6. Construction of the Project

This section contains information in relation to a possible construction methodology for the Project to provide a basis for the assessment of the environmental effects. This section should be read in conjunction with the Construction Water Assessment Report and the Drawings, which form part of the AEE documentation.

Based on the current degree of detail available, the information provided in this section is indicative but serves to provide certainty that the Project can be practically and feasibly constructed. It is intended to provide sufficient detail on the proposed construction activities to assess their potential environmental effects and to identify any necessary measures to avoid, remedy or mitigate those effects, where appropriate.

The final construction methodology for the Project will be influenced by a number of factors, including:

- The detailed design and value engineering process for the Project, which will occur once consents have been obtained and a contractor(s) appointed;
- The construction duration, and target completion date;
- The procurement method adopted; and
- Technological advances.

Detailed design may result in some refinement of the alignment within the designation boundary and changes to the indicative construction methodology outlined in this section.

The detailed design will be subject to an OPW process under s176A of the RMA and conditions of the designation and resource consents. The OPW process is described in greater detail in Section 1.9 of this AEE. The conditions of the resource consent and designation will control the environmental effects of the Project and will dictate the key design parameters.

In order to assess the environmental effects associated with the construction of the Project, this section outlines the following indicative construction aspects:

- Construction zones;
- Construction yards and bridge staging areas;
- Enabling works;
- Materials required for construction;
- Water use requirements for construction;
- Erosion and sediment control;
- Works in streams;
- Earthworks;
- Hazardous substances and materials;
- Viaducts and bridges;
- Protection and relocation of existing network utilities; and
- Construction programme.

6.1 Construction Zones

For the purposes of assessing the environmental effects related to the construction of the Project, the Project Sectors (outlined in Section 5.2.3 of this AEE) have been divided into 11 indicative construction zones based on delineation by earthworks, major structures and catchment areas.

The indicative construction zones are shown on Figure 6-1 and in Drawings C101 – C117 in Volume 4 and are summarised in Section 6.2 of this AEE.

It is anticipated that construction of the Project will be staged, with a number of the construction zones being open and worked on concurrently. The total area of open earthworks in Mahurangi and the Pūhoi catchment will be subject to constraints that have been identified in the Construction Water Assessment Report. These constraints are discussed further in Section 10.7.2 below.

