

# Belfast to Pegasus Motorway & Woodend Bypass Pre-implementation and MSQA Professional Services

Construction Methodology Statement

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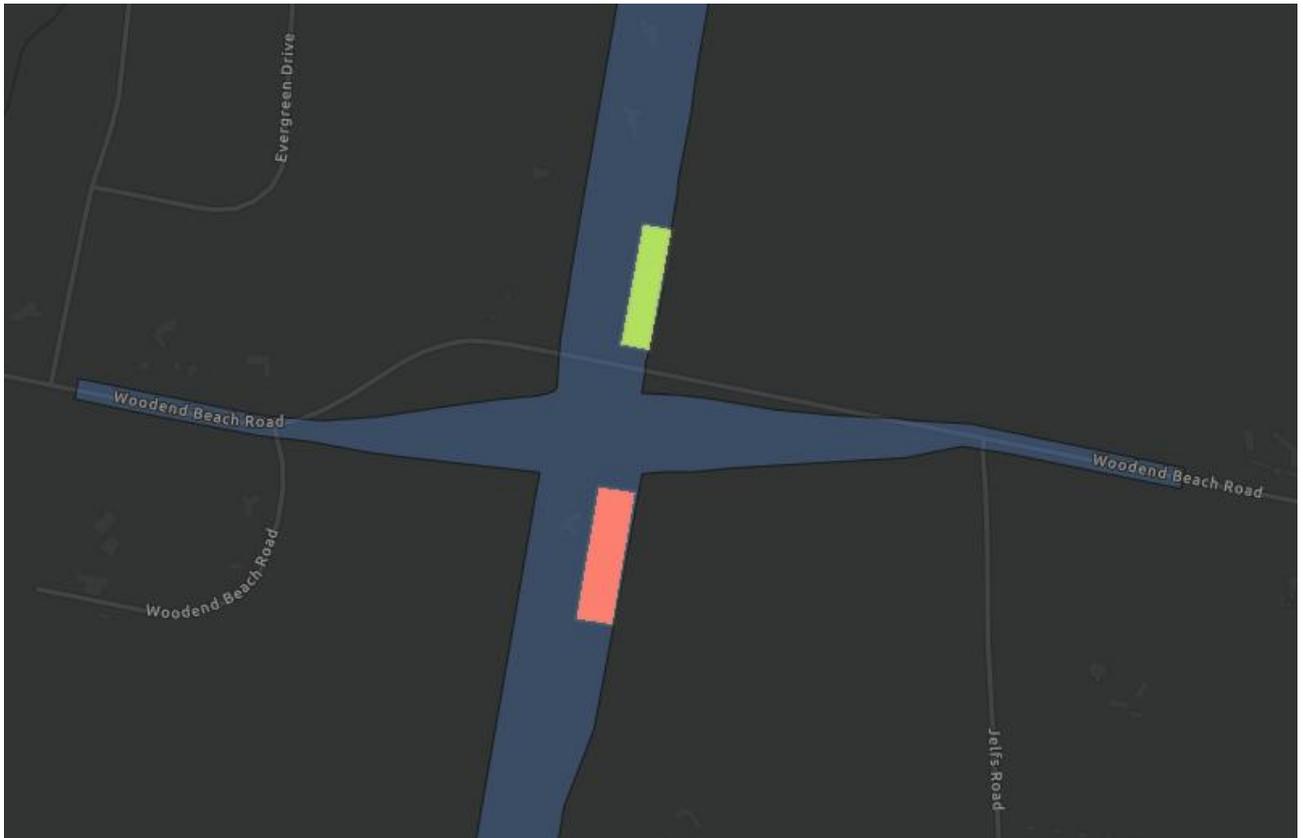


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# 1 Introduction

This Construction Methodology Statement (**CMS**) provides a high-level overview of the proposed works necessary to construct the State Highway 1 North Canterbury—Woodend Bypass Project (Belfast to Pegasus) (the **Project**). It provides technical support to the Substantive Application Report (**SAR**) for various applications made by New Zealand Transport Agency Waka Kotahi (**NZTA**) under the Fast-track Approvals Act 2024 (**FTAA**).

The construction methodology described in this CMS is a realistic and feasible methodology from which the anticipated effects on the environment of construction activities, for the purposes of the FTAA applications, can be identified and assessed. However, it is important to note that a contractor(s) has yet to be appointed to construct the Project. Different contractors may have different methods for establishing and constructing the works. The intent of this CMS is to provide sufficient information to enable the identification and assessment of potential effects, while retaining sufficient flexibility for differing approaches to construction.

Furthermore, the designation for the Project was included in the Waimakariri District Plan in 2015 and is subject to 104 conditions. Among other things those conditions require, prior to the commencement of construction, the preparation and certification of a Construction Environmental and Social Management Plan (**CESMP**) and the submission of an Outline Plan (**OP**) to Waimakariri District Council (**WDC**). At that time, the CESMP and OP will contain more comprehensive details on the construction methodology based on final design and contractor inputs.

The project aims to have resource efficiency across water, waste, energy and materials in line with NZTA'S P48 policy: specification for resource efficiency for infrastructure delivery.

## 1.1 Expert witness statement

While this is not a matter before the Environment Court, the authors of this report have each read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 ('Code'). The authors have each complied with the Code in the preparation of this report.

The data, information, facts and assumptions the authors have each considered as part of this report are set out in this report. The reasons for the conclusions of the report are also set out in this report. Unless stated otherwise, this report is within each of the authors' expertise and the authors have not omitted to consider material facts known to them that might alter or detract from the opinions expressed.

## 1.2 Applicability statement

We understand and agree that NZTA will submit this report as part of an application under the Fast-track Approvals Act 2024 and the appointed panel will use this report for the purpose of assessing that application.

## 2 Structure of this CMS

The following sections describe the construction programme, activities and methodologies, including specific focus on the following items which are of importance for assessing the environmental effects of the project:

- Section 3: General construction programme
- Section 4: Key features of the project works for construction, including typical sequencing of key activities
- Section 5: Construction activities and methodologies including
  - Site access, construction support access including compounds, laydown areas and stockpiles.
  - Erosion and sediment control philosophy
  - Construction water needs, including for dust management and mitigation
  - Dewatering methodologies key structures interfacing with streams and wetlands and ground water.

## 3 Construction Programme

### 3.1 Construction duration

The Project works will be undertaken over an approximate 3 - 4 year programme. Actual dates will be confirmed once detailed design is completed and a contractor is appointed, however the target programme is as follows:

- Early works commencing end of 2025 (subject to separate applications). These have been identified to enable main works to proceed in a timely and efficient manner.
- Contract award mid 2026 to enable main works to commence on site by October 2026
- Likely opening date is 2030/31

In order to achieve the target completion date, many elements of the B2P Project will likely need to be undertaken concurrently during the construction period, including the completion of works in sections.

All dates indicative and subject to detailed design, funding approvals, land acquisition, contractor appointment, and other influences such as weather.

### 3.2 Hours of Work

Except where noted in the circumstances and exceptions described below, construction works will occur within daylight hours, 07:00 to 19:00, Monday to Saturday. No construction works will occur on Sundays or public holidays.

Some night works will be required for specific activities. Night works will generally be limited to key activities that cannot be undertaken during the day (due to safety and operational impact on traffic along SH1) such as;

- General traffic switching along SH1.
- Bridge beam and truss installation at key structures, as well as installation of the overhead VMS gantry and signal poles where adjacent to live traffic.
- Utility service connections and switches.
- Final surfacing and lane marking works along the existing SH1.

Weekend and overnight closures/block of lines of the MNL railway will also be required to enable safe working conditions during construction of the Kaiapoi Bridge widening works.

Extended working times between 5am and 10pm resulting in double shifts may be needed to achieve the construction programme dates, critical path items, or in respect of works where night work is unavoidable, e.g. works that interface with the current state highway network, or bridge works above live traffic or rail.

Dust suppression activities may be required at any time to manage potential impacts of dust, particularly in dry and windy conditions.

Lastly, some pre-start activities may occur before 07:00, including the arrival of staff to site and pre start briefings.

## 4 Key features of the project works

A detailed description of the design is outlined in the '30% Design Statement'. The following sections describe particular aspects of the design in relation to the constructability of features that may have environmental impact during construction.

### 4.1 Earthworks

Earthworks will comprise stripping of existing soil and filling with imported hardfill to achieve the proposed design alignment and embankment profile. Fill slopes are primarily to form up new traffic lanes within the designation.

Approximate earthwork volumes have been calculated by zone, as illustrated in the following figure and table. However, the overall fill volume may be in the order of 700,000m<sup>3</sup>, as part of refining the geometrics through to 50% design and taking into account earthbunds for the noise walls. (refer to Section 4.4)



Figure 1 B2P Zones for Constructability Assessment

**Table 1 Preliminary earthwork volumes**

Zone		By Zone		Area	Subtotals		Total	
		Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )		Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Zone A	South of Kaiapoi	10,000	6,000	Widening	65,000	160,000	135,000	680,000
Zone B	Kaiapoi to Cam	52,000	13,000					
Zone C	Cam to Williams	3,000	137,000					
Zone D	Quarry Lakes	15,000	147,000	Bypass	70,000	520,000		
Zone E	Lakes to Woodend Beach Rd	7,000	87,000					
Zone F	Woodend Beach Rd to Gladstone	5,000	35,000					
Zone G	Gladstone to Pegasus	13,000	58,000					
Zone H	Pegasus Interchange	26,000	68,000					
Zone I	Woodend Beach Bridge	2,000	75,000					
Zone J	Gladstone Road Bridge	2,000	47,000					

Standard earthworks practises will be followed in accordance with the specifications and guidelines of Waka Kotahi.

The general earthwork strategy will be developed in more detail by the contractor. However, the general earthwork strategy assumed for works currently is to import fill (from local quarries/river sources where possible) for all fill embankments.

