Transport Agency F/1
SPECIFICATION FOR EARTHWORKS CONSTRUCTION
June 2016
(PROVISIONAL)

F/1: SPECIFICATION FOR EARTHWORKS CONSTRUCTION (PROVISIONAL)

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1 GENERAL

1.1 Introduction

Earthworks are used to create stable slopes and foundation platforms for roads and other infrastructure to be subsequently built on and thereby achieve their intended function and design life. Stable earthwork formations are made up of suitable layers of soil and rock materials that are obtained from within a designated construction site, or where necessary using other suitable imported borrow materials. Earthworks are usually constructed by the excavation, transport and placement of suitable materials in a controlled manner.

Earthworks are often executed in conjunction with other engineering operations including, but not limited to, temporary and permanent drainage works, service relocation and development, specialised foundation construction, pavement construction.

The effective execution of earthworks includes the management, and if necessary, the mitigation of natural and man-made hazards on a construction site, including health and safety and environmental hazards.

1.2 Scope

The activities covered by this specification are described in Table 1.

Table 1: Activities Covered by this Specification

Activity Description	Section
General - Introduction, Scope, Definition of Key Earthwork Terms, Survey Set-Up, Control and Planning, Earthworks Management, Environmental Management, Site Clearing, Topsoil Management, Stockpiles, Surface Drainage, Temporary Fencing	1
Earthworks Materials – classification of soil and rock materials for selection purposes	2
Excavation – excavation of cuttings, borrow areas, storage and disposal areas	3
Bulk Fill Construction – transporting, placing and compacting suitable materials to the specified dimensions and tolerances into embankments and other specified Bulk Fill Zones	4
Subgrade Construction - transporting, placing and compacting suitable materials to the specified dimensions and tolerances into Subgrade areas	5
Surface Reinstatement – the reinstatement of completed earthwork surfaces, including shaping, topsoil construction, re-vegetation works, and slip management	6
Maintenance – the maintenance of the site, including cut and Fill Zones, environmental controls, slips and unforeseen events such as soil erosion	7
Quality Control – the control of earthworks to achieve the outcomes covered by this specification	8
Basis of Measurement and Payment – methods of measurement and payment prescribed for the activities covered by this specification	9

1.3 Definition of Key Earthwork Terms

Borrow is excavation from outside the construction batter limits shown on the construction drawings which is used for earthworks construction

Bulk Fill is material used in the construction of a designed fill, after clearing and removing of top soil and any unsuitable materials, up to the underside of the Subgrade

Characteristic Value (CV = $\mu \pm f\ s$) is the average value (μ) plus a factor " f " times the standard deviation (s), and f is 2 unless otherwise specified, with appropriate corrections for seasonal moisture variations, testing temperature and test method.

Clean Topsoil is the layer of material between the topsoil and subsoil layers, which includes some topsoil and humus but excludes vegetation and other non-decomposed organic matter

Contaminated Land is any land that is known to or has the potential to have been adversely affected by previous land use activities, as described in the National Environmental Standards (NES), specifically the Hazardous Activities and Industries List (HAIL)

Cut is excavation within the construction batter limits shown on the construction drawings

Fill Layer within the earthwork formation is Bulk Fill, Subgrade or Landscape Fill

Fill Zone is a measured volume of placed and compacted fill material within the overall earthworks construction in either the Bulk Fill or Subgrade which is made up of a consistent soil type or homogeneous mix of soil types. Unless otherwise directed by the Engineer, the Contractor will be responsible for selecting the soil or mix of soils to be used in each and every Fill Zone

Field Compaction Effort is the minimum Compaction effort delivered by the Contractor's earthworks operations and plant in the field in a Fill Zone (or Zones) within either the Bulk Fill or Subgrade. The Field Compaction Effort shall be chosen from NZ Standard; Heavy or Vibrating Hammer compaction test standards (refer Tests 4.1.1, 4.1.2, and 4.1.3, NZS 4402). The choice of Field Compaction Effort by the Contractor shall take into account the expected nature and condition of the fill material being worked, the location of the fill in question within the overall earthworks construction, and the specified compaction outcomes (refer Section 4)

Field Moisture Content is the moisture content (or range of moisture contents) necessary to facilitate the Contractor's delivery of the specified compaction outcomes (refer Section 4.6 of this Specification) within a Fill Zone (or Zones). The Field Moisture Content can be either the existing moisture content (if deemed suitable) or can be manipulated by drying or wetting to more closely match the measured Optimum Moisture Content (OMC), as tested by an independent IANZ accredited laboratory, for the soil or homogeneous mix of soils being used in a particular Fill Zone (or Zones). The Contractor's selection and use of the Field Moisture Content shall take into account the type of soil or soil mixes, the location of the Fill Layer in the embankment, the Field Compaction Effort, local geographic and geological conditions, and specified compaction outcomes (refer Section 4)

Landscape Fill is material that the Engineer confirms is not suitable to be used as Bulk Fill or Subgrade but rather than being cut to waste can be placed into specified landscape works

Overbreak is excavated material removed by the Contractor's operations from outside the construction cut batter limits shown on the construction drawings, but not authorised as borrow. In rock cuttings, overbreak may be hard to avoid, and should be taken into account during the design and construction process

Percentile Value is a measure indicating the value blow which a given percentile of observations in a group of observations fall. For example the 10%ile means 10% of the observations fall below this value

Rock Fill is any igneous, sedimentary, or metamorphic stone (or mixture of stones) which in their natural state are solidly bonded or cemented together and which naturally occur in masses, ledges, seams or layers. Rock Fill does not break down appreciably during normal earthworks construction but can be removed using specialised plant. When used in earthworks contracts rock fill is defined as being rock and large gravel > 125mm in diameter (or largest dimension) measured on a square opening screen

Slip is material dislodged by the forces of nature from outside the construction batter limits or from within a cut or fill slope shown on the construction drawings

Soft Rock Fill will be prone to slaking and natural break down during construction. Soft rock materials will be treated as rock fill initially, but as a soil once it has suitably broken down or softened to make it suitable for working with earthwork plant

Soil is all material that cannot be described as rock fill, (Unconfined Compressive Strength UCS<1MPa as defined by NZ Geotechnical Society *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005) and can be further subdivided into either granular fill or cohesive fill, as shown: **Granular Fill** is material which has been placed in either Bulk Fill or Subgrade which contains less than 35% passing a 75µm sieve, or has a Sand Equivalent (SE) greater than 20; **Cohesive Fill** is material which has been placed in either Bulk Fill or Subgrade which is not granular fill

Subgrade is selected rock or soil material used or encountered in the construction of the foundation immediately below the pavement, in either an embankment fill or cut situation. In a fill the Subgrade is the top 1.0m of an embankment construction measured down from the Top of Subgrade surface. In a cut the Subgrade is the top 1.0m of material exposed in a cut measured down from the Top of Subgrade surface

Surface water channel is an open drain excavation typically along the edge of a road

Topsoil is the layer of material immediately below the ground surface, which includes vegetation, any non-decomposed organic matter, turf and humus

Top of Subgrade surface is the designed transition line between the earthwork and overlying pavement construction. The pavement construction may include a Subgrade Improvement Layer (SIL)

Undercut is excavation below a defined surface, such as the Top of Subgrade surface in a cut situation, due to the material being designated by the Engineer as being unsuitable for continued use.

