STORMWATER FLOODING ASSESSMENT

KIWIRAIL PALMERSTON NORTH REGIONAL FREIGHT HUB - NOTICE OF REQUIREMENT

PREPARED FOR KIWIRAIL HOLDINGS LIMITED

October 2020

Stantec

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Executive Summary

This assessment has considered the potential stormwater impacts of the proposed KiwiRail Palmerston North Regional Freight Hub (Freight Hub) and the land requirments for the mtigation of these effects.

The Freight Hub has the potential for both positive and negative effects from a stormwater perspective.

Potential positive effects include:

- The opportunity to reduce upstream flood effects in future climate change events
- The ability to improve fish passage to upstream of the exisitng North Island Main Trunk Rail Line (NIMT)
- The opportunity to improve the degraded in-stream habitat.

Potential adverse effects identified include:

- Potential construction related effects, in particular silt generation
- Potential operational effects including:
    - Upstream flooding risk
    - Loss of stream habitat
    - Loss of fish passage
    - Increased downstream flooding
    - Water quality deterioration.

This assessment has considered the likely land requirements for the mitigation of the above potential stormwater related effects based on a set of assumptions agreed with the Horizons Regional Council (HRC) and Palmerston North City Council (PNCC) which is included within Appendix A. It also identifies the opportunity for stream ecological enhancement, particularly within a reformed channel for the stream at the northern extent of the site (Site).

The assessment concludes that approximately 80,000m3 of storage volume is required to manage the stormwater from the Freight Hub and potential flood risk. In order to accommodate this, stormwater detention and treatment via wetland systems have been incorporated on the downstream boundary of the Freight Hub as well as the provision of a detention system within the operational site area at the southern end of the Site. The opportunty for stream enhancement to provide improved habitat has also been identified for the watercourse at the north end of the Site.

Futher analysis of the stormwater management systems will be required at the detailed design stage. The analysis will include detailed hydraulic modelling to demonstrate that flood effects have been managed. It is recommended that a Stormwater Management Framework be prepared for the Site at that time. The contents of a possible Stormwater Management Framework for the Site has been included in Appendix B to this assessment.

Abbreviations

CEMP	Construction Environmental Management Plan
GD01	Auckland Council Guideline Document, GD01, Stormwater Management Device in the Auckland Region, December 2017
GD04	Auckland Council Guideline Document, GD04, Water Sensitive Design for Stormwater, March 2015
HRC	Horizons Regional Council
Freight Hub	KiwiRail Palmerston North Regional Freight Hub
LID	Low Impact Design
LIDAR	Laser Imaging Detection And Ranging
MCA	Multi-Criteria Analysis
NEIZ	North Eastern Industrial Zone, within the Palmerston North District Plan
NOR	Notice of Requirement
NIMT	North Island Main Trunk Rail Line
PNCC	Palmerston North City Council
SMF	Stormwater Management Framework

Glossary

Low Impact Design	Auckland Council GD04 Defines it as Water Sensitive Design "*An approach to freshwater management, it is applied to land use planning and development at complementary scales including region, catchment, development and site. Water sensitive design seeks to protect and enhance natural freshwater systems, sustainably manage water resources, and mimic natural processes to achieve enhanced outcomes for ecosystems and our communities.*"
Hydraulic Neutrality	Is not defined in the PNCC District Plan or the One Plan. But is referred to by the HRC as a means to not increase stormwater effects on surrounding properties from a development.

KiwiRail Holdings Limited

KiwiRail Palmerston North Regional Freight Hub - Notice of Requirement

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1. Introduction

This assessment has been carried out to assess the stormwater effects and flood risk with respect to the proposed KiwiRail Freight Hub. This assessment covers:

- the existing environment insofar as it is relevant to stormwater
- an assessment of potential effects of the Freight Hub, including flood risk within the proposed Site, upstream of the Site and downstream of the Site
- the measures to manage potential adverse effects, including the land requirements for the management of stormwater and flood risk.

The analysis reported in this assessment has been carried out to support the Notice of Requirement (NOR) for the Freight Hub.

The effects from construction activities have not been assessed in detail for the stormwater discharges as these will largely revolve around the temporary sediment and erosion effects, as well as the effects of working within watercourses.

This assessment refers to hydraulic modelling of the Mangaone Stream catchment previously carried out by the Horizons Regional Council (HRC) and the Palmerston North City (PNCC). That modelling is based on LIDAR information collected in 2013. The assessment has been supported by site inspection of key areas of interest from a hydrological and hydraulic perspective either from accessing properties directly when available or by observation (from public land, of aerial photographs and LIDAR data) where direct access was not possible.

No specific detailed numerical analysis has been carried out to support this assessment, but approximations have been made as agreed with HRC and PNCC representatives at a meeting on 25 June 2020. The agreed assumptions for this analysis are appended in Appendix A of this report.

2. Project Description

The project involves the development of approximately 177.7 ha of land to enable the construction and operation of the Freight Hub, which is an intermodal freight facility that connects the rail network with the road transport system.

KiwiRail is seeking to designate the land required for the Freight Hub. The Freight Hub has been developed to a concept design stage and an indicative site layout for it is shown on the concept Landscape Plan (shown below in Figure 1). The design will be further developed through future stages of the project.