There are limited opportunities to cut to fill on site due to very low cut volumes and the requirement for these site won materials to be both suitable for structural fills and free of contamination (unless adequately managed as part of the contaminated land management strategy). A Contaminated Sites Management Plan will be proposed as a condition of consent, and will include Accidental Discovery Protocols which address how suspected contaminated materials are segregated, contained, investigated, and reused / disposed. Site won fill is likely to be reused onsite for landscaping and noise bunds.

Embankments will generally incorporate geogrids placed within the slopes as constructed as required to ensure slope or wall stability.

### 4.1.1 Bulk Fill

The sequence for the construction of low embankments along the alignment, i.e. the embankments along the bypass section, is outlined below and illustrated in Figure 2. Note that typically low embankments (<2.0m high) comprise 30% of the total project imported fill volumes.

1. Clearing the permanent works footprint plus a 10m zone beyond the permanent works footprint.
2. Establishment of erosion and sediment controls in accordance with the EMP noting that the proposed soil stripping and stockpiling strategy as shown below will facilitate sediment control by reducing cartage and stockpiling, allow rapid stabilisation and grassing and provide cutoff of clean overland flow.
3. Stripping topsoil from the permanent footprint under the structural fill zone only and stockpiling this soil adjacent to the alignment.
4. Establish haul road within the designation works footprint (note that this would happen progressively with the stripping such that stripped areas are not left exposed for extended periods of time) and place first layer of structural fill.
5. Construct the road pavement layers
6. Respread the windrowed topsoil as non-structural fill to form embankment batters and stabilise with planting or grass.

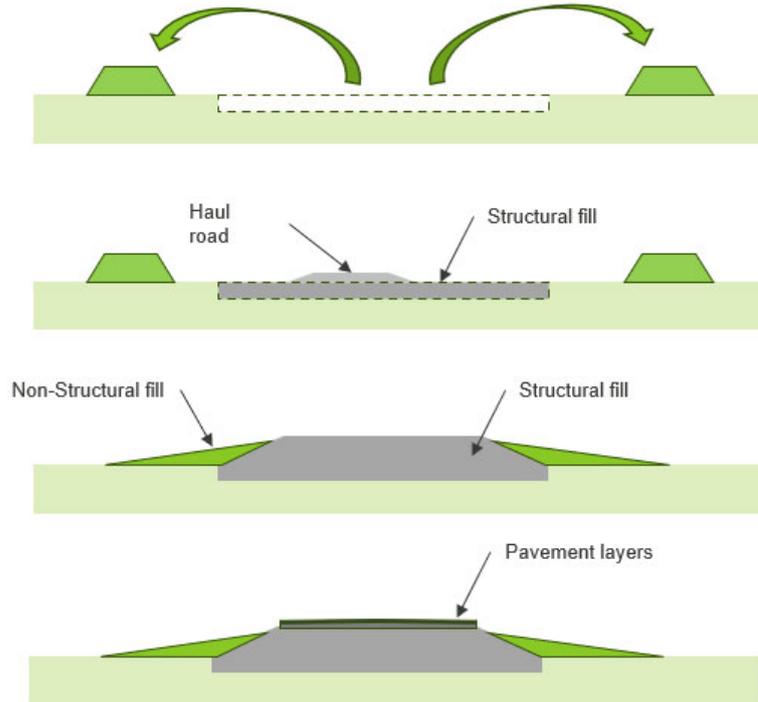


Figure 2 Sequencing of bulk fill along the main alignment bypass section

The extent of the disturbed area through the greenfield section of the designation is indicated below.

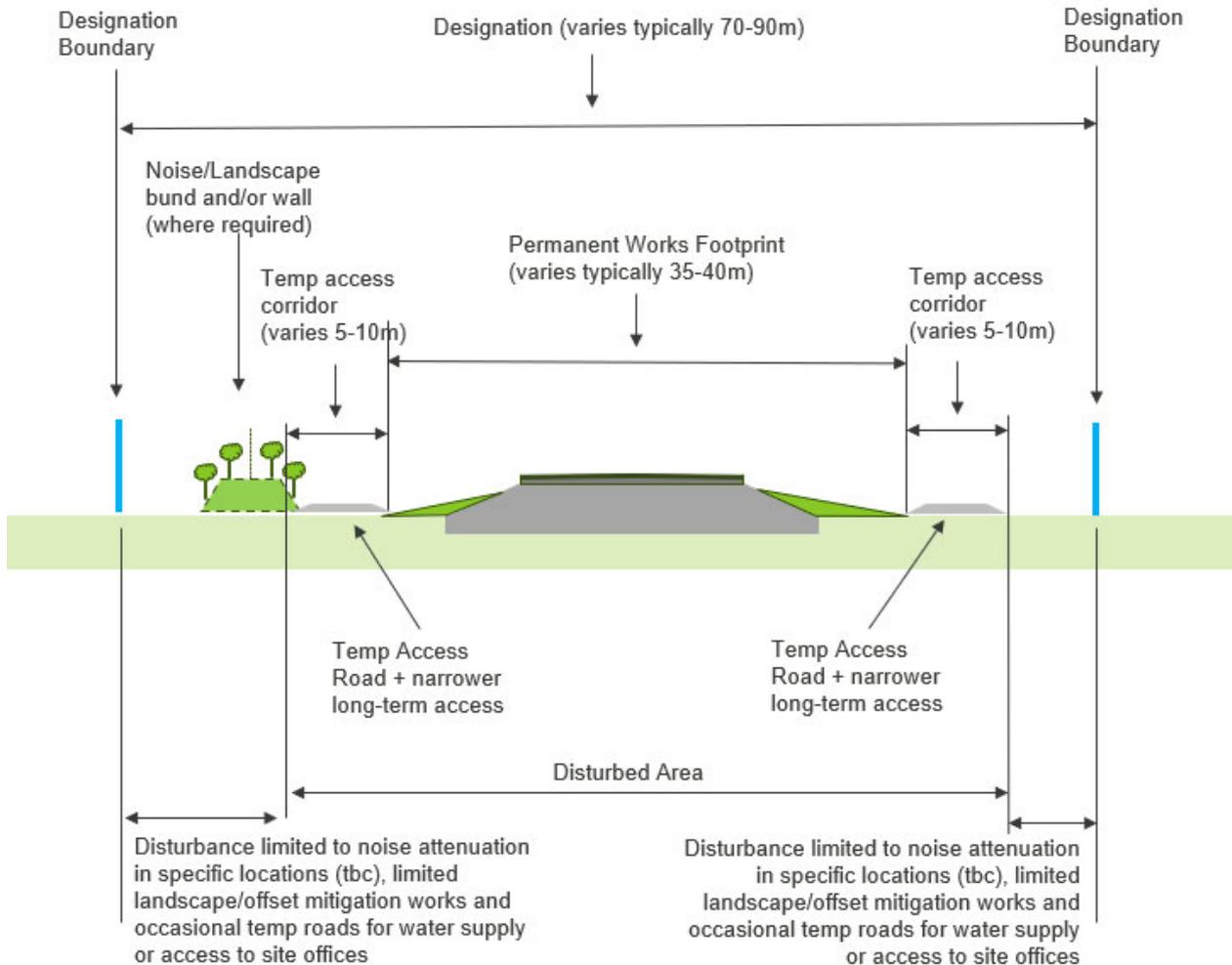


Figure 3 Cross- Section of disturbed area through the greenfield bypass section

### 4.1.2 Gladstone Road Landfill

The property at 162 Gladstone Road has historically been used as a landfill. Investigations of the landfill have found the former gravel pit has been filled with primarily hardfill.



Figure 4 Landfill site at 162 Gladstone Road

As illustrated in Figure 4, the western half of the landfill site sits under the proposed alignment. Subject to detailed design there are options to construct the proposed alignment through this area.

The landfill material which has been placed higher than the surrounding ground will need to be removed either offsite to a suitable location or respread within the designation. Below surrounding ground level, the options are;

1. Dig out and replace the landfill material with hard fill
2. Compact the landfill material in place using impact rollers or similar
3. A combination of dig out and compact in place

All works are within the designation.. The extent of works will likely cover the full site (north-south) length but may not need to extend the full width, given the proposed alignment does not fully extend to the eastern boundary of the site. Treatment of the landfill would be one of the first construction activities in this area once the site is established (i.e. these works would be completed prior to any utilities work, installation of temporary access road or general construction works in this area).

Dewatering is expected to be required in deeper parts of the landfill if dig out is required as per options 1 and 3 above. It is expected that dewatering the excavation could be possible by pumping out from a sump at the base of the excavation (sheet piling not anticipated to be required). Based on the current understanding of the landfill, only up to an estimated half of the footprint of the landfill would require dewatering. Dewatering is not expected to be required if material is compacted in place as per option 2.

### 4.1.3 Quarry Lake Southern Remnant Lake

A remnant waterbody (circa.2.5 ha) will be created through the partial reclamation of the quarry lakes for the new alignment (to be completed as early works and consented separately) refer to Figure 5 following. To provide project benefits this area will be backfilled and a wetland constructed as part of the main works. The

## NOT FOR CONSTRUCTION

filling and creation of a wetland environment addresses concerns about potential stagnation of the remnant waterbody and provides offset for the adverse effects on wetlands across the wider project.