Figure 1 illustrates the terminology for earthwork zones typically used in road on embankment and in block cutting construction:

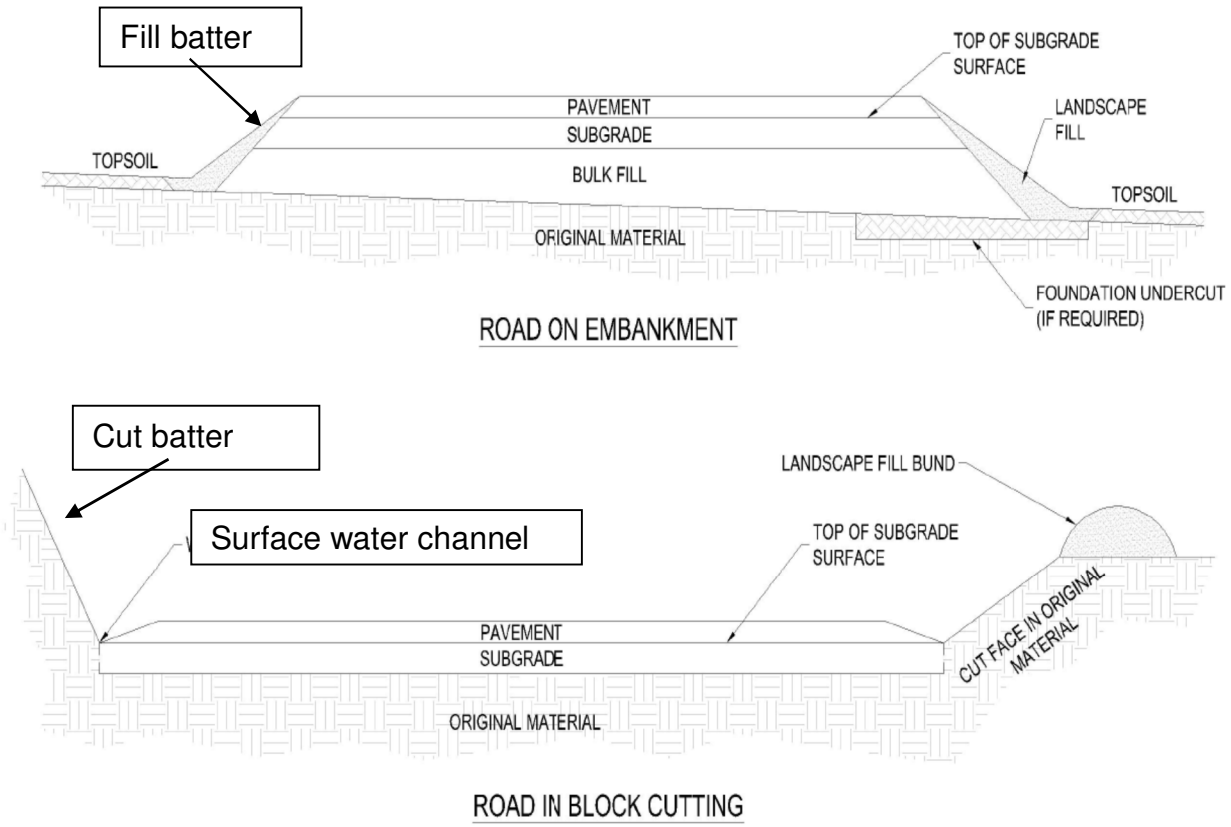

Figure 1: Earthwork Zones in Road Constructions

The definitions above should be used in conjunction with this specification, the construction drawings and any special conditions of contract.

1.4 Survey Set-Up, Control and Planning

The position and extent of all cuts, fills, embankments and other works as shown on the construction drawings (including electronic model data) shall be set out, marked and maintained by the Contractor in a manner that allows the Contractor to deliver the specified outcomes, and that can be effectively re-established if damaged, in a manner that does not delay the works. The final relative location (in terms of position, line and level) of property boundaries, the Top of Subgrade surface, permanent surface water channels, top of embankment profiles, permanent benchmarks, areas requiring protection, and any other "special" areas specified in the construction drawings shall be clearly identified with sufficient accuracy to enable the Contractor to build the works to the specified tolerances. This identification shall be well maintained for the specified period.

The relative position and level of all earthworks testing and sampling locations shall be surveyed to an accuracy of $\pm$ 0.5m horizontal coordinated distance or better and $\pm$100mm vertical so as to produce an "as-built" plan of these works to facilitate on-going review by the Engineer to ensure the specified frequency of testing is being delivered.

The personnel, equipment and processes used to set up and maintain the necessary survey controls shall be clearly documented in the approved Earthworks Management Plan (refer Section 1.5), or as otherwise specified or instructed by the Engineer.

1.5 Earthworks Management

The Contractor's Earthworks Management Plan (EMP) shall document and illustrate at least the following:

- The proposed earthworks construction sequence including strategies and procedures for earthwork material selection and use (refer Sections 1.3 and 2) in cuts and fills, borrow areas, stockpiles and disposal areas

- A site specific and suitably detailed mass haul diagram showing how the Contractor plans to achieve or better the design earthwork balances, or to proactively demonstrate where and why changes to the specified material volumes need to be recognised

- How the suitability of materials and if required material treatments (e.g. wetting or drying) will be determined and planned in advance of on-site operations so that the available earthwork materials can be correctly classified (refer Section 2) and used effectively

- The quantity measurement procedures that will be used to demonstrate that the specified and claimed volumes of Cut materials have been successfully moved, handled and placed, and that the specified and claimed Fill Layer depths have been achieved

- earthworks specific quality assurance plans, methods and procedures that will be used to demonstrate that; the cut and fill materials are being moved, handled, placed and tested for compaction in accordance with the specification; the available materials are being classified correctly; moisture contents in the materials are being monitored and adjusted accordingly; specified Fill Layer compaction outcomes are being effectively monitored and achieved; the completed works (cut and fill batters) can be maintained in a stable condition

- The procedures and processes that will be used to safety remove contaminated land, including the accidental discovery protocols to be followed if contaminants are found

- The procedures and processes that will be used to monitor and protect the earthworks from the potential adverse effects of erosion, water infiltration, dust, noise and other injurious effects

- The procedures and processes to be used to prevent damage to the earthworks from construction traffic or normal road traffic

The following may also be required:

- A blasting plan (including meeting all Health and Safety requirements) showing how the Contractor plans to prepare, implement and complete all rock blasting and associated material move and place operations

The approved Earthworks Management Plan will be reviewed and updated regularly by the Contractor (at least every three months and after any recognised change in season) to ensure that changes on the project site are being recognised, and that the current approved

Earthworks Management Plan continues to demonstrate how the Contractor will meet the agreed contract milestones and construction outcomes.

