km to the north of Pukekohe. A new station would service the largely rural areas to the west, in addition to passengers located in the northern parts of Pukekohe.

Options to increase peak and non-peak headway at both Drury and Pukekohe to align with Papakura were discounted after discussions with Auckland Transport Operations and KiwiRail. There is unlikely to be sufficient patronage to warrant such an increase in frequency in the foreseeable future. Additionally, a 10 minute peak headway to Drury only, would require Drury to become a terminal station. This would involve significant expenditure in rail infrastructure to move passenger trains off the main lines.

Options to run an express DMU service from Pukekohe via Papakura to Britomart at peak times are not deemed to be viable. This is due to operational complexities that would arise with EMUs and DMUs operating on the same lines.

Do Minimum

The Do Minimum option assumes that DMU shuttles will operate from Pukekohe, with a platform interchange to connecting EMUs at Papakura. The terminal and signal design for Papakura means that every second EMU service connecting to a DMU shuttle will need to dock at the western platform in order to enable a simple cross-platform interchange (see fig. 08).

Four DMUs from the current fleet will receive a significant overhaul to extend their life for the planned 30 year period. Four DMUs are required, based on the assumption that two are in service at any time, one is a “hot” spare, and one is available for maintenance.

The Pukekohe station (see fig. 08) is old and in poor condition and therefore an upgrade is included as part of the Do Minimum Option. Included in this upgrade are raising the platform, new signage and major repairs to the station and overbridge.

Figure 08: Papakura Station DMU / EMU interchange (left) Pukekohe Station (right)



Removal of Platform Interchange

Electrification removes the requirement for a platform interchange at Papakura for passengers to and from Pukekohe. The schedule structure means that every second train to and from Papakura is a through train to and from Pukekohe.

Electrification & EMU Requirements

The electrification options (A-C) include signalling, overhead line equipment (OLE) and track improvements required for electrification. KiwiRail advise that there is no requirement for additional traction power in any option.

There are nine road-over-rail bridges between Papakura and Pukekohe. Detailed measurement has identified that three bridges along the route would need to be replaced because they lack the minimum clearances required for electrification (see appendix). The bridges are Onslow Road, the Southern Motorway (Northbound) and Stadium Drive No.2. Track lowering is required under one additional bridge at Great South Road, south of Drury. Track lowering was discounted as an uneconomic solution for the other three bridges due to the need for expensive works to underpin the existing bridge abutments.

AT estimate that only two extra 3-car EMUs are required under the electrification options. Spare EMUs are not required given the synergies of operating as part of the wider EMU fleet.

Full Pukekohe Station Upgrade

The electrification options (A-C) include a full upgrade to Pukekohe station. Included in the full upgrade are new facilities for park and ride and bus interchange to be located on the western side of the track, closer to the CBD and the majority of local residents. A new overbridge is required to connect these facilities to the station. Also included are the necessary upgrades to rail and signals infrastructure (see Appendix: Pukekohe Station Upgrade)

The full station upgrade enables the withdrawal of the existing bus services operating between Pukekohe and Papakura. Local buses operating at Pukekohe would be able to transfer passengers to trains. Additional school buses would be added to service Wesley College.

Adding Stations at Drury and Paerata

Option B includes the addition of a station at Drury, and Option C stations at both Paerata and Drury. Park and ride facilities are incorporated within these stations. Drury has the capacity for 80-350 car parks, and Paerata has the capacity for 65-180 car parks. Capacity would be added with growth in demand over time.

Given that it would be unattractive for passengers from Drury and Paerata to have to change from a DMU to an EMU service after a short distance at Papakura, there are no options that retain DMUs with additional stations.

Commencement Year

Under all options the first full year of operations is assumed to be 2016, to align with the completion of the rollout of EMU services under the existing AEP. The required capital spend is assumed to occur in the preceding two years to allow for construction (2014/15).

Staged Implementation

An option to stage the electrification over a period of 6 years has been included in the business case, in the event that funding is only available over a longer timeframe. Under the staged option, the project commences in 2013/14 and is completed in 2018/19 as outlined below (fig 9). Stage I includes electrification work and a minor upgrade to the Pukekohe station. Stage II includes new park and ride stations at Drury and Paerata. Stage III includes the Pukekohe park and ride and bus interchange facility, and the purchase of the additional two EMUs. It is assumed there is enough capacity in the new EMU fleet to enable the delay of the additional two EMUs.

Figure 09: Project Stages and Timeframes

Stage	Project Component	Indicative Timeframe
I	Rail Electrification	2013/14 – 2016/17
	Bridge Upgrades	2014/15 – 2016/17
	Pukekohe (minor station upgrade)	2014/15 - 2015/16
II	Drury (park & ride station)	2016/17 – 2017/18
	Paerata (park & ride station)	2017/18
III	Pukekohe (park & ride station, bus interchange)	2017/18 - 2018/19
	EMU purchase	2018/19

Option C was chosen to assess the impact of a staged implementation, given it generated the best BCR (see Option Evaluation). No delay cost penalty has been incorporated under a staged implementation at this time. Note that further analysis would be required to confirm the feasibility and costs of the staging option.

Details of the proposed staging can be found in the Appendix – Cost Breakdown.

Delay

An option to delay the electrification for a period of 10 years has been included in the business case as funding is assumed to come through in the next LTP (2022/23). Under the delay option, the first year of operation is 2026. Option C was chosen to assess the impact of delay, given it generated the best BCR.

With this option, it is assumed that the base case applies in the initial 10 year period from 2016-2026, and the same Do Minimum upgrades to the DMUs are required to extend their life through to 2026.

A delay cost penalty of 40.0% over 10 years is applied to all capital expenditure, based on estimates of the rate of increase to general construction costs over and above CPI, and the loss of opportunity to leverage the existing construction and manufacturing contracts.

V8 Supercar Series

The V8 supercar series will return to Pukekohe in 2013, and ATEED projections are for upwards of 50,000 visitors each year over the 4 days of the event. The Pukekohe raceway is adjacent to the rail line, approximately 1km south of the rail station, and 1.80km by road or footpath from the rail station. ATEED are suggesting that a fan trail could be established for visitors walking the 1.80km from the Pukekohe station to the raceway.

However, under the Do Minimum option, there would be very limited capacity to transport patrons to Pukekohe for such an event. It may be possible to deploy the hot spare for such events, but this would only increase capacity by about 280 patrons per hour. It is proposed that the balance of the ADL/ADC DMU fleet be mothballed, and the sale or disposal of all other existing rolling stock. It would be impractical and costly to maintain part of this fleet for one-off events. Additionally, the platform transfer system between trains at Papakura would potentially come under enormous pressure, with the EMU service delivering many more patrons to Papakura, than the DMU service to Pukekohe could handle.

Cost Estimates

Costs incurred in the various options are outlined in the table below. Estimates were sourced from KiwiRail and Auckland Transport and include normal construction contingencies.

Figure 10: Papakura to Pukekohe Option Costs

Capital Costs \$m	Option			
	Do Minimum	A	B	C
Rail		\$66.50	\$66.50	\$66.50
Bridges		\$13.75	\$13.75	\$13.75
Stations	\$3.00	\$10.00	\$15.00	\$18.00
Rolling Stock	\$5.43	\$15.00	\$15.00	\$15.00
Total	\$8.43	\$105.25	\$110.25	\$113.25
3 rd Party Contribution		\$10.95	\$10.95	\$10.95
Net Total	\$8.43	\$94.30	\$99.30	\$102.30
Operating Costs (pa)				
Rolling Stock	\$4.69	\$3.52	\$3.52	\$3.52
Stations	\$0.25	\$0.25	\$0.35	\$0.45
Total	\$4.94	\$3.77	\$3.87	\$3.97

Rail electrification costs under Options A-C include signalling, overhead line equipment (OLE) and track improvements.

The bridges capital cost allows for the replacement of the three bridges identified as being too low for electrification (Onslow Road, the Southern Motorway (Northbound) and Stadium Drive No.2), and the lowering of the track under one bridge (Great South Road, Drury).

The station capital costs are based on previous studies and are Pukekohe (Do Minimum \$3m), Pukekohe (Full \$10m), Drury (\$5m) and Paerata (\$3m). Station operating costs are estimated to be Pukekohe (\$0.25mpa), Drury (\$0.10mpa) and Paerata (\$0.10mpa).

Rolling stock capital costs under the Do Minimum option include the upgrade of four existing 3-car DMUs at \$1.36m each. The cost of each new EMU is estimated to be \$7.50m.

Rolling stock operating costs for both EMUs and DMUs include maintenance, labour and energy costs and are proportional to the estimated distance travelled by the trains.

All the costs outlined above have been incorporated into the business case. Provision has been made for some contribution from third parties such as KiwiRail and NZTA.

The level of detail of the cost estimates is appropriate for a business case and the overall assessment of benefits and costs. However, if the business case is to proceed, it would be necessary to undertake a more detailed assessment of the capital requirements. This should include agreement to funding contributions from third parties who have ownership of some of the assets, and benefit from any improvements made to the assets as part of this project. Additionally, detailed assessment would include any cost impact of staging work over a longer 6 year timeframe.

For a more detailed cost breakdown refer to Appendix - Cost Breakdown.

Benefits

Patronage Growth

Patronage forecasts for the AM peak for each of the three stations have been developed using a variety of techniques which are described in this section. These reflected the fact that Drury and Paerata are “green field” sites but there is already a service to Pukekohe. It should also be noted that all stations south of Drury are beyond the geographical scope of the Auckland Public Transport (APT) model which has been used in the Rail Business Case and many other rail evaluations. However the forecasts used here have been checked against the ART3 (Auckland Regional Transport) model and were found to be consistent.

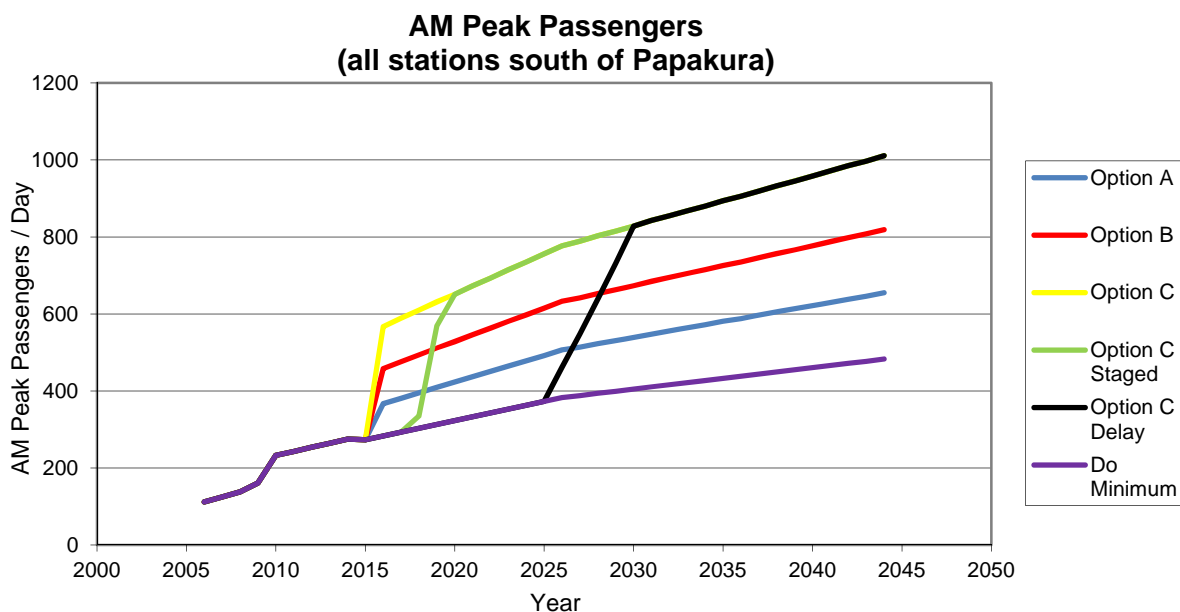
For the station at Drury, use was made of the 2008 study into a possible park and ride station. This was based on assessments of the number of motorway users likely to be diverted to rail, following experience with the Northern Busway.