Backfilling and wetland creation in this area will broadly comprise:

- Site establishment - will use access off Lees Road developed in the Early Works
- Filling the remnant lake up to about 0.5 m- 1.0m below water level (note water levels vary). Approximately one third of the area will remain as shallow open water, the remaining area will be formed as wetland.
- A total fill volume is approximated at 50,000 m<sup>3</sup> (assuming filling to current water level – approx 1 m below typical lake water levels).
- The bulk fill material shall comprise pitrun (raw unprocessed gravel) or similar hardfill. The bulk fill shall contain stone between 10 to 400 mm particle size, will be free of organic matter, and the fraction passing the 75-micron sieve shall be substantially non-plastic.
- The upper 200-300mm of the land area shall be formed using site won topsoil. The approximate volume of topsoil required is 10,000 m<sup>3</sup>.
- The lakes will likely be filled starting from the causeway embankment within the existing designation. The filling will occur through progressive end tipping from the embankment using the haul road along the lake embankment for material importation.
- Later stages of filling and access for wetland planting may occur from the existing southern lake margin, via access from the Lees Road Construction Support Area. No excavation or earthworks will be required to create haul roads in this area beyond vegetation clearance and placement of haul road hard fill.
- Earthworks around the lake margin to tie in the infilling will not extend further than 20 m from the upper lake shore, in part so that works within 100 m of the Barkers Road wetland are avoided. This offset from the lake edge is to provide access around the lake during construction and establishment of the offset wetland area.
- Trucks will deliver material directly to the remnant lake edge where heavy machinery will distribute the material into position. If the material is unable to be immediately manoeuvred to the lake, it will be temporarily stockpiled within the stockpile area the north (see Appendix A). Daily fill placement volumes are expected to range between 1,000 and 2,000 m<sup>3</sup>.

The timing of the works in this area will depend on the contractor's programming but is expected to occur following the completion of the early works to form the causeway crossing the lakes. Approximately 25 to 50 working days of filling will be required based on the estimated fill rates.

Once filled to required levels, wetland construction works will comprise re-contouring the fill, planting out of the area, fencing to protect planting and for predator control.



Figure 5 Southern Remnant Lake wetland development location – wetland layout to be confirmed

## 4.2 Bridges and Structures

### 4.2.1 New Bridge Construction Sequencing

The typical construction sequence for new bridge structures is outlined below. The duration of works at each location would be in the order of approximately 18-24 months.

1. Clearing and Stripping
2. Hardstand working area
3. Ground Improvement (see below)
4. Piling (Cam River only)
5. Abutments retaining wall construction and approach embankments
6. Bearing seat construction to support bridge beams
7. Lifting in bridge beams (constructed offsite, night works and land/road closures required to lift due to proximity of live traffic)
8. Pouring concrete bridge deck
9. Pavement works
10. Barriers, lighting and signage
11. Landscaping and planting

## 4.2.2 Ground Improvements

Ground improvements are required on all of the proposed bridges to ensure the ground has sufficient bearing capacity to support the bridge abutment. Ground improvements are also required to ensure that performance under earthquake loading is satisfactory, especially where seismically induced ground liquefaction and lateral spreading affects the overall performance of the bridge structure and abutments.

Ground improvements will be specific to each bridge and comprise from reinforced undercuts, stone columns and installation of displacement rigid inclusions such as Continuous Flight Auger or Displacement Piles. Ground improvement design and construction is bespoke to each bridge abutment. A description of the proposed ground improvement at each location, including extent and depth, is summarised in Table 2.

A description of the different ground improvement options is included in Appendix A.

## 4.2.3 Existing Bridges

### Kaiapoi River Bridge

At Kaiapoi River, an additional south bound lane is proposed, which requires an additional 4m wide bridge deck will be installed on the west side of the southbound bridge deck (between the two existing bridge decks).

Note strengthening works associated with this bridge are being undertaken as a separate Early Works package and are subject to a separate consent. The main works at Kaiapoi Bridge comprise the additional deck slab and associated surfacing and barriers.

Likely method of construction will include the following steps:

- Offsite precasting before transport to site;
- Cutting back of the existing deck edge and preparation of the existing piers, for landing of beam sections;
- Transport of beams to bridge lifting location, tandem mobile cranes set up on the deck and girder section lifted into place – likely 100T cranes, which will need to be reviewed for bridge deck weight;
- Hold downs fixed to pier and then repeated for each span;
- Linkages fixed between spans;
- In-situ concrete deck prepared, and concrete placed;
- Barrier and expansion joints placed; and
- Surfacing completed for full deck.

The piles required for this additional deck are already in place and hence no new piling nor access from the river is required. If a temporary work platform is required, this will be established from above, from a tower installed outside the river at either embankment or from the pile caps.

Cutting of the deck slab may result in some debris, so while access will be limited beneath during these works, a debris capture system will be established to capture any loose debris.

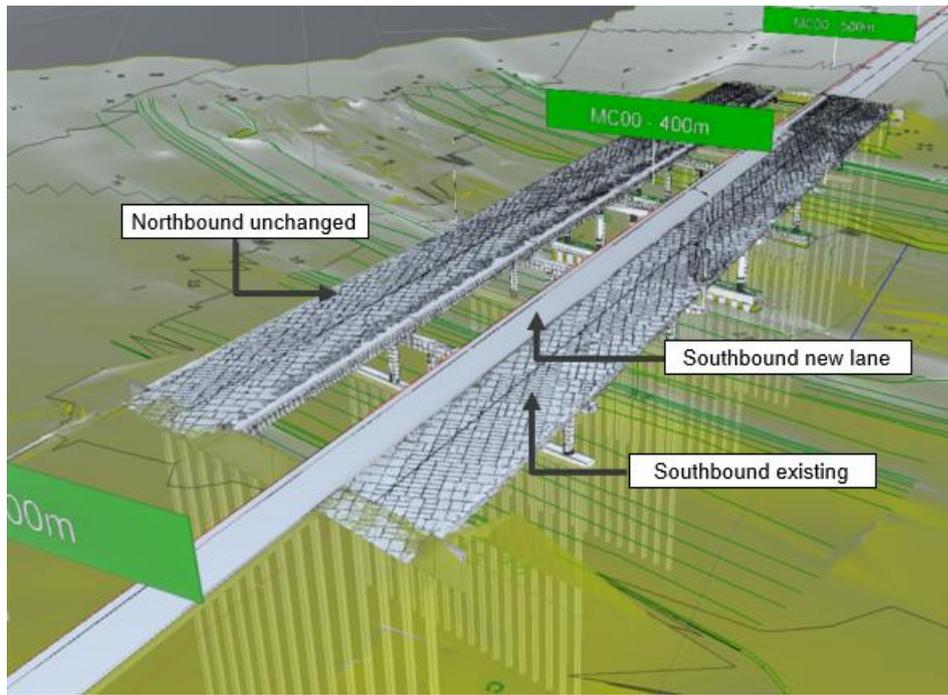


Figure 6 3D Illustration of Kaiapoi Bridge Widening

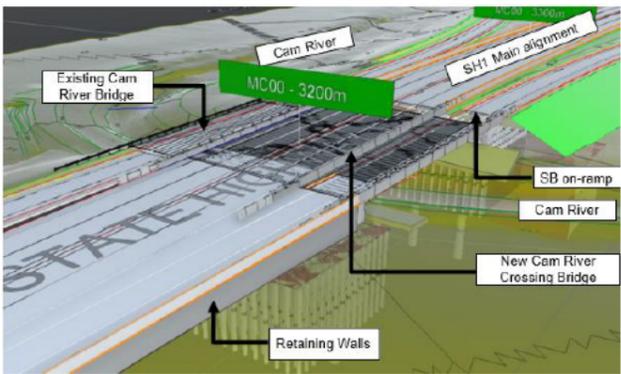
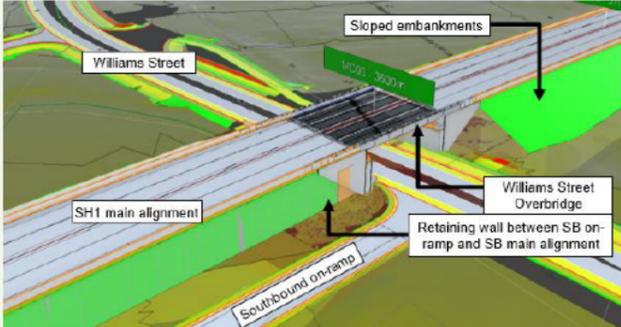
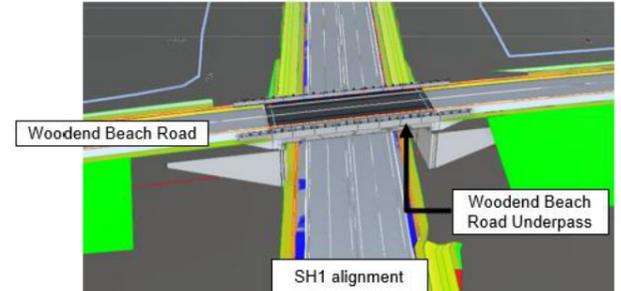
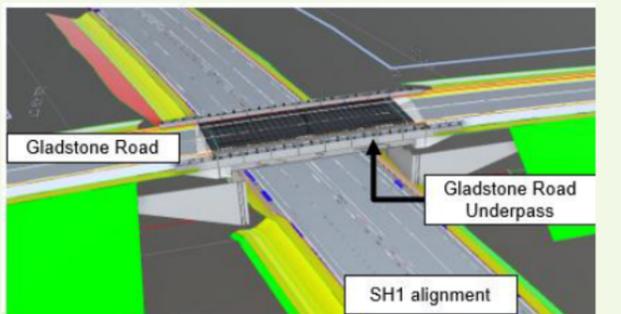
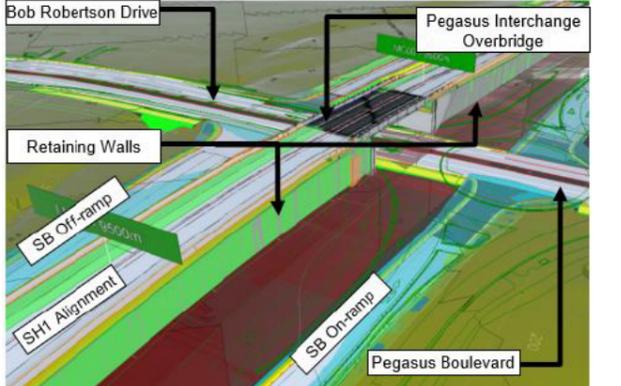
#### 4.2.4 New Bridges

##### Overall dimensions

Five new bridges are proposed along the alignment. For each structure the overall dimension, extent and type of ground improvement approach is summarised in the following table. For structures with additional features, such as culverts or in close proximity to rivers, further detail of the construction works is outlined in subsections following this table.

