INTERMODAL FREIGHT HUB MASTER PLAN - PALMERSTON NORTH REPORT

PREPARED FOR KIWIRAIL

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Stantec

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Glossary & Abbreviations

Arrival/Departure yard:	The tracks used by arriving and departing trains, allowing incoming trains to be held off the mainline until classification takes place. Locomotives are removed/added here.
Ballast	The aggregate 'stones' beneath the rail tracks that form the track bed and supports the track. It also helps with drainage.
Back shunts	Section of track outside the terminal to enable the shunting of trains
Classification	Where wagons are sorted by destination into blocks that can then be combined in the departure yard to form new trains.
CT Yard	Container Terminal yard where containers are transferred from rail to truck and vice versa and includes container storage, rail tracks and truck parking.
Coupler	Mechanism for connecting rolling stock in a train
HACCP	Hazard Analysis and Critical Control Point - a widely used science-based control system for assuring food safety. Food safety is achieved by systematically assessing hazards, developing control systems and focusing on preventative measures. It can be applied throughout the food chain from producer to consumer.
HPT	Horsepower per tonne – pulling power of a locomotive
Intermodal hub	Locomotive, cargo handling equipment, and truck activity
Maintenance Facilities	Where locomotives, wagons and work equipment are maintained and repaired
Marshalling yard	A train yard where trains are marshalled, generally by shunting as part of breaking down or compiling a train as well as the stabling, light maintenance, inspection, and queuing of trains.
Network Services	The team responsible for the track, structures, signals, power, and other railway infrastructure
PSR	Precision Scheduled Railroading - A railway operations and management philosophy adopted by the main freight railroad companies in North America
TEU	Twenty-foot equivalent units – term used for containers that are usually 40 feet long though originally twenty -foot long boxes were used
Top lifter	Specially designed forklifts that grab containers from the top
Unit train	Train in which all cars carry the same commodity and are shipped from the same origin to the same destination, without being split up or stored en-route.
Zero Harm	An approach to occupational safety with the goal to operate a workplace without exposing an individual to injury through the implementation of safe work systems.

Kiwi Rail

Intermodal Freight Hub Master Plan - Palmerston North Report

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1. Introduction

KiwiRail's regional freight hubs are key to supporting an efficient transport network and the sustainable growth of rail throughout New Zealand. As population and freight volumes in New Zealand grow, and our need to reduce carbon emissions intensify, rail presents a sustainable alternative freight option.

New Zealand's freight task is expected to increase by over 58% by 2042. KiwiRail's freight handling business currently carries about 17% of New Zealand's freight task. With pressure to reduce carbon emissions and to use rail as a sustainable alternative to increasing road freight volumes, KiwiRail needs to be ready to meet the increasing freight demand and ensure rail is an integral part of New Zealand's freight flows.

Rail terminals and yards are a crucial part of the railway network. KiwiRail is seeking to improve the quality, location and layout of its freight terminals and yards, creating a more efficient and dependable network for the future. Larger freight facilities at key locations on the network developed using efficient modern designs are required to achieve improved speed, connectivity, capacity, and to reduce double handling.

KiwiRail intends to provide well designed intermodal freight 'hubs' that will make the movement of freight by rail faster and more cost effective. KiwiRail recognises that to enable higher volumes to be carried by rail, investment is needed in the network infrastructure – particularly in facilities that accommodate longer and heavier trains, which will contribute to operating efficiencies of scale. KiwiRail has therefore developed a theoretical master plan for intermodal freight hubs to enable it to plan and meet future growth.

This report outlines the process followed to develop the theoretical master plan for KiwiRail (layout shown in Appendix A) that will guide the development of future intermodal freight hubs. The master plan enables KiwiRail to identify the indicative size for a new hub, plan the location of the different site components and adapt the design to different parts of its national network.

Provincial Growth funding has enabled KiwiRail to develop the master plan and to use it to identify an intermodal hub near Palmerston North. As a result, the master plan process uses the projected freight case for the Central North Island (CNI) as a key design input.

2. Master Plan Design

2.1 What is a master plan?

Master planning is a tool that major infrastructure providers employ to plan for the effective and efficient use of land, including developing new sites or redeveloping existing sites. A master plan is a strategic plan that guides the delivery of individual projects. The process defines and quantifies the key requirements for site development in an integrated way.

A master plan approach has been used to help KiwiRail integrate its technical and operational rail requirements and translate this into spatial requirements, to plan for future freight growth. The master plan defines operational and spatial requirements for future intermodal rail freight hubs.