To forecast patronage at Paerata, use was made of trip rates from TRL 593 ('The Demand for Public Transport: A Users Guide') combined with population data from the 2006 census for the surrounding areas

The starting point for patronage forecasts at Pukekohe was the existing peak patronage. The impact on patronage of detailed changes was modelled using the elasticity with respect to the generalised cost (GC) of a trip. The GC includes all aspects of a trip including access and egress and fare. For example, the change in GC can be used to represent a faster service if there is a direct EMU service from Pukekohe, rather than a combination of an EMU and DMU shuttle. For the Do Minimum option, a loss of patronage was forecast in view of the increased GC due to the need for the platform interchange at Papakura.

The patronage forecasts for the various options including the Do minimum option are illustrated on the graph below (fig. 11). The AM peak passenger forecasts are factored to provide annual passenger figures for use in the business case.

Figure 11: Patronage Growth Forecast



The peak passenger forecast for the Do Minimum option at Pukekohe is based on the observed 2010 patronage of 233 in the AM peak. For years after 2013 forecast patronage was reduced by 4.5% to reflect the impact of the platform interchange at Papakura. With the full upgrade at Pukekohe in options A-C, there is a one-off 20.0% forecast patronage increase due to the station upgrade incorporating park and ride and bus transfer facilities.

For future years, Pukekohe is forecast to experience high population growth. A passenger growth rate of 4.0% p.a. has been assumed in the Do Minimum option. Under Options A-C, growth has been increased to 5.0% p.a. to reflect a higher level of service. A growth rate of 4.0% p.a. has been assumed at Paerata. The assumed growth of 5.0% p.a. at Drury is a reflection of the increasing use of park and ride for motorway users.

It is to be expected that there will be interactions between stations; e.g. the opening of Drury or Paerata could reduce patronage from Pukekohe or Papakura. This has been included as part of the benefit calculation and took into account the specific features of each option.

In Option C staged, passenger growth is linked to the completion of stages I, II and III. The largest contributors to growth occur when new park and ride stations are added at Paerata and Drury (stage II), and when new park and ride and bus interchange facilities are added at Pukekohe.

Transport Benefits

The transport benefits from new users are calculated using Simplified Procedure 10 in the NZTA Economic Evaluation Manual (EEM), incorporating both road user benefits (RUB) and public transport user benefits (PTUB).

A survey of passengers departing Pukekohe has been undertaken with the major destinations being Middlemore (33km), Newmarket (45km) and Britomart (50km). Given this, and the fact that new passengers from Paerata and Drury will travel shorter distances, the average trip length for the three stations has been estimated to be around 35km. This is in contrast to the EEM assumption of an average Auckland rail trip length of 16.5km. The EEM values have been adjusted to reflect the longer distances.

The EEM benefits per new passenger were increased using the factors in the table below:

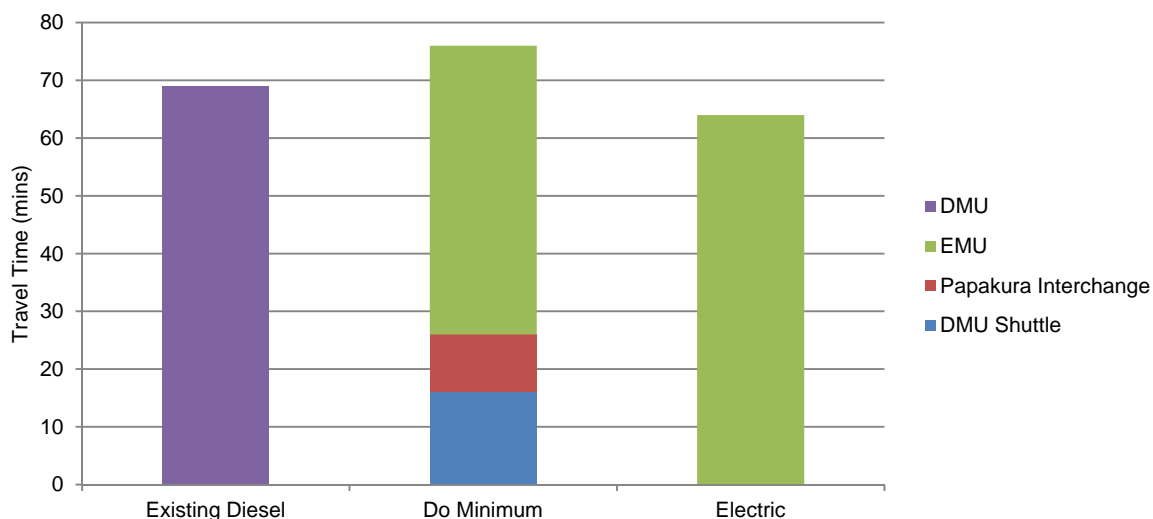
Figure 12: Average Rail Trip Length

	km	station factor
Ave trip length EEM	16.50	
Ave trip length Drury	29.10	1.76
Ave trip length Paerata	37.60	2.28
Ave trip length Pukekohe	41.80	2.53

Electrification to Pukekohe would also give benefits to existing passengers as it would remove the need to change at Papakura. This time saving was monetised using the appropriate values of time from EEM.

The estimated journey times between Pukekohe and Britomart for the various options are contained on the graph below. It shows that journey time increases from 69 minutes under the existing diesel services, to 76 minutes under the Do Minimum option. Electrification reduces the total journey time to 64 minutes.

Figure 13: Estimated Journey Times (between Pukekohe and Britomart)



Environmental Benefits

The use of EMUs to serve Pukekohe would have environmental benefits in terms of both improvements to local air quality and reduction in greenhouse gases (GHG), especially carbon dioxide. These impacts have been incorporated in the business case using data from the ARTA Rail Business Case (RBC) in consultation with Carl Chenery, Environmental & Sustainability Advisor at Auckland Transport.

In terms of carbon dioxide, the RBC figures indicate that for each diesel unit that is replaced by an electric one about 1,000 tonnes would be saved each year. Using the current value in EEM of \$40/tonne this equates to a benefit of about \$40,000pa, and is included in the BCR calculations. There is a view within AT and elsewhere that the true benefits of carbon dioxide reduction are closer to \$100/tonne. However, including benefits using this higher value does not make a significant impact on the BCR results.

There would be reductions in noise and improvements in air quality for neighbouring properties. However, given the low density of housing along the route, such benefits are likely to be low and have not been quantified for the business case.

Benefits linked to Auckland Transport and Auckland City Strategies

There are some strategic benefits that arise from this scheme that help deliver on key Auckland Transport and Auckland City strategies:

Community

- A key piece of transport infrastructure to support urban residential development in the Auckland Region in one of the few areas where there is a significant amount of land available. It may well act as a catalyst for faster development to ease Auckland's housing shortages.
- Improved and sustainable access to public transport for the people of Pukekohe, Paerata and Drury, and surrounding areas
- Potential to reduce congestion around central Pukekohe

Transport

- Further development of the electrification network and creating a more complete, modern and efficient passenger services network.
- Reductions in emissions and noise and improvements in local air quality
- Integration of rail and bus passenger services
- Improved travel time reliability
- Improved resilience of the wider public transport network
- Makes use of the existing track network capacity

Option Evaluation

The options have been evaluated under EEM guidelines. Present Value (PV) costs and benefits (including both capex and opex) for each option have been calculated based on the incremental or decremental differences between the option and the Do Minimum option. The evaluation period is 30 years, and a discount rate of 8.0% is applied to future costs and benefits.

The results of the economic evaluation are highlighted on the table below:

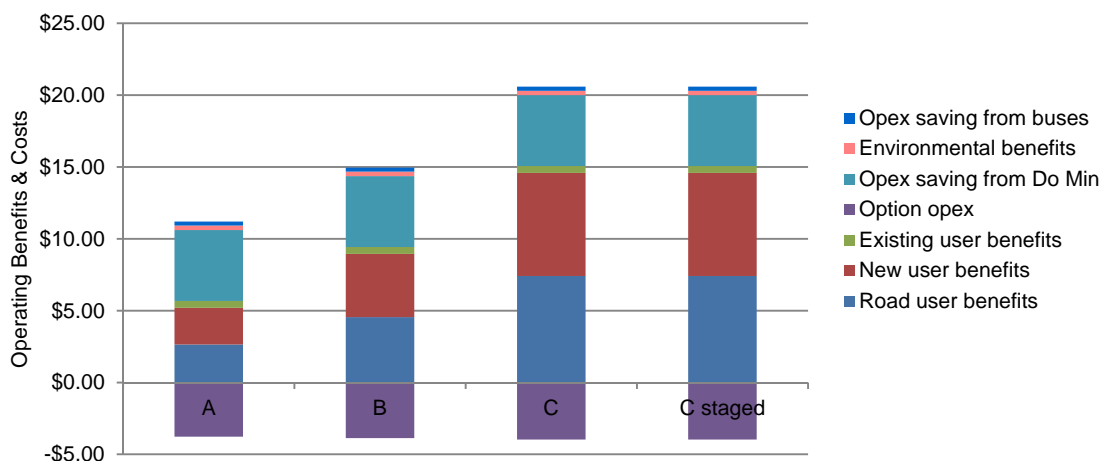
Figure 14: Economic Evaluation of Options

Option	Headway at			PV Costs (\$m)	PV Bens (\$m)	BCR (8% Disc)
	Pukekohe	Paerata	Drury			
A	20E	X	X	\$62.68	\$58.45	0.9
B	20E	X	20E	\$68.10	\$96.58	1.4
C	20E	20E	20E	\$71.73	\$153.97	2.1
C Delay	20E	20E	20E	\$51.81	\$78.39	1.5
C Staged	20E	20E	20E	\$58.90	\$125.36	2.1

The results show that either Option C or Option C staged, are the preferred options with a BCR of 2.1. It demonstrates that substantial patronage growth is required to drive high enough benefits to cover the capital costs of electrification. The required patronage growth will only be achieved with new stations at Paerata and Drury. In examining operating benefits and costs, the greatest drivers of overall net benefits are those arising from new users (passengers), and existing road users as a result of decongestion (see fig. 15). Staging Option C does delay benefits coming on-stream, but also delays the expenditure. Hence the BCR is very similar.