Note while the following table outlines a number of exact dimensions, these are based on the 30% design and may be adjusted up or down as the structural design is optimised through to 100%.

Table 2 Summary of each new bridge structure

Structure	Figure	Total bridge structural footprint	Foundations	Ground improvement	Approaches	Close proximity to
Cam River		37m by 28m	Piled foundations (1.5m dia., 14 m deep) 3m long settlement slabs behind abutments	Rigid inclusions (510mm dia., 1.5m c/c spacing, 11m long) Ground improvement footprint approx. 60m x 20m on both sides.	Embankments with 112m retaining wall on east side south of bridge	Cam River
Williams Street		29m by 22m	Shallow footings on MSE abutment walls	Rigid inclusions underneath MSE abutment walls (510mm dia., 1.5m c/c spacing, 13m long). Footprint 27x36m on each side of bridge. Stone columns (8.5m deep) under full width of embankment to south toward Cam River on west side of bridge, and halfway to Quarry Lakes on east side of bridge.	Embankments with retaining wall on east side between mainline and onramp	
Woodend Beach Road		35m by 16m.	Shallow footings on MSE embankments	Ground improvements beneath embankments (6.5m deep stone columns) Ground improvement extend is embankment footprint.	Embankments	
Gladstone Road Bridge		38m by 16m.	Shallow footings on MSE embankments	No ground improvement beneath embankments But dig out 1.5m and replace with geogrid raft 1.2m -3m thick	Embankments	Waihora Flow Path
Pegasus Interchange		34m by 17m	Shallow footings on MSE embankments	Ground improvements beneath embankments (510mm dia, 2.0m c/c spacing, 18m long). Ground improvement extend is embankment footprint.	Retaining walls	Taranaki Stream

## Cam River Bridge

At the Cam River the design retains the existing bridge, as northbound off ramp, and constructs only one new bridge that will carry the mainline traffic and the south bound on ramp.

**Existing bridge:** No works are proposed on the existing bridge, with the exception of surface works (e.g. line markings) that will be completed near the end convert the current two way bridge to a one way off ramp.

**New Bridge:** The new bridge is a single span deck and slab bridge, with a bored piled structure. The new Cam River bridge is the only new bored piled structure on the Project. The piles are required due to the proximity of the river and potential for scour and lateral spreading in flood and earthquake events, however **no median piers are proposed in the river**. Once cleared of vegetation, a gravel working platform will be laid over the existing ground and the ground improvements (rigid inclusions and stone columns) will be constructed. This would be followed by the bored piles and then MSE abutment support and retaining walls.

The bridge spans will be lifted in during several night closures on SH1.

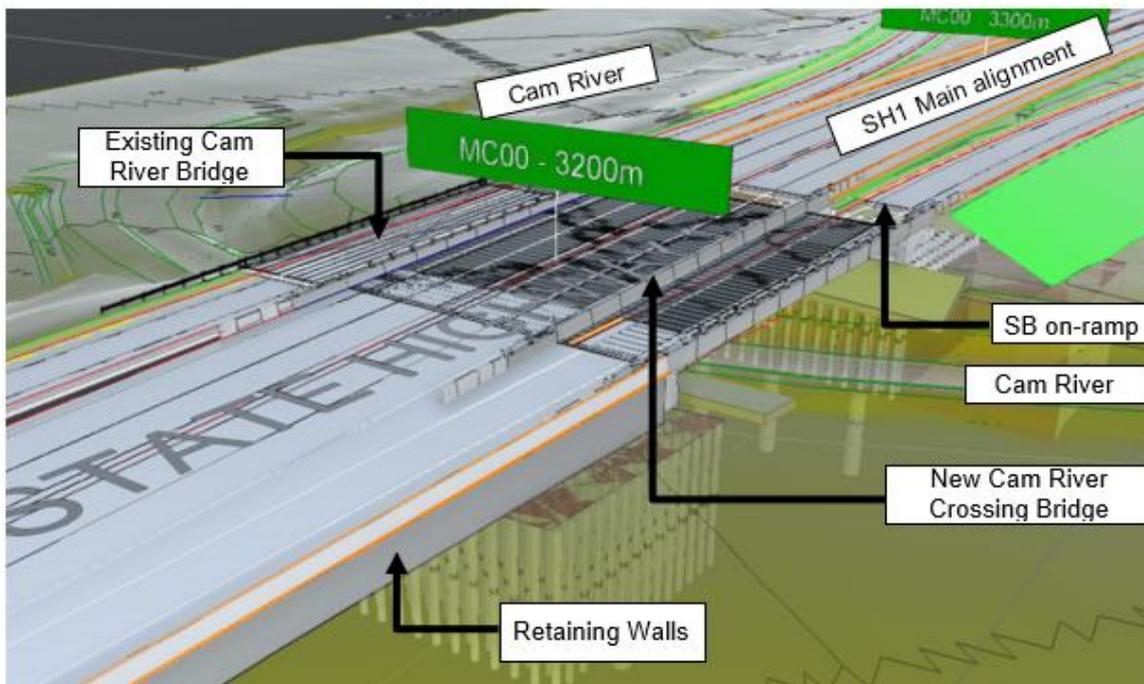


Figure 7 3D Illustration of New Cam River Bridge

The following cross section shows the location on the piles in relation to the river. None of the works require access to the river.

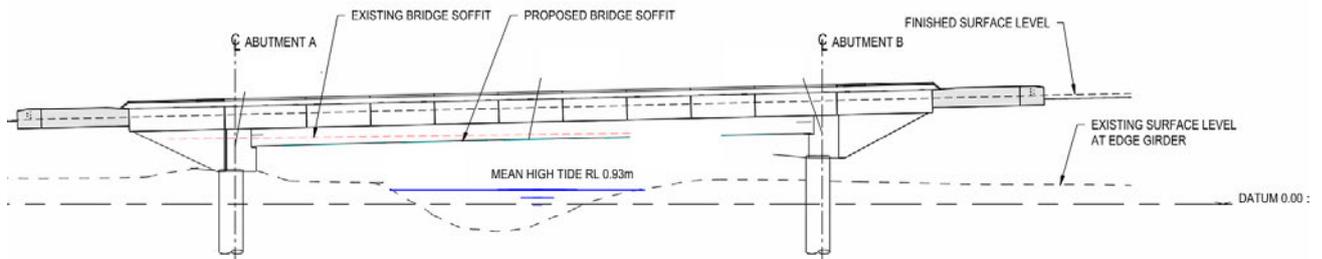


Figure 8 Bridge Cross Section at Cam River

## Gladstone Road Bridge

The first works in the Gladstone Road bridge location will be the work related to the adjacent landfill refer to section (Refer to Section 4.1.2) and the relocation of existing services out of the ground improvement footprint. A temporary road for local traffic and realigned utilities will be located north of the proposed bridge within the designation. This will also provide for the Waihora overland flowpath which will ultimately connect to the new culvert being constructed as part of the approach embankments, noting at this location the overland flow path is absent of any surface water body.

An indicative cross section showing these enabling works on the north side of Gladstone Road, in relation to the constructed embankment approaches, is provided in Figure 9.

With the construction footprint cleared, there will be a dig out of approximately 1.5m below existing ground and a geogrid reinforced gravel raft will be laid under the structure. There is no requirement to dewater the excavation if ground water is encountered.

Once this work is completed the typical construction phase for a new bridge as outlined in 4.2.1 will be followed.

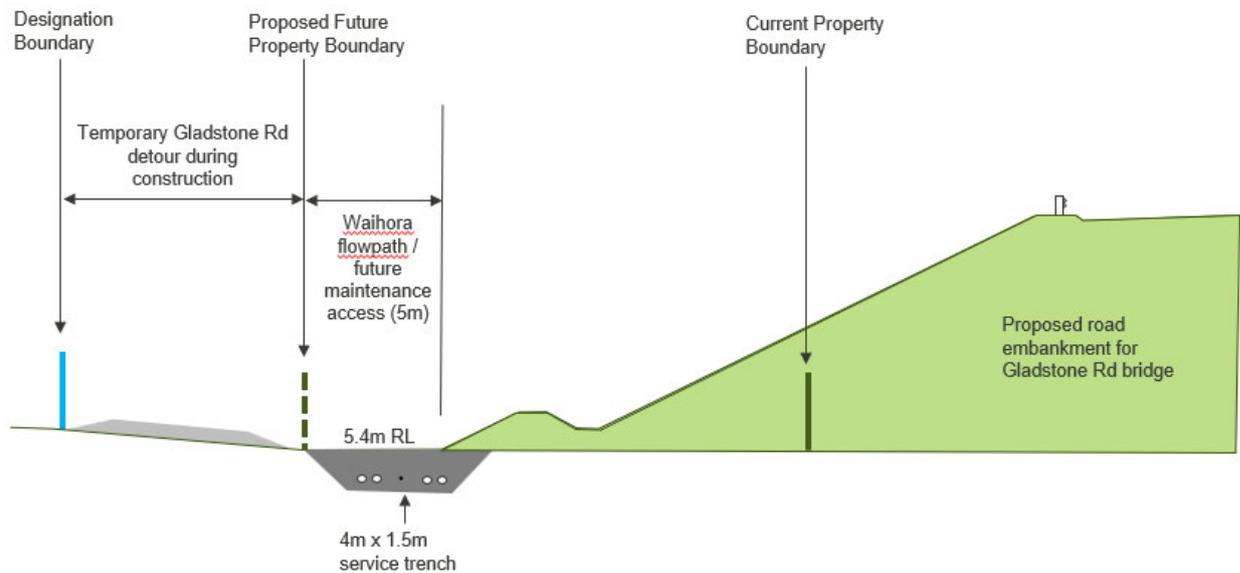


Figure 9 Indicative Cross section at Gladstone Road

## Pegasus Interchange

Construction of Pegasus Interchange will follow the typical construction phase for a new bridge as outlined in Section 4.2.1. In addition, this interchange will require some additional early pieces of work to relocate utilities and divert Taranaki Stream in conjunction with construction on the new culvert. The Taranaki diversion is discussed further below.