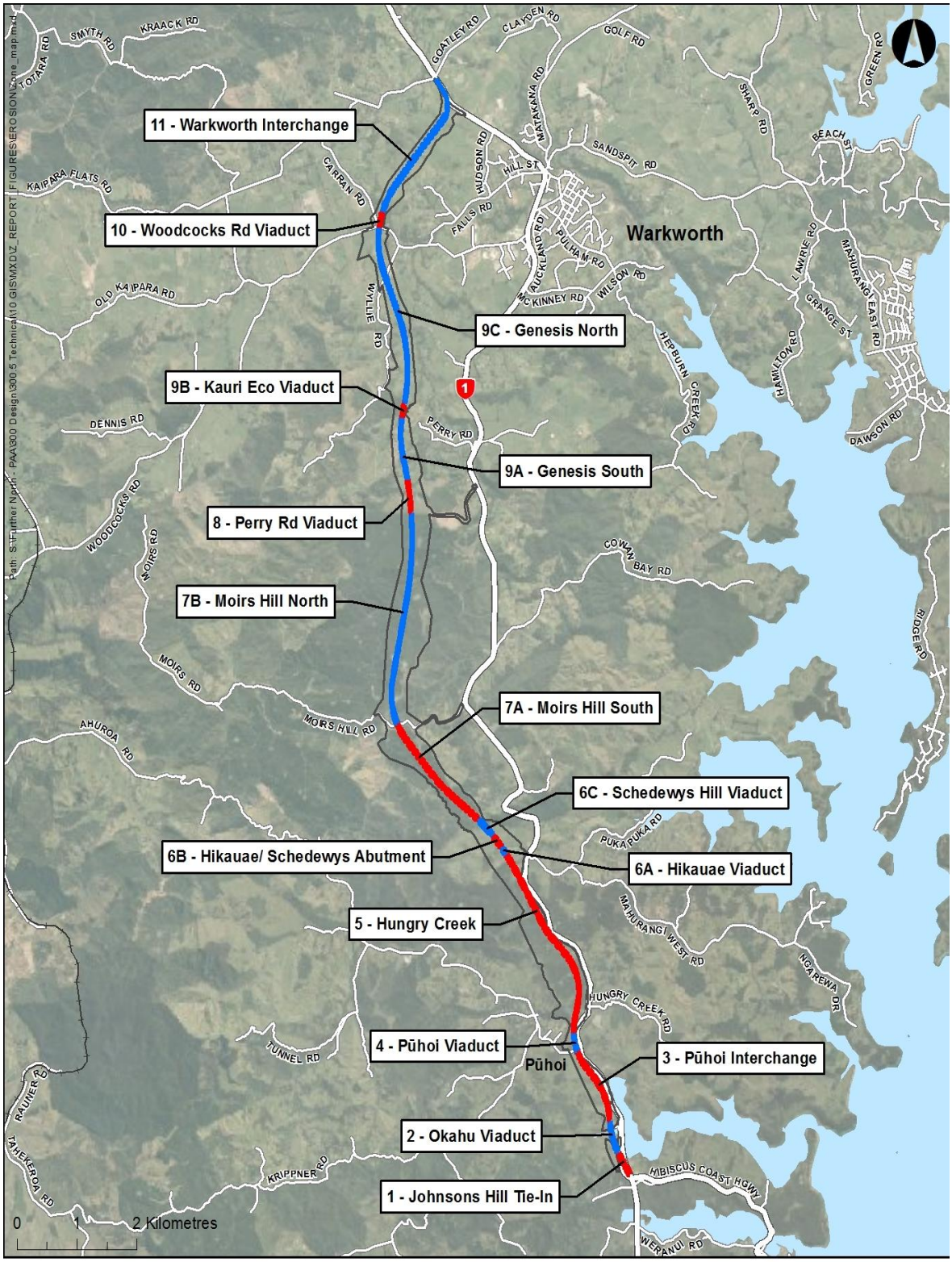

Figure 6-1: Indicative Project construction zones

6.2 Construction yards and bridge staging areas

Each construction zone will require the establishment of a construction yard and/or bridge staging area. These areas will be required for the construction of the viaducts, earthworks activities, the project and design offices and the precast yard (refer to Section 6.2.1 below) as outlined in this section.

It is likely that the indicative construction yards and bridge staging areas shown in Table 6-1 will be required. The designation is wide enough to accommodate construction yards and bridge staging areas. Final locations and areas required for the construction yards and bridge staging areas will be confirmed in the OPW.

Table 6-1 Indicative Project construction yards and areas

Purpose	Approximate size required
Bridge Staging Area-1	10,000m^2
Construction Yard-2	10,000m^2
Project and Design Office Area-2	10,000m^2
Bridge Staging Area-3	5,000m^2
Construction Yard-4	10,000m^2
Construction Yard-5	10,000m^2
Bridge Staging Area-6A and 6B	10,000m^2
Construction Yard-7	5,000m^2
Construction Yard-8	10,000m^2
Construction Yard-9	10,000m^2
Bridge Staging Area 9a	5,000m^2
Bridge Staging Area-10	5,000m^2
Construction Yard-11	10,000m^2
Construction Yard-12	10,000m^2
Bridge Staging Area-13	5,000m^2
Construction Yard-14	10,000m^2
Precast Yard Area-15	20,000m^2

Bridge staging areas are required for the assembly of launching gantries, lay down and storage areas for materials delivery, workshops, project offices and ablution facilities. The assembly area required for balanced cantilever structures will be approximately 200m–250m in length and approximately 100-150m in length for the precast super-tee structures.

Construction yards are required for repairs, maintenance and re-fuelling of earthmoving equipment, lay down and storage areas for materials delivery, workshops, project offices and ablution facilities.

The main project and design office is proposed to be located at the corner of Pūhoi Road and the existing SH1. The compound will contain features commonly associated with construction facilities, including:

- Temporary site office buildings;
- Material laydown areas;
- Workers' office and workshop accommodation;
- Ablution facilities
- Plant and equipment maintenance facilities;
- Fuel storage and refuelling facilities;
- Wheel washing and cleaning facilities;
- Car parking; and
- Plant and equipment storage areas.