The Option C delay includes the impact of the 40.0% capital cost penalty. However, the effect of this is masked by the discounting effect over 10 years. The benefits are lower, given that they only accrue for 20 years out of the total 30 year period.

Figure 15: 2022 Operating Benefits & Costs (by Option)



Sensitivity Analysis

A series of sensitivities have been tested as outlined below. The results indicate a good level of robustness with adjustments to the key variables of capital and patronage growth. However, Option C is still the preferred option.

Figure 16: Sensitivity Loading

Capital	Patronage Growth	Option				
		A	B	C	C Delay	C Staged
0%	0%	0.9	1.4	2.1	1.5	2.1
+10%	0%	0.8	1.3	1.9	1.4	1.9
0%	+50%	1.3	1.8	2.9	2.2	2.9
0%	-50%	0.8	1.1	1.7	1.1	1.7

Variations from Preliminary Business Case

The BCR results from this business case are weaker than for the Preliminary Business Case, primarily because of:

- a reduction in patronage growth arising from 10 minute headways being removed due to operational difficulties, and a lack of total patronage numbers.
- more detailed analysis narrowing the gap between maintenance costs for EMUs and DMUs.
- rail capital costs increasing with more detailed analysis

Timetable to Implement

High-level draft implementation project plans for electrification projects based on Option C and Option C (staged) are included in the Appendices. Option C has completion of the entire project by the end of 2015, to align with the completion of the wider AEP. Option C (staged) has completion by 2019, with work undertaken over a 6 year timeframe. Both project plans incorporate the following phases:

- Design
- Consent
- Procurement
- Construction

Conclusions & Recommendations

The Do Minimum option for operating the Papakura to Pukekohe passenger rail post the completion of the AEP is to utilise upgraded DMU shuttles, transferring to the new EMUs at Papakura. This option incorporates an upgrade of Pukekohe station. The capital cost of the Do Minimum option is estimated to be \$7.80m.

The preferred option (C) for extending the electrification of the rail network from Papakura to Pukekohe is estimated to cost \$102.30m. This includes:

- rail electrification and signal upgrades
- purchase of two additional 3-car EMUs
- raising of three bridges and track lowering in one location
- construction of new stations incorporating park and ride facilities at Paerata and Drury
- upgrade of the Pukekohe station including a new overbridge, plus park and ride, and bus interchange facilities

The BCR for the option C is 2.1, relative to the base case. Option C is preferred because it:

- delivers the best financial outcome, that is robust under sensitivity loading
- delivers the most patronage growth, and the corresponding benefits
- completes electrification of the Auckland rail passenger network, removing legacy DMUs from the network and providing a consistent and high quality service to all rail passengers.
- provides an important piece of public transport infrastructure in one of the few areas of Auckland where there is considerable land available to support urban and residential growth

Given that the economic evaluation produces a substantially similar outcome, Option C can be completed in either:

- 2014/5, to align with the completion of the existing Auckland Electrification Project, or,
- 2019 allowing staging over a longer 6 year period.

Recommendation

Based on the conclusions above, the recommendation is to implement Option C at a cost of \$102.30m. AT has the choice to either:

- complete the work by the end of 2015, to align with the completion of the rollout of EMU services under the Auckland Electrification Project, or,
- stage the work over a 6 year period, with completion in 2019, should more flexibility be required for funding the project over a longer timeframe.

Appendix

Population Estimates

Benefit and Patronage Assumptions

Cost Breakdown

Draft Project Plan

Papakura to Pukekohe Bridges

Pukekohe Station Survey Results

Drury and Paerata Station Information

Pukekohe Station Upgrade Information

KiwiRail Inputs

Population Estimates

ART3 Zone	Suburb	Household		Employment	
		2006	2041est	2006	2041est
494	Hingaia Stg1	212	3,187	254	624
495	Hingaia Stg2	22	469	38	51
496	Runciman	130	6,372	155	1,897
497	Drury	475	6,171	1,080	6,553
498	Drury Quarry	450	590	213	312
499	Papakura Rural	338	391	124	147
500	Ramarama	804	13,985	682	11,056
501	Pukekohe East	1,313	8,921	625	1,159
502	Paerata	2,316	7,365	965	1,305
503	Pukekohe South	2,316	8,497	3,052	6,986
504	Pukekohe Centre	285	833	2,200	3,033
505	Karaka	1,095	12,085	873	4,398
506	Clarks Beach	668	719	225	337
507	Patumahoe	1,481	1,699	1,379	1,562
508	Waiuku	2,518	2,835	2,421	2,527
509	Awhitu	987	978	543	664
510	Hunua	1,566	1,288	1,006	1,042
511	Pokeno	424	259	333	375
512	Tuakau	1,800	1,628	969	1,051
Total		19,201	78,271	17,137	45,080

Patronage and Benefit Assumptions

The NZTA Economic Evaluation Manual (EEM) has been used to develop the business case. Cost and benefit streams have been calculated over a 30 year period and discounted at 8.0% p.a., consistent with EEM. Benefits arise as a result of both existing and new patronage.

Patronage

The starting point for patronage forecasts at Pukekohe is the existing peak patronage. The impact on patronage of detailed changes was modelled using the elasticity with respect to the generalised cost (GC) of a trip. GC includes all aspects of a trip including access and egress and fare. For example, the change in GC can be used to represent a faster service if there is a direct electric service from Pukekohe rather than a combination of diesel shuttle and electric service. For the Base Case a loss of patronage was forecast in view of the increased GC due to the need to change platforms and trains.

For the station at Drury use was made of the 2008 study. This was based on assessments of the number of motorway users likely to be diverted to rail, following experience with the Northern Busway.

To forecast patronage at Paerata, use was made of trip rates from TRL 593 combined with population data from the 2006 census. This covered four Census Area units:

- Kingseat, taking into account that if there was a station at Drury this would be closer for most of the population than Paerata
- Paerata Cape Hill, most of which is close to the proposed station
- Patumahoe, a largely rural area west of Paerata
- Pukekohe North, from where Paerata gives more direct access to rail than Pukekohe.

For future years passenger growth of 4.0% p.a. has been assumed at Paerata. As Pukekohe is forecast to experience high population growth, passenger growth of 5.0% has been assumed there for Options A-C, but only 4.0% p.a. under Do Minimum, given the older trains. Annual growth of 5.0%pa has also been assumed at Drury to reflect the increasing attractiveness of Park & Ride as SH1 becomes more congested.

As far as possible the patronage forecasts have been compared with the results from the ART3 multi-modal model for 2021 and found to be similar.

Results are on the table below

Passenger Growth Forecast

AM Peak Daily Passengers	Pukekohe	Paerata	Drury
2012	254	0	0
2013	264	0	0
2014	275	0	0
2015	273	0	0
2016	283	109	91
2017	293	113	95
2018	303	116	98
2019	313	120	102
2020	323	123	105
2021	333	127	109
2022	343	130	112
2023	353	134	116
2024	363	137	119
2025	373	141	123
2026	383	144	126
2027	388	147	128
2028	394	150	130
2029	399	152	132
2030	405	155	134
2031	411	158	137
2032	416	160	139
2033	422	163	141
2034	427	165	143
2035	433	168	145
2036	438	171	147
2037	444	173	149
2038	450	176	151
2039	455	179	153
2040	461	181	155
2041	466	184	158
2042	472	187	160
2043	477	189	162
2044	483	192	164

Passenger Benefits

For new passengers, use was made of Simplified Procedure (SP)10 in EEM, which is for use in evaluating improvements to existing PT services. SP10 gives unit benefits per new passenger for both road and PT users and for both peak and off-peak. Since these are based on an average rail trip length of 16.50km, the unit benefit values from EEM have been increased to reflect the increased trip lengths in this case.

The benefits arising from new PT passengers fall into two categories. Firstly the new passengers themselves each receive a benefit and secondly there are benefits to remaining road users from decongestion. Both these have been taken into account in the economic model using SP10.

Additionally, benefits have been calculated separately for peak and off-peak periods. To annualise the benefits from peak patronage forecasts, it was assumed that two-thirds of total annual patronage occurs during the peaks and the remainder in the off-peak. This is based on recorded patronage at a number of Auckland stations and on data from the Wellington rail network.

Electrification to Pukekohe would also give benefits to existing passengers as it would remove the need to change at Papakura, This time saving was monetised using the appropriate values of time from EEM.

Environmental Impacts

Emissions of particulate matter would effectively be removed by the use of electric traction and emissions of oxides of nitrogen would be reduced by up to 80.0%. GHG emissions would be reduced by about a quarter.

In terms of carbon dioxide, the RBC figures indicate that for each diesel unit that is replaced by an electric one about 1,000 tonnes would be saved each year. Using the current value in EEM this is a benefit of about \$40,000 per unit per annum or a present value of about \$0.50m over the 30-year evaluation for each diesel unit replaced.

With EMUs operating between Papakura and Pukekohe, there would be reductions in noise and improvements in air quality for neighbouring properties. However, given the low density of housing along the route, such benefits have not been quantified for the business case.

Cost Breakdown

Capital Expenditure (\$m)

	Option			
	Base	A	B	C
Rail				
Track Freeze		\$5.00	\$5.00	\$5.00
Pukekohe Yard		\$5.00	\$5.00	\$5.00
Signals		\$18.00	\$18.00	\$18.00
OLE		\$36.00	\$36.00	\$36.00
OLE - Puke Yard		\$2.50	\$2.50	\$2.50
Traction Power				
sub total	\$0.00	\$66.50	\$66.50	\$66.50
Structures				
Bridges		\$13.75	\$13.75	\$13.75
sub total	\$0.00	\$13.75	\$13.75	\$13.75
Stations				
Pukekohe	\$3.00	\$10.00	\$10.00	\$10.00
Paerata				\$3.00
Drury			\$5.00	\$5.00
sub total	\$3.00	\$10.00	\$15.00	\$18.00
Rolling Stock				
DMU Upgrade	\$5.43			
EMU Purchase		\$15.00	\$15.00	\$15.00
sub total	\$5.43	\$15.00	\$15.00	\$15.00
Total capex	\$8.43	\$105.25	\$110.25	\$113.25
3rd Party Capex	\$0.00	\$10.95	\$10.95	\$10.95
Net Capex		\$94.30	\$99.30	\$102.30

The Do Minimum option assumes that Pukekohe station receives a minor upgrade including platform raising, general repairs and new signage. The Do Minimum option also requires 4 existing DMUs to be upgraded, which may extend their life through the entire planning period.

