APPENDIX AB

Earthworks Strategy and Draft Soil Management Plan

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Inland Rail is a subsidiary of
Australian Rail Track Corporation

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Abbreviations

Abbreviation	Definition
ARTC	Australian Rail Track Corporation
AS	Australian Standard
ASC NEPM	*National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013
B2G	Border to Gowrie
BGL	Below ground level
CBR	California Bearing Ratio
CEC	Cation exchange capacity
CEMP	Construction Environmental Management Plan
DTMR	Department of Transport and Main Roads
EAT	Emerson Aggregate Test
EC	Electrical conductivity
EIS	Environmental Impact Statement
ESP	Exchangeable sodium percentage
GRC	Goondiwindi Regional Council
km	Kilometres
m	Metres
m^2	Square metres
m^3	Cubic metres
mm	Millimetres
MSU	Mapped soil unit
(the) Project	the Border to Gowrie Inland Rail Project
QLD	Queensland
SMU	Soil management unit
TRC	Toowoomba Regional Council
WPI	Weighted Plasticity Index

Glossary

Term	Definition
Borrow pit	An area/pit where excavations are made for additional material.
California Bearing Ratio	A measure of the load-bearing capacity of soils, typically in a re-compacted and saturated state, or in situ.
Capping	A layer or layers of graded crushed rock or other engineered fill within the Formation, usually provided for the purpose of sealing the earthworks from surface water and structurally supporting the track.
Contamination/ Contaminated Materials	Any material containing a chemical substance(s) at above background levels and posing, or potentially posing, a risk of harm to human health, the environment, water supply or agriculture, based on applicable legislation and standards.
Cut	Earthworks constructed by excavation.
Earthworks Materials Management Framework	The framework for reuse of site won or generated earth and rock materials, where the reuse: ▸ Is genuine, rather than a means of waste disposal. ▸ Is beneficial or fit for purposes. ▸ Will not cause harm to human health, the environment. ▸ Will not adversely impact current and future rail infrastructure, maintenance or operations.
Embankment	Earthworks constructed by placement of fill for the purpose of constructing an overlying formation.
Fill	Earth or rock materials placed as a part of the construction process.
Formation	Earthworks constructed by material, usually capping and structural fill, placed between the Subgrade Level and Formation Level below the ballast.
Mass haul	Refers to a calculation that multiples the volume of material with the distance that it is transported during construction.
Spoil	Material surplus to the Contract requirements which must be managed onsite or disposed of off the Site.
Structural Fill	A layer or layers of engineered fill, usually placed to provide a gradational structural support zone between the Subgrade Level and Capping Layer.
Subgrade Level	The finished surface of an embankment or cutting upon which the formation is constructed.
Suitable materials	Material that complies with the requirements of the ARTC Earthworks Material Specification.
Topsoil	The upper most layer of the soil usually dark in colour and rich in organic material.
Unsuitable materials	All material identified as unsuitable for use as a foundation for earthworks or structures or for use as fill material in its present position or condition in consideration of both geotechnical and environmental aspects.
Weighted Plasticity Index	Defined as the value of the Plasticity Index times the percent passing the 0.425 mm sieve.
Zoned embankment	An embankment comprised of zones of different types of fill materials.

1. Introduction

1.1 Structure and objectives

This document has been prepared for the Border to Gowrie section (the Project) of the Inland Rail Program and consists of two parts, as follows

- Part A: Earthworks Strategy – the objective of the Earthworks Strategy is to guide the decision-making process and management intent for earthworks required for the Project, specifically in relation to:
  - The types of material that may be encountered and the classification definitions for those material types
  - Opportunities for material reuse, as an alternative to disposal
  - Overarching principles for the movement and transportation of material
  - Overarching principles for the storage and stockpiling of material
  - Biosecurity considerations
  - Principles for site rehabilitation
- Part B: Draft Soil Management Plan – the objective of the Draft Soil Management Plan is to establish soil conservation and management measures applicable to the construction of the Project which, when implemented, will assist in minimising impacts to soil and the receiving environment. The plan forms part of the environmental management framework to enable the identified environmental and social outcomes to be achieved for the life of the Project, and the process for the preparation and implementation of the Construction Environmental Management Plan (CEMP).