The master plan product is a high-level concept plan containing the key elements for an intermodal hub which may be used by KiwiRail as a planning tool when it is identifying, redeveloping or developing freight hubs across its network. The master plan can be adapted to match regional freight variations across the country and tailored to meet the particular requirements of a project in a specified location.

2.2 What did the process involve?

The process to develop KiwiRail's intermodal freight hub master plan required an analysis of existing freight volumes and technical railway information, the development of planning criteria, the assessment and testing of alternate operational layout options, and the development of a preferred concept. The process has also included consideration of:

- optimising rail operational layouts.
- achieving rail connectivity to other transport modes; and
- new/alternate operating models, including improved technologies.

Existing and future freight demand in the CNI was used as a real-world example from which to develop the first concept master plan. Applying information about the existing Palmerston North yard rail operations and predicted CNI rail freight growth has enabled the development of a concept master plan which has immediate value. This is outlined in further detail in section 3.

2.3 Technical design influences

The first step in developing a master plan is to consider the future operational requirements. This process included:

- Sourcing and analysis freight information
- Sourcing and developing rail network operational criteria
- Developing and testing various options for the KiwiRail facilities and rail served facilities

Railway standards were also a key influence on the master plan design. These included:

- Speed requirements across the different parts of regional hubs
- Axle loads
- Track structure
- Minimum horizontal radius curves for specific activities such as coupling and uncoupling of rolling stock
- Maximum vertical gradients across the different parts of the hub
- Track spacing minimums
- Turn out design to enable a train guiding from one track line to another

Another key consideration was anticipating the full range of facilities that KiwiRail, and KiwiRail's future freight partners are typically expected to need at regional hubs such as:

- Arrival/Departure and Back Shunt Tracks
- Marshalling Yard
- Wagon Storage Yard
- Container Terminal (CT) for refrigerated and non-refrigerated containers
- Maintenance Facilities – Wagons, Diesel Locomotives, Electric Locomotives, and Network Services Work Equipment
- Network Services Depot and Yard Operations Facility
- Rail connected and non-rail connected Freight Forwarding facilities
- Log handling
- Tanks for bulk storage for liquids and solids
- Inland port capability for import/ export containers

The guiding principles of Precision Scheduled Railroading (PSR) have been used to guide the master plan. These are:

- Safety in every aspect of work
- Providing outstanding service to customers
- Cost control – eliminating unnecessary costs
- Optimised asset utilisation – productive and efficient use of assets (locomotives, wagons, crew, yards/terminals, work equipment, maintenance facilities, etc.)
- People development – cultivating the best teams by providing them facilities that meet their needs

Railway service design factors were also considered including:

- Minimise wagon dwell time in yards and terminals
- Minimise wagon classification
- Create options for getting wagons to destination
- Run general purpose trains
- Minimise power requirements
- Plan for steady/regular workflows

Finally, the master plan incorporated future efficiencies planned for across KiwiRail's wider rail network. This included:

- The use of more efficient and higher horsepower
- Marshalling a new fleet of wagons capable of higher loads – more capacity, with stronger couplers and axles
- Ability for longer trains up to 1500m to operate on the North Island Main Trunk Line
- Optimising locomotive power requirements (HPT)
- Seven-day operations cycle
- Balancing traffic/power in two directions
- New partnership opportunities and integration with freight forwarders

The master plan process used an analysis of the existing and future freight demands in the lower Central North Island to identify future hub requirements. The existing operations at the Palmerston North yard were used as an example of existing freight facilities within the lower Central North Island. This data is provided in the following section.

3. Current Situation in the Central North Island

This section examines the existing rail operations at Palmerston North Yard and analyses predicted CNI freight flows. These inputs then inform the conceptual hub's operational and spatial requirements.

The New Zealand freight task is expected to grow by over 58% by 2042. The Manawatū-Whanganui region and Palmerston North have been identified as being a key freight and distribution location for New Zealand and a vital enabler for economic growth. As a result, KiwiRail has already identified a need to secure and protect land in the Central North Island to enable it to deliver to (and through) the region, sustain its capacity to meet increasing freight demands, and ensure rail remains an integral part of central New Zealand freight flows.

As the first new intermodal regional hub development location to benefit from the masterplan process, both the use of data about existing Palmerston North operations and projected CNI freight flows provide a real-world base for the master plan. The key design, functional and spatial requirements of new hubs have been captured in the master plan concept. In the future, the master plan can be adapted to address different freight flows/operations in other regions on a case by case basis.