1.6 Environmental Management

The Contractor's Environmental and Social Management Plan (ESMP) shall be prepared in accordance with the current version of the NZTA *Guideline for preparing an Environmental and Social Management Plan*. With specific reference to earthworks the ESMP shall include the following:

- Processes and procedures that will be used by the Contractor to meet and monitor compliance with all contract site applicable Resource Consent and Land Entry agreements and conditions, including implementing effective, proactive maintenance plans for all temporary environmental protection works

- In addition to meeting all applicable resource consent conditions, show how the Contractor plans to effectively control surface and subsurface drainage, water infiltration into fills, soil erosion, dust, noise and unplanned injury to adjoining land or features

- Identify and protect areas of environmental sensitivity both within the limits of the earthworks and in adjoining areas affected by the earthworks, including the accidental discovery protocols to be followed if unexpected biodiversity is found.

The approved ESMP will be reviewed and updated regularly (at least every three months and after any recognised change in season or changes in Consent Conditions) to ensure that changes on the contract site are recognised, and that the current approved ESMP shows how the Contractor will achieve the agreed contract milestones and construction outcomes whilst meeting all relevant Resource Consent and Land Entry conditions.

1.7 Site Clearing

The specified area contained by the limits of the earthworks and any additional area shown in the construction drawings, or as directed by the Engineer, shall be cleared of all obstructions except those mentioned in the construction drawings as requiring protection.

Clearing shall include the complete removal of stumps, trees, logs, scrub and coarse vegetation, and all known and/or nominated above-ground services, fences and structures with subsequent disposal by dumping, burying or burning in accordance with any particular specified requirements or approved methods. All man-made services or objects, natural vegetation and features of the land and water designated to remain shall be preserved from injury or defacement during clearing and all subsequent operations. Any damage to protected services, objects, natural vegetation or natural features caused by the Contractors' negligence will be made good by others at the Contractor's expense.

Clearing of contaminated land will be as specified, detailed in the EMP, or otherwise approved by the Engineer.

1.8 Topsoil Management

Topsoil and Clean Topsoil shall be uplifted and moved within the limits of the earthworks as specified in the construction drawings. Care shall be taken during the removal to avoid cross

contamination of the Topsoil and Clean Topsoil. These materials shall by preference be spread immediately rather than stockpiled.

If necessary, these materials shall be stockpiled in areas approved by the Engineer for this purpose. Whilst the Topsoil and Clean Topsoil materials are retained in separate stockpiles (or as otherwise specified) the Contractor shall effectively control the growth of weeds, contamination by unsuitable materials, and erosion. To assist with preservation of the planting media, the Contractor shall include the following provisions in the management of the Topsoil stockpiles, unless otherwise directed by the Engineer:

- limiting the height of the stockpiles to 3 metres and the width of the base of stockpiles to 10 metres;

- adopting batter slopes, protective covers and drainage measures which reduce the potential for erosion and/or segregation;

- limiting the period of stockpiling to the minimum practical time, or no more than six months from the start of placement unless otherwise approved by the Engineer.

The Contractor shall carefully manage all Topsoil and Clean Topsoil stockpiling operations and achieve effective utilisation of these resources, in accordance with the approved Earthworks Management Plan (EMP)

1.9 Stockpiles

The Contractor's use of stockpile sites and stockpile management practices shall ensure that stockpiled materials do not deteriorate before being used, that damage to natural vegetation, watercourses and drainage features is prevented, that the stockpiles are stable at all times and that the stockpiled material can be effectively utilised on the project works, in accordance with the approved Earthworks Management Plan (EMP). All stockpile sites shall be accessible and able to be moved if required by the Engineer. Reference shall also be made to Section 1.8 when stockpiling Topsoil or Clean Topsoil.

1.10 Surface Drainage

Surface drainage measures employed on the project site shall preserve the integrity of all natural water drainage facilities and adjoining land in accordance with any applicable Resource Consent or Land Entry Consent agreements and conditions, in accordance with the approved Environmental and Social Management Plan (ESMP).

Temporary surface drainage works shall be carried out by the Contractor as required during construction to safeguard the integrity of the works. The earthworks shall have at all times a sufficient fall to shed water and to prevent water lying on the surface and infiltrating the earthwork cuts and fills, the Bulk Fill or the Subgrade.

At the end of each day of construction and at any time in anticipation of adverse weather, the Contractor will take all practical steps to ensure that the as-built earthwork surfaces are rolled smooth and graded to discharge stormwater onto stable ground without causing an erosion or surplus water/silt nuisance on adjoining land.

1.11 Temporary Fencing

Temporary fencing shall be erected at locations indicated in the construction drawings, or as required by applicable Land Entry or Resource Consent agreements and conditions, until permanent fencing is constructed or otherwise as specified or directed by the Engineer. The temporary fencing shall have a stock holding capacity and integrity similar to that of the fences removed from the contract site and/or the adjacent existing fences unless detailed otherwise in the construction drawings.

In urban areas, temporary fencing may take the form of suitable vehicle and/or pedestrian barriers.

2 EARTHWORKS MATERIALS

2.1 Introduction

Material to be excavated and either used within the fills (refer Section 1.3), stockpiled or removed from site shall be classified as either Type A, R1, R2, R3, W, or U as defined below. Whenever the Contractor wishes any material to be classified as other than Type A, the Contractor shall notify the Engineer in writing as soon as practicable seeking a decision. This decision shall be progressed promptly and shall not be used as excuse by either party to withhold payment or delay the works in accordance with the current, approved Earthworks Management Plan (refer Section 1.5).

2.2 Type A Material

Type A material is all excavated material which does not fall within categories R1, R2, R3, W, or U as shown below.

2.3 Type R1 and R2 Materials

Rock materials in the designated cut or borrow areas which in order to be productively used elsewhere on the project site need first to be ripped by modern, appropriately sized, well maintained crawler tractors or tracked excavators fitted with hydraulic rippers or ripper tipped buckets working safely at full power, as defined in Table 2.

Table 2: Transition between Types A, R1 and R2 material

Transition	Recorded Production Rate	Minimum Plant Specifications to deliver recorded production rate
Type A to Type R1	<300m^3/hour	crawler tractor fitted with a twin shanked hydraulic ripper having net engine power up to 100 to 120kW or: 30 tonne tracked excavator using a rock ripper tipped bucket
Type R1 to R2	<75m^3/hour	crawler tractor fitted with a twin shanked hydraulic ripper having net engine power up to 270 to 315kW or: a 30 tonne tracked excavator using a single rock ripper off the boom

Should the Contractor choose to use larger construction plant to speed up a normal excavation process, and the material being excavated could have been productively ripped and moved as specified Table 2, then the material will not be re-classified upwards as either R1 or R2.

2.4 Type R3 Material

Rock materials in the designated cut or borrow areas which cannot be ripped and require drill and blast techniques to dislodge and move the material and to allow the subsequent construction by-products to be used as specified.

2.5 Type W Material

This is excavated material which is too wet for immediate use but is suitable for use in construction of the Bulk Fill or Subgrade after drying, provided that the Contractor can demonstrate to the Engineer that it is economical to do so.

The method of drying shall be chosen by the Contractor to achieve maximum productivity, and shall be described and monitored in the manner prescribed in the Earthworks Management Plan (refer Section 1.5).

Material designated as Type W material can be re-designated as Type U material and cut to waste or used as Landscape Fill if the Engineer considers the options for drying proposed by the Contractor to be uneconomic and instructs accordingly.