Section 6.4.13 of the Construction Water Assessment Report contains methodologies for managing surface water drainage from these yards during the construction phase.

6.2.1 Precast yard

A temporary, purpose built, precast concrete manufacturing facility is proposed for the construction of the precast concrete segments, beams and barriers for the seven major structures proposed for the Project. The Precast Yard is proposed to be located at Woodcocks Road as it is suitable for heavy vehicle access and is in close proximity to local ready mix concrete batching plants. No concrete batching for the Project is anticipated to occur on-site. The precast yard location is shown on Drawing C-115.

The layout of the Precast Yard will consist of an industrial factory requiring a likely area of 2,000m^2 to 3,000m^2, a hard stand area of approximately 20,000m^2 and administration and site office facilities. The facility set up could include 4 moulds for match casting the balanced cantilever segments, two moulds for casting the pre-stressed super-tee beams, areas for the fabrication of reinforcement and the areas for the storage of pre-stressing wire strand and reinforcement bar.

An example of a precast manufacturing facility is shown in Photo 6-1 and Photo 6-2.

Photo 6-1: A precast manufacturing facility

Photo 6-2: Interior of a precast manufacturing facility

Refer to Section 6.4.13 of the Construction Water Assessment Report for detail on the management of stormwater from the yard, including consideration as an industrial or trade process.

6.3 Enabling works

Prior to the commencement of construction of the Project, some early enabling works may be necessary. Such works include the creation of access tracks. Enabling works will require soil disturbance and vegetation clearance, which will be undertaken in accordance with the principles as outlined in Section 6 of the Construction Water Assessment Report and the associated erosion and sediment control and earthworks principles outlined later in Section 6.6 of this AEE.

Access tracks for construction activities will be required in a number of locations along the length of the Project. Access is required to construction and laydown sites, bridge staging areas, construction yards, site and project offices and other construction related activities.

The indicative location of proposed construction access tracks is shown on Drawings C101 – C-117 in Volume 4. The indicative access tracks are as follows:

- Existing SH1 at the connection point with the proposed Pūhoi southbound ramp;
- Existing SH1 just north of the intersection with Pūhoi Road to provide access to the main project and design office area;
- Existing SH1 north of the intersection with Hungry Creek Road;
- Existing SH1 south of the intersection with Mahurangi West Road;
- Existing SH1 just south of, and at the intersection with Hungry Creek Road;
- Moirs Hill Road, on the eastern side of the alignment;
- Moirs Hill Road, on the western side of the alignment;
- Existing SH1 south of Perry Road;
- Wyllie Road;
- Woodcocks Road; and
- Existing SH1 just north of the northern tie-in.

The effects of forming construction access tracks will be addressed in the Construction Erosion and Sediment Control Plans (CESCP), which will be developed subsequent to consents being granted and detailed design being undertaken. Section 6 of the Construction Water Assessment Report provides a conceptual approach to construction water management including construction access tracks.

6.4 Materials required for construction

The Project will require approximately 6.2M m^3 of fill for the proposed embankments as outlined in Section 6.8 of this report.

A mobile rock crusher will be required to crush cut material as needed. The rock crushing plant will require resource consent under the ARP:ALW for the discharge of contaminants to air. There is the potential for dust to be generated from the crushing of the rocks and the conveying of crushed materials. The potential for dust emissions will largely depend on the moisture content of the materials and the amount of fines generated. Refer to Section 18.3.1 of this report for further information on the potential dust effects associated with the mobile rock crusher (refer to Section 7.4.4 of the Air Quality Assessment Report for further detail). The location of rock that may require

crushing is shown in Drawings C101 – 117 in Volume 4. Areas where crushing may be required are the hill country, and primarily from Pūhoi to the northern extent of the existing forestry area.

Other common materials required for the construction of the Project will be manufactured off-site and transported in as required. These will likely include but not be limited to:

- Road surfacing materials (including bitumen);
- Road furniture, for example lighting columns, traffic signage; and
- Steel required for structural components.