3.1 Physical Characteristics of Palmerston North Yard

The existing KiwiRail land in Palmerston North is about 40 hectares in area and includes the existing freight hub yard and rail station. The existing hub contains the following facilities:

- Network Services Depot.
- Marshalling Yard including arrival/departure tracks.
- Container terminal.
- Wagon and Locomotive storage tracks.
- Maintenance facilities for wagon and locomotives.

The Palmerston North yard extends from the passenger terminal accessed from Mathews Avenue to the south west, under SH3 to Milson Line to the north (see **Figure 3-1**). The bulk of KiwiRail's operations occur in the marshalling area where trains arrive, depart and are marshalled.

The Marshalling Yard area is approximately 1,400m in length, and around 70 m wide. It consists of 19 tracks with lengths varying from 320m to 730m, and 810m to 900m in the Arrival/Departure Yard area. Overhead lighting masts are distributed across the Palmerston North yard, but most are in the marshalling area. Access areas are covered with a fine grade granular material like ballast between the rail tracks to allow for vehicle access to any part of the yard. The exception is along the Arrival/Departure tracks, where regular ballast is used. Most of the train traffic is in-bound from the north and most of the switching occurs at the north end of the Marshalling Yard.

Figure 3-1 Palmerston North yard

In the CT Yard the movement of the containers is handled by top- lifters that transfer the containers from rail to truck and from truck to rail. The facility consists of an island container storage pad, approximately 40m wide and 300m long, with a limited amount of storage. There are two tracks servicing the CT Yard that are 300m long which limits the ability to load or unload a full train without additional movements. The CT

Yard is serviced by truck working aisles adjacent to each track and the trucks access the CT Yard via a signalised access at Tremaine Avenue. Twenty-Foot Equivalent Containers (TEUs) are stacked on the island up to three high and there is provision for a small number of refrigerated containers.

The maintenance team at Palmerston North maintain both diesel and electric locomotives, wagons and rail network equipment. The maintenance area is primarily located in the north-eastern part of the yard with the facilities located in separate buildings and work/storage areas. The Palmerston North yard's maintenance function is strategically important. In addition to the locomotives, wagons and rail equipment being maintained and repaired here, they are also cleaned in the yard.

The network services depot is located on the west side of SH3. There is a common maintenance yard which consists of 13 tracks. This includes locomotive fuelling facilities and a turntable. Locomotives, wagons and other equipment are stored and sometimes repaired in various works locations across the yard. A large cell tower is also located in the maintenance area. Individual teams are spread across the yard due to the small size of the main administration facility, which is located with the main parking area and accessed from KiwiRail's entrance off Tremaine Avenue.

Also located at the Palmerston North yard are several leased facilities with rail services to each. A log loading siding is in the yard close to the Milson Line bridge. The siding consists of two loading tracks, approximately 250m in length and log storage. The log loading area is accessed from the main KiwiRail access off Tremaine Avenue. There are also three freight forwarding facilities located close to SH3 that are accessed via the signalised road access from Tremaine Avenue. Each of the facilities has rail access connected to the yard.

3.2 Central North Island Freight Analysis and Future Demand

The Palmerston North yard plays a significant role in the movement of commodities through the country on KiwiRail's freight network. To determine the individual components of the master plan in a real-world sense, forecasted changes in national and regional economic growth out to 2050 have been considered along with emerging trends and future demand. As shown in **Figure 3-2** below the flow of freight in the North Island will grow significantly.