The electrification options incorporate the necessary upgrades to rail, structures, stations and additional EMU purchases. Specifically included are:

- Replacement of bridges at Onslow Road, Drury Northbound Motorway and Stadium Drive No. 2, and the lowering of the up-main at the Great South road Bridge.
- Park and ride facilities with both new stations
- Purchase of 2 EMUs in addition to the main fleet

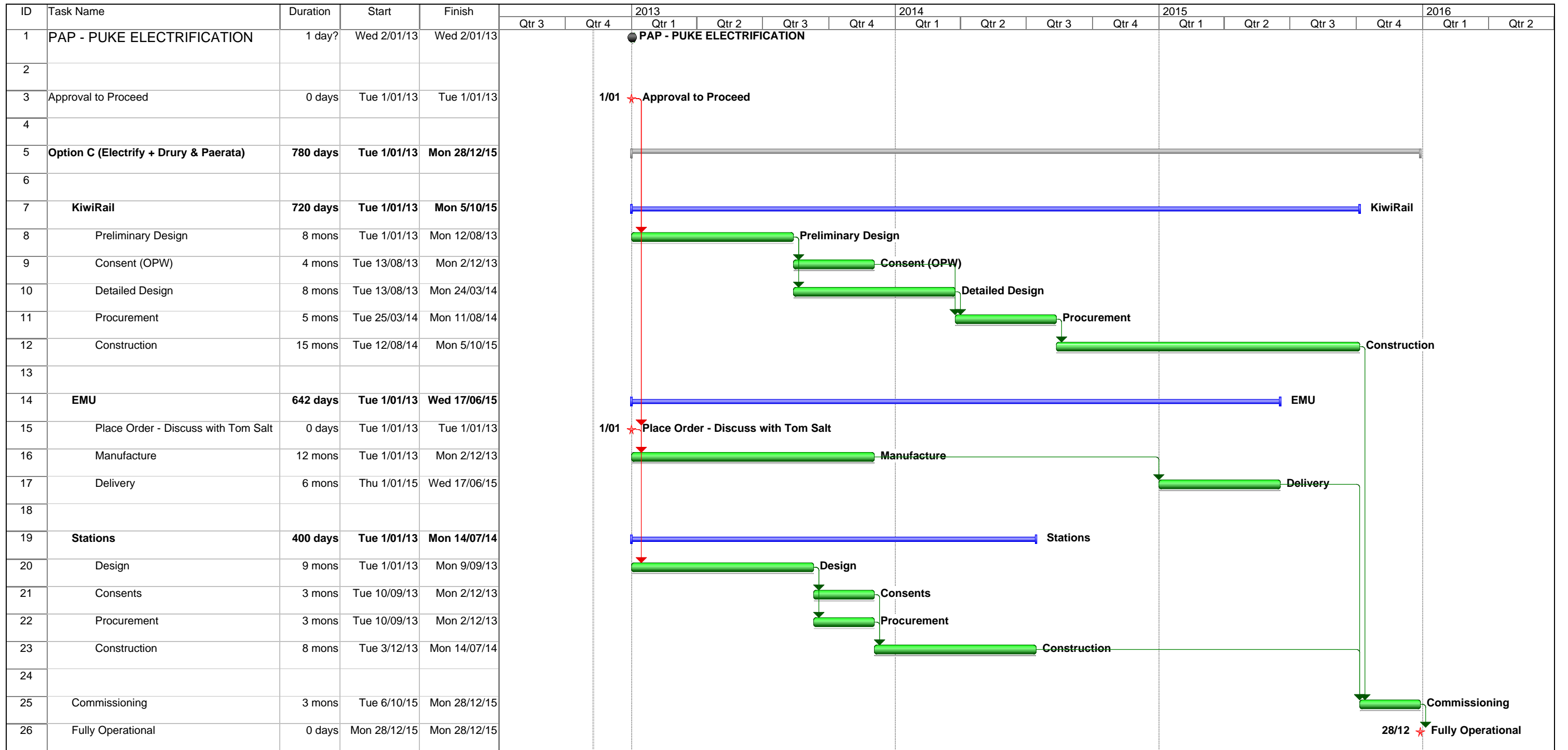
Operational Expenditure (\$mpa)

	Option			
	Base	A	B	C
DMU	\$4.69			
EMU		\$2.86	\$2.86	\$2.86
OLE		\$0.66	\$0.66	\$0.66
Station Drury		\$0.00	\$0.10	\$0.10
Station Paerata		\$0.00	\$0.00	\$0.10
Station Pukekohe	\$0.25	\$0.25	\$0.25	\$0.25
Other				
Total opex p.a.	\$4.94	\$3.77	\$3.87	\$3.97

Option C Staged Capital Expenditure (\$m)

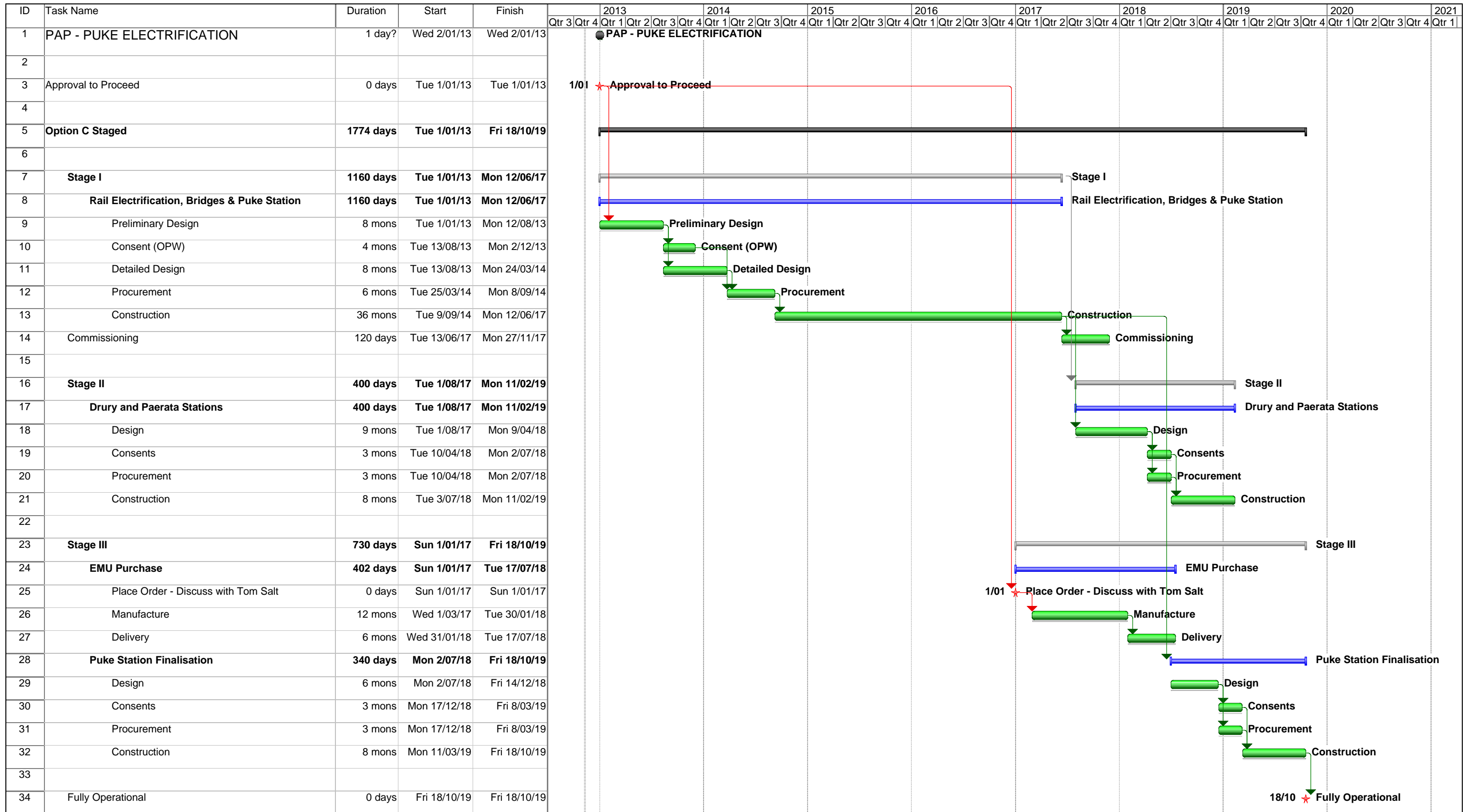
Project Component	Stage I				Stage II	Stage III	Total
	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	
Rail Electrification	\$3.00	\$3.00	\$30.50	\$30.00			\$66.50
Bridges		\$2.00	\$6.75	\$5.00			\$13.75
Pukekohe – Stage I		\$1.00	\$2.00				\$3.00
Drury				\$0.50	\$4.50		\$5.00
Paerata					\$3.00		\$3.00
Pukekohe – Stage II						\$7.00	\$7.00
EMU Purchase						\$15.00	\$15.00
Total	\$3.00	\$6.00	\$39.25	\$35.50	\$7.50	\$22.00	\$113.25

Draft Project Plan



Project: Pap-Puke Preferred Option Irr
Date: Thu 8/11/12

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			



Papakura to Pukekohe Bridges

ON SLOW ROAD OVER RAIL BRIDGE

Travelling South



Travelling North



SETTLEMENT ROAD OVER RAIL BRIDGE

Travelling South



Travelling North



WAIHOEHOE ROAD OVER RAIL BRIDGE

Travelling South



Travelling North



SOUTHERN MOTORWAY OVER RAIL BRIDGES

*Bridge 1 (Southbound Motorway)
Travelling South*



Travelling North



*Bridge 2 (Northbound Motorway)
Travelling South*



Travelling North



*Bridge 3 (Northbound Off Ramp)
Travelling South*



Travelling North



GREAT SOUTH ROAD OVER RAIL BRIDGE

Travelling South



Travelling North



STADIUM DRIVE OVER RAIL BRIDGE No. 2

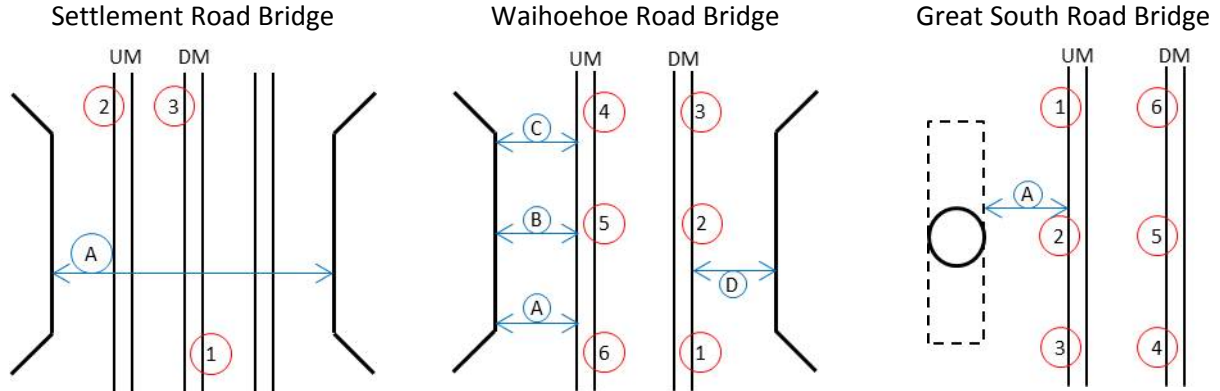
Travelling South



Travelling North

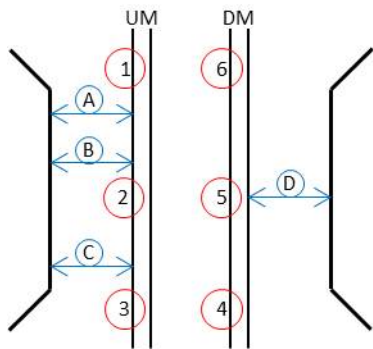


BRIDGE CLEARANCES

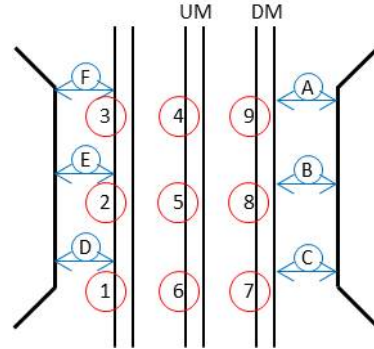


Settlement Road		Waihoehoe Road		Great South Road	
1	5.13 m	1	5.22 m	1	4.75 m
2	5.03 m	2	5.29 m	2	4.88 m
3	5.01 m	3	5.10 m	3	4.78 m
A	14.86 m	4	5.06 m	4	5.20 m
		5	5.21 m	5	5.25 m
		6	5.20 m	6	5.12 m
		A	1.89 m	A	3.32 m
		B	1.92 m		
		C	1.91 m		
		D	> 7.00m		