6.5 Water use requirements for construction

Water will be required for construction activities, such as dust suppression.

Water supply may be obtained from a variety of sources, including but not limited to, stored sources, groundwater or the Pūhoi River. The Mahurangi River is fully allocated and therefore is not an available water supply source for the Project at this stage.

The successful contractor will be required to obtain sufficient water supply for construction of the Project. At this stage it is not desirable to restrict the contractor to a particular source or sources, given the linear nature of the Project and the segmentation of the Project works due to the viaduct structures required. If the contractor's chosen source requires additional resource consents, they will be required to obtain these from Auckland Council prior to the commencement of works.

6.6 Erosion and sediment control

The scale of the Project will require the disturbance of a large area of land within the designation. An overriding principle for the Project has been to minimise the land disturbance required in order to reduce construction related sediment from entering streams and watercourses and, in turn, the Pūhoi Estuary and the Mahurangi Harbour (refer the Construction Water Assessment Report).

A key erosion and sediment control principle will be to minimise the area and length of time that particular areas of ground are open in conjunction with the use of proven structural and non-structural control devices and methods. The extent of open areas in any one catchment will be restricted and will be stabilised on a progressive basis. Consent conditions will ensure this requirement will be achieved.

From an erosion and sediment control perspective, the Project has been classified into two distinct types of terrain as follows:

- Hill Country – including the prominent landforms of Pūhoi, Schedewys Hill and Moirs Hill; and
- Flat Country – including the relatively flat areas from Perry Road to Warkworth along the Mahurangi River Right Branch.

The proposed erosion and sediment control methodology detailed below is considered a practical approach to achieving the associated cut and fill operations within these locations while minimising

erosion, increasing the capture of sediment generated, and minimising sediment yield during the construction of the Project.

The methodologies proposed incorporate some procedures and measures that are conservative and exceed the guidance provided in Auckland Regional Council's 'Technical Publication 90 – Erosion and Sediment Control: Guidelines for Land Disturbing Activities in the Auckland Region' (TP90).

6.6.1 Erosion control measures

Erosion control on the Project will be based on the minimisation of sediment generation in the first instance through a reduction in the erosion potential of exposed soils. Erosion control will be the highest priority in the design of erosion and sediment control measures as it prevents, as far as practicable, sediment generation through a range of structural (physical) and non-structural (construction sequencing and staging and site management practices) measures.

Erosion control measures proposed for the Project will be designed to minimise the generation of sediment in the first instance and will include:

- A maximum open area for each catchment, including the Hill Country and Flat Country areas within the Mahurangi catchment (as defined in the Construction Water Assessment Report (Section 1.7));
- Construction staging and sequencing;
- Diversion channels;
- Contour drains;
- Stabilisation construction entranceways; and
- Flumes and pipe drop structures.

The key erosion control measure remains the use of industry recognised best practice including progressive stabilisation and the limitation of exposed open area at any one time.

Construction staging and sequencing: The extent of exposed soil and length of time that area is exposed has a direct influence on the sediment yield leaving a particular area of the site. Bulk earthworks and construction activities will be staged and sequenced in order to limit the area of exposed soil required to complete an element of the work. Open earthworks areas will be progressively stabilised to reduce the potential for erosion to occur.

Stabilisation for erosion and dust management purposes: Open soil areas will be progressively stabilised by the placement of topsoil, grass seed, mulch, geotextile and the use of hard fill material to reduce the potential for erosion to occur to assist with minimising dust and erosion potential.

Mulch will include hay/straw and wood bark generated on site though the removal and mulching of existing vegetation as appropriate. Stabilisation will particularly apply at stockpile areas and batter establishment to reduce both erosion and dust generation.

Clean and dirty water diversions (CWD and DWD): CWDs provide for the controlled conveyance of stormwater runoff and will be used on the Project to prevent run on water from the

undisturbed catchment above the works from entering the construction area. DWDs are effectively a conveyance device that transfers sediment laden water to sediment retention devices for treatment. Both systems are designed to take the 20 year rainfall event (refer to Drawing ES-152 in Volume 4 for a typical cross section).