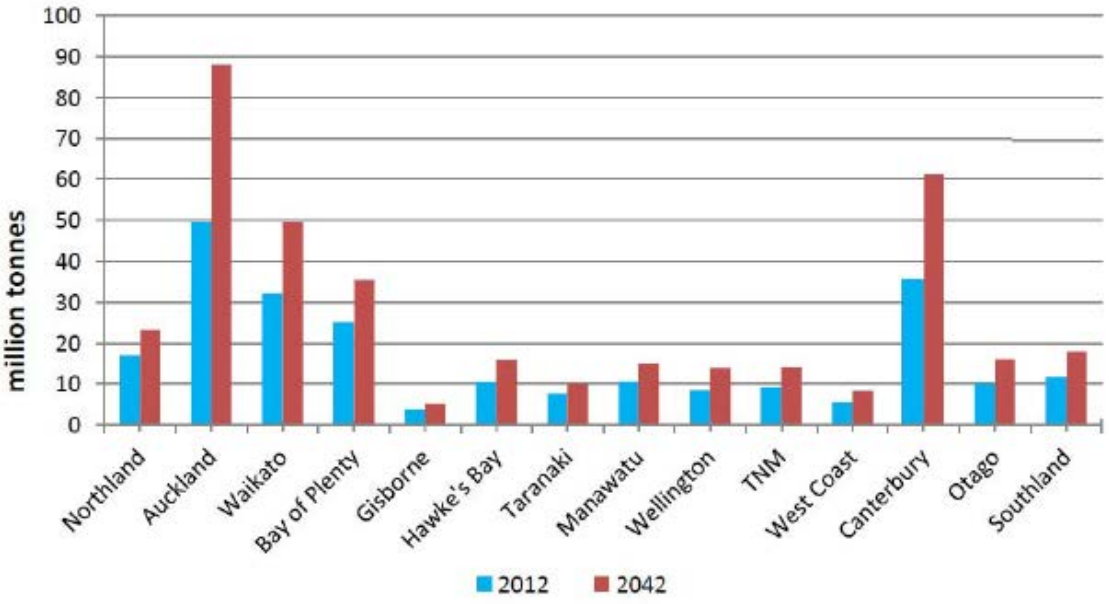


Figure 3-2 Freight flows changes by origin regions from 2012 to 2042

The top commodity growth groups and estimated growth rates were assessed. These include:

- Building materials, fertiliser and other minerals: 111%.
- General freight: 60%.

- Steel and aluminium: 60%
- Logs and timber products: 28%.
- Milk and dairy: 65%.

The sizing of the individual components or building blocks of the hub has relied on the analysis of future demand based on the current freight information and review of train movements to, from and through Palmerston North. A spatial view of the freight movements and train counts to and from the existing Palmerston North terminal (including through traffic) is shown in **Figure 3-3** below.

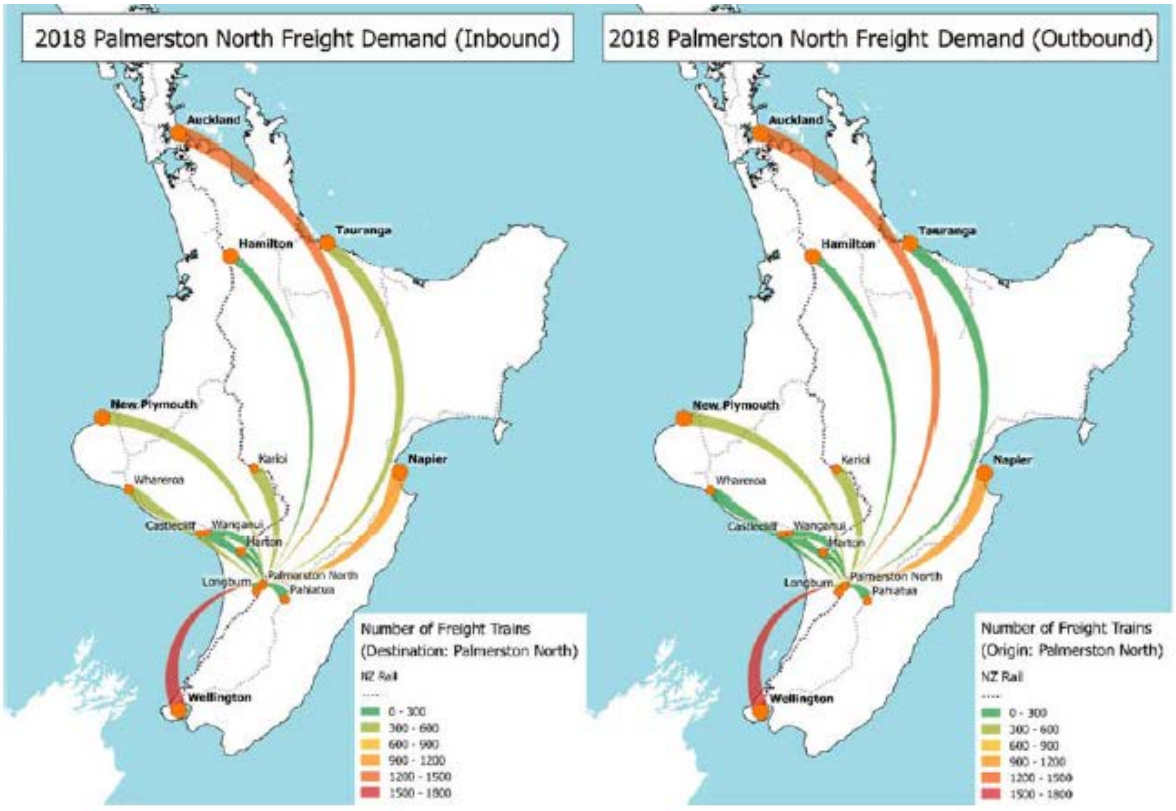


Figure 3-3 Freight movements and train counts to and from the existing Palmerston North terminal