## 4.3 Culverts and Stream Realignment

### 4.3.1 Culvert Locations

There are a number of culverts to be replaced/constructed throughout the Project, with some in flowing waterways and others in dry overland flow paths.

- There are three large culverts in flowing watercourses: Taranaki Stream, Waihora Stream-SH1, and McIntosh's Drain

- There are two existing culverts on WDC drains under the existing section of the motorway between Lineside Road and Cam River that will be replaced.
  - At chainage 1600, Rossitier drain which is an artificial watercourse.
  - At chainage 2350, Wilsons Creek which is a modified natural watercourse
- The remaining culverts are on normally dry watercourses
- Stream realignment methodology that may be associated with the culverts is outlined in the following sub sections, while dewatering requirements are detailed in Section 5.9.2. For the culvert replacements on existing drains between Lineside Rd and Cam River (ch 1600 and Ch 2350) the waterway will be overpumped to allow the works to take place.

### **4.3.2 Stream Realignments**

The Project involves the permanent diversion of sections of the Waihora Stream, Taranaki Stream (including tributary WDC stormwater drain) and McIntosh Drain. The stream realignment sections are:

- Taranaki Stream – (including existing culvert)
- Taranaki Tributary stormwater drain
- Waihora Stream (SH1 crossing) – (including culvert)
- McIntosh Drain – (including culvert)

Diversion of dry sections of the Waihora Stream are also required to maintain overland flow paths and mitigated potential flooding impacts due to construction of the motorway embankment within existing flow paths.

- Waihora Stream (flow path through 160 Gladstone Road)
- Waihora Stream (flow path downstream of Gladstone Road)

### **Flowing streams**

The methodology for constructing stream diversions on the flowing streams will be to construct and stabilise as much as possible of the new alignment offline to the existing streams, before connecting into the flowing channel. Once the main diversion has been constructed and stabilised, and any remaining sediment laden water pumped from the channel, the downstream connection to the existing stream will be established.

Other diversions of dry portions of the Waihora Stream are required to maintain secondary overland flow paths. These will be constructed in the dry and prior to undertaking embankment filling work affecting existing flow paths.

## **4.4 Noise Barriers**

Up to 3km of noise barriers (total on both sides) are planned along the alignment. The preferred design for the noise barriers is still being refined but will consist of one of the following options:

1. A timber or steel/concrete fence at ground level at the edge of the alignment
2. A small earthbund, set outside of the proposed swales with a timber or steel & concrete fence
3. An earth bund set beyond the swales. If earthbunds are required at all identified noise wall locations, an additional 50,000 m<sup>3</sup> of imported fill will be required.

All noise barriers will be constructed within the designation.

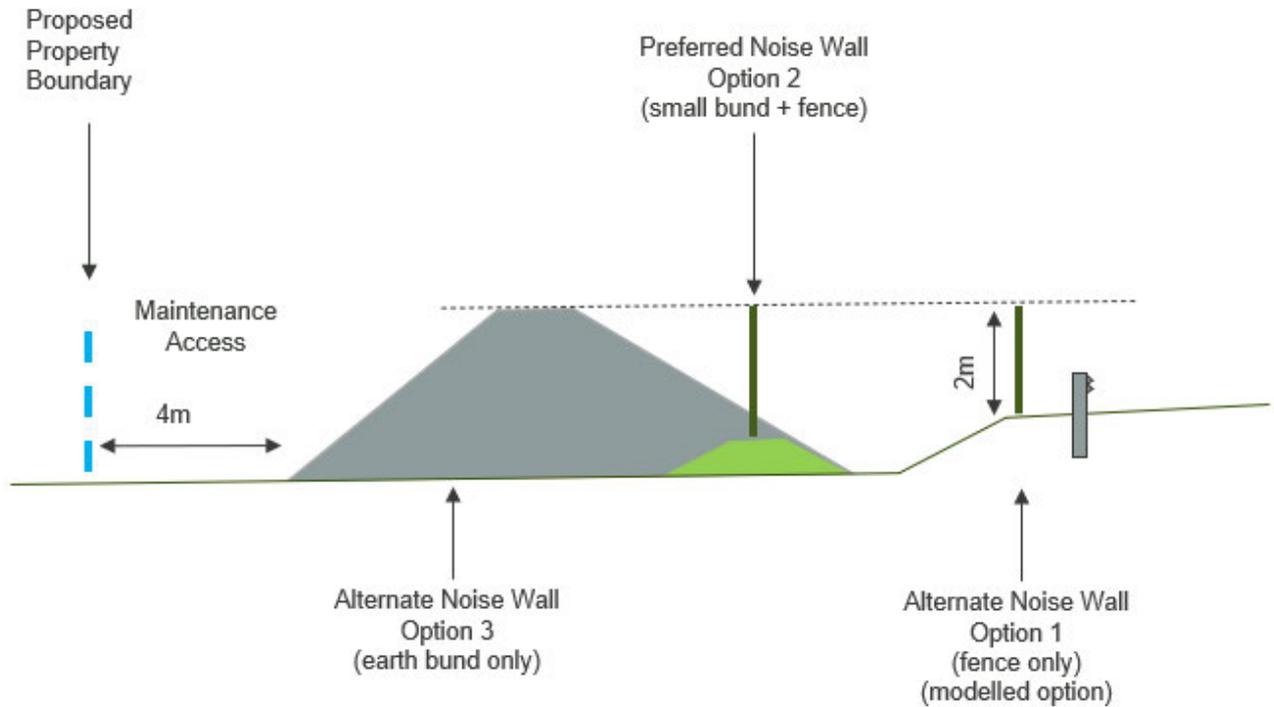


Figure 10 Noise Barrier options

## 4.5 Utilities

For the affected utilities within the Project extent, the proposed design will be developed to comply with the minimum cover and clearance requirements. Where the minimum requirements aren't practical to achieve, a protection methodology such as either a concrete slab over ducts or concrete encasement will be developed in coordination with the relevant utility operator as the do-minimum option. This is to reduce disruption of the respective utility operators and their customers in accordance with the relevant utility standards.

Where it is not practical or feasible to protect utilities in-situ, then relocation of utilities will be considered.

Where utility relocations underneath the carriageways are required, these are proposed to be perpendicular with the road centre line. Longitudinal relocations will be generally proposed outside of the embankment areas and located as close to the final motorway corridor boundary as possible.

Any utility works within the State Highway or Motorway and local road reserves will comply with the Utility Identification and protection minimum standard as well as the National Code for Utilities' Access to the Transport Corridors guidelines to avoid, or at least mitigate the potential adverse effects on the health and safety of people and on the surrounding environment.

In addition to above, the utility relocation works will be managed so that the installation, design, operation, maintenance and upgrade will be in compliance with the relevant standards, codes of practice or guidelines. All relocation works will take into account the relevant provisions in the Local Government Acts and Acts relevant to the statutory powers and responsibilities of Waka Kotahi and any other relevant legislation.

The utilities design for the Project will consider future proofing by prompting Utility Operators to undertake high level infrastructure assessment for future proofing their networks to meet the future developments and demands.

Dewatering requirements in relation to the services relocations are outlined further in Section 5.9.2

## 4.6 Local Roads

The Project includes works on the following connecting local roads, which will be designed at the interfaces to tie-in with existing geometry with the following existing road:

- Williams Street
- Woodend Beach Road
- Gladstone Road
- Bob Robertson Drive
- Pegasus Boulevard

For the existing roads, the pavement will be designed to tie in with the existing alignment at the project interface.

In addition, at Garlick Street a new arterial road will form an Urban Connector (under the future One Network Framework) connecting the State Highway to Bob Robertson Drive. For the new connection at Garlick Street, the topsoil will be removed and sealed pavement constructed to WDC collector road standard. The road will be constructed with a low point that ties into with existing stormwater management over flow path, with excavation depth in the order of 0.5m (i.e. above existing groundwater).

## 4.7 Private Accessways

As part of the Project, 12 private driveways are affected and will be realigned as part of the construction works, including access to properties off Main North Road, Gladstone Road, Woodend Beach Road and Fullers Road.

The final location of these driveways are to be negotiated with the property owner and will be realigned such that they do not interfere with lizard habitat, wetlands or archaeologically sensitive areas.

Note, to enable the construction of Gladstone Road bridge, temporary access will be provided to properties accessing off Gladstone Road, until such time the structure is complete and permanent access can be connected.

## 5 Construction activities and methodology

### 5.1 Introduction

To inform the construction activities associated with site, a Construction Site Requirement concept plan has been developed outlining the following:

- Worksite areas depicting primary site office and satellite office locations;
- Laydown areas; and
- Stockpile areas.

Note while these have been identified as suitable for the works, the suitability and extent of these will need to be confirmed by the contractor.

This concept plan is provided in Appendix A and referred to in further detail where relevant in the following sub sections.

### 5.2 Establishment

Establishment and enabling works may occur in advance of the main works and may consist of the following:

- Site-wide geotechnical investigations;
- Topographical surveys;
- Ecological, cultural, archaeological and heritage surveys/ baseline monitoring, exploration and assessments including relocation and stabilisation activities;
- Contaminated land testing;
- Relocation of accesses to properties;
- Protection and relocation of utilities;
- Formation of site access and haul roads, including temporary stream crossings;
- Development of construction access tracks and / or reconfiguration of existing access tracks, and development of the construction yards and main site offices including site compounds and laydown areas;
- Works associated with the abstraction of water needed to construct the Project, as outlined further in Section 5.7;
- Property fencing and demarcation of areas where construction activities will not occur;
- Installation of erosion and sediment control measures associated with establishment works;
- Clearance of vegetation associated with establishment works (and clearing buildings and other features including relocation of wildlife); and
- Management plan production.