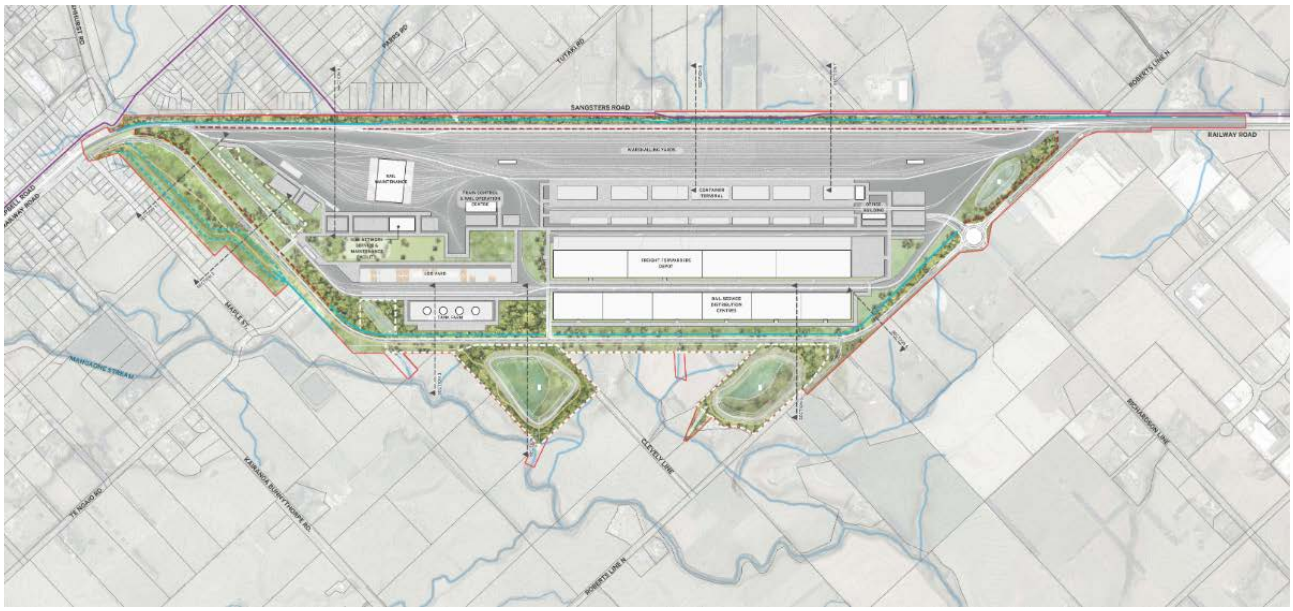

Figure 1: Indicative Landscape Plan for the Palmerston North Regional Freight Hub Site

The Freight Hub will include the following key elements:

- marshalling yards including arrivals and departure tracks to accommodate trains up to 1,500m in length, signals, overhead line equipment and other associated track assets including safety lighting (low level, street and tower).
- container terminal
- wagon storage
- maintenance and network services facilities
- freight forwarding facilities
- log handling
- bulk liquid storage
- train control and rail operation centre and administrative office buildings and associated carparking
- staff facilities including car parking
- stormwater management areas with associated planting
- noise management areas with associated planting
- access roads
- buildings and other activities ancillary to Freight Hub.

3. Methodology for Effects Assessment

This assessment has largely been a desktop assessment to determine the land required for the management of stormwater and flood risk from the Freight Hub, relying on readily available information such as:

- Topographical information from the contributing catchment areas
- Flood model outputs from the PNCC and the HRC for the Mangaone Stream
- Existing asset information, in particular related to upstream culverts
- LIDAR level information for the Site and surrounds, flown in 2013
- Review of recent subdivision requirements in Palmerston North
- Consideration of One Plan and District Plan requirements for stormwater management
- Consideration of in particular, stormwater requirements for the North Eastern Industrial Zone (NEIZ)
- High level approximate calculation techniques where needed
- Site visits by the author undertaken on:
    - o25 June 2020 (this site visit was limited to observation from public areas)
    - o27 and 28 July 2020. These site visits included visiting a number of potentially affected properties and discussions with property owners.

No detailed hydraulic modelling has been carried out for the purposes of this assessment as this will be carried out at a later stage once the detailed design has been undertaken.

In preparing this assessment, the following has been considered:

1. The passage of stormwater flows through the Site from upstream catchments. This work included:
    a. The identification of the upstream catchments
    b. The volumes of stormwater discharging onto the Freight Hub Site from the upstream catchments
    c. The volumes for stormwater discharging from the Freight Hub Site and in particular the potential change in volume post development
    d. The consideration of available topographic information, both on the rail and road alignments and also on the upstream land
    e. The consideration of existing flood levels and future potential risks and their mitigation
    f. The consideration of mitigation options for identified risks.
2. The potential impact on downstream flood levels caused by the proposed Freight Hub Site development. This included:
    a. Considering the Site in the context of the upstream catchments and the flood plains
    b. Considering the available flood extents information
    c. The consideration of the likely impact of the Site of the flood plain in terms of both the loss of existing flood plain storage and the increased flows from the Site
    d. The consideration of mitigation options.
3. The consideration of contaminants being transported from the Site via the stormwater system and affecting downstream environments and the mitigation of these effects, including both on-site mitigation (including treatment and source control techniques) and off-site mitigation (treatment).
4. The potential loss of streams and the mitigation options for this loss as well as options considering fish passage options.
5. The consideration for the on-site implementation of LID solutions. This includes practices such as volume reduction, on-site reuse, treatment, retention or enhancement of streams and options for the selection of neutral building materials for the Site development.

4. Existing Environment

4.1 Catchment Context

From a stormwater perspective the existing environment of the Freight Hub Site can be described as flat to rolling countryside with a predominantly rural pastoral land use. The upstream catchment draining through the Freight Hub Site can be described as rolling to steep.

The Freight Hub Site is part of the wider Mangaone Stream catchment. Catchments in the order of 1,200Ha in total drain through the Freight Hub Site from the east of Railway Road and the NIMT, draining to the Mangaone Stream to the west of the Freight Hub Site. The predominant landuse of this contributing catchment is rural pastoral.

The geological conditions are described in the Geotechnical Technical Assessment Report. In summary, the soil types in the upstream catchments include ocean beach deposits of gravel with sand and mud. These deposits can be expected to have good but possibly variable drainage characteristics. In the flatter areas closer to and within the Site, the soils include alluvium consisting of poorly sorted gravel with loess, sand and silt. Stormwater runoff generation will vary for these two soil types.

Stormwater from the northern and central upstream catchments is conveyed through the Freight Hub Site in two main unnamed watercourses and the southern upstream catchment through a smaller unnamed watercourse to the south.

Figure 2 below shows the Freight Hub Site outlined within the context of the contributing catchments described below.

Northern Catchment

The northern catchment comprises around 623Ha (6.23km2) and drains through the Freight Hub Site via a wide flat, generally poorly drained area and watercourse. The northern watercourse is fed via a number of culverts under the NIMT and Railway Road, with flows travelling through the Site, draining to a single culvert under Te Ngaio Road, and then away to the Mangaone Stream via a modified watercourse. This northern watercourse passes through the Site in a generally east to west direction and is part of a wide shallow floodplain on the Freight Hub Site which occupies in the order of 23Ha of the Site, based on the 200year flood maps available from the PNCC.