The analysis has considered the type and volume of inbound and outbound commodities that arrive and depart from Palmerston North (through traffic) and the type and volume of commodities travelling to Palmerston North, to be sent by rail to other destinations. It analysed the length of trains and the number of trains and the type of wagons / commodities they carried. The analysis also looked at the frequency of the trains, the peak periods in the year and considered weekly traffic counts.

Group of Waybill OD	Escalation Factor	Ex PNth	Thru' PNth Ex East	Thru' PNth Ex North	Thru' PNth Ex South	Thru' PNth Ex West	To PNth	Total	Total
Commodity Grouping		Net Weight	Net Weight	Net Weight	Net Weight	Net Weight	Net Weight	Net Weight	% Net Weight
Freight Forwarding	1.60	31,478	82,942	496,755	146,874	84,802	344,666	1,187,517	33%
Milk & Dairy	1.65	7,347	168,866	191	203,387	543,398	216	923,406	25%
Logs and Forestry Products	1.28	326,935	937	303,154	0	176,122	0	807,148	22%
Meat, Produce & Groceries	1.66	57,765	27,173	23,033	25,259	142,405	87,616	363,250	10%
Other Products	1.28	6,346	50,560	61,612	206,440	19,875	23,560	368,392	10%
Total			**330,478**	**884,745**	**581,959**	**966,600**		**3,649,712**	
		429,872	**2,763,782**				**456,058**		
		12%	**76%**				**12%**		
Increase over 2018		**35%**	**51%**				**59%**	**50%**	

Figure 3-4 2050 Commodity Weight Estimates at Palmerston North

Current traffic patterns show significant container traffic coming off the branch lines, between Palmerston North and Auckland and between Palmerston North and Tauranga. The main commodity departing Palmerston North to head south to Wellington is logs. It was noted that train lengths to and from Wellington to the South Island are impacted by ferry capacity constraints.

The analysis of future demand outlined in **Figure 3-4** above identified a 50% increase in tonnage/business for the Palmerston North yard by 2050 with more container traffic predicted. In addition, more train traffic for the shorter 900m routes (on the branch lines and south to Wellington) was predicted and longer 1,500m trains (65% increase in length) were identified as being needed to absorb the increased box and container traffic forecasted to be running Northbound and Southbound between Palmerston North and Hamilton/Auckland.

The assessment of current operations and freight flow analysis confirms the need for three key CNI rail hub functions:

- The primary function is the marshalling of trains where individual railway wagons are made up into trains (76% of rail traffic are through trains, with 12% this trains originating from and 12% trains destined for Palmerston North).
- A second and significant function is the wagon storage, equipment maintenance, network services, and yard operations.
- The third and growing function is related to container and commodity storage and commercial opportunities to work with partners in freight forwarding, and additional activities such as log handling.

The predicted changes in freight flows and increased demand has a spatial impact in terms of the extent of land required to develop facilities that will meet the projected demand. In particular, the analysis has shown a need to, provide longer track lengths, plan for higher speeds for marshalling traffic, and work the marshalling yards from both ends of the terminal in order to reduce dwell times.

In addition to the need to minimise dwell times, provision needs to be made for safe and secure working environments that enable 7-day, 24-hour operations and support the ability to adapt to meet domestic and international freight requirements. The next section describes how the freight requirements of the CNI case study have been applied to develop the operational and spatial requirements of the master plan.

4. Key components of the Concept Master Plan

4.1 Inputs

The forecasted commodities types and freight volume projections covered in the previous section have been added to the inputs below to further develop the master plan concept:

- Rail network and hub operational requirements and changes
- Requirements of KiwiRail's freight partners
- International practice in hub design and operations
- Zero harm - safety and environmental requirements

As explored in the previous section, moving to longer trains, means that the marshalling yard, arrival and departure yard and the CT yard in the master plan concept all need to be sized to reduce the number of touch points while managing site operations with longer trains. Long trains, arriving more frequently, require additional operational space, including space in which to meet greater safety and environmental requirements. This means that tracks within the yard need to be long enough to manage 1500m trains, have enough tracks to accommodate the greater frequency of trains and enable the appropriate management of goods/tracks and facilities to cater for the forecasted range of commodities and related wagons/ containers.