Contour drains: Contour drains are temporary ridges or excavated channels or a combination of the two that are constructed to convey water across a slope at a minimum gradient. They reduce the slope length, the velocity of water flowing down disturbed slopes and reduce the erosive power of construction runoff.

Check dams: Check dams are small dams made of rock or other non-erodible material constructed across a swale or channel to act as a control structure. The purpose of a check dam is to reduce the velocity of flow within the channel and prevent scour of the channel surface. Check dams also allow for some settlement of suspended solids within the channel.

Pipe drop structure / flume: Temporary pipe drop structures or flumes are constructed to convey construction runoff down a slope face without causing erosion of the slope and will be used to ensure no scour of these batters occurs. These structures will be designed and implemented as per Drawing ES-153 in Volume 4.

Stabilised construction entranceways: Stabilised construction entranceways are a pad of aggregate placed on a filter base located where construction traffic will exit or enter a construction site. They help to prevent site entry and exit points from becoming a source of sediment and also help to reduce dust generation and disturbance along public roads.

No vehicles will be allowed to leave the site unless tyres are clean (refer to Drawing ES-153 in Volume 4 for a typical cross section).

6.6.2 Sediment control measures

Sediment control on the Project will involve the interception and treatment of sediment-laden runoff from the various construction areas along the Project and as a minimum will be carried out in accordance with the guidelines contained in TP90. Sediment control will be established through the use of recognised sediment control measures and site management practices.

Sediment control measures proposed for the Project include:

- Sediment retention ponds;
- Decanting earth bunds;
- Super silt fences;
- Container impoundment systems; and
- Chemical treatment.

Typical details of these are contained in Drawings ES 151-152 and 154-155 in Volume 4. An example of erosion and sediment controls are shown in Photo 6-3 below.

Photo 6-3: Erosion and sediment controls – NGTR

Sediment retention ponds: Sediment retention ponds (SRP) are detention structures used during the construction phase of earthworks activity to capture and treat any sediment laden runoff and retain sediment. SRPs operate by storing sediment laden runoff allowing the sediment to fall out of suspension and be retained within the pond.

Treatment of construction runoff, collected in the SRPs, will be carried out to ensure that sediment is removed to the maximum extent possible from the runoff before being discharged to the receiving environment.

The number, sizing and location of SRPs will be relative to the size and slope of the catchments. Where higher sediment loads are expected, typically in larger catchments and/or on steeper slopes, the effectiveness of ponds will be increased through the addition of chemical flocculation (outlined below).

The indicative operational stormwater treatment for the Project will include a number of permanent stormwater treatment wetlands. Where the location of a SRP coincides with a permanent stormwater treatment wetland, the wetland will be used on a temporary basis as a SRP. These will be converted to long term stormwater wetland features at the completion of the earthworks activity within that sub-catchment.

Decanting earth bunds: Decanting earth bunds (DEB) are temporary berms or ridges of compacted soil, which are constructed to create impoundment areas where ponding of sediment-

laden runoff can occur and provide time for suspended solids to fall out of suspension before the runoff is discharged to the receiving environment.

Pumping activities: It is proposed that all SRPs and DEBs be fitted with floating decants with a mechanism to control outflow, such as a manual decant pulley system to be used during pumping activities to these structures. Wherever possible, gravity flow will be used rather than pumping.

Pumping flows to SRPs and DEBs ensures that any sediment laden flows are discharged to a treatment device prior to entering the receiving environment.

Super silt fences: Super silt fences (SSF) are fabric fences reinforced with stakes and netting backing to allow a physical barrier to flows leaving the area of earthworks. The design and placement of SSFs will be based upon the criteria contained within TP90. SSFs will be used in those areas of work adjacent to, or in the immediate vicinity of watercourses.

Container impoundment systems (CIS): In locations where SRPs or DEBs cannot be located due to slope, area constraints or instability issues, CIS will be used. These will be fitted with a decant system and will also be subject to chemical flocculation. It is expected that these systems will be used primarily in the early stages of earthworks for small catchment areas prior to the ability to develop SRP structures.

Flocculation: Flocculation is a chemical treatment method for increasing the retention of suspended solids from construction earthworks runoff in SRPs and DEBs. Flocculent is added to construction runoff flowing into a SRP or DEB via a rainfall activated system (flocculent shed) or via manual batch dosing.