Central Catchment

The central catchment comprises around 596Ha (5.96km2) and drains through the Freight Hub Site predominantly via a single modified watercourse and culvert under the NIMT and Railway Road around 489 Railway Road. This watercourse is well defined through the Freight Hub Site and is also within a shallow floodplain. The area occupied by this floodplain within the Freight Hub Site is in the order of 10Ha, based on the 200year flood maps available from the PNCC. This central watercourse passes in an east / west direction through the Freight Hub Site and then turns more southerly beyond the extent of the Freight Hub Site to drain under Roberts Line and then to the Mangaone Stream through 815 Roberts Line.

Southern Catchment

The southernmost catchment draining through the Freight Hub Site is a small catchment of around 20Ha (0.2km2) which drains onto the Freight Hub Site, just to the north of the Roberts Line / Railway Road intersection. It drains away from the Freight Hub Site to the west, around the Roberts Line / Richardson Line intersection, to then turn to drain to the northwest and eventually to the Mangaone Stream below 815 Roberts Line.

Mangaone Stream

The Mangaone Stream starts well north of and drains to the west of the Freight Hub Site to discharge into the Manawatu River south of Palmerston North. The total catchment area of the Mangaone Stream to the downstream connection point from the Freight Hub Site (via the central and southern watercourses) is around 15,000Ha. It is the existing receiving system for stormwater flows from, through and adjacent to the Freight Hub Site. The Mangaone Stream is a modified watercourse which is stop-banked for much of its length downstream of the Freight Hub Site. Downstream of the lower connection point it is stop-banked on both banks. The stop-banking on the true left bank terminates downstream of this lower connection point. This lack of stop-banking on the true left bank means the areas on that true left bank are not protected from flooding and are subject to inundation in flood events.

The Assessment of Ecological Values and Effects provides descriptions of the environmental values of the existing streams through and below the Freight Hub Site.

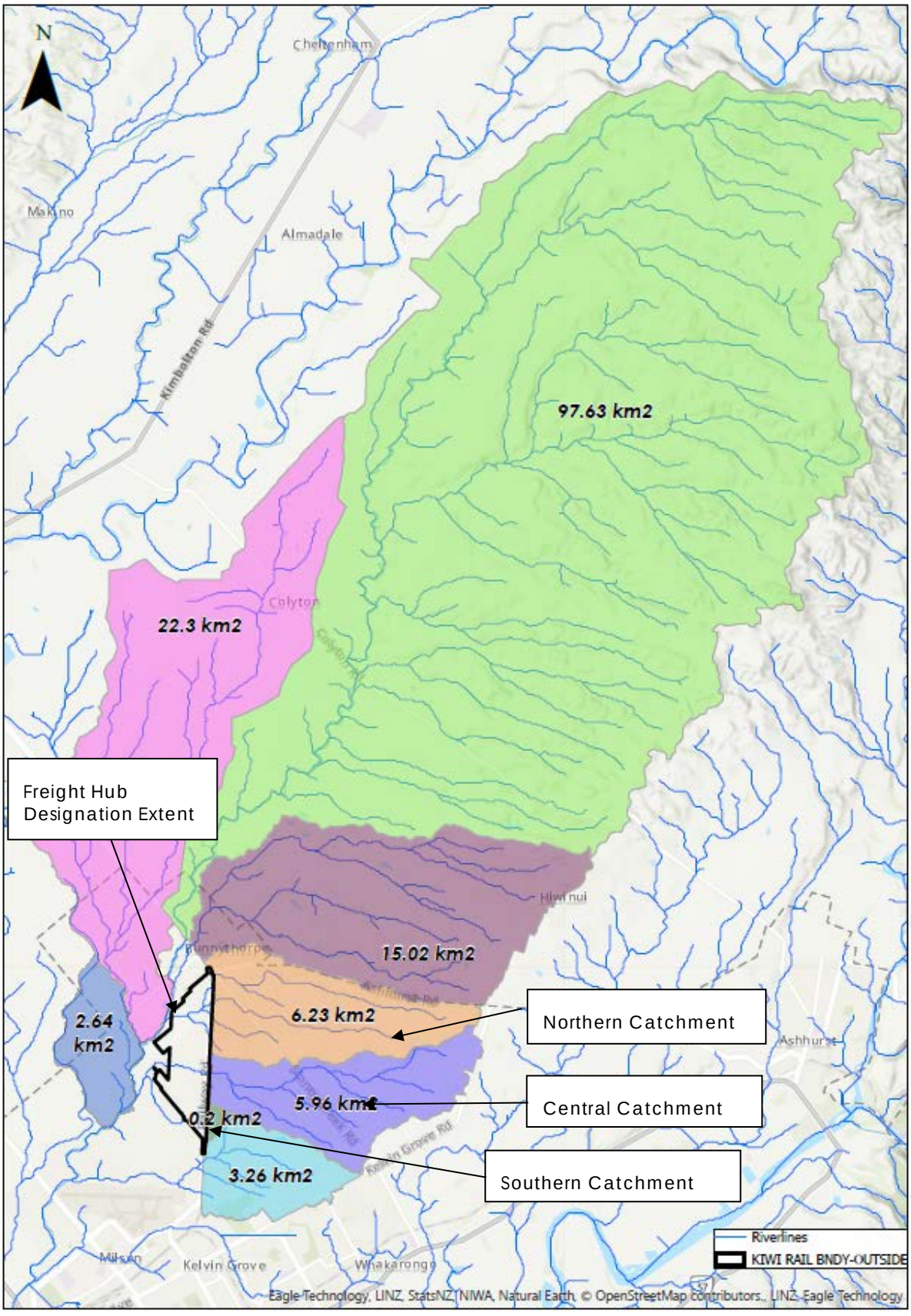

Figure 2: Plan of Mangaone Catchment to Freight Hub Site, with Proposed Freight Hub Site Outlined

4.2 Landuse and Zoning

The proposed Freight Hub Site is currently zoned rural and industrial within the Palmerston North District Plan. Approximately one third of the southernmost portion of the Freight Hub Site (north of Roberts Line) is contained within the NEIZ and the remainder of the Freight Hub Site has a rural zoning. The existing landuse is predominantly rural or lifestyle with no large industrial uses within the Freight Hub Site.