Regional hubs will potentially operate seven days a week, 24 hours a day to achieve the operational efficiencies required. Wagon storage, equipment maintenance, network services and yard operation are another significant function of the hub. This means that high quality facilities must be provided to reduce pressure on tracks in the marshalling yard being used for example for wagon storage and allocate appropriate areas for maintenance and service activities and to meet the requirements of staff operating the yard. The hub needs to be both safe for the staff and support the different requirements for the various teams across the KiwiRail work force in a cohesive manner, with larger and adaptable shared amenities and administration spaces.

The future intermodal hub concept promotes the separation between internal and external services services/facilities and optimises equipment and personnel movements as well as safe operations within the terminal. The master plan concept separates terminal train traffic from the expected increase in vehicles/trucks traffic promoting the best Zero Harm work practices.

As container and commodity storage has been identified as a growing part of future operations, the master plan allocates areas for these functions. This also provides commercial opportunities for KiwiRail to work with freight partners to widen the range of commodities moved through a future hub to meet future and potentially regionally focused demands.

4.2 Key physical components

The concept master plan (in Appendix A) lays out the yard and facilities in the hub to cater for larger trains, containers and a wider range of commodities and partners. The arrangement of tracks and components and the scale of the hub has been sized to minimise dwell times and reduce the multiple touch points and enable seven-day operation in forthcoming decades. The arrangement allows for technology changes and new innovations and meets anticipated on site environmental management requirements. **Figure 4-1** shows the marshalling yard with arrival and departure tracks, container terminal and freight distribution.

The following key physical components are included in the master plan:

Terminal Operations

- Eight arrival and departure tracks and at least 10 marshalling tracks of different lengths to accommodate both unit trains (trains carrying a single commodity) and manifest trains (trains carrying a mix of commodities). The split ladder 8 track configuration in the Arrival/Departure Yard provides the ability to stage a 1,500m long train on any track, and the split ladder configuration for the Marshalling Yard provides the ability to build full length 900m and 1,500m long trains.
- The tracks allow for trains of different lengths up to 1,500m long to be accommodated. The tracks also improve capacity and efficiency in high peak periods and allow the hub to operate seven days a week.
- Additional tracks for back shunts (two tracks at each end of terminal) to cater for storage of up to 100 wagons. It is anticipated that the Back Shunts could either be accommodated within the existing site, or within a sliver of adjacent widened track/corridor.

Figure 4-1 Marshalling yard, container terminal and freight distribution

Container Terminal

- A container terminal (see **Figure 4-2**) is provided in an island configuration to enable simultaneous loading and unloading on separate tracks. The three tracks to the centrally positioned Container Terminal provide easy access for direct arrival and departure of short (900 metre) unit trains. In addition, there is space for storage of 200 – 40-foot containers stacked three high on the two islands and includes refrigeration and temperature-controlled Hazard Analysis and Critical Control Point (HACCP) plug in capability. The facility will allow a truck to container service with the ability for truck traffic to drive directly onto the loading platform. The facility will have inland port capability for import/ export containers.

Figure 4-2 Container terminal

KiwiRail's Facilities

- Facilities for the maintenance of the current fleet of wagons, diesel, electric and battery powered locomotives and equipment are provided in a common Maintenance Building and a Network Services Maintenance Depot with track maintenance depot, hardware and machinery is also provided (see **Figure 4-3**).

Figure 4-3 Maintenance Facility and network services depot

Commercial Services

- There is provision for four large and six smaller Freight Forwarder facilities that are expected to be up to three storeys high along a common loading/unloading track so they can be serviced by rail directly. This will result in more consistent and efficient terminal operations. Each customer would still have a separate connection to the service lead track should independent service be required.
- The Log Loading facility is sited away from the commercial customers.
- A tank farm for bulk storage of liquids and solids with rail service is located on the edge of the hub away from the marshalling yard and day to day operations (see **Figure 4-4**).

Figure 4-4 Log handling area, and tank farm with rail service

Sizing the key physical components

In the development of the master plan, the components outlined above have been sized to accommodate forecasted freight growth based on Palmerston North's role in the network. These are detailed in the **Table 4-1** following.