1.2 Further development

This document has been developed in response to the revised reference design for the Project, as described Chapter 5: Project Description. It will be reviewed and updated as the Project design progresses following the EIS process as described in the Draft Outline Environmental Management Plan (Chapter 24). Such updates may be required in response to:

- Changes to the design and subsequent changes to the volumes of material produced from the works
- Changes or improvements in Project processes, including Project approvals
- Changes in Project scope
- Changes in applicable legislation, policy and guidelines
- Consultation with, and feedback from, landholders, stakeholders and regulators
- Outcomes from further geotechnical testing and site investigations, including for contamination and other problematic materials
- Confirmation of the construction methods and sequencing to be implemented for delivering the Project, including material haulage routes
- Continuous improvement and evaluation of environmental management performance against environmental policies, objectives and targets.

2. Part A: Earthworks Strategy

This Earthworks Strategy is intended to provide a management and decision-making framework for earthworks required for the Project. The Earthworks Strategy has been designed to meet relevant regulatory guidelines, policies and standards in a manner that preserves soil conservation and minimises waste. This Earthworks Strategy has been developed in reference to regulatory requirements, as well as the following relevant ARTC and third-party specifications:

- Railway earthworks:
  - In compliance with *Australian Standard (AS) 7638: Railway earthworks*
  - Queensland Rail will default to the relevant Department of Transport and Main Roads (DTMR) specifications – General Earthworks (MRTS04).
  - ARTC Earthworks Materials Specification (ETC-08-03)[1]:
    - Defines properties and compliance requirements of earthworks material for use in the construction of railway earthworks for the Inland Rail Program.
  - ARTC Earthworks Construction Specification (ETC-08-04)[2]:

    Defines the requirements for construction of railway earthworks for the Inland Rail Program, relating to the following works:
    - Setting out of the works
    - Construction and testing of all cut and fill earthworks and associated site preparation works
    - Supply, placement and testing of all formation materials, including structural fill and capping
    - Provision of temporary and permanent drainage
    - Rehabilitation of the site of any temporary deviations required
    - Compliance with the CEMP.
  - Road corridor earthworks:
  - DTMR Specification – *MRTS04 General Earthworks*:
    - Defines properties and compliance requirements of earthworks material for use in construction of earthworks for retuned works (within the road corridor) for the Inland Rail Program.
  - DTMR Specification – *MRTS05 Unbound Pavements*:
    - Defines properties and compliance requirements relevant to the supply and construction of unbound granular pavements which form part of the retuned works for the Inland Rail Program.

This Earthworks Strategy has been developed with the objective of ensuring compliance with the above-mentioned specifications and any relevant regulatory frameworks applicable to the Project.

2.1 Material types and classification

This section identifies materials that are suitable, unsuitable and non-conforming for use in Project earthworks.

2.1.1 Suitable material

Soil and rock material to be used on the Project is required, in the first instance, to comply with the minimum criteria outlined in the ARTC Earthworks Material Specification (ETC-08-03) for railway earthworks and DTMR General Earthworks Specification (MRTS04) for road corridor earthworks. Soil and rock material that meets the minimum criteria outlined within these specifications is considered 'suitable material' for the use cases as described in Table 2-1. It should be noted the description provided below is for general context only, for detailed description of the compliance requirements associated with each material type, reference should be made to the relevant specification nominated.

1 A 'live' document, subject to regular update. Current version can be accessed via ARTC's extranet: **https://extranet.artc.com.au/docs/eng/track-civil/procedures/earthworks/ETC-08-03.pdf**
2 A 'live' document, subject to regular update. Current version can be accessed via ARTC's extranet: **https://extranet.artc.com.au/docs/eng/track-civil/procedures/earthworks/ETC-08-04.pdf**