From a stormwater perspective, the NEIZ has provisions relating to the detention, retention, hydraulic neutrality, treatment and Low Impact Design (LID) implementation requirements. The rural zone has no specific provisions relating to stormwater requirements. The Regional Plan has provisions around development in areas prone to flooding, flood hazard avoidance and developments having no more than minor effects on the effectiveness on existing mitigation and avoidance measures. The HRC also supported the NEIZ provisions around integrated stormwater planning, detention, retention, hydraulic neutrality, treatment and LID implementation requirements.

Figure 3 below is an excerpt from the PNCC District Plan maps with the proposed Freight Hub Site designation boundary overlain on it. The industrial zone is shown in the dark purple colour, the rural zone in the light grey and the identified flood prone land in the blue crosshatch.

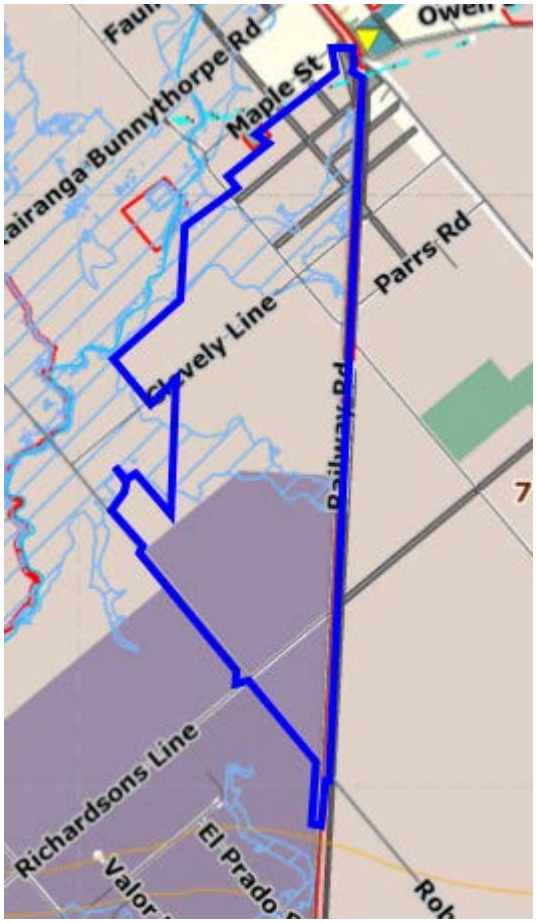

Figure 3: Landuse Zones in the Region of the Freight Hub site, from PNCC District Plan Maps

4.3 Flood Plains

Flood levels and flood extents on the Freight Hub Site are influenced by the flows through the Freight Hub Site and from examination of the flood plain data appear to be largely controlled in extreme events by the flood levels and flooding within the Mangaone Stream.

Flooding in the Mangaone Stream has been modelled by both the PNCC and the HRC. The flood prone areas modelled by the PNCC and referenced in the District Plan and the HRC flood hazard maps reference the indicative flood extents. Each of these sources reference the 200 year event and have been referenced in this assessment. Figure 4 below shows flood depths in the vicinity of the Freight Hub Site as supplied from modelling carried out for the PNCC.