The use of flocculation chemicals increases the efficiency of SRPs and DEBs and reduces the amount of sediment discharged to the receiving environment.

All SRPs and DEBs will be chemically treated on an as required basis with a flocculants appropriate for the soil type and discharge location.

6.6.3 Construction Erosion and Sediment Control Plans

Various Construction Erosion and Sediment Control Plans (CESCPs) will be submitted for consideration by Auckland Council for specific work areas or activities prior to commencement of works. They will provide the detailed design, erosion and sediment control measures, staging and sequencing of works for that location. The plans will include how devices will be maintained.

Further detail regarding the development of CESCPs is contained in Section 4.3 of the Construction Water Assessment Report.

6.7 Works in streams

6.7.1 Stream realignment

Some temporary stream diversions will be required during the construction of the Project to allow construction works to progress or to provide access to a construction area. Permanent stream

diversions will also be required to divert the stream around or through permanent Project features, such as an embankment, bridge or culvert. In both cases, stream diversions will be necessary in order to establish an 'off-line' environment to allow construction works to be completed outside of the active stream channel.

Stream works activities are generally considered to have a greater potential for adverse effects than earthwork activities due to the works being undertaken within the immediate receiving environment and the associated increased potential for sediment yield and direct impacts. Stream works required for the Project will be undertaken in a manner that recognises this risk and the sensitivity of the receiving environment.

Where practical, stream work activities and any associated works within these environments will be undertaken in an 'offline' environment, being outside of the watercourse itself. This strategy will be based upon the temporary diversion of flows around the area of works or working immediately next to the stream.

The works will be programmed and undertaken so that fish spawning and migration periods will be managed accordingly.

A conceptual sequence of events for temporary and permanent stream diversions is outlined in Section 6.1.5 of the Construction Water Assessment Report. During the detailed design phase of the Project and prior to any stream works commencing on the site, a final stream works methodology will be developed, with particular emphasis on timing, staging and sequencing of stream works. The typology (refer 5.10.3 above) will be determined based on site-specific analysis prior to construction.

A CESCP will be developed for each circumstance where stream realignment works are required.

6.7.2 Culverts, erosion control and protection structures

Temporary and permanent culvert construction will be required in a number of locations throughout the Project. Temporary culverts will be provided to allow construction vehicles to cross watercourses and overland flow paths, and these will be removed when no longer needed and the stream bed will be rehabilitated.

Culverts will be constructed in a dry condition, isolated from the existing stream flows. A stream diversion will be required either prior to construction works commencing on the culvert or to direct flows into the culvert once construction works have been completed. Temporary and permanent stream diversions are discussed in Section 6.7.1 above.

Where culvert installation or an extension is required within a stream channel, the culvert works, depending on stream flows and fish passage requirement could be carried out either by bypassing the flows around the culvert footprint establishing a stream diversion as discussed in Section 6.7.1 above or by pumping the flows around the culvert works areas.

Prior to undertaking the works at a particular culvert location, a specific construction methodology will be developed and will be detailed within the CESCP for the particular location.

6.8 Earthworks

The Project will involve large volumes of earthworks, approximately 189ha. The total volume of cut material is approximately 8.0M m^3, approximately 6.2M m^3 of fill material and approximately 1.8M m^3 difference.

It is anticipated that most earthworks operations and movements can be contained within the designation boundary with minimal movement of spoil using public roads. Mass haul distances will be minimised to increase efficiency of the operation.

An example of bulk earthworks is shown in Photo 2–4 below.

Photo 6-4: Bulk earthworks NGTR

6.8.1 Disposal of surplus material

With the indicative design approximately 1.8M m^3 of surplus material is likely to be generated. Surplus material will be cut from the various cuttings zones within the Project and disposed of within spoil sites and embankment widening works associated with the Project. The locations of the spoil sites are indicated on Drawings R-100 to R-115 in Volume 4.

The majority of the disposal areas identified are located close to the indicative alignment and involve extensions to the upstream sides of embankments, using some large gullies above the road. These require design and drainage measures to minimise any discharge of sediments onto the road alignment or blocking of culverts.