TABLE 2-1 TYPES OF 'SUITABLE MATERIAL' AND DESCRIPTIONS

Material type	Relevant specification (application)	Description
Capping material	ETC-08-03 (rail)	Capping material must be a well-graded natural or artificially blended gravel/soil. It is required to have sufficient fines to allow for compacting to high densities by static or vibratory steel-tyred rollers or by ballasted pneumatic-tyred rollers. Capping material must be capable of providing structural support to the ballast layer and shedding water from the ballast away from the formation.
Structural fill material	ETC-08-03 (rail)	Structural fill must be a material with properties which when placed, provides a gradational support zone over the underlying material. Structural fill is typically used to provide a stable formation for the support of the track infrastructure and a stable construction platform for the placement, compaction and maintenance of the capping layer and track.
General earth fill material (Type A to Type D)	ETC-08-03 (rail)	The purpose of general earth fill is to provide a stable embankment for the support of the track infrastructure and a stable construction platform for the placement, compaction and maintenance of the structural fill layer, capping layer and track superstructure.
Select fill for use adjacent to structures	ETC-08-03 (rail)	The select fill must be durable and not disintegrate in water or when exposed to the weather. Compacted select fill material must be placed adjacent to structures where the fill depth is greater than 3 m.
Bedding sand	ETC-08-03 (rail)	Bedding sand for pipes, culverts and other miscellaneous structures must be well graded natural or crushed quarry product sands sourced from designated sources, free from organic or other materials harmful to pipes, concrete, structures and the environment.
Rock protection	ETC-08-03 (rail)	Rock protection must be clean, sound, dense and durable rock that will not disintegrate in water or when exposed to the weather. Rock protection should be non-acid forming, angular, blocky and well graded with dimensions ranging nominally from 100 mm to 1,000 mm. The thickness of a single stone must be not less than one-third its length. Rock protection may be used for protecting embankments and structures from scour and erosion. Rock protection must be obtained from certified sources.
Rock fill	ETC-08-03 MRTS04 (road and rail)	Rock fill derives its stability from mechanical interlock and requires a method specification for compliance (rail) or must be placed in accordance with MRTS04 (road). Rock fill must be strong, hard durable rock obtained from certified sources.
Earth fill material (Class A1 to Class D)	MRTS04 (road)	As for general earth fill material used within the rail corridor – earth fill is used to construct stable embankments to support the construction and permanent loading associated with road infrastructure.
Embankment Fill material	MRTS04 (road)	Material making up an Embankment to Subgrade Level, used to Backfill Subgrade treatments or to replace Unsuitable Material. Includes both Earth Fill and Rock Fill.
Bedding material and drainage aggregate	MRTS04 (road)	Bedding material for use in the foundation bedding zone of culverts and for pipes, conduits, pits and so on which will form part of the road corridor.
Backfill	MRTS04 (road)	Backfill material to be placed within the road corridor in confined excavations for culverts, structures, conduits, pits and so on, or in some instances, to fill excavations of 'unsuitable material'. Backfill includes bedding material and all materials placed in the foundation bedding, haunch, side and overlay zones during culvert Backfill. In accordance with MRTS04 the following types of Backfill may be utilised in the works; Select Backfill Material, Free Draining Granular Material, Sand, Coarse Sand, Bedding Material, Filter Material, Cement Stabilised Unbound Granular Material, Stabilised Sand, Dry Stabilised Sand and Lean Mix Concrete.
Unbound pavement materials (Type 1 to Type 4)	MRTS05 (road)	Unbound pavement materials are specified within MRTS05 to provide a high probability of a satisfactory pavement being produced. Typical applications for each unbound pavement material subtype (Type 1 to Type 4) are given in the Transport and Main Roads Pavement Design Supplement. Unbound pavement materials will be obtained from certified sources.

A cross-section schematic of a rail zoned embankment according to ETC-08-03 is provided in Figure 2-1. The figure demonstrates an example of a railway embankment showcasing various material types defined within Table 2-1.