### 5.3 Site Access

#### 5.3.1 Site Access Points

Construction access and egress is primarily required for:

- transport of site sourced material such as earthworks;
- transport of material from off-site sources; and

- access and egress by construction staff, plant and vehicles.

HCV access for the supply of material from off-site sources will be via site access points (SAPs) which will be located, designed and constructed with the safety of all road users and construction staff in mind. It is expected that these SAPs may be categorised, as follows:

- Access from SH1 to road side laydown areas around Lineside Interchange for Kaiapoi Bridge and 4 laning south of Cam River;
- Access off SH 1 at Cam River;
- Access from Williams St to the northern side of Cam River and the quarry lakes area for Woodend Bypass section;
- Williams Street for the main site office compound;
- Access across local roads that intersect with the construction corridor;
- SH1 for the northern end of the Woodend bypass alignment; and
- Bob Roberson Drive for the Pegasus Interchange and site office facilities.

These anticipated SAPs are expected to be formed so that they may be trafficked by road legal vehicles. Management of site access will be through the Construction Traffic Management Plan.

### **5.3.2 Haul Roads**

Beyond the existing road network, the transport of site sourced material such as earthworks will be on temporary haul routes within the designation of the Project. For the bulk fill and pavement materials this will typically be within the footprint of the permanent works with haul roads formed using imported gravels or rockfill. 5.7Construction Water

### **5.3.3 Local Road Management**

In terms of managing traffic movements across the wider road network, this is considered separately, as part of the Outline Plan process.

However, in terms of local roads immediately adjacent to the site, this is generally expected to be limited to light vehicles with the exception of the northern section of Williams Street, to access the quarry lake area and south to Cam River. While the occasional heavy vehicle may use the adjacent local roads along the alignment the majority of heavy vehicles will access along the proposed alignment from Williams St (near the Lees Road intersection) or SH1 at Pegasus. For the online section of works access will be directly from SH1.

## **5.4 Construction Support Areas**

### **5.4.1 General**

Construction support areas (CSAs) will be required for the provision of contractor and welfare facilities, plant/material storage, and earthworks stockpiling as required. All CSAs will be wholly located within the existing Project designation, with the exception of the primary CSA at Lees Road (a designation alteration for temporary occupation at this location forms part of the Project).

### **5.4.2 Locations**

The following sites are envisaged to be potential construction support areas for the Project. The primary site will be at Lees Road with additional satellite CSA sites at strategic locations along the Project extents.

- 236-264 Lees Road. This site will include the primary construction office with parking and facilities for approximately 80 people.
- Smaller local site offices and laydown areas will be located at the major structure locations
  - Kaiapoi Bridge
  - Cam River
  - Woodend Beach Road
  - Gladstone Road
  - Pegasus Interchange

### **5.4.3 Establishment**

It is envisaged that the CSAs may be established in the above locations as follows:

- All CSAs will be appropriately secured. Site establishment activities will include site clearance, ground preparation, and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the works, the CSAs will be disestablished, and the areas restored to at least their previous condition prior to construction or as mutually agreed between the landowner and the Contractor.
- CSAs are likely to be provided with water, telecommunications, power and toilets. Where a local connection is available connection directly to the existing adjacent networks will be made. Where there is no existing network adjacent to the CSA, a remote service will be established (i.e water trucked in, satellite comms, portable toilets, generators etc). Any connections made will be removed after the completion of the Project.
- CSAs are likely to be established on compacted fill to provide usable storage and amenity areas.

### **5.4.4 Likely amenities**

The CSAs are likely to include some or all of the following amenities:

- Project offices (portacom style buildings).
- Welfare facilities including:
  - Toilets.
  - Break out / Dining areas.
  - First Aid equipment.
  - Employee car parking.
- Weighbridge.
- Lockable buildings and/or containers for storage of small tools/equipment and materials

### **5.4.5 Likely storage and site activities**

Activities likely to occur within the CSAs include but is not limited to:

- Site offices and construction personnel amenities, including car parking.
- Construction vehicle and machinery parking and maintenance.
- Loading and unloading of construction materials.
- Storage of construction materials.

- Fabrication, reinforcement cutting and bending.
- Storage of plant and equipment and building materials.
- Storage of ground improvement plant and materials.
- Storage of hazardous construction materials (if any, and none within a Community Drinking Water Protection Zone).
- Construction vehicle wheel washing areas (where necessary).
- Stormwater and groundwater treatment facilities where required.
- Waste storage and collection.
- Spoil handling and storage.
- Storage of supplanted trees / shrubs.

## 5.5 Stockpile Sites

It is expected that some cut material may be suitable for the construction of the bulk fill, non-structural landscaping fill and topsoiling the finished works. It is likely that some of this material will need to be temporarily stockpiled to suit the logical construction sequencing and provide a material buffer in case of supply disruption. The number and locations of the potential stockpile areas will be determined in the final design and construction methodology of the contractor.

In addition, a stockpile of aggregate materials for embankment and pavement construction may be established adjacent to the main worksites in laydown areas. This will allow continuity of working in the event of disruption to material supply from offsite.

The potential impacts of any temporary stockpiles will be mitigated as for any other earthworks activity. Mitigation measures will include effective erosion and sediment controls, and dust suppression, as described in the following sections.

## 5.6 Erosion and Sediment Control

This section describes the methods and practices to be implemented to minimise the effects of sediment generation on receiving environments associated with the Project in accordance with the NZTA Erosion and Sediment Control Guidelines for State Highway Infrastructure (2014), ECan's erosion and sediment control toolbox (ESCT)<sup>1</sup> and the relevant regional resource consent conditions (Volume 2D).

### 5.6.1 Environmental Performance Standards

Several key features of the Project are of importance in terms of erosion and sediment control:

- Proximity to sensitive water bodies including the Cam River and wetlands
- Values of the receiving environments adjacent to and downstream of the Project
- Site topography
- Areas of exposed soils or geotechnically unstable areas
- This is a long, linear project that crosses six (6) catchments within a narrow designation corridor.

These items have been considered while developing this methodology and are reflected in the overall approach taken. In addition, the NZTA has adopted as part of its wider national Environmental Plan (EP)<sup>2</sup>, a

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<sup>1</sup> <https://www.esccanterbury.co.nz/>

<sup>2</sup> NZTA, 2008. *Environmental plan: improving environmental sustainability and public health in New Zealand*. June.

series of erosion and sediment control objectives for roading projects. These three erosion and sediment management objectives are outlined below:

1. Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition.
2. Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas.
3. Use bio-engineering and low-impact design practices where practicable.

These objectives have been fully considered and are reflected in this methodology.

## **5.6.2 Overall Erosion and Sediment Control Approach**

The following section outlines the measures that will be implemented as part of the erosion and sediment control and builds on the principles of the ESCT. This section provides an overview of how sediment and runoff will be managed during the construction works. Further detail and design are required, and this will be set out in the Erosion and Sediment Control Management Plan (ECSMP) prepared by the contractor.

The focus of the construction erosion and sediment control management during works will be as follows:

- Erosion control will be a key priority to reduce the sediment generation requiring subsequent treatment.
- The main erosion and sediment control risk associated with earthworks include:
  - Works within and adjacent to watercourses and wetlands (stream diversions, bridge works, culvert placement)
  - Exposure of bare land and trafficking of unsealed surfaces (potential dust generation, refer to Section 5.8 for details on dust suppression)
  - Sensitive receiving environments and their associated values
  - Stockpiling of materials
  - Discharge of sediment laden water from excavations
- Key structural measures for sediment control include:
  - Diversion channels
  - Decanting earth bunds
  - Silt fences and super silt fences
  - Container impoundment systems
  - Sediment retention ponds with chemical treatment
- Where possible structural measures will be aligned with the permanent works, for instance forming a bioretention basin early in the project to function as a SRP during construction and be able to remain in place during the entire project
- Management of unconsolidated surfaces will be important to minimise potential for sediment generation. This will be done through prompt stabilisation of areas not actively worked. The ECSMP will provide further detail on this stabilisation trigger.
- Progressive stabilisation including placing basecourse, seeding, mulching and geotextiles will occur throughout the course of the project to minimise erosion and dust generation.
- Regular informal monitoring of controls will be undertaken by construction staff with notes for repairs noted in their daily diaries.
- Regular documented weekly inspections will be undertaken by the Environmental Manager (or delegate), checking the controls for compliance and maintenance requirements.

- Daily weather reports including the five day look ahead will be sent to the construction team by the Environmental Manager (or delegate).
- Water quality monitoring upstream and downstream of the site to demonstrate compliance with consent conditions.

### **5.6.3 Erosion and Sediment Control Management Plan**

As expected with projects of this size and nature, site and activity a detail erosion and sediment control management plan (ESCMP) will be developed which will follow the general principles of this section.. The ESCMP will be submitted to ECan for certification prior to commencement of works.

The Contractor may develop specific ESCMPs for different stages of the work or higher risk locations/activities.

The detailed ESCMP will consider a number of factors including:

- The specific construction activity to be undertaken and associated risk
- The area and volume of the earthworks and/or stream works at specific locations
- The location of the works with particular consideration of the receiving environment
- The duration of the works
- The time of the year the works are to be undertaken
- Specific construction erosion and sediment control measure methodologies and design criteria
- Details of chemical treatment (flocculation) (if needed)

The detailed ESCMP will take into account the environmental and ecological values of the specific work areas and determine the most effective and appropriate form of erosion and sediment control devices and management practices on a site-by-site basis.

Once the erosion and sediment controls are in place, on-going site monitoring by the contractor and the NZTA representatives will occur to ensure that the proposed erosion and sediment control measures have been installed correctly and are functioning effectively throughout the duration of the works.

The detailed ESCMP process also allows for improvement in management measures as a consequence of learning from the Project's comprehensive monitoring programme. The detailed ESCMP will be updated throughout the course of the Project to reflect material changes associated with changes to construction techniques or the natural environment.