2.6 Type U Material

This is unsuitable material which shall not be used in the construction of Bulk Fill, Subgrade or Landscape Fill, nor retained as material within the Subgrade in cuts unless otherwise specified or as directed by the Engineer. Unsuitable material shall include:

- contaminated land
- material from swamps, marshes and bogs, including logs, stumps, perishable materials and other deleterious materials
- material susceptible to spontaneous combustion
- materials that are prone to swelling or with linear shrinkage greater than 10%
- Bulk Fill or Subgrade materials which are not capable of achieving the specified strengths in terms of Allowable Bearing Capacity, Undrained Shear Strength or California Bearing Ratio (CBR), refer Section 4.6.2
- material that is not suitable for use in the specified fill because of oversized particles (e.g. large rock)
- materials containing noxious weeds and other matter that may adversely affect the local environment, except where these are treated in an approved manner
- building rubble including concrete, asphalt bound materials and other materials except where these are broken down or otherwise treated and approved for use by the Engineer.

Type U material shall be disposed of in suitable, approved disposal sites, either on or off site.

2.7 Ripping Productivity Trials

Where agreement cannot otherwise be reached on classification of excavated materials as Type R1, R2 and R3, ripping productivity trials shall be carried out by the Contractor under the supervision of the Engineer, and with the full support of the Contractor, using a suitable crawler tractor or tracked excavator (refer Table 2). Where the appropriate plant is not available on site, the Contractor shall be reimbursed using day works rates for the cost of transporting it to and from the site for the purpose of the ripping trial.

2.8 Rock Blasting

The Contractor shall be responsible for planning, implementing and monitoring all blasting works of Type R3 material, including planning drill patterns, charge sizes and rock fall collection and transportation operations, providing appropriate health and safety protection,

and for obtaining all necessary legislative approvals. Such approvals may include conditions that require monitoring the environmental effects of the blasting operations (air blast, noise, dust and vibration) and ensuring that adjoining landowners are kept informed in advance of blasting operations and are not adversely affected. The procedures for planning, implementing and monitoring of all blasting operations shall be documented in the Earthworks Management Plan (refer Section 1.5).

Should the Contractor choose to use drill and blast techniques to speed up a normal excavation process, and the material being excavated could have been productively ripped and moved as either Type A, R1, or R2 material, then the material will not be re-classified as R3.

3 EXCAVATION

3.1 Introduction

The excavation of cut batters in an earthwork project involves a number of inter-related construction operations needed to achieve the specified outcomes including, but not limited to, cutting, benching, trimming, foundation treatments (if specified), transitions from cut to fill, and the uplifting and placement of the cut material. Materials encountered in cuts and intended for use as fill shall be carefully loosened and processed as needed so that they meet the specified material end results.

3.2 Excavation Management

The batter slopes in cuttings shall be constructed in accordance with the construction drawings or as directed by the Engineer on the basis of on-going site inspection. The Contractor's planning and implementation of the excavation and cartage operations shall at all times optimise the use of the available soil and rock materials, and prevent unplanned strength loss due to poor planning and management of earthworks operations by the Contractor.

Where material is being excavated as cut to fill, cut to stockpile, or cut to waste, the excavations shall minimise the mixing of unsuitable materials unless otherwise required by the construction drawings, detailed in the Contractor's EMP (refer Section1.5) or directed by the Engineer.

All excavated materials shall by preference be spread, placed and compacted immediately rather than being stockpiled. If stockpiling of excavated materials is either specified (into a nominated stockpile area), directed by the Engineer, or is otherwise undertaken by the Contractor during the execution of the earthworks in accordance with the EMP, the Contractor shall control all stockpiling operations and achieve effective utilisation of the resource (refer Sections 1.8 and 1.9)

Should the Contractor choose to use material stockpiling as a part of the earthwork operations rather than place the material directly into the fill when this is possible, then this will be considered to be a cut to fill operation only for payment purposes, and not two separate cut to stockpile and then cut stockpile to fill operations.

All earthworks and in particular the excavation works shall be managed so that as far as is reasonably practicable the "best material" (e.g. material with the higher potential bearing capacity or CBR) is reserved for the construction of the Subgrade (refer Section1.3). The Contractor shall describe how this will be achieved in the EMP.

Subgrade construction operations shall be managed preferably as cut to fill. Where double handling is required because of the location of the "best material" in the cut batter, the works shall be managed, following approval by the Engineer, as cut to stockpile into approved stockpile sites, followed by cut stockpile to fill. The Contractor shall describe how this will be successfully achieved in the EMP.

Earthwork operations for cut to fill, cut to stockpile and cut stockpile to fill materials shall be undertaken in a manner that minimises strength loss in and maintains integrity of the excavated material.

All excavation works shall be carried out in a manner that limits overbreak and slips as far as is reasonably practicable.

Whenever construction traffic needs to use live construction surfaces as a haul or access road, cuts shall be left a minimum of 1.0m above the Top of Subgrade surface or cut batter surface respectively, and fills left a minimum of 0.5m below the underside of the Subgrade fill until the area(s) in question are now longer needed as a haul or access road.

The Contractor shall at all times prevent unnecessary damage to all Subgrade and Bulk Fill.

3.3 Undercutting for Subgrade Preparation

The condition of the Top of Subgrade surface and the underlying Subgrade materials (refer Section1.3) will be used by the Engineer to determine whether the exposed in-situ materials in cut locations need to be undercut below the planned Top of Subgrade surface and replaced with suitable compacted imported Subgrade material either to replace unsuitable material or to provide continuity in the construction of the Subgrade layer between cut and fill zones, or both. The depth of the undercut shall be as directed by the Engineer.

When a transition between cut and fill is required, the minimum depth of the new compacted Subgrade fill within the transition zone shall be 0.5m (refer Figure 2), and the extent of the transition excavation shall be as directed by the Engineer.

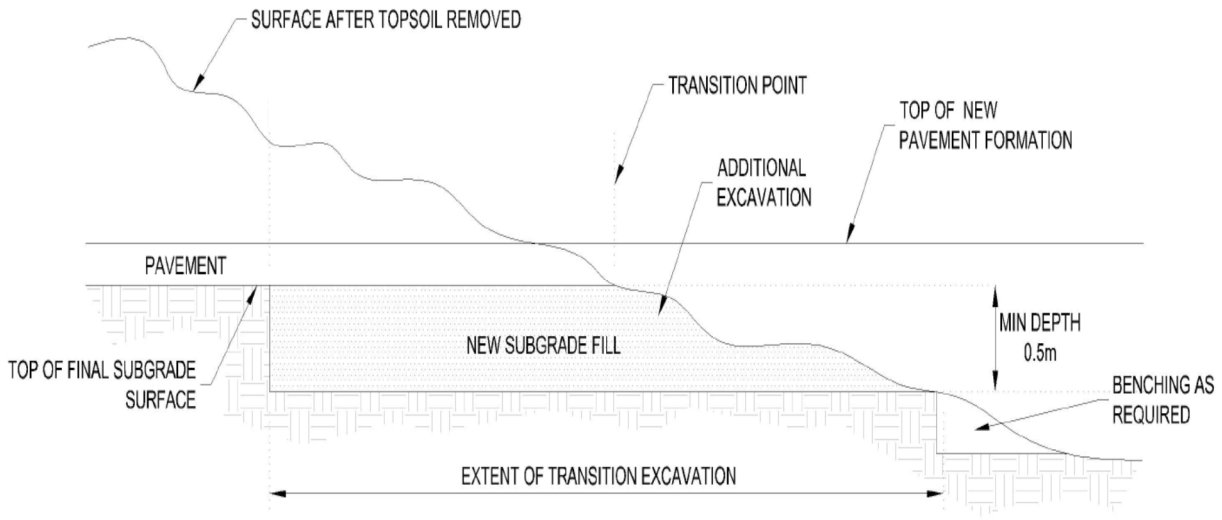

Figure 2: Subgrade Transition between Cuts and Fills

On completion of all undercuts the exposed cut surface shall be shaped and trimmed so as not to hold water. Subsoil drainage shall be installed if required in the construction drawings or directed by the Engineer. Subgrade material placement and compaction shall then proceed (refer Section 4).