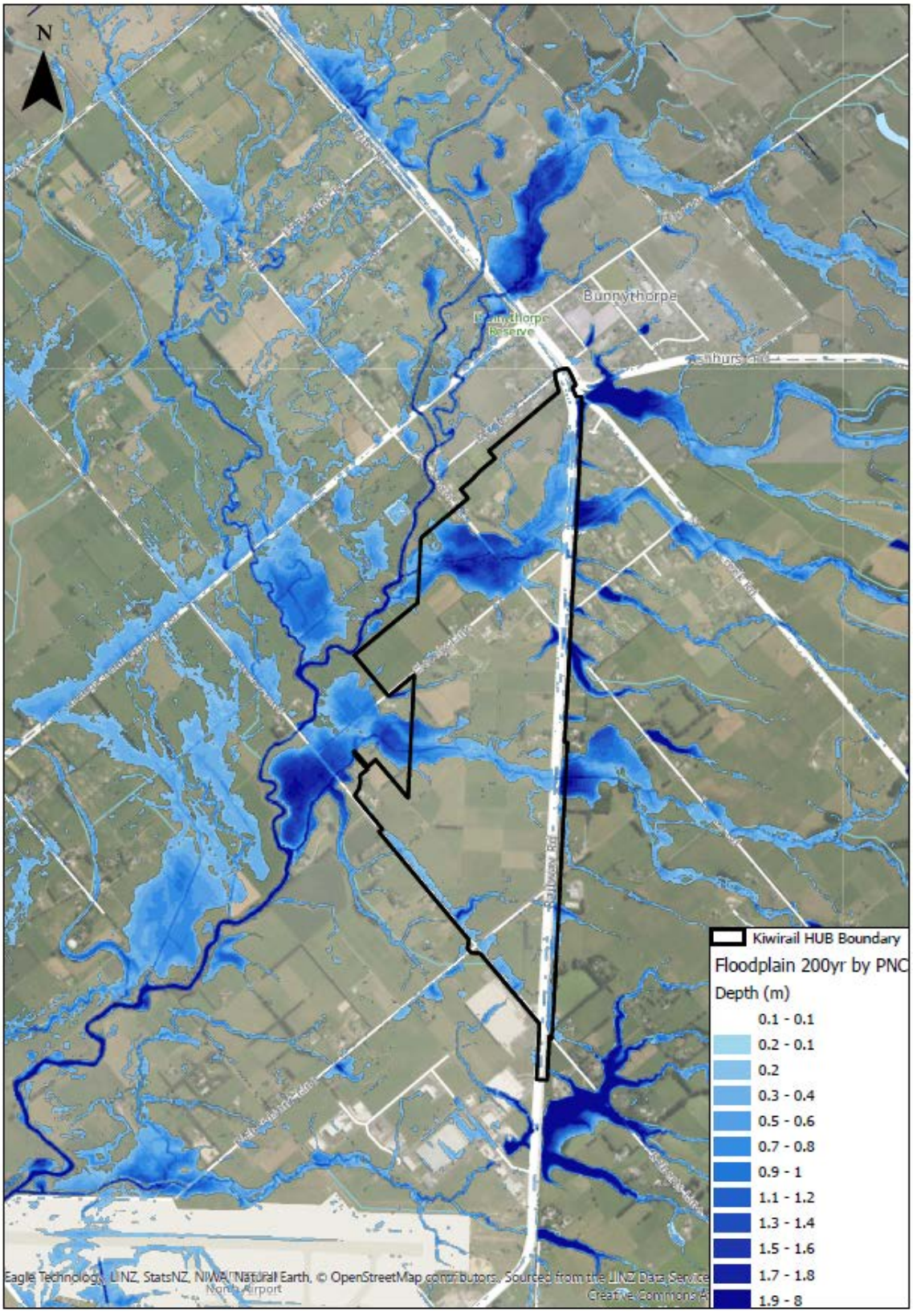

Figure 4: Modelled Wet Extents of Flood Plains, from PNCC Supplied Information

4.4 Ecology

The ecological values within the Freight Hub Site are described in the Assessment of Ecological Values and Effects report.

In summary, from a stormwater perspective, there are no identified sensitive aquatic environments within or immediately downstream of the Freight Hub Site. The watercourses through the Freight Hub Site have been impacted by clearing and agricultural activities and currently have low ecological values. At the site visit on 27 to 28 July 2020 a number of reaches of the main streams were also noted to be actively eroding both within the Freight Hub Site as well as upstream and downstream of it.

5. Assessment of Potential Effects

5.1 Positive Effects

5.1.1 Operational Effects

The potential positive effects will be realised through the active consideration of them during the design and Site development phases. The potential effects include:

1. Reduced Upstream Flooding

Current upstream flood levels and frequency are largely controlled by several culverts under both the NIMT and Railway Road. These culverts have been in place for some time and it is unlikely they have been designed considering the effects of climate change on stormwater runoff rates. With appropriate consideration during the detailed design phase, the culvert hydraulics can be brought up to current design standards thus anticipating and addressing a potential future risk to upstream properties.

2. Improved Fish Passage

Design of the existing culverts upstream of the Freight Hub Site is likely to have involved limited consideration of fish passage criteria. The culvert upgrades and extensions required as part of the Freight Hub Site development creates an opportunity to incorporate measures to improve the opportunities for fish passage through the Site (either through culverts or new or modified open channel systems) to the upstream watercourses.

3. Improved Stream Environment

As can be seen in the ecological assessment, the current streams through the Freight Hub Site have low ecological values. With the development of the Freight Hub Site, the opportunity exists to improve the habitat on retained or reconstructed stream reaches.

4. Reduced Sediment Loads

Change from rural to urban landuse and the inclusion of stormwater treatment systems will reduce sediment loads discharged to the streams. This will occur as the sediment runoff from paved or otherwise stabilised surfaces is low compared to that from unsealed or unstabilised surfaces.

5. Reduced Load on Public Water Supply System

Inclusion of on-site collection of rainwater (particularly from buildings) and reuse of that water for non-potable sanitary and cleaning purposes will reduce the increase in load on the public water supply system.

6. Comprehensive Development Allows for Comprehensive Management

The comprehensive development of the Site allows for the implementation of Best Management Practices (BMPs) to manage stormwater and flooding issues in a comprehensive manner. This opportunity would be unlikely to be available with piecemeal developments.

5.2 Adverse Effects

5.2.1 Introduction

As with any landuse change, there are several potential adverse effects that could be generated and need to be considered. For the Freight Hub Site development, the potential adverse effects from a stormwater and flooding perspective are discussed below.

5.2.2 Construction Activities

The key temporary effect of developing the Freight Hub Site is the discharge of sediment from exposed surfaces during the construction activities.

To date no sensitive receiving environments have been identified downstream of the Freight Hub Site. Notwithstanding this, any uncontrolled discharge of sediment from the Freight Hub Site during construction works will be unacceptable and the effects will need to be managed and mitigated, including through an Erosion and Sediment Control Plan.

5.2.3 Operational Activities

The potential long-term effects from the development and operation of the Freight Hub (without mitigation) include the following:

1. Increased upstream flooding risk through changes to the existing conveyance systems.
2. Increased upstream flooding risk due to proposed developed levels of the Freight Hub Site being above the current level of the rail embankment and design exceedance events (such as higher rainfalls) or blockage of the primary system, in particular, culvert inlets.
3. Loss of stream systems and stream habitat through the Freight Hub Site due to the piping of watercourses.
4. Loss of fish passage due to piping or culverting activities.
5. Increased downstream flooding level, extent or duration generated by:
    a. Passing of flows from upstream more rapidly through the conveyance systems through the Freight Hub Site
    b. Loss of flood plain storage by filling for site formation
    c. Increased impervious surfaces generating more runoff.
6. Stormwater quality deterioration in receiving systems, through the change in landuse including:
    a. The discharge of contaminated runoff. This may come from:
        i. Changed chemical nature of the runoff from the changed activities on the Freight Hub Site
        ii. The carrying out of activities on-site with a high risk of contaminant generation
        iii. Increased risk of spills from the Freight Hub Site activities
        iv. Contaminants generated from non-stabilised building materials, such as zinc
    b. Increased temperature of runoff.
7. Stream erosion generated from a change to the runoff hydrology from the development of the Freight Hub Site.

6. Measures to Avoid, Remedy or Mitigate Actual and Potential Adverse Effects

6.1 Construction Activities

To date, no sensitive receiving environments have been identified downstream of the Site, however, uncontrolled sediment discharges from the Site will be unacceptable and will need to be managed.

Typical techniques for managing sediment discharge include measures such as:

- Limiting the area of exposed earthworks at any one time. That is, the staging of the works
- Limiting the time of exposure of surfaces cleared of vegetation
- Exposing surfaces at times of year when they are less susceptible to erosive effects
- Limiting slopes in exposed areas
- The construction of clean water diversions around exposed areas
- The construction and maintenance of sedimentation facilities
- The diversion of flows around work sites, particularly for work within existing watercourses
- The stabilisation of exposed areas as soon as possible after earthworks has been completed.