Stadium Drive No. 1 Bridge

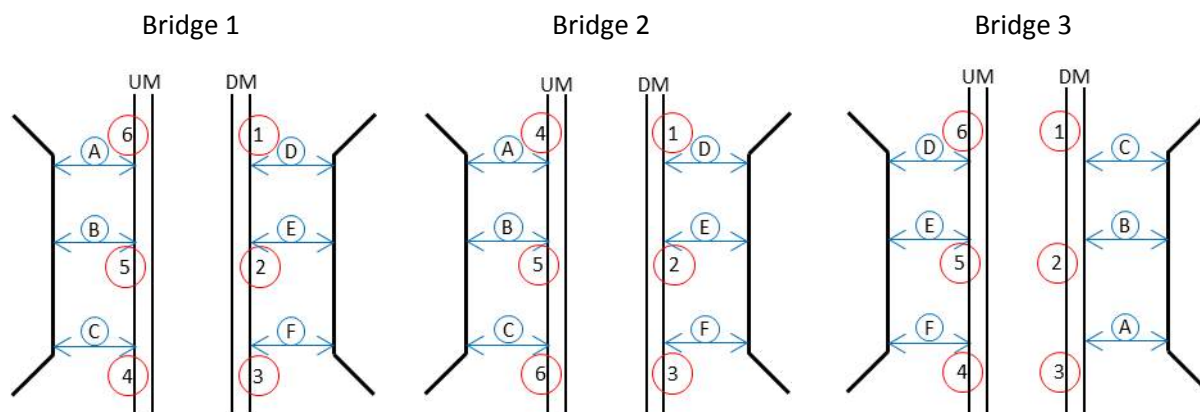


Stadium Drive No. 2 Bridge



Stadium Drive No.1				Stadium Drive No. 2					
1	6.56 m	6	6.63 m	1	4.91 m	6	4.85 m	B	1.77 m
2	6.45 m			2	4.73 m	7	4.66 m	C	1.75 m
3	6.13 m	A	2.39 m	3	4.74 m	8	4.51 m	D	3.72 m
4	6.22 m	B	2.33 m	4	4.74 m	9	4.54 m	E	3.71 m
5	6.52 m	C	2.35 m	5	4.69 m	A	1.74 m	F	3.69 m

SOUTHERN MOTORWAY BRIDGE CLEARANCES

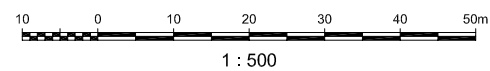
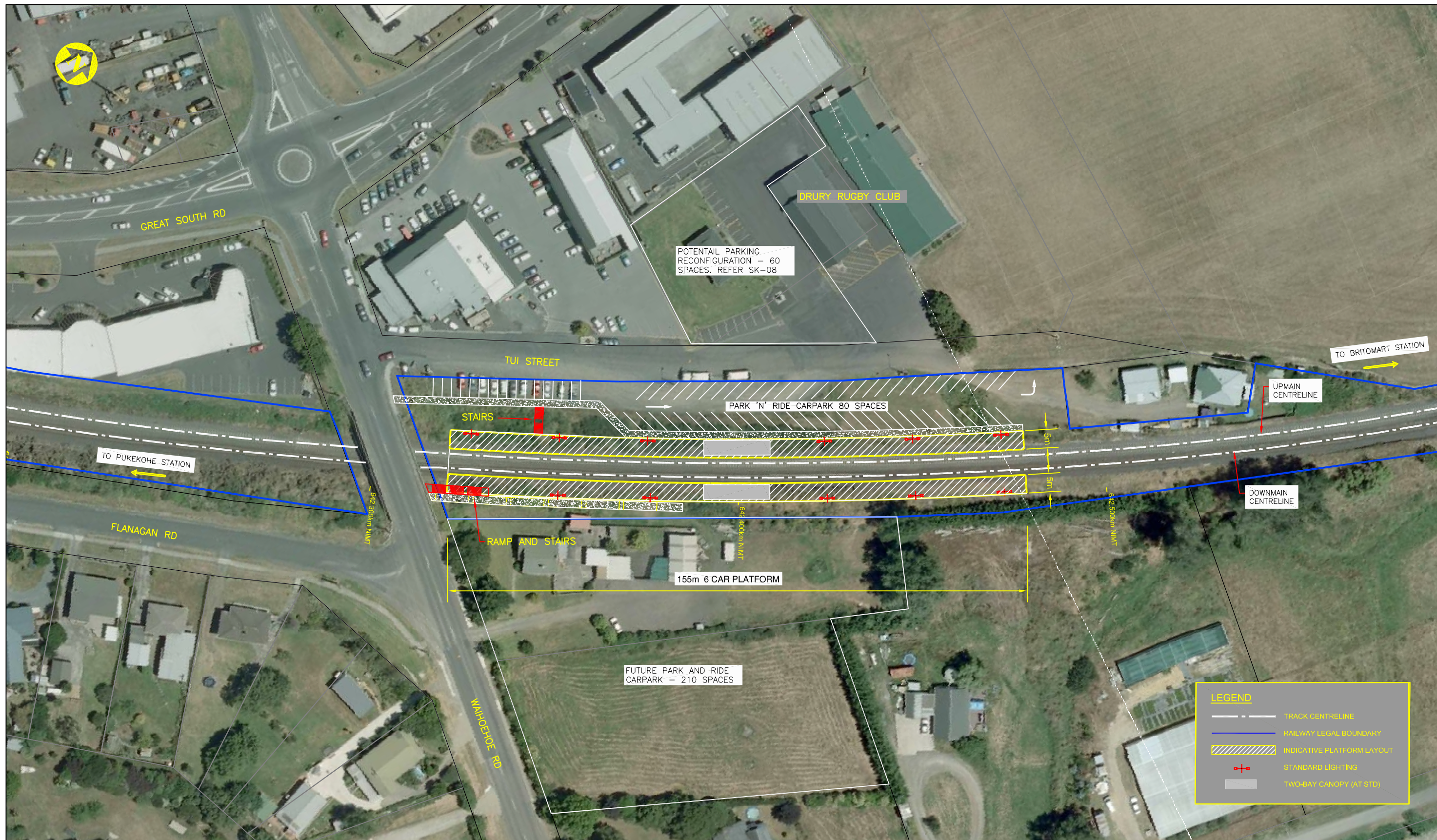


Bridge 1		Bridge 2		Bridge 3	
1	5.33 m	1	4.67 m	1	5.10 m
2	5.50 m	2	4.65 m	2	5.18 m
3	5.68 m	3	4.57 m	3	5.23 m
4	5.46 m	4	4.48 m	4	5.08 m
5	5.25 m	5	4.48 m	5	5.13 m
6	5.09 m	6	4.45 m	6	5.16 m
A	2.35 m	A	1.98 m	A	2.34 m
B	2.33 m	B	1.87 m	B	2.33 m
C	2.36 m	C	1.87 m	C	2.32 m
D	2.45 m	D	1.71 m	D	2.27 m
E	2.32 m	E	1.77 m	E	2.29 m
F	2.19 m	F	1.76 m	F	2.35 m