The final disposal site locations for surplus material and final volumes will be determined during the detailed design phase of the Project as part of the OPW process.

Section 5 of the Construction Water Assessment Report provides details of the proposed water management to be employed for the spoil sites during the construction phase.

6.9 Hazardous substances and materials

Construction activities and site works will include a wide range of machinery and construction plant, the majority of which will be motorised and require a regular supply of fuels and oils. The machinery will require refuelling on-site; hence fuel, oils and other lubricants will be stored on site. These products can become pollutants if discharged both directly or indirectly to land or water. Other construction materials such as cement, bitumen sealants, flocculants, degreasers and adhesives can also have environmental effects if they are not managed in an appropriate manner.

The management of hazardous substances, including storage, handling, transport and disposal, will be subject to specific management practice and industry guidelines. This management will minimise potential effects on health and safety from exposure to hazardous substances and reduce potential effects on the environment.

Refer to Section 7.1.1 of the Construction Water Assessment Report for further detail on hazardous substances and associated site management.

Ultimately, the management of hazardous substances will form part of the OPW, which will identify the suite of hazardous substances to be stored on site and the methods to manage these to prevent unlawful discharges to the stormwater system or receiving environment.

6.10 Viaducts and bridges

The construction of the major structures, including seven viaducts and several smaller bridges, will be a significant part of the Project. Where possible, viaduct and bridge components will be precast at the main site compound off Woodcocks Road, or elsewhere offsite. Where required, it is anticipated that bored piles will be cast in-situ.

The concrete box girder viaducts may involve construction of the superstructure on precast segmental balanced cantilever technology. A launching gantry of approximately 600-800t capacity and 150-200m long will likely be required to erect the precast segments.

The concrete beam and slab viaducts may involve construction of the superstructure on precast prestressed concrete super-tee beams and an in situ concrete deck. The precast concrete beams will likely be erected span by span using a launching girder approximately 100-150t and 70-100m in length.

6.11 Protection and relocation of existing network utilities

As outlined in Section 4.1.7 of this AEE, existing network utilities affected by the construction of the Project will need to be maintained, protected or relocated.

Protection or relocation of existing utilities will generally occur in conjunction with the construction of the Project. The appointed contractor(s) will need to work closely with the relevant network utilities to undertake the necessary protection and/or relocation works. The scope and timing of the necessary utility relocation and protection works will be developed and agreed between the NZTA and network utility providers to mitigate any safety hazards and provide cost efficiency for the required works.

The construction activities require the relocation of the Vector gas supply that feeds Warkworth and works within road reserve (notably Moirs Hill and Wyllie Roads).

An approval is required pursuant to section 177(1)(a) of the RMA prior to any works occurring in an earlier designation. The NZTA continues to work with Auckland Transport and Vector Limited to obtain approvals in this regard.

6.12 Construction programme

An indicative construction programme of five years has been scoped to inform the AEE. This is based on a typical sequence of works and a 100-120 day earthworks season (October-April) with works within the CMA, the Pakiri formation and on structures having no seasonal constraint. The programme includes:

- Temporary works such as construction access tracks, erosion and sediment control and temporary and permanent stream diversions;
- Underfill works including ground improvement, undercuts, and shear keys;
- The installation of culverts;
- Clearing and stripping;
- Bulk earthworks (cut to fill and cut to waste);
- Roadworks (drainage, pavement and traffic services); and
- Landscaping.

Construction of some individual elements of the Project, such as the large viaducts and some of the cut to fill operations, will require construction duration of several years (potentially up to 3 years depending on the final design and construction methodology for the Project). The indicative programme for structures based on the indicative alignment and conceptual construction methodology is based on a typical sequence of works, namely:

- Temporary works such as access tracks, staging areas and erosion and sediment control;
- Foundations including piling and pile caps to abutment and piers;
- Sub-structure including abutments, piers and headstocks;
- Superstructure beams or segments, diaphragms and bearings and joints; and
- Deck and barriers.

Construction staging is likely to involve the progressive construction of the Project, with material from cuts being used at adjacent fill sites. This methodology reduces transport generation external to the site, times and distances. The Construction Noise and Construction Traffic Assessment Reports reflect this principle.