The Subgrade layer shall, unless otherwise directed by the Engineer, be constructed over adjoining cut and fill sections in one continuous operation so as to provide continuity over the transition point between the new cut and fill (refer Figure 2).

Benching for subgrade fill construction zone shall be in accordance with Section 4.5.

3.4 Cut Batters

Cut batters shall be constructed to the lines, levels and tolerances shown on the construction drawings, using suitable excavation equipment that allows the Contractor to present stable and resilient cut shapes, that do not pond water or encourage unplanned erosion. Cut batters must be cleared of loose or unstable material progressively as the excavation proceeds.

The tops of cuttings shall be rounded to the dimensions shown on the construction drawings unless otherwise directed by the Engineer. Batters shall generally require progressive flattening at the ends of cuttings owing to the likely presence of less stable materials and the need to blend with the surrounding ground contours.

All cut batters shall be left with a texture which will aid the establishment of approved vegetation.

3.5 Borrow Areas

Borrow areas shall be opened up and excavated in an orderly manner at the locations shown on the construction drawings, and/or at locations agreed by the Engineer, in a manner that does not pond water or encourage unplanned erosion. At completion, the borrow areas shall be cleared of loose or unstable material, and shaped to blend with surrounding ground contours or as directed by the Engineer. All batters shall be left with a texture which will aid the establishment of approved vegetation.

3.6 Dump Areas

The locations of dump areas within the construction area or in other areas shall be as specified in the construction drawings, or otherwise directed by the Engineer. The Contractor shall control all dumping operations to optimise the utilisation of each area. Existing Topsoil shall be removed and stockpiled for re-use (refer Sections 1.8 and 1.9) If necessary, benching may be required (refer Section 4.5). If required in the construction drawings or directed by the Engineer, subsurface drainage shall be installed. All dump sites shall be shaped during the progress of the work to conform to the contours of the adjoining land and prevent ponding of storm water, or as directed by the Engineer.

Should the Contractor wish to provide alternative dumpsites, the Contractor will need to obtain and provide evidence to the Engineer that all necessary site specific Resource Consents and Land Entry Approvals (in accordance with the approved Environmental Management Plan refer Section 1.6) have been obtained and conditions met before opening up and using any alternative dump sites.

3.7 Surface water channels

These shall be excavated as detailed in the construction drawings, or as required by the Contractor during the works to effectively manage stormwater and surface water discharge. Surface water channels shall have an even and true grade to outlets onto stable ground so that water will not stand in any part. Surface reinstatement shall limit the potential for erosion during the works, and shall provide a texture that will aid the establishment of approved vegetation, or as otherwise specified in the construction drawings or directed by the Engineer.

All surface water channel outlets shall be clear of made or unstable ground or as otherwise described in the construction drawings. Material excavated from water tables shall be utilised or disposed of as appropriate to its classification (refer Section 2).

4 FILL CONSTRUCTION

4.1 Introduction

The purpose of the Contractor's fill construction works shall be to form an earthwork formation (as either Bulk Fill or Subgrade) using the nominated cut to fill, borrow to fill and cut from stockpile to fill materials effectively, achieving a stable earthworks formation that:

- Optimises the use of the available soil and rock materials within the designated construction site or approved borrow areas
- Limits future settlement under imposed or self-weight loads
- Controls fill permeability to achieve the intended purpose
- Delivers the specified material strengths in support of long term stable cut and fill slopes and pavement subgrade performance in accordance with design expectations.

Materials identified in the contract drawings for specific use (e.g. drainage layer or subgrade construction) shall be protected and given particular attention in the Earthworks Management Plan (EMP).

4.2 Fill Management

The soil and rock materials used in fills shall be spread and compacted in layers of uniform quality and thickness, in a manner that avoids segregation or contamination. The thickness of each layer shall be managed to ensure that the appropriate Field Compaction Effort is achieved for the full depth of each layer taking into account the types of fill material and Field Moisture Content being used by the Contractor.

Unless otherwise directed by the Engineer, fill batters shall be adequately compacted beyond the limits of the design profile as the filling proceeds, and then trimmed back to the lines and levels shown on the construction drawings, in a manner that presents a stable and resilient shape, and that does not pond water or encourage erosion.

The movement of all construction vehicles and other traffic over Bulk Fill materials shall be carefully controlled and monitored so as not to damage or overstress the construction fills. Where specified in the construction drawings or directed by the Engineer construction haul roads shall be located outside the limits of the fill.

The Subgrade shall be constructed in a continuous operation resulting in the construction of a stable, consistent pavement foundation layer. Subgrade shall not be used as construction haul roads unless otherwise directed by the Engineer.

If material which has already been placed in any fill is considered by the Engineer to be too wet then, the Contractor shall either:

(a) Dry or mix the material so that it is suitable to remain as fill, or

(b) Excavate the material to waste, and replace with suitable fill material.

When drying is necessary, it shall be carried out to allow the full depth of the layer to dry uniformly (refer Section 2.5). Drying and subsequent compaction operations shall be carried out only under favourable weather conditions.

Wetting of material which has become too dry for use in the fill shall be carried out with sprinkling or direct injection equipment in a manner that ensures uniform and controlled distribution of water. After wetting, the material shall be conditioned to ensure a uniform distribution of moisture throughout the layer.

When the condition of the in-place fill has deteriorated and for example become either too wet or too dry because of the Contractor's negligence, the remedial works required (including but not limited to those described above) will not be treated as a variation (refer NZS 3910:2013, Section 9).

At the end of each day of construction and at any time in anticipation of adverse weather, the as-built fill surfaces shall be rolled smooth and graded to discharge water onto stable ground clear of the fill.

The materials used and the methods of placement of the fill construction are required to take into account whether the fill is a Bulk Fill or Subgrade (refer Section 1.3) as shown in Section 4.3 and 4.4.

4.3 Bulk Fill Construction

The Contractor must manage the maximum particle size and layer thicknesses of the Bulk Fill materials in accordance with Table 3 unless Contractor led field trials show, to the satisfaction of the Engineer, that these requirements can be varied.