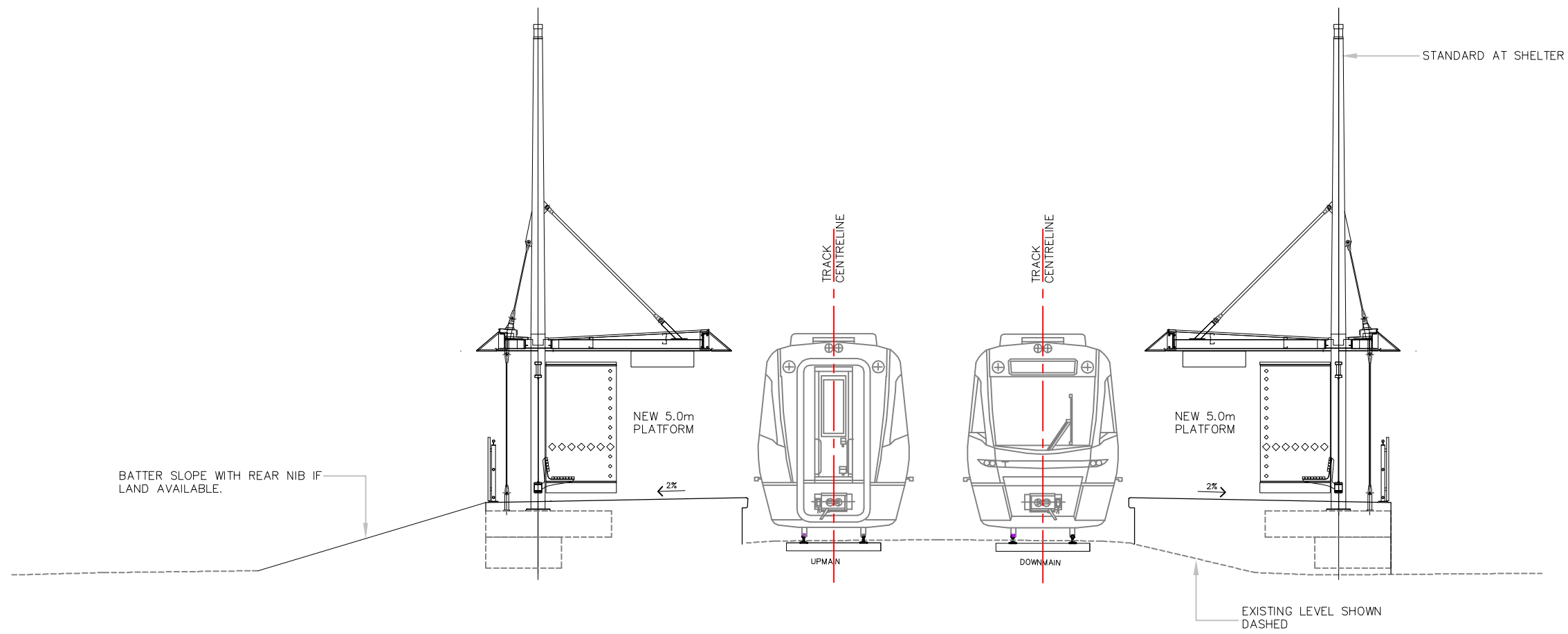
Pukekohe Station Survey Results

Average Journey Length from Pukekohe Station						
				Distance From Pukekohe	No. of Pax Departing Train	Total Kms
Pukekohe	628.86					
Papakura	647.04			18.20	19	345.46
Takanini	650.65			21.80	2	43.59
Te Mahia	652.24			23.40	1	23.38
Manurewa	653.24			24.40	4	97.50
Homai	655.75			26.90	2	53.77
Puhinui	658.94			30.10	2	60.15
Manukau		2.48		32.60	3	97.67
Papatoetoe	660.39			31.50	7	220.70
Middlemore	662.22			33.40	35	1167.60
Otahuhu	664.12			35.30	6	211.54
Westfield	665.32			36.50	3	109.38
Sylvia Park	668.31			39.50	3	118.36
Panmure	670.44			41.60		
Glen Innes	672.64			43.80	7	306.43
Meadowbank	676.19			47.30		
Orakei	677.47			48.60	1	48.61
Penrose		2.59		39.10	9	351.47
Te Papapa			1.99	41.00		
Onehunga			3.56	42.60		
Ellerslie		4.08		40.50	7	283.76
Greenlane		5.48		41.90	1	41.94
Remuera		6.92		43.40		
Newmarket		8.46		44.90	36	1617.19
Britomart		4.09		49.00	136	6665.22
Grafton		9.53		46.0		
Mt Eden		10.60		47.1	1	47.06
Kingsland		12.01		48.5		
Morningside		12.88		49.3		
Baldwin Avenue		14.25		50.7		
Mt Albert		15.30		51.8		
Avondale		17.37		53.8		
New Lynn		19.60		56.1		
Fruitvale Road		21.02		57.5		
Glen Eden		22.37		58.8		
Sunnyvale		24.90		61.4		
Henderson		26.54		63.0		
Sturges Road		28.96		65.4		
Ranui		30.81		67.3		
Swanson		32.15		68.6		
Waitakere		36.08		72.5		
Total Passengers and Kilometers Travelled					285	11910.78
Average Journey Length (km)						41.79

Drury and Paerata Station Information



DATE: 22 DEC 2011



A SECTION
 SCALE: 1:50
 1:100

NOTES:
 TYPICAL SECTION ONLY, PLATFORM BACK EDGE
 WILL BE DIFFERENT FOR EACH LOCATION OPTION
 PENDING EXISTING GROUND LEVELS.

DATE: 22 Dec 2011

SOUTHERN STATIONS: Drury Station - Tui Street

Summary of Estimate

Status: Feasibility

Project: Southern Stations Feasibility
Job no: 42125473.00800
Date: 22/12/2011

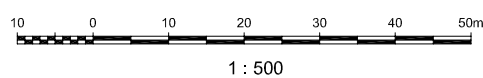
By: Indra Gyawali
Chk: Blair Rogers
Rev: 1

Item	Item Description	Amount
1	Preliminary and General	\$380,000.00
2	Platform Construction	\$820,000.00
3	Stormwater	\$60,000.00
4	Structures	\$890,000.00
5	Electrical Services	\$300,000.00
6	CCTV / PA, SAFETY and AIFS	\$120,000.00
7	Park 'N' Ride (Existing Carpark Improvement 80 Spaces)	\$520,000.00
8	Unforeseen Ground Condition & Service Relocations	\$150,000.00
9	Trackwork, Signals and Turnouts	\$0.00
	SUB-TOTAL OF CONSTRUCTION	\$3,240,000.00
10	Protection	\$40,000.00
11	Design/Consenting/AT Costs (15%)	\$490,000.00
12	Additional Park 'N' Ride spaces (Council Land)	\$350,000.00
13	Land Purchase	\$0.00
	Base Estimate	\$4,120,000.00
	Expected Estimate	\$4,740,000.00
	Funding Estimate	\$5,150,000.00



LEGEND

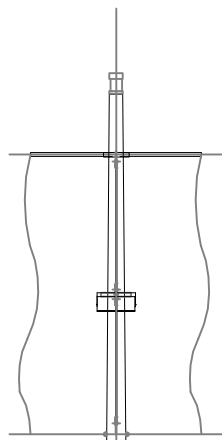
- TRACK CENTRELINE
- RAILWAY LEGAL BOUNDARY
- ▨ INDICATIVE PLATFORM LAYOUT
- ⊕ STANDARD LIGHTING
- ⋯ BUS TYPE SHELTERS



DATE: 12 Dec 2011

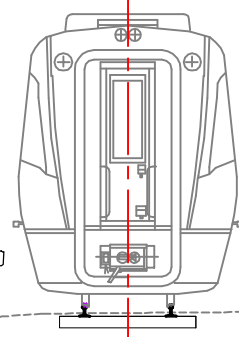
PAERATA ROAD

RAIL CORRIDOR BOUNDARY LINE



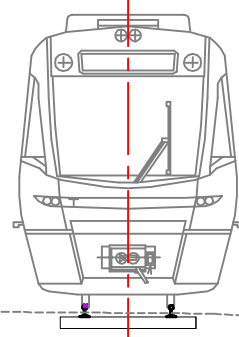
NEW 5.0m PLATFORM

2%



TRACK CENTRELINE

UPMAIN

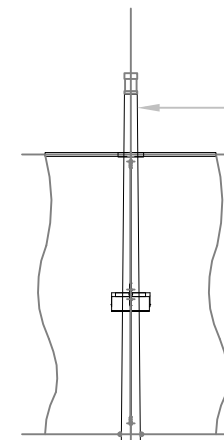


TRACK CENTRELINE

DOWNMAIN

NEW 5.0m PLATFORM

2%



STANDARD AT LIGHT MAST

NEW 3.0m ACCESS

CARPARKING

RAIL CORRIDOR BOUNDARY LINE

CROWN ROAD

POTENTIAL FOR NIB AND BATTER SLOPE WHERE BOUNDARY IS FURTHER FROM PLATFORM FACE.

EXISTING LEVEL SHOWN DASHED

A SECTION
01 SCALE: 1:50
1:100

NOTES:
EXISTING LEVELS SHOWN INDICATIVE FOR TYPICAL SECTION. NO SURVEY INVESTIGATION HAS BEEN UNDERTAKEN.

DATE: 12 Dec 2011

SOUTHERN STATIONS - Paerata Station

Summary of Estimate

Status: Feasibility

Project: Paerata Road Station
Job no: 42125473.00800
Date: 12/12/2011

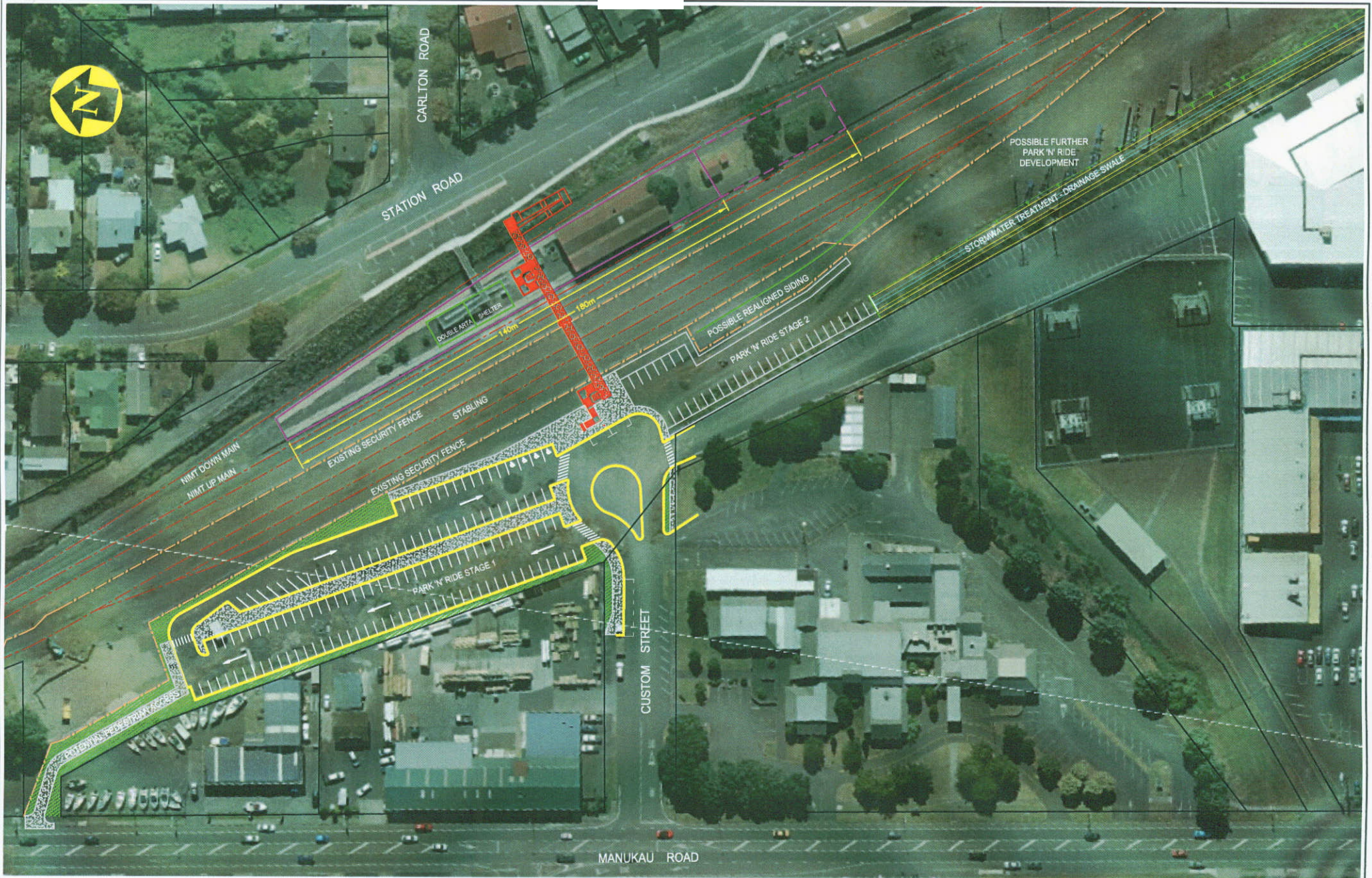
By: Indra Gyawali
Chk: Blair Rogers
Rev: 2

Item	Item Description	Amount
1	Preliminary and General	\$190,000.00
2	Platform Construction	\$760,000.00
3	Stormwater	\$30,000.00
4	Structures	\$420,000.00
5	Electrical Services	\$240,000.00
6	CCTV / PA, SAFETY and AIFS (Platform Only)	\$110,000.00
7	Park 'N' Ride (66 Parking Spaces)	\$260,000.00
8	Unforeseen Ground Condition & Service Relocations	\$70,000.00
9	Station Landscaping	\$30,000.00
10	Maze / Level Crossing	\$100,000.00
	SUB-TOTAL OF CONSTRUCTION	\$2,210,000.00
11	Protection	\$40,000.00
12	Design/Consenting/AT Costs (15%)	\$330,000.00
13	Land Purchase	\$0.00
	Base Estimate	\$2,580,000.00
	Expected Estimate	\$2,970,000.00
	Funding Estimate	\$3,230,000.00

Pukekohe Station Upgrade Information

URS accepts no liability for the use of this drawing where it has been provided in electronic format, nor for any changes made to it following its issue. URS considers the printed version to be binding. A hard copy of this drawing is held on file by URS and may be provided if requested.