The works to form the Site will be constructed over time. This gives the opportunity to use parts of the Site not being worked on as locations for construction site erosion and sediment control devices. It is also standard practice in developments to use the proposed stormwater treatment wetlands sites (discussed below) as part of the erosion and sediment control facilities during the earthworking process.

In summary there are suitable opportunities to manage the temporary effects of the stormwater generated construction related activities within the proposed designation boundaries and a suitable erosion and sediment control plan can be developed in the future detailed design phase.

6.2 Operational Activities

In order to manage the potential adverse flooding effects of the Freight Hub, a number of onsite stormwater detention devices are required. This assessment for the NOR has considered the stormwater measures to a level to have reasonable confidence that it is possible to implement suitable measures to manage the stormwater effects and flood risk, and that they can be contained within the proposed designation footprint (Designation Extent). As detailed earlier, further work will be needed during the detailed design to demonstrate numerically (anticipated to be by computer modelling of the catchment and flood plains) that the outcomes sought are being achieved, particularly the management of flooding effects on downstream receiving environments.

To determine the land required for the stormwater detention devices, the following analysis was carried out:

1. Approximate sizing of detention storage requirements was carried out considering the difference in volume between the pre-development and post-development runoff volumes from the Site for the 100 year 24-hour storm (consistent with recent developments, the NEIZ provisions and as agreed in the Assumptions document). This technique yields a conservative result compared to the more extensive flood routing techniques. In the order of 80,000m3 of storage volume was assessed as being required for the Site.
2. Consideration of options for siting a flood detention basin (or basins):
    a. Opportunities within the operational site area of the Freight Hub were first considered, but it was apparent that there was not enough available land within the operational Site to allow for the construction to provide the total volume of detention storage required. Although there is some land available near the southern end of the Site which can be used to detain flows discharging near the Roberts Line / Richardson Line intersection, that area alone would not be sufficient for the whole Site.

b. Providing storage on the stream channel upstream of the Site was then considered. While opportunities exist for this, downstream Sites were preferred for the following reasons:

   i) Storage would need to be constructed on-line. That is, on the line of the existing stream and the existing floodplain

   ii) Storage within the existing floodplain would increase the area currently at risk of flooding, affecting further properties

   iii) On-line storage can have adverse environmental effects, particularly on fish passage and habitat

   iv) The option of combining the detention storage with a treatment system was much more problematic to achieve with this option

   v) It introduced a range of further property effects and disruption on adjacent properties.

c. Providing storage downstream of the Site was selected as the preferred option. Site selection then considered the following factors:

   i) Storage being kept out of the floodplain (off-line) as raising the flood levels would have adverse effects on upstream properties and reduce the ability to drain these properties through the Freight Hub Site. Combining storage with treatment systems (a common approach in stormwater management) is also much more problematic with on-line systems, further strengthening the argument to not put detention storage in the floodplain.

   ii) The ability to drain the large flat Freight Hub Site. Pipe systems will be required, and they require fall to operate. To achieve this fall over the lengths of pipelines required and avoiding the flood plains meant that at least two sites would be needed for the detention storage. This meant that an elevation difference between the Site and the storage system is needed, meaning the storage system to be in the order of 5 metres below the Freight Hub Site level.

   iii) There are currently three main discharge points from the area of the Freight Hub Site and retaining the natural drainage pattern was considered preferable to concentrating or diverting flows to areas not historically subject to these flows. Therefore, three storage areas were selected to enable discharges to continue to the existing discharge points from the Freight Hub Site.

The above considerations relate to the recommendation to designate land for the management of stormwater flows at two locations to the west of the Perimeter Road as well as the provision of an on-site detention system at the southern end of the Site, to accommodate discharges from the three natural drainage paths, as illustrated in Figure 1. The purpose of the detention ponds is to allow for reduction of peak flows from the Freight Hub Site in order to ensure that flood levels are not increased downstream of the Site. The provision of these ponds outside of the operational site area translates to footprints in the order of 70,000m2 and 60,000m2, once side batters, maintenance access and stream connections are allowed for, as shown on Figure 1.

A Stormwater Management Framework will be a key document to both guide the implementation of stormwater management principles on the Site and to also demonstrate that the outcomes sought are being achieved in the detailed design. An outline of the SMF is included in Appendix B and a summary of the outcomes sought are set out below.

1. <u>Management of Upstream Flooding Risk due to Conveyance System Changes</u>

Management of this risk will be demonstrated through hydraulic modelling of the stormwater systems passing through the Site, with options assessed and the outcome of the process reported in the SMF. Options to manage this potential effect include the sizing of the conveyance systems through the Site as well as the managing of the hydraulic efficiency of the conveyance systems.

2. <u>Management of Upstream Flooding Risk due to the Level of the Site being above the Current Overflow Level</u>

This risk could be realised by either design exceedance events, such as higher than design rainfalls or from blockage of the primary system.

Management of this risk will be demonstrated at the detailed design stage, with options examined and the outcome of the examination reported in the SMF. Options available to manage this effect include; the final sizing of the conveyance systems (as discussed in the Design Construction and Operation Report), designing the system inlets to minimise the blockage risk, the provision of alternative entries into the culverts in the event of blockage, and potentially to allow for the diversion of flows to alternative entries along the available land on the existing rail corridor.

3. Loss of Stream Systems and Stream Habitat through the Site due to the Piping of Watercourses

As noted above and in the ecological assessment report, the existing watercourses are described as having low ecological values. The opportunity has been identified, particularly on the northern watercourse through the Site, for stream naturalisation and enhancement to improve instream habitat above that which exists in the area at the moment. There may be further opportunities identified once land acquisition has been completed on residual parcels of land, in particular those around the existing watercourses. The proposed treatment wetlands will also provide enhanced habitat opportunities.

4. Loss of Fish Passage due to Piping or Culverting of Watercourses

There are a range of design mechanisms for fish passage that can be incorporated at the design phase. As well as allowing fish passage in culverts, any channel improvement works will also incorporate fish friendly design characteristics, such as in particular, shallow gradients, and shading.