## **5.7 Construction Water**

Construction water will be required to facilitate compaction of fill embankments and pavements, dust control, vegetation establishment and to a lesser extent for equipment cleaning and concrete curing. This demand will peak in summer to reduce dust during strong winds and could be up to 2,000m<sup>3</sup> of water per day.

Construction water may be taken from the following sources:

- Surface water take from quarry lakes, which will be able to recharge naturally from groundwater.
- Waimakariri District Council water supply network
- Ground water bores (subject to separate consent process and allocation availability)

## 5.8 Dust Suppression

### 5.8.1 Construction Air Quality Management Plan (CAQMP)

Any dust generated on the Site will be managed in accordance with a CAQMP. The CAQMP will be prepared to identify factors that may cause a dust nuisance during the construction phase and proposed mitigation for these factors as part of consent application.

The objectives of the CAQMP are to:

- Ensure management of construction dust and air emissions.
- Minimise adverse impacts.
- Achieve target dust deposition and particulate benchmarks.

### 5.8.2 Key Issues

Key issues include:

- Working near existing properties.
- Exposed site with limited shelter.
- Earthworks and stockpiling operations.
- Working with contaminated soils.
- Working near existing waterways (Kaiapoi and Cam Rivers, MacIntosh's Drain, Taranaki Stream).
- Working on a main carriageway (SH1).

### 5.8.3 Sources of Dust and Emissions

Construction will typically involve the following potential dust and emission sources:

- Clearing of existing vegetation.
- Exposing of bare earth.
- Excavation and earthmoving (earthworks).
- Handling and stockpiling of excavated and imported material.
- Vehicle movement within the site on unsealed haul roads/tracks.
- Loading and unloading of materials.
- Transportation of material.
- Respreading of silt and topsoil.
- Dynamic compaction (of quarry lakes embankment)
- Building and structure demolition/removal.

### 5.8.4 Mitigation Measures

Measures to limit dust generation will include:

- Minimisation of the time excavated surfaces are exposed before they are covered with hardfill materials.
- Disturbed areas are to be stabilised as soon as practicable with permanent or temporary vegetation.
- Utilise granular material on haul and access roads to reduce dust from vehicle movements.

- Stockpile management including alignment and compaction of the outer surface.

Measures to mitigate effects will include:

- Dust suppression with water spray or water carts.
- Utilisation of dust suppressant additives.

## **5.9 Dewatering**

Dewatering or works within 1m of groundwater during construction is expected to be limited to culvert replacements/relocations, service trenching/relocations and stream diversions.

Dewatering may also be required at Gladstone Road Landfill if the full landfill material is removed – further detail on dewatering at the landfill is presented in Section 4.1.2.

### **5.9.1 Culverts**

There are a number of culverts located throughout the Project, with some on flowing waterways and others in dry overland flow paths. Selected dewatering assessments have been completed to represent the various ground conditions and the excavation scenarios, resulting in a range of conditions to cover off most of the scenarios. For the dewatering assessments, a conservative estimate of excavation and dewatering to a depth of 1m below the culvert invert has been assumed.

For large culverts in flowing watercourses (Taranaki Stream, Waihora Stream-SH1, and McIntosh's Drain), construction of the culverts will be offline to the existing stream flow. This will enable excavation and dewatering for construction to occur separated from the flowing waterbody.

Two existing culverts on WDC drains, as outlined in Section 4.3.1, under the existing section of the motorway between Lineside Road and Cam River will be replaced online. Dewatering for these culverts will also include damming and potentially diversion of surface water past the culvert works. Due to these culverts crossing the existing highway, the construction will be done in sections to allow traffic to be diverted around the open portions of the works.

The remaining culverts are on dry watercourses and will only require localised dewatering should the foundation excavation encounter groundwater.

### **5.9.2 Stream Diversions**

Stream diversions that may require dewatering are required on the Waihora Stream, Taranaki Stream (and tributary WDC stormwater drain) and McIntosh Drain.

The methodology for constructing stream diversions will be to construct and stabilise as much as possible of the new alignment offline to the existing streams, before connecting into the flowing channel (refer Section 4.3.2 Stream Realignment for further description of these works). Depending on the location, dewatering may be required to locally lower the groundwater level to enable excavation and stabilisation works on the new channel to be undertaken.

### **5.9.3 Service Relocations**

There are a number of service relocations and new service installations associated with the construction works. Service relocations are concentrated around the Pineacres intersection, Woodend Beach Road bridge, Gladstone Road bridge and the Pegasus Interchange.

Service trenches are typically 0.6m to 2.0m wide and 0.8m to 1.5m deep. Generally, these trenches will work with 0.6 to 1.2m cover unless they are having to cross under drains and swales. Where groundwater is expected to be intercepted dewatering is likely to be required for a period of several days to allow trench bedding material and services to be laid and backfilled in a dry trench. This would typically be achieved via local drawdown through well pointing and/or a sump pump in the trench base during working hours.

## NOT FOR CONSTRUCTION

Where services are located in or under river beds, such as those crossing under the Taranaki Stream and Waihora stream, the intention is that these will be installed by trenchless methods such as directional drilling. The length of open trench at any one time and therefore the amount of pumping required will depend on the service being relayed. PE pipes can be done in short runs whereas power cables require longer lengths to be installed at once.

# Appendices



# Appendix A

## Extent of Work

Key (note that the extent of indicated stockpile areas will be confirmed once a contractor is appointed as per section 5.5).

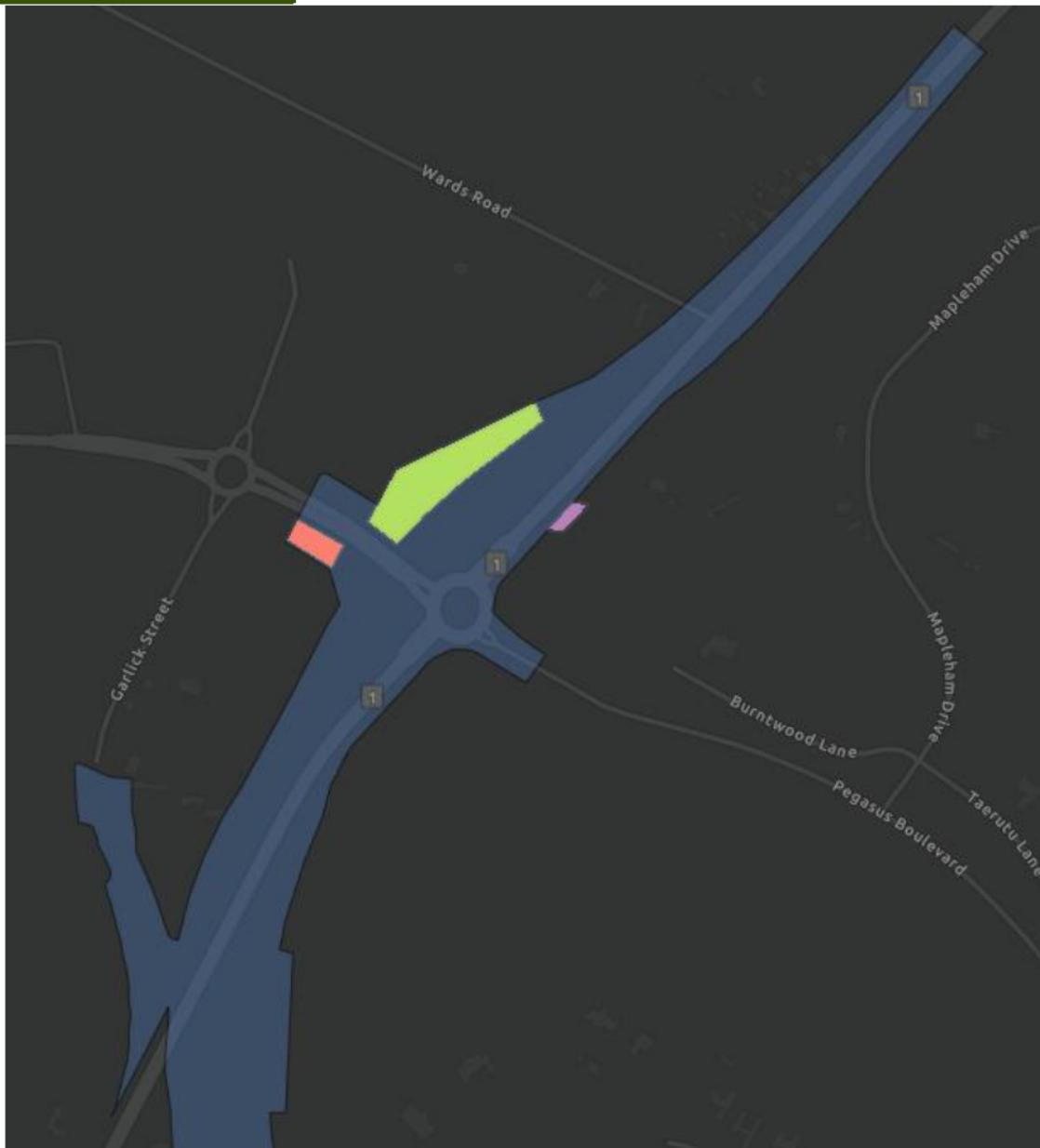
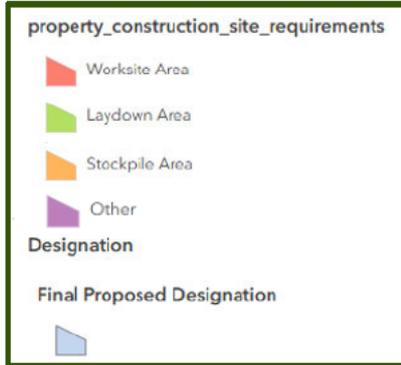