Table 3: Particle Size and Loose Layer Thickness for Bulk Fill Materials

Nominal Maximum Particle Size	Maximum Loose Layer Thickness
Up to 100mm	200mm
100mm to 200mm	1.5 times the 85 percentile size
Over 200mm	As Specified

If the Contractor proposes to use part width or staged construction the layers of any subsequent stage shall be placed to overlap at least 0.5m horizontally onto the completed part or stage by benching out the completed part at the level of each successive layer, and then bevelling the newly exposed vertical face within the completed part at no steeper than 1H:1V prior to backfilling with new fill.

4.4 Subgrade Construction

The Contractor must manage the maximum particle size and layer thickness of the Subgrade materials in accordance with Table 4 unless Contractor led field trials show, to the satisfaction of the Engineer, that these requirements can be varied.

Table 4: Particle Size and Compacted Layer Thickness for Subgrade Materials

Position of Material within Subgrade	Maximum Loose Layer Thickness	Maximum Particle Size (measured on square opening screen
Lower 600mm	200mm	125mm

Position of Material within Subgrade	Maximum Loose Layer Thickness	Maximum Particle Size (measured on square opening screen
Upper 400mm	150mm	75mm

If the Contractor proposes to use part width or staged construction the layers of any subsequent stage shall be placed to overlap at least 0.5m horizontally onto the completed part or stage by benching out the completed part at the level of each successive layer, and then bevelling the newly exposed vertical face within the completed part at no steeper than 1H:1V prior to backfilling with new fill.

4.5 Benching

Any portion of the original ground where the pre-existing slope is steeper than three horizontal to one vertical (3H:1V) shall be benched before filling commences, unless otherwise directed by the Engineer. Each bench shall be constructed to a width adequate to permit suitable construction equipment to operate safely. The base of the benches shall be sloped inwards at a minimum slope of 12 horizontal to 1 vertical. The longitudinal profile of each bench shall be graded to ensure adequate drainage and safe discharge of overland, surface or intercepted groundwater onto stable ground clear of the bench, and shall also incorporate subsoil drainage if specified in the construction drawings or directed by the Engineer.

4.6 Compaction

4.6.1 Introduction

The Contractor's compaction operations shall at all times be directed to optimise the utilisation of the available soil and rock materials, delivering optimum compaction outcomes and thereby achieving long-term stability in all constructed fills and strength in pavement subgrades.

Compaction is the mechanical process of rearranging the rock or soil material to expel air from the voids. Soil fill materials can be either granular (refer Section 1.3) or cohesive. In either case, the compaction of each successive layer shall continue until the whole layer has attained a dense, stable state.

The presence of some water in the material is needed to enable compaction. In fine grained soils in particular, too much water can fill the voids, resist compaction and cause instability. Too little water can also act to resist compaction, particularly in cohesive soils.

Unless otherwise specified or shown on the construction drawings (refer Section 4.6.2) or directed by the Engineer, the Contractor shall, within each specified Fill Layer verify by inspection, recording, measuring and testing that:

- the Contractor managed Field Moisture Content (refer Section 1.3) for each Fill Zone within a specified Fill Layer has been effectively utilised during compaction operations

- the Contractor managed Field Compaction Effort (refer Section 1.3) has been delivered in the field

- Whether water needs to be added to or removed from a rock or soil material to deliver good compaction outcomes, the residual Field Moisture Content in each Fill Zone shall be evenly mixed throughout material before on-going compaction work is undertaken.

Compaction shall not continue if any fill material being worked shows signs of heaving or weaving excessively, or conversely the compaction process disturbs dust and dry particles, until such time as stable compaction conditions return, as both signs would indicate that more effective water control is needed.

If the fill material has become too wet, and is showing signs of heaving or weaving excessively the Contractor may dry the material rather than cut to waste by ensuring the fill material is either; left to dry naturally; or dried mechanically or chemically to suitable moisture content where job progress would be adversely affected by a delay. The Contractor may also, with the Engineer's approval, alter the Field Compaction Effort to mitigate soil heaving and weaving.

When the condition of the fill being compacted has deteriorated and become either too wet or too dry because of the Contractor's negligence, the remedial works will not be treated as a variation (refer NZS 3910:2013, Section 9).

4.6.2 Methods to Monitor Compaction Outcomes

One or more of the following methods (as specified or directed by the Engineer) will be used by the Contractor to inspect, record, measure, test, and verify compaction outcomes on soil and rock materials in the Bulk Fill and Subgrade, in addition to the requirements in Section 4.6.1:

Rock fill shall be placed in layers not exceeding 300mm loose layer thickness. Thicker layers may be used for larger stone based on Contractor led field trials, and then only when directed by the Engineer. Water shall be applied prior to compaction in quantities that control dust, and so that the surface of the stones appears wet. The rock fill shall then be compacted to a dense stable condition using heavy vibrating sheep's foot, club foot or grid roller plant, until no appreciable on-going reduction of the layer surface height is measured.

Soil materials shall be placed and compaction monitored and verified per homogenous Lot (refer Section 8.1) using one or more of the methods below (Table 5), as specified or directed by the Engineer, with all results to be certified by an independent IANZ accredited laboratory. For definitions refer Section 1.3.

Table 5: Methods to be used to monitor and verify earthwork compaction outcomes

Compacted Soil property	Expected outcome per homogenous Lot
Dry density	Characteristic Value > 98% of the laboratory maximum dry density for the consistent soil type or homogeneous mix of soil types used in each Fill Zone
Bulk Density	Characteristic Value > 98% of the laboratory maximum bulk density for the consistent soil type or homogeneous mix of soil types used in each Fill Zone

Compacted Soil property	Expected outcome per homogenous Lot
Air void or total void content	Maximum air void or total void based on field density measurements, for the consistent soil type or homogeneous mix of soil types used in each Fill Zone, calibrated by laboratory solid density and moisture content testing < specified design value
Soil strength	Reported 10%ile value based on field measurements, calibrated by laboratory testing > specified design value
Surface deflection	Characteristic Value < specified design value

The Contractor shall inspect, record, measure, test, and verify the compaction outcomes, in accordance with Section 8 of this specification.

Where any in-process testing of the rock fill or soil compaction works reveals non-conforming results, the Contractor shall cease placing and compaction of any new fill materials, and propose for the Engineer's approval, actions to be taken to rectify the observed non-conformances before filling and compaction can re-commence, in accordance with the Contractor' Quality Management Plan (QMP). The Engineer will not unreasonably withhold approval of the proposed remedial works if the Contractor has provided sufficient information from which a sound, technical decision can be made.

4.6.3 Choice of Compaction Plant

The Contractor shall when choosing the type and size of compaction plant to be used in the earthworks to match the specified Field Compaction Effort(s) consider the type of soil and /or mix of soils being worked, the location of a Fill Layer in the overall works, and the planned depth of each successive Fill Layer in order to deliver the specified compaction outcomes.

The Contractor shall manage the proposed compaction methods and capacities of the compacting plant through the EMP (refer Section 1.5).

4.6.4 Field Moisture Content for Soil Materials

The Contractor shall undertake sufficient independent IANZ Accredited laboratory tests of representative soil samples from the site to determine the OMC value or values relative to the soils or mix of soils and specified Field Compaction Effort to be used in a particular Fill Zone. From this information the Contractor shall then determine the most appropriate Field Moisture Content value to be used for each Fill Zone within a specified Fill Layer.