5. Increased Downstream Flooding Level, Extent or Duration

The Mangaone Stream downstream of the Freight Hub Site is known to flood, not just immediately adjacent to the Site but also further downstream near the urban areas of Palmerston North. Various flood models of the Mangaone Stream have been created both for the PNCC and the HRC. As discussed above, the proposed designation includes detention ponds to allow for the reduction of peak flows from the developed Freight Hub Site to not increase flood levels downstream of the Site. The detail of this flow reduction will be determined during the design phases, but is likely to include both the 10 and 100 year ARI events, as on recent developments in PNCC. The effects of any flow reduction will be demonstrated by the running and modification of the existing catchment hydraulic models to include the proposed Freight Hub Site development changes (including the passing of upstream flows through the Site via piped systems, filling of flood plain storage and increased impervious surfaces) and the detention ponding.

6. Water Quality Deterioration in Receiving Systems

Stormwater treatment will need to include both on-site practices to limit contaminant generation and the isolation and treatment of high contaminant generating areas as well as general or final polishing treatment practices. The detail of the treatment systems will be addressed at detailed design stage and as part of the regional consenting process. Preliminary sizing of a wetland system has been carried out and has been included within the detention areas proposed for the Site. The overall stormwater treatment system will be detailed in the SMF, but is expected to involve practises such as:

- The selection of neutral building materials to limit the generation of contaminants such as zinc.
- The provision of at source LID techniques such as swales and raingardens at locations consistent with operational needs on roads and carparks within the Site.
- The collection and reuse of stormwater runoff from (in particular) roof areas on the Site. The required holding tanks for the storage of roof water will become settlement and pre-treatment tanks, with overflows going to the downstream treatment wetland systems.
- The identification and isolation of areas comprising activities at risk of high contaminant load generation, such as fuel storage areas, log yard, refuelling areas, hazardous substance storage areas and workshops. Some of these areas will be isolated, diverted to wastewater and / or alternatively receive pre-treatment (consistent with the nature of the contaminant risk) prior to discharging to either the stormwater or wastewater systems.
- The reticulation of general site discharges to a dedicated stormwater treatment wetland facility. The Designation Extent has been developed including an allowance for a treatment wetland within the land set aside for the detention ponds. In the siting and sizing of this land, consideration has been given to the ability to drain to the land and maintain the device.

7. Stream Erosion Generated from a Change to the Runoff Hydrology from the Development Site

This issue is more particularly a concern in the development of catchments with unmodified streams. In the case of the Freight Hub Site development, it is clear from inspection that all of the streams in the area (including the Mangaone Stream) have been highly modified by historical interventions, hence the hydrological changes generated from development of the Site are of limited concern. However, the LID measures discussed in item 6 above, combined with the reuse of collected rainwater on Site, the construction of the stormwater treatment wetlands and the re-creation of stream channels where possible will all contribute to further reducing this risk.

8. Maintenance Activities

For the ongoing performance of any treatment or conveyance system, ongoing maintenance is required. This may be as simple as carrying out inspections, the clearance of debris, the replacement of dead plants or include extensive activities such as the excavation of accumulated sediments or the specific maintenance requirements for contaminant specific treatment devices.

The preparation of operation and maintenance plans, the training of operators and the carrying out of this maintenance in an appropriate manner at appropriate times is integral to the successful long-term performance of the stormwater management system. This requirement will be identified further in the SMF.

7. Conclusion

The NOR as lodged includes sufficient land to manage and mitigate the stormwater and flooding related effects from the development of the Site for the proposed Freight Hub. In particular, land has been included within the designation for stormwater treatment and detention purposes to reduce contamination and downstream flooding risks.

The detailed design phase will include detailed modelling based on updating the existing Mangaone Stream models. The purpose of this modelling will be to allow for refinement of the detention design and to numerically demonstrate that effects on the downstream flood levels have been managed.

A Stormwater Management Framework will be developed at detailed design stage to address the detail of, flooding, stormwater quality, environmental and low impact design provisions on the Freight Hub. An outline of the matters that will need consideration is included in the SMF outline in Appendix B to this report.

Appendices

Appendix A Flooding and Stormwater Impacts Assessment Assumptions

Goals

1. Understand, at a high level, the effects of flooding and flows through the Site and on the Site development and operation.
2. Understand the effects of the Freight Hub Site development on the upstream and downstream flood levels.
3. Where there is an adverse effect on the upstream or downstream flooding caused by the Site development, to understand the scale of the effect and to identify at a high level mitigation strategies to be incorporated into the Stormwater Management Framework to be developed for the Site.

Methodology

1. Effects of off-site flooding on the Site to be determined using the existing PNCC/HRC flood modelling of the Mangaone Stream. Freight Hub Site to be located above the 200year ARI flood level.
2. Upstream flood levels:
    a. Develop both a 2-D rain on grid model and a simplified HEC HMS model of the upstream catchment contributing to the watercourses that drain through the proposed Freight Hub Site (approximately 1200Ha). Consider from available information the worst case existing and future flood levels. Also consider upstream areas that would be required if detention storage upstream of the current rail line is used to attenuate flows for downstream flood reduction.
        i. Model assumptions include:
            1. Use HEC RAS 2-D and HEC HMS
            2. Rainfall patterns based on High Intensity Rainfall Design System (HIRDS) V4 rainfall with a 3.1-degree climate change allowance (MfE Guidance for the Manawatu to the end of the century, RCP8.5)
            3. Losses to be accounted for in the rainfall profile
            4. Topographical data based on Palmerston north 2015 DEM
            5. No field survey data is available
            6. KiwiRail culverts based on 2015 culvert survey data (KiwiRail have confirmed no culvert upgrades post 2015)
            7. Railway Road culvert information from PNCC GIS, where available
            8. Downstream boundary will be determined from existing model results from PNCC and HRC where available
            9. HEC HMS CN adopted as 61 for pervious surfaces and 98 for impervious surfaces on the hub site and 74 and 98 respectively for upstream
            10. Initial losses adopted as 5mm for pervious and 0mm for impervious surfaces
            11. Assume Freight Hub Site 90% impervious surfaces post-development.
3. Downstream flood levels
    a. Consider the likely effects at the downstream boundary (and further downstream) of the Freight Hub Site. For NOR adopt the available 200 year flood depth information and generate a flood level based on existing DEM.
        i. Consider whether there is likely to be an effect based on the relative sizes of the contributing catchments (Hub site vs total upstream catchment)
            1. Consider catchment to the lowest discharge point from the Freight Hub to the Mangaone Stream.

b. If it is considered likely that an increase in flood level will result from the development, consider detention options to mitigate flows from the Freight Hub to pre-development levels.

i. Use simple HECHMS hydrological model of the site to determine approximate pond size to reduce 100year flows through and from the Freight Hub to predevelopment flowrates, using on-site storage options and above parameters:

1. Size detention for single device

2. Assess if multiple devices likely to be needed

3. Proportionally size multiple devices based on proportion of overall catchment served.

ii. Pre- and post-development flows to use the same climate change assumption as listed above.

iii. Use simple HECHMS model of the upstream catchment to consider potential storage options upstream of the existing rail line:

1. Size detention for single device

2. Proportionally size multiple devices based on proportion of overall catchment served.

iv. Consider loss of flood plain storage volume, based on available 200year flood depths and 2015 DEM, and opportunities to provide this storage elsewhere on or adjacent to the Freight Hub.