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Rev	Revision Description	Designed	Drawn	Checked	Approved	Date	Original Size
A	DRAFT ISSUE FOR ARTA REVIEW	PH	PH	PE		30/03/09	A1

Tab OVERALL
Scales
1:500 (A1)
1:1000 (A3)
Original Size A1

URS
URS New Zealand Limited
Level 6, URS Centre
13-15 College Hill, Auckland
Phone: 9-355 1300
Fax: 9-355 1333



ARTA STATIONS - CONTRACT No.PS0801 - PUKEKOHE STATION

OVERALL LAYOUT WITH LIFT OPTION

Status	DRAFT
Drawing Number	C1301
Revision	A

KiwiRail Inputs

Signalling Costs

	Otahuhu depot signalling costs	Cost ea	Unit	Total Req	Total
1	Signal heads	\$10,000	ea. head installed	59	\$590,000
2	Gantries	\$80,000	ea. TTC installed	0	\$0
3	Masts	\$20,000	ea. folding signal mast	40	\$800,000
4	Balise pairs	\$20,000	pair installed	40	\$800,000
5	Point Machines	\$40,000	ea. installed with ground gear	19	\$760,000
6	Train Detection	\$20,000	ea. axle counter section	69	\$1,380,000
7	New Junction Locations	\$80,000	ea. Location installed	4	\$320,000
8	New Intermediate Locations	\$45,000	ea. Location installed	11	\$495,000
9	New Huts	\$120,000	ea. Hut installed	2	\$240,000
10	Power/Communications backbone#	\$44	per m installed	20750	\$913,000
11	Power/Communications terminations	\$1,400	per termination	18	\$25,200
12	Power feed loactions	\$50,000	per feed installed	3	\$150,000
13	Interlocking/Object Controller	\$40,000	per installation	13	\$520,000
14	Ducts and pits	\$150	per m (incl pits) installed	20750	\$3,112,500
15	UTX	\$12,500	per UTX with 2 pits	23	\$287,500
16	Train Control	\$250	per hour	2500	\$625,000
17	Level Crossings	\$150,000	per crossing	4	\$600,000
18	Standby Generator	\$80,000	per installed plant	1	\$80,000
19	Papakura modifications	\$220,000	Installation and data	1	\$220,000
20	Safeworking	\$100	per hour for weekend work	2305	\$230,500
21	Design (incl stageworks)	\$250	per hour	4000	\$1,000,000
22	Testing and Commissioning	\$250	per hour	3000	\$750,000
23	P&G	\$100,000	per month	12	\$1,200,000
24	Contingency	20	%		\$3,019,740
	Subtotal				\$18,118,440
	Notes:				
	Assumed a 18 month				

	delivery timeframe				
	Assumed new duct route will be installed through entire route				
	Scope				
	SIMBIDs	Paerata to Papakura block			
		Pukekohe to Paerata block			
	Level Crossings	Opaheke Road			
		Sutton Road			
		Crown Road			
		Tuhumata Ped			
	Re-signal Paerata	7 point machines			
		12 mainline signals			
		14 track sections 19 heads			
		20 signal heads			
		12 masts			
		12 LS or R light units			
	Re-signal Pukekohe	12 point machines			
		7 mainline signals			
		8 shunts			
		10 track sections 19 heads			
		11 mainline signal heads			
		7 masts			
		7 LS or R light units			
	North block	17 intermediates			
		20 signal heads			
		39 track sections (same number of heads)			
		6 DC tracks			
	South block	4 intermediates			
		8 signal heads			
		6 track sections (same number of heads)			
	Papakura	2 new mainline signals			
		3 new route indicators			

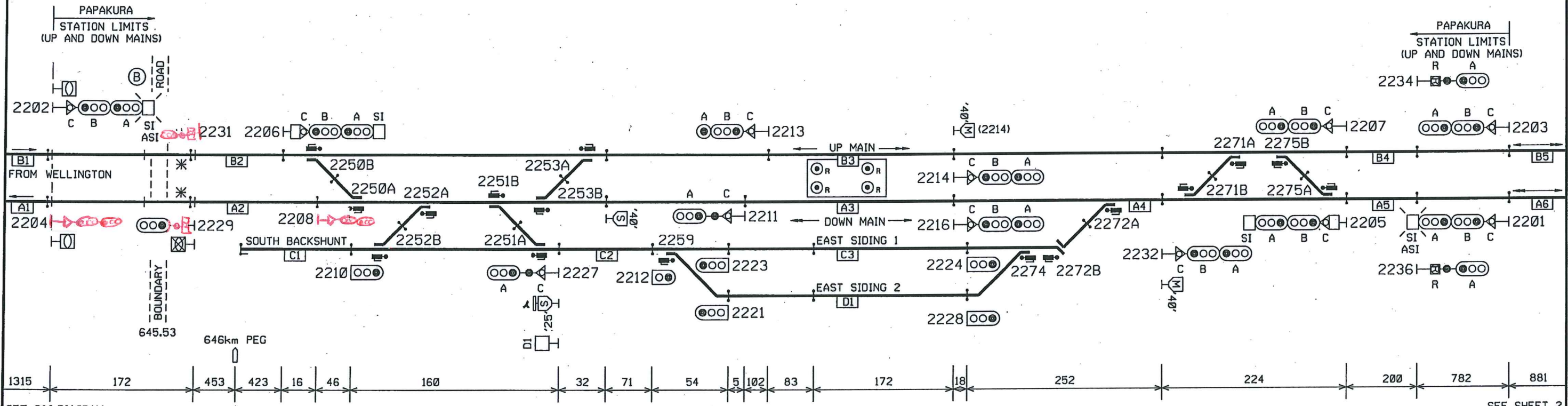
Signalling Diagrams

SIGNALLING & INTERLOCKING ARRANGEMENTS

THESE ARRANGEMENTS WILL BE BROUGHT INTO USE AT A TIME AND DATE TO BE ADVISED BY SEMI-PERMANENT BULLETIN.
THIS CANCELS S&I No. 3013

THESE TO BE COMPLETED BY THE RECIPIENT OF THE S & I DIAGRAM

UP
PAPAKURA (PAP)



SEE S&I DIAGRAM FOR PAERATA

SEE SHEET 2

SIGNAL	ROUTE INDICATOR	DESCRIPTION
2205	U	UP MAIN (P1)
	D	DOWN MAIN (A4)
	S1	EAST SIDING 1
	S2	EAST SIDING 2
2206	U	UP MAIN (P1)
	D	DOWN MAIN (A3)
	S	EAST SIDING (C2)

▲ ADDITIONAL BOARD WITH WORDING 'THROUGH TURNOUT'

D1 'DEPOT LIMITS' SIGN

↓ AXLE COUNTER

* TRACK CIRCUIT FOR HRV ON AND OFF TRACKING

☐ NOTICE BOARD: ENTRY TO ETCS

☒ NOTICE BOARD: EXIT FROM ETCS

SI SPEED INDICATOR
ASI ADVANCED SPEED INDICATOR

DESCRIPTION OF LEVERS

2201ABC	DOWN OUTER HOME FROM A6	NORMAL SPEED TO A5 # CAUTION NORMAL SPEED (40 km/h) TO 2205 LOW SPEED TO A5	2214ABC	UP DIRECTING FROM B3	NORMAL SPEED TO B4 MEDIUM SPEED TO A5 LOW SPEED TO B4 OR A5
2202ABC	UP OUTER HOME FROM B1	NORMAL SPEED TO B2 # CAUTION NORMAL SPEED (40 km/h) TO 2206 LOW SPEED TO B2	2216ABC	UP DIRECTING FROM A3	NORMAL SPEED TO A4 LOW SPEED TO A4
2203ABC	DOWN OUTER HOME FROM B5	NORMAL SPEED TO B4 LOW SPEED TO B4	2221	DOWN SHUNT FROM D1	LOW SPEED TO C2
2204	UP SHUNT FROM A1	LOW SPEED TO A2	2223	DOWN SHUNT FROM C3	LOW SPEED TO C2
2205ABC	DOWN HOME FROM A5	NORMAL SPEED TO A3 # CAUTION MEDIUM SPEED (40 km/h OR 20 km/h) TO 2213 LOW SPEED TO A4, B3, C3 OR D1	2224	UP SHUNT FROM C3	LOW SPEED TO A4
2206ABC	UP HOME FROM B2	NORMAL SPEED TO B3 # CAUTION NORMAL SPEED (20 km/h) TO 2214 MEDIUM SPEED (40 km/h) TO A3 LOW SPEED TO A3, B3 OR C2	2227AC	DOWN DIRECTING FROM C2	NORMAL SPEED TO A2 LOW SPEED TO C1, A2 OR B2
2207ABC	DOWN HOME FROM B4	NORMAL SPEED TO B3 MEDIUM SPEED TO A4 LOW SPEED TO D1, C3, A4 OR B3	2228	UP SHUNT FROM D1	LOW SPEED TO A4
2208	UP SHUNT FROM A2	LOW SPEED TO A3, B3 OR C2	2229	DOWN STARTING FROM A2	NORMAL SPEED TO A1
2210	UP SHUNT FROM C1	LOW SPEED TO A3, B3 OR C2	2231	DOWN SHUNT FROM B2	FIXED RED
2211AC	DOWN DIRECTING FROM A3	NORMAL SPEED TO A2 LOW SPEED TO C1, A2 OR B2	2232ABC	UP DIRECTING FROM A4	NORMAL SPEED TO A5 MEDIUM SPEED TO B4 LOW SPEED TO B4 OR A5
2212	UP SHUNT FROM C2	LOW SPEED TO C3 OR D1	2234AR	UP DEPARTURE FROM B5	NORMAL SPEED TO B5 RESTRICTED SPEED TO B5
2213ABC	DOWN DIRECTING FROM B3	MEDIUM SPEED TO A2 LOW SPEED TO C1, A2 OR B2	2236AR	UP DEPARTURE FROM A5	NORMAL SPEED TO A6 RESTRICTED SPEED TO A6