4.6.5 Compaction Trials

The Contractor shall complete on-going compaction trials over the duration of the works to demonstrate that in each specified Fill Layer and Contractor controlled material specific Fill Zone that the proposed construction techniques, including types of rollers and if necessary soils conditioning plant (watering and or drying plant) can achieve the specified compaction outcomes (refer Section 4.6.2) in the most effective and efficient manner. The frequency of and methods used to complete and respond to the results of the compaction trials shall be documented in the EMP (refer Section 1.5).

The Contractor shall be responsible for planning and delivering the compaction trials, including all necessary earthworks testing. The results from each compaction trial shall be reported to the Engineer before any subsequent earthworks are undertaken. The Contractor will be expected to use the outcomes of the compaction trials to support effective and proactive planning and implementation of the compaction works, thereby ensuring that all staff, including field operations staff, are aware of the expected compaction outcomes and how to achieve these effectively.

4.6.6 Material Testing

The Contractor shall undertake sufficient IANZ accredited laboratory tests on representative soil samples from the site to confirm that the Field Moisture Content and specified compaction density and strength outcomes for the soil or homogeneous mix of soils have been achieved in each Fill Zone.

The Contractor may use on site calibrated “intelligent compaction” measuring systems to support the management of the fill operations. Only IANZ accredited laboratory and field test results can be used to verify that the specified compaction outcomes have been delivered. Where necessary the Contractor shall take suitable corrective actions on site to ensure that the specified Field Compaction Effort and specified compaction outcomes are being delivered in each Fill Zone.

The results of the monitoring procedures and processes described above will be submitted to the Engineer by the Contractor as evidence of soil and rock fill placement and compaction outcomes. The Engineer may also choose to undertake independent random verification tests (RVT) as a check on the Contractor’s test reports. If these RVT tests show the Contractor’s work to be non-conforming then the Contractor shall immediately review the outcomes and propose remedial actions for the approval of the Engineer, in accordance with the QMP.

4.6.7 Top of Subgrade Surface Testing

Construction of the Subgrade (refer Section 1.3) requires the Contractor to confirm that the specified compaction, strength and stiffness outcomes (refer Table 5) have been achieved. When the Subgrade construction is deemed by the Contractor to be complete for the works (or parts thereof), based on evidence provided by the Contractor of the inspection, recording, measurement, testing, and verification completed by the Contractor, the Contractor shall inform the Engineer.

The Engineer will use these results, and independent monitoring and testing, to certify whether the Top of Subgrade Surface and underlying Subgrade meets the specified outcomes and the design, or whether additional works are required by the Contractor before handover to the pavement construction operation can be approved. The Engineer will not unreasonably withhold approval of the works if the Contractor has provided sufficient information from which a sound, technical decision can be made.

5 SUBGRADE FINISHING

5.1 Introduction

The construction of the Subgrade shall be as described in this specification.

5.2 Trimming, Rolling and Shaping

The entire surface of the compacted Subgrade shall be made consistently firm and smooth by machine grading and rolling. The exposed Subgrade surface shall not pond water, where the design slope of the Subgrade is 2% or steeper, and shall facilitate the passage of water over the surface and into surface water tables rather than allowing water to soak into the Subgrade material.

The surface of the Subgrade shall be finished so that all points are within 30mm from a 3m straight edge laid parallel to the centreline of the road and from a cross-section camber board placed at right angles to the centreline.

The passage of construction traffic or other traffic on the finished Subgrade shall be prevented.

5.3 Surface Finishing Tolerances

Unless otherwise specified in the construction drawings or directed by the Engineer, the reduced level of any point on the finished Subgrade surface shall be within the limits of zero above to 30 mm below the designed or nominated level. The finished Subgrade surface shall be free from potholes and present a smooth and even ride.

5.4 Surface water channels

Surface water channels shall be uniformly graded so that they do not hold water and shall be neatly and evenly trimmed to allow unimpeded flow onto stable ground. Surface water channels with a gradient steeper than 3H:1V shall be protected from scour using suitable temporary weirs or erosion control devises (or as specified in the construction drawings or otherwise directed by the Engineer) normally until such time as the appropriate vegetation or other permanent features are is established. All surface water channel outlets shall be clear of made or unstable ground or as otherwise described in the drawings, and shall be configured to prevent erosion on adjoining land.

5.5 Subgrade Improvement

If Subgrade improvement layers are specified (this could include in-situ lime or cement stabilisation of the upper Subgrade materials) then these shall be completed once the Subgrade has been constructed to the lines and levels shown on the construction drawings, and as described above, and certified as complete by the Engineer. The Subgrade improvements works shall then be undertaken in accordance with the contract specification. Compaction of a Subgrade improvement layer shall meet the requirements of Section 4.6.2, unless otherwise specified.

5.6 Handover

The finishing of the Subgrade works as shown in the construction drawings and specified herein shall constitute the handover point between the preparation of the Subgrade in terms

of this specification and the construction of the pavement layers. Thereafter the earthworks contractor shall ensure that the Subgrade is protected and not be allowed to deteriorate by drying out, becoming over wet or otherwise contaminated until such times as the pavement works commence or as otherwise directed by the Engineer.

6 REINSTATEMENT

6.1 Shaping and Topsoil work

6.1.1 Slopes 3H:1V and Flatter

Cut and Fill zones, dump areas, borrow areas, stripped land within the construction zone and any other areas directed by the Engineer with a slope of three horizontal to one vertical (3H:1V) or flatter, shall be trimmed to design grade or to conform easily with the adjoining land. Any transition zone between disturbed and undisturbed land shall be trimmed and treated so that the overall profile fits in with the adjoining undisturbed landforms.

After trimming, the affected areas shall be covered with previously approved Topsoil free of weeds and deleterious material, to a minimum loose depth of 75mm or as otherwise specified in the construction drawings. The Topsoil shall be lightly compacted using a light sheep's foot or clubs foot roller to resist wind/water damage, and not made too dense by unplanned passage of construction or other traffic.

6.1.2 Slopes Steeper than 3H:1V

Disturbed areas steeper than 3H:1V including cut batters shall be trimmed to design grade (or as otherwise specified in the construction drawings or directed by the Engineer) to produce an even profile with a slightly roughened surface texture which shall aid the establishment of the approved vegetation and mitigate against concentration of surface stormwater flows that are likely to cause erosion.

6.2 Batter Protection and Re-Vegetation Operations

The Contractor shall programme the batter protection works and specified vegetation operations on all disturbed areas to take advantage of the local optimum growth period (normally early autumn or late spring).

Unless specified otherwise in the construction drawings the Contractor shall submit to the Engineer for approval the proposed seed mixture, fertiliser type, and respective application rates prior to the commencement of any grass application. The generic characteristics of the seed mix for use within the road reserve shall be such that the vegetation cover is low growing with a robust and deep rooting system, and well suited to the soil conditions and locality, unless otherwise specified in the construction drawings or directed by the Engineer.

For slopes at or flatter than 3H:1V the Topsoil layer shall be dragged and trimmed so that the loose and stable surface is free from large clods. The top 20 mm of the Topsoil layer shall then be made free and open in preparation for the application of the seed mixture.