ON-STE STORMWATER MANAGEMENT

Goals

1. Allow for efficient drainage of the Site for operational and safety reasons
2. Minimise the discharge of untreated contaminants from the Site and ensure that there is sufficient area to provide appropriate treatment for runoff from potentially contaminated areas
3. Minimise the downstream impacts from the hydrological changes caused by the development.

Methodology

1. Based on Site layout, land use proposed across the Site (particularly considering contamination risk), downstream water levels and discharge points determine feasible drainage discharge points:
   a. Specify (in SMF) design to generally be in accordance with Building Code requirements for private drainage
   b. Specify (in SMF) high contaminant areas to bypass the stormwater system, for example areas that may discharge to the trade waste system
   c. Confirm with PNCC the particular design requirements such as Palmerston North Engineering Standards for Land Development[1]
   d. Specify (in SMF) the need to consider the use of culverts through the Site. Consider and where possible implement opportunities to retain or reconstruct existing streams, to minimise environmental impacts.
2. High level sizing of stormwater treatment wetlands (including maintenance access areas) at each discharge point
   a. Use Auckland Council GD001, for sizing
   b. Incorporate flood detention storage where required to determine footprint
   c. Consider levels and ability to drain, particularly in high tailwater conditions.
3. Specify (in SMF) to consider opportunities for the application of Low Impact Design principles to minimise the effects of hydrological and contaminant effects on the downstream systems. This will include opportunities for on-site collection and use of stormwater.

[1] https://www.pncc.govt.nz/media/3131292/engineering-standards-2018-2019-final.pdf

OUTCOMES

1. Approximate footprint and location of key stormwater drainage and management systems or devices, to form the basis for stormwater and flooding inputs to the NOR.
2. Identify opportunities at a high level, to implement Low Impact Design techniques to minimise downstream effects.
3. Identify at a high level, opportunities to retain or reconstruct the streams that currently pass through the Site.
4. A Stormwater Management Framework for the Site, setting out the outcomes and suggested items for designation conditions and issues to be considered in detail to guide the consenting and detailed design stages.

Appendix B Stormwater Management Framework – Indicative Outline of Contents

As part of the development process for the KiwiRail Palmerston North Regional Freight Hub Site it is expected that a Stormwater Management Framework (SMF)will be developed for the Freight Hub Site. The goal of the SMF will be to provide the detailed sizing and design to demonstrate that the stormwater management system is achieving its desired outcomes.

The items expected to be included in that framework are set out below.

1. Stormwater Management Goals or Outcomes
    - Description of the outcomes sought to be achieved by the on-site stormwater management. It is expected that the goals will need agreement with both the PNCC and the HRC and will include issues such as:
        - Management of the potential effects of the Site development on upstream flood levels
        - Managing the surface water groundwater interface in terms of quality and quantity
        - Identifying the best practicable option to manage and reduce the risk of contaminants leaving the Site, by means such as source control, on-site training and education, isolation of risk areas and treatment (both land use specific and general treatment) of runoff prior to it leaving the Site.
        - Identification of the flood events requiring mitigation
        - Maximise opportunities for the on-site reuse of stormwater
        - Provide fish passage as required following the detailed ecological assessment
        - Identify and utilise on-site opportunities for the implementation of low impact design approaches such as:
            - Storage and reuse
            - Areas (such as carparks) where green infrastructure can be used to achieve outcomes
            - Stream enhancement.

2. Basis of Stormwater Design
    - List the design standards to be adopted. For example, Building Code for on-site reticulation and overland flow paths, Auckland Council Guideline Document 01 (GD01) for stormwater treatment, enhanced with specific treatment for high risk areas
    - List what modelling packages will be used (this is anticipated to reflect and build on the work done by the HRC / PNCC modelling within the Mangaone Catchment)
    - List the key design inputs to be used such as curve numbers or runoff coefficients, roughness coefficients, rainfall data and profiles.

3. Stormwater Management during Construction
    - Erosion and sediment control will need to be addressed, this could either be in the SMF, a Construction Environmental Management Plan or in a separate Erosion and Sediment Control Plan.

4. Long-Term Stormwater Management
    - Demonstrate by appropriate calculation or modelling the effectiveness of the proposed stormwater management system and that the goals have been achieved including:
        - The potential effects on upstream and downstream flood risk has been managed
        - That the effects of low flows have been mitigated as far as practical by on-site storage and reuse of captured stormwater

- On-site Stormwater Treatment meets the appropriate design standards, as above, including particular attention to areas identified as high contaminant generating areas
- Areas not suitable for stormwater collection and discharge are isolated and discharged to trade waste
- Low-Impact Design has been incorporated to maximise on-site reuse and reduce volumes of discharge and help replicate the natural hydrology
- Groundwater quality and quantity have not been adversely impacted
- Opportunities for enhancement of existing streams, such as, the reconstruction of a stream channel on the northern watercourse through the site
- How fish passage has been allowed for in the design.

5. Asset Ownership, Operations & Maintenance

- Outline the ownership of the stormwater infrastructures proposed, and with whom the responsibilities of operations and maintenance lies. Describe the operations and maintenance items required to ensure that the stormwater infrastructure (in particular the treatment and LID infrastructure) will continue to meet its operating criteria.

6. Resource Consents and Engineering Approvals Required

- Obtain all required resource consents, building consents and engineering approvals and update the SMF to reflect the final outcomes of the approvals process.

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