AS DISPLAYED ON SPEED INDICATOR

I. D. COTTON
RAIL OPERATING STANDARDS AND PROJECTS MANAGER

WELLINGTON
07/01/09

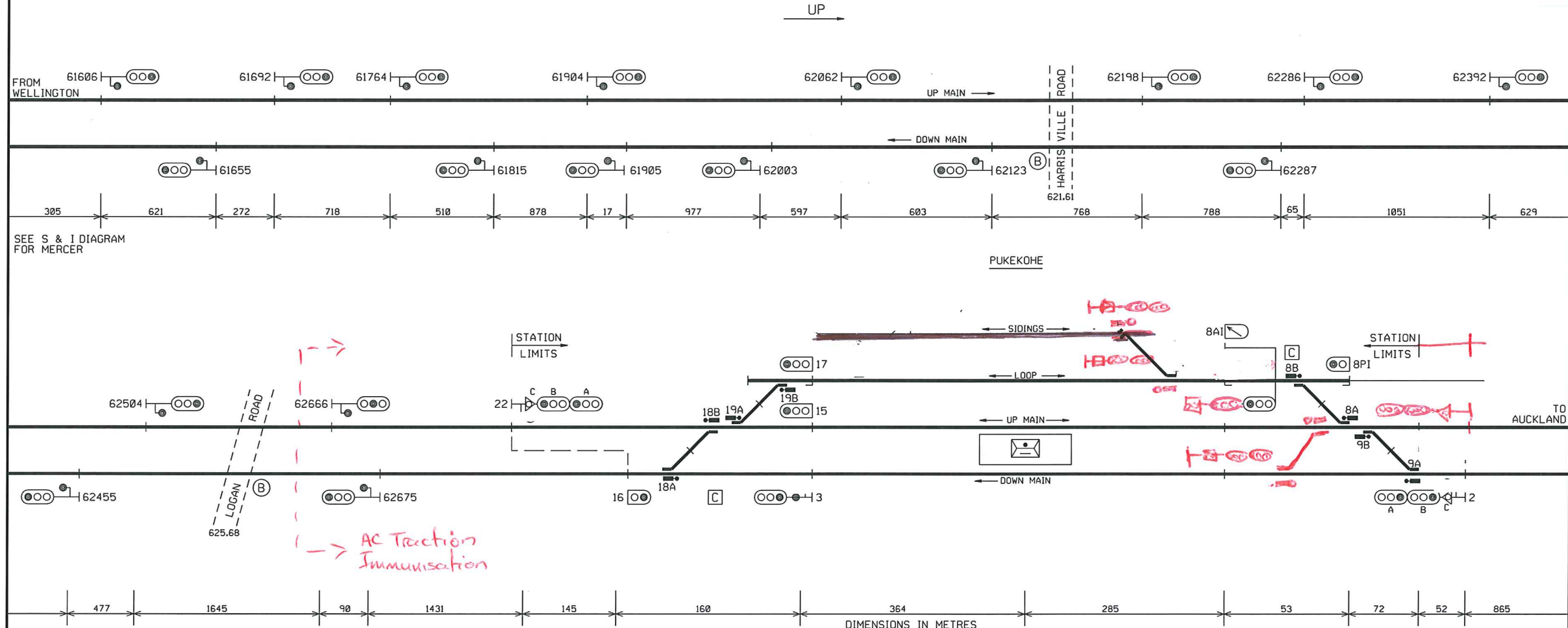


S & I DIAGRAM No.2912
SHEET No.1 OF 1
DATE IN SERVICE
BULLETIN No.

PUKEKOHE

SIGNALLING & INTERLOCKING ARRANGEMENTS

THESE ARRANGEMENTS WILL BE BROUGHT INTO USE AT A TIME AND DATE TO BE ADVISED BY SEMI-PERMANENT BULLETIN.
THIS CANCELS S&I No.2428
THESE TO BE COMPLETED BY THE RECIPIENT OF THE S & I DIAGRAM



SEE S & I DIAGRAM FOR MERCER

SEE S & I DIAGRAM FOR PAERATA

PUKEKOHE: DESCRIPTION OF SIGNALS

2ABC	DOWN HOME	NORMAL SPEED TO DOWN MAIN MEDIUM SPEED TO UP MAIN LOW SPEED TO LOOP
3	DOWN STARTING FROM DOWN MAIN	
6	SHUNT FROM UP MAIN	LOW SPEED TO UP MAIN, LOOP OR SIDINGS
7	SHUNT AND UP STARTING FROM LOOP	LOW SPEED TO UP MAIN
15	SHUNT AND DOWN STARTING FROM UP MAIN	LOW SPEED TO DOWN MAIN
16	SHUNT FROM DOWN MAIN	LOW SPEED TO DOWN MAIN OCCUPIED, UP MAIN, LOOP OR SIDINGS
17	SHUNT AND DOWN STARTING FROM LOOP	LOW SPEED TO DOWN MAIN
21	UP STARTING FROM UP MAIN	
22ABC	UP HOME	NORMAL SPEED TO UP MAIN LOW SPEED TO LOOP

— CONTROLLED NETWORK
 - OPERATOR CONTROLLED TERRITORY

I. D. COTTON
RAIL OPERATING STANDARDS AND PROJECTS MANAGER



Signals Engineering

PUKEKOHE

ORIGINAL OF S & I DIAGRAM No.2912

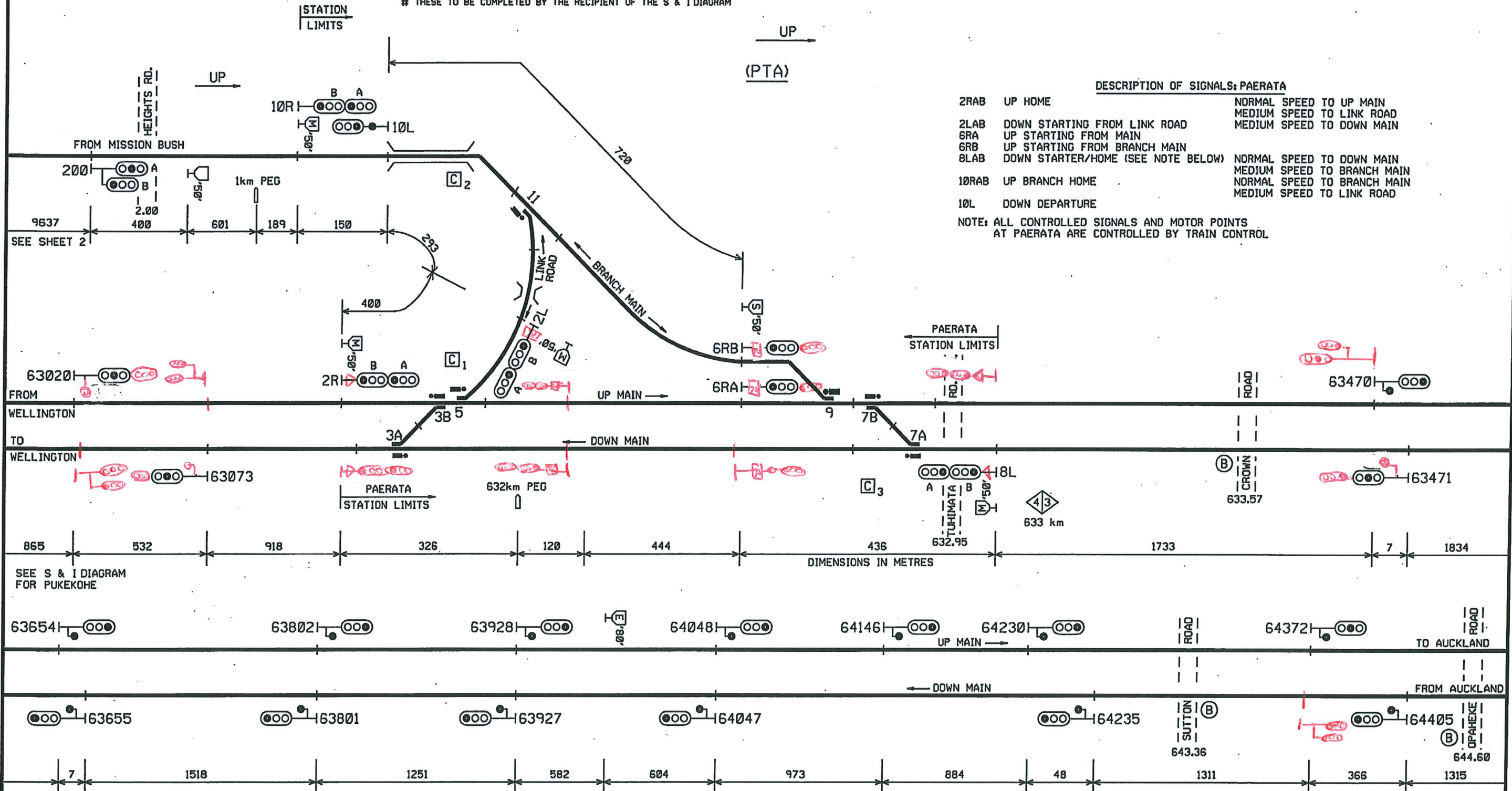
DRAWN	100/	DATE	27.07.04	APPROVED
DESIGNED	100/	FILE		
CHECKED	CIB	SUPERCEDES		
PASSED				
DRAWER	A2	S.24044	SHEET 2	CONTD ON SHEET

PAERATA

SIGNALLING & INTERLOCKING ARRANGEMENTS

THESE ARRANGEMENTS WILL BE BROUGHT INTO USE AT A TIME AND DATE TO BE ADVISED BY SEMI-PERMANENT BULLETIN.
THIS CANCELS S&I No. 2882

THESE TO BE COMPLETED BY THE RECIPIENT OF THE S & I DIAGRAM



DESCRIPTION OF SIGNALS: PAERATA

2RAB	UP HOME	NORMAL SPEED TO UP MAIN MEDIUM SPEED TO LINK ROAD
2LAB	DOWN STARTING FROM LINK ROAD	MEDIUM SPEED TO DOWN MAIN
6RA	UP STARTING FROM MAIN	
6RB	UP STARTING FROM BRANCH MAIN	
8LAB	DOWN STARTER/HOME (SEE NOTE BELOW)	NORMAL SPEED TO DOWN MAIN MEDIUM SPEED TO BRANCH MAIN
10RAB	UP BRANCH HOME	NORMAL SPEED TO BRANCH MAIN MEDIUM SPEED TO LINK ROAD
10L	DOWN DEPARTURE	

NOTE: ALL CONTROLLED SIGNALS AND MOTOR POINTS AT PAERATA ARE CONTROLLED BY TRAIN CONTROL

C₁ CRANK HANDLE (CODED)
SE STATION ENTRY BOARD

△ RADIO CHANNEL CHANGE BOARD (CHANNEL NUMBER SHOWN INSIDE EACH TRIANGLE)

NOTE: WHEN AT STOP 8LAB SIGNAL MUST BE PASSED UNDER STARTING SIGNAL RULES FOR MOVEMENT TO DOWN MAIN

SEE S & I DIAGRAM FOR PAKAPURA