Table 4-1 Components of the hub sized to accommodate forecasted freight growth

Key physical components	Area (m2)
Terminal Operations	**204,000**
• Arrival and Departure Yard	83,100
• Marshalling yard	106,500
• Wagon Storage	14,400
Kiwi Rail Facilities	**173,000**
• Equipment Maintenance	130,000
• Network Services (roadway maintenance)	43,000
Container Terminal	**176,000**
Commercial Services	**302,500**
• Freight Forwarding	215,000
• Log Handling	87,500

Other elements

To optimise equipment and personnel movements, safe operations and to promote efficiencies in management and operations within the various working groups, the master plan provides for:

- Vehicular access from the opposite side of the terminal from the mainline and a perimeter roadway network along three sides of the hub (not including the mainline side) with security gates at multiple terminal access locations to control access. The concept provides for multiple connections from the perimeter road to the local road network.
- Grouping of services/facilities such as offices, and staff amenities (lunchroom, toilets, showers, lockers), staff and visitor parking and equipment and materials storage.

- Security such as fencing, CCTV, lighting, and gates with controlled access to KiwiRail's operational facilities.
- A buffer around the perimeter property limits, allowing for potential environmental mitigation in the form earth bunds and planting.

The master plan concept with all the elements included totals around 120 hectares.

5. Conclusions

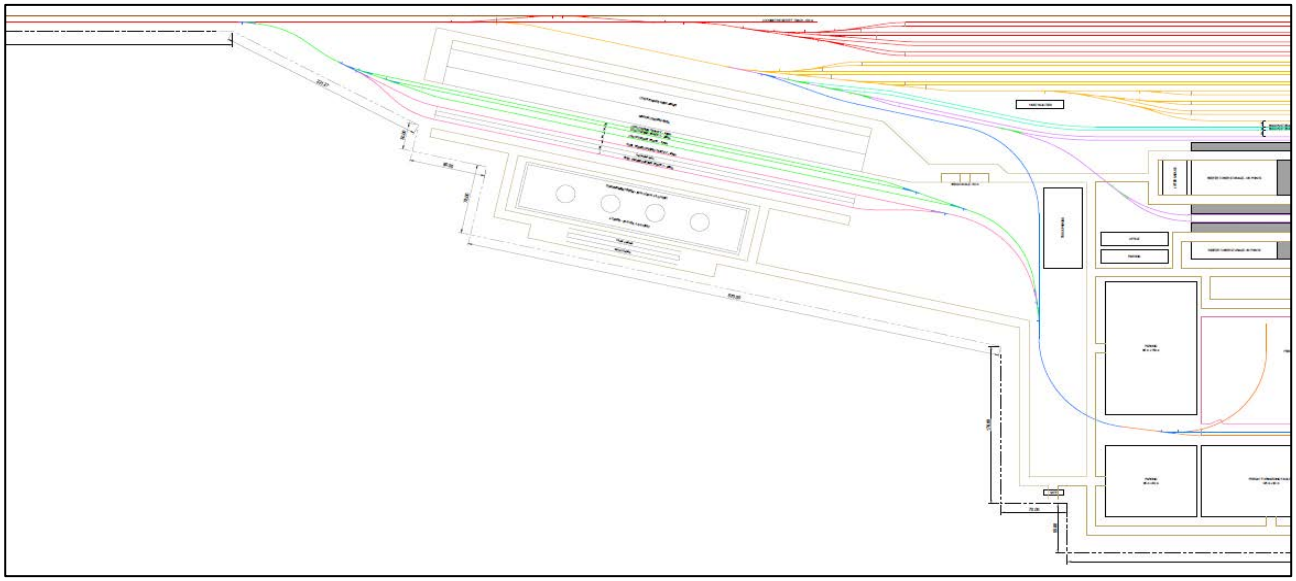
The master plan provides a high level concept plan for the management of regional rail freight based on predicted rail freight demand for the CNI. The plan provides for an intermodal freight hub capable of achieving high freight handling capacity while also anticipating technological and site practice changes.

A large network facility with an efficient modern design is presented in the master plan to achieve improved speed, connectivity, capacity, and to reduce double handling. The master plan provides a full integration of freight yard operations including maintenance and freight facilities (both KiwiRail's and its freight partners), ensuring a safe and sustainable environment.