The Contractor shall plant and encourage the growth of the approved vegetation cover, encourage a good grass strike and cover once the seed is placed in the ground, by watering as appropriate, and applying more seed if required to fill in gaps.

6.3 Intersecting Roads and Private Access Ways

All intersecting roads and private access ways within the limits of the site shall be constructed, trimmed and maintained to the standards detailed in the construction drawings, or as directed by the Engineer.

7 MAINTENANCE

The Contractor shall maintain the completed Subgrade surface and all other parts of the earthworks construction, including new grassing and vegetation cover, and all temporary and permanent environmental protection measures until either they are covered or otherwise used for later construction works or until the end of the specified maintenance period whichever comes first.

Material from any slips and debris flows shall be removed and used in fills or removed to waste as directed by the Engineer. Slips which occur prior to completion of Subgrade trimming at the location of the slip shall be considered to be earthworks cut to waste or fill as appropriate.

The area affected by any slip or debris flow shall be shaped, trimmed and repaired to return it to the condition as specified in the construction drawings or as directed by the Engineer. The extra work involved shall be treated as a variation, unless the slip or debris flow has been caused by events resulting from the Contractor's negligence or inattention to environmental management on the site. In such a case the required works will be part of the Contractor's on-going maintenance obligations and will not be separately compensated.

If during the maintenance period, or before the completed Subgrade surface is covered, areas of weakness appear in the Subgrade, the Engineer must be informed immediately. The Engineer will then determine what remedial works are required (if any). All remedial work at this stage shall be treated as a variation, unless the damage has been caused by events resulting from the Contractor's negligence, including allowing traffic onto the Subgrade surface. In such a case the required works will be part of the Contractor's on-going maintenance obligations and will not be separately compensated.

8 ACCEPTANCE QUALITY CONTROL

8.1 Fill Construction Acceptance Monitoring

The earthwork construction for Bulk Fill and Subgrade within the construction sequence described in the approved Earthworks Management Plan (refer Section 1.5) require the Contractor to inspect, record, measure, test, and verify construction outcomes.

The Contractor shall inspect, record, measure, test, and verify construction outcomes in representative, homogenous Lots per m^3 of earthwork material (maximum lift thickness of 200mm).

The minimum acceptable frequency of testing shall be two complete set of tests (e.g. 2NDM's and 4 Shear Vanes tests as specified or directed by the Engineer) in randomly selected locations per $200m^3$ of compacted fill. If the testing shows non-conformance, all subsequent filling in the Fill Zone shall stop until such time as a corrective action is confirmed by the Contractor, in accordance with the QMP. All recorded test results (including non-conforming test results) shall be supplied to the Engineer as evidence.

The location of every test site shall be recorded on an as-built plan of the site (refer Section 1.4). This plan shall be updated each time testing is undertaken and submitted as evidence to the Engineer.

The minimum acceptable frequency for deflection testing shall be testing in one direction per traffic lane, with the spacing between test drops to not be greater than 25m.

The frequency of inspection, sampling and testing per Lot shall be completed by the Contractor, in accordance with the EMP, based on minimum quantities provided above, to deliver statistically significant outcomes, whilst removing obvious data outlier values from further analysis.

Reported changes in the mean, standard deviation and percentile value of tested material properties as specified in the contract shall be continually monitored by the Contractor during construction against the specified outcomes using a recognised process control method (e.g. the CUSUM method). The results of this ongoing review shall be used by the Contactor to enable informed decision making and timely corrective actions.

All inspection, sampling and testing shall be timed to deliver the results needed to support specified verification deliverables.

All sampling and testing shall be completed by an IANZ Accredited Laboratory in New Zealand, and undertaken in a safe manner by suitability qualified, experienced and resourced personnel.

Quality records in digital form shall be kept and maintained by the Contractor in agreed digital form throughout the contract, remain accessible to the Principal and the Principal's Agents at all times via "Cloud" or server based technology, and thereafter be supplied to the Principal as permanent record.

Reports of and responses to complaint/query, non-conformance and corrective actions shall be in accordance with the QMP.

The suitability of, frequency and location of alternative test methods, such as within-plant compaction meter testing, shall be agreed with the Engineer before results are presented as evidence for fill construction acceptance.

8.2 Cut Batter Acceptance Monitoring

The earthwork construction outcomes for cut batters within the construction sequence described in the approved Earthworks Management Plan (refer Section 1.5) shall be accepted on the basis of a maximum 500m completed length along one side of the road alignment.

8.3 Test Procedures

Quality assurance testing presented by the Contractor as evidence of compliance with the specification shall be endorsed by staff from an independent IANZ Accredited Engineering Laboratory that holds the appropriate test certifications. Dry density and air void testing (if required) shall be supported by IANZ accredited laboratory testing described in Table 6.

Table 6: Test Requirements to support Compliance Testing

Specified Acceptance Testing	Test Requirements for use with this Specification
Density Testing by NDM	For every set of tests on cohesive fill materials, a laboratory based oven dried moisture content test using random "grab samples" shall be completed to enable the Contractor's agent to calibrate the in-situ moisture readings
Air Void Testing	For every Fill Zone, and hence consistent soil type or homogeneous mix of soil types, two laboratory based Solid Density Tests shall be completed to allow the Contractor's agent to calibrate the in-situ air void calculations

9 BASIS OF MEASUREMENT AND PAYMENT

9.1 Basis of Measurement

For calculating volumes of Topsoil and Clean Topsoil prior to use or stockpiling, the Contractor should in consultation with the Engineer carry out sufficient field depth measurements prior to stripping to adequately represent the site. It may be necessary to calculate average depths over individualised sections of the site, if the recorded depths of Topsoil and Clean Topsoil vary significantly. The solid volume can then be computed from the actual surface areas stripped, which in turn can be determined from the original baseline topographic survey of the site, before any works are started.

For all other cut and fill works, the measurement of quantities shall be by direct survey of the material as specified for payment, based on solid in place measure using a baseline topographic survey of the site that shall be taken once the Topsoil is removed, and before any other cutting of filling takes place, unless otherwise directed or agreed with the Engineer. Where agreement is reached between the Engineer and Contractor, the direct survey may be wholly or partly based on information available from the contract construction drawings.

The measurement of other quantities (e.g. subsoil drains) shall be by direct measurement using calibrated measuring equipment on site, based on the specified measurement for payment.

9.2 Basis of Payment

9.2.1 General

The basis of payment to be used shall be as specified in the contract.

Allowance for all items such as supervision, on site survey control and reinstatement as required, production and environmental planning and implementation, traffic management associated with the earthworks project, quality assurance sampling and testing, conveyance of plant, construction, maintenance and reinstatement of internal access and haul roads, charges for plant, labour and materials, general overheads, administration, profit, accommodation and on-going maintenance shall be deemed to be incorporated in the unit rates listed in the pricing schedule, unless otherwise individually scheduled.

Where material is classified as R1, R2 or R3 in accordance with Section 2 of this specification, an extra over unit rate shall be paid in addition to the rate for Type A material. This shall be in full compensation for the additional work involved in excavating/removing and handling the material through all stages. The quantity for payment shall be the solid in place volume in cubic metres before excavation unless otherwise specified.