Figure 11 Construction Site Requirements at Pegasus

**NOT FOR CONSTRUCTION**



Figure 12 Construction Site Requirements at Gladstone Road

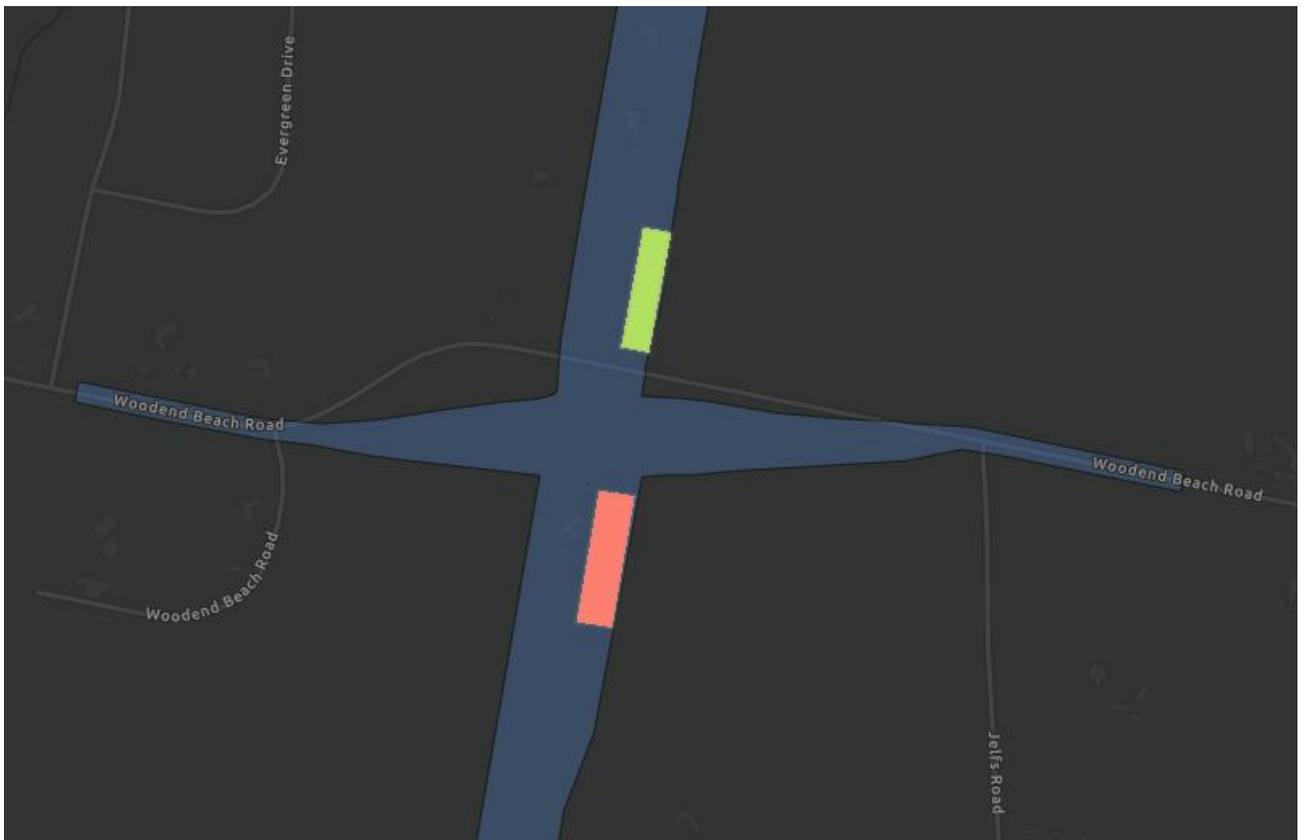


Figure 13 Construction Site Requirements at Woodend Beach Road

**NOT FOR CONSTRUCTION**



**Figure 14 Construction Site Requirements at Williams Street**



**Figure 15 Construction Site Requirements at Lineside Road – Smith Street**

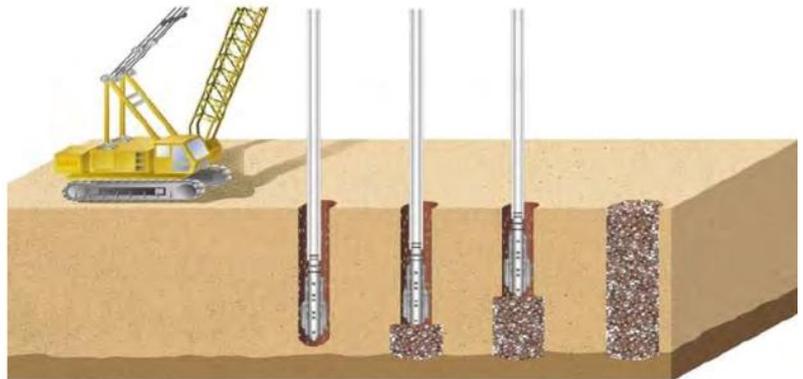
# Appendix B

## Ground Improvement Methods

### Ground Improvement Methods

#### Stone Columns or Rammed Aggregate Piers (RAP)

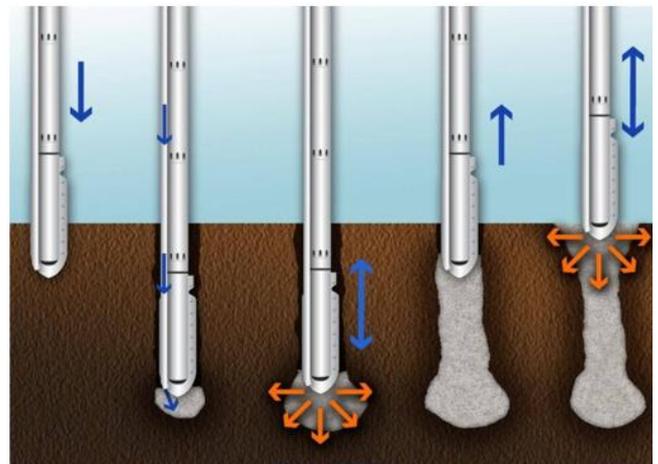
- Stone columns are constructed by making holes up to the desired depth in the ground & filling the hole with gravel or small stones.
- The size of stones may vary from 6mm to 40mm. The hole for stone columns is excavated using a vibroflot or displacement probe.
- Once the excavation is complete, the hole is filled with stones.
- The diameter of the stone column varies from 0.5m to 0.7m and the spacing between two adjacent columns is usually 1.5m to 3m.



#### Rigid Inclusions

Rigid inclusions are a ground improvement technique that uses stiff columns, often made of concrete or aggregate, to reinforce weak or compressible soils and transfer structural loads to deeper, more stable layers.

They are an alternative to deep foundations like piles, allowing for shallower footing systems and reduced construction costs

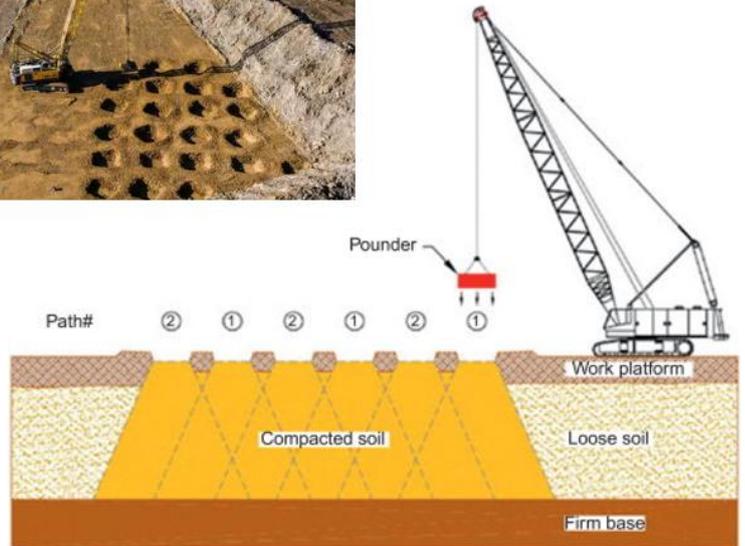


## NOT FOR CONSTRUCTION

### Dynamic Compaction

Dynamic compaction is a ground improvement technique used to densify loose granular soils by repeatedly dropping a heavy weight from a height.

This impact transmits high-energy waves through the soil, compacting it and improving its geotechnical properties, especially the soils performance under earthquake loading.

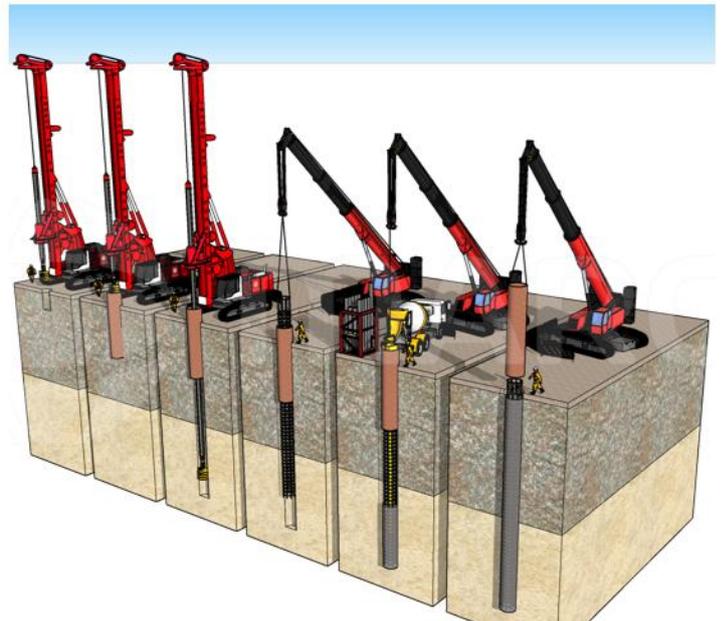


### Bored piles

Bored piles, also known as drilled shafts, are a type of deep foundation used to support structures with high vertical loads such as bridges.

They are constructed by drilling a hole into the ground, placing reinforcement, and then filling the hole with concrete.

This method transfers the load of the structure to deeper, more stable soil or bedrock layers.



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