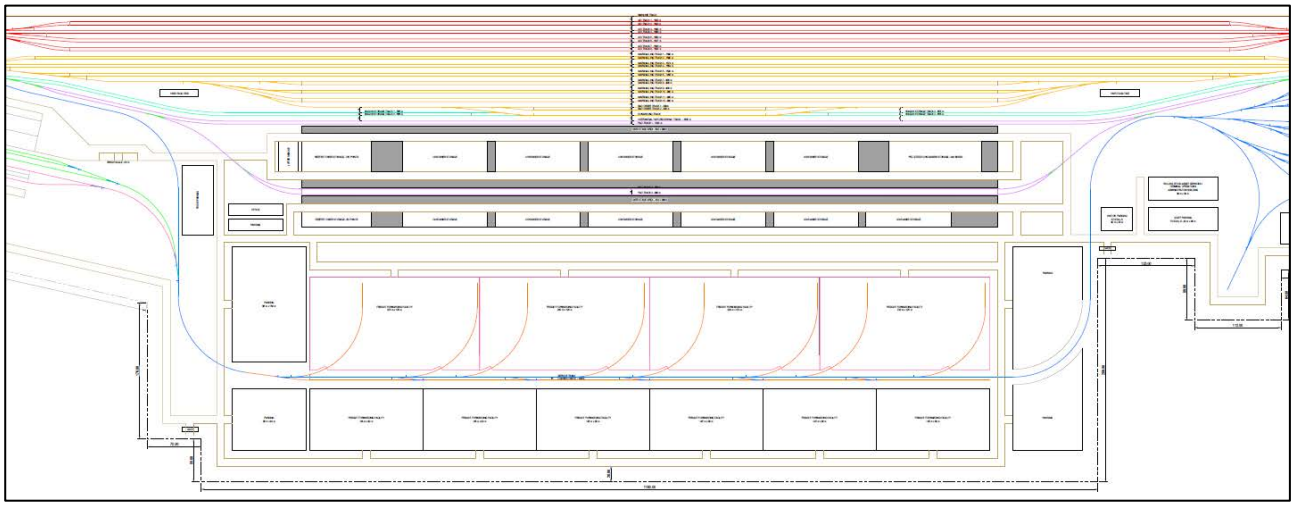
The master plan will initially be used by KiwiRail to identify an appropriate location for a new CNI regional Hub. It provides a strategic document for future development of intermodal freight hubs across the country that guides both the extent of land and key operational requirements.

Appendices

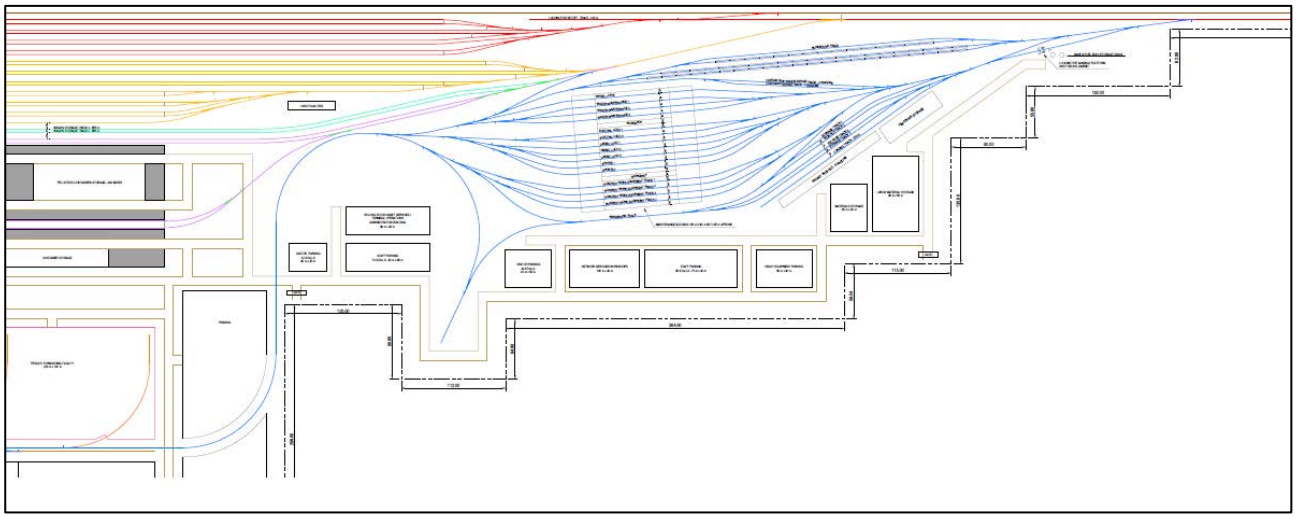
Appendix A Master Plan Concept



Log Loading and Transloading



Arrival/Departures / Marshalling / Container Terminal / Freight Forwarders



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