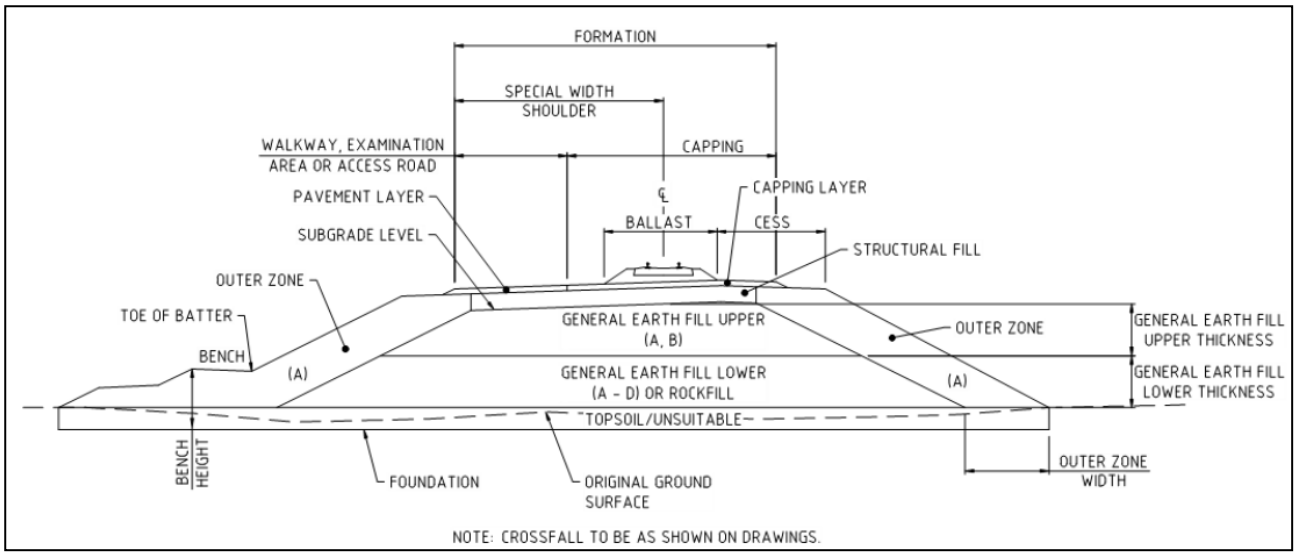


FIGURE 2-1 SCHEMATIC OF RAIL ZONED EMBANKMENT CROSS SECTION

A cross section schematic of a road zoned embankment according to MRTS04 is provided in Figure 2-2. The figure demonstrates an example of a road embankment showcasing various material types defined within Table 2-1.

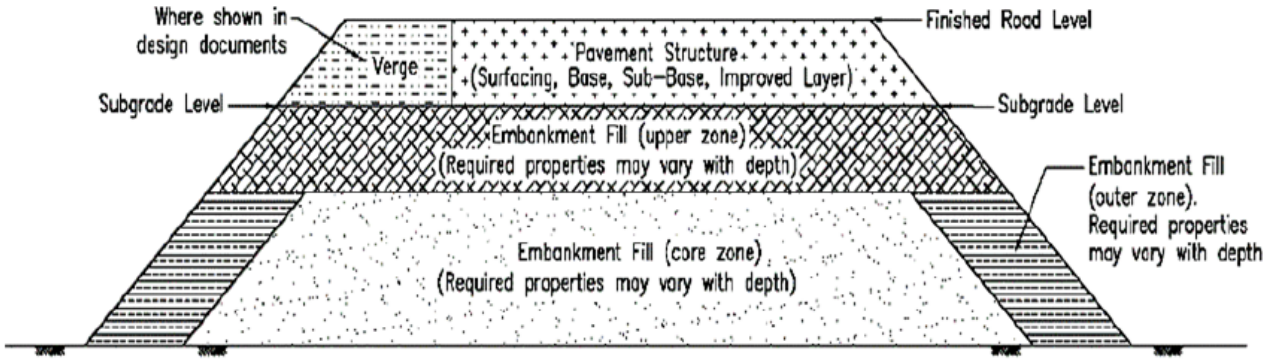


FIGURE 2-2 SCHEMATIC OF ROAD ZONED EMBANKMENT CROSS SECTION

2.1.2 Unsuitable material

2.1.2.1 Rail corridor

Unsuitable materials must not be used as engineering fill for designed purposes unless treated and approved for use in accordance with the Earthworks Construction Specification. These materials are classified as inherently unsuitable or unsuitable material based on the following properties:

- Inherently unsuitable material:
  - Dispersive: The material is found to be dispersive and therefore highly prone to erosion and piping, such as fine single sized sand, windblown sand and non-cohesive silt. Dispersive materials are typically unsuitable as usage can compromise the structural integrity of the earthworks and lead to long-term maintenance issues.
  - Organic soils: Soils with Unified Soil Classifications of Pt, OH or OL (AS 1726:2017 Geotechnical Site Investigations).
  - Extraneous matter: Materials with high organic content, vegetable matter, large rocks, gypsum, debris, or other materials that could cause the fill not to compact to specification.
  - Contamination: Contaminated materials or prescribed waste materials, as defined in reference to the *Environmental Protection Act 1994* and *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013 (ASC NEPM), with the exception of materials deemed suitable (low risk) from a contamination and geotechnical perspective in accordance with the CEMP.

- Unsuitable materials:
  - Moisture content: Based on the natural moisture content, the material may either be too wet or too dry in its current condition to meet the required specifications or consistency.
  - By virtue of position: Unsuitable materials by virtue of position are soil having insufficient strength to carry the loads that will be superimposed on the completed fill without excessive settlement, swell, erosion or loss of stability.

Materials will be tested in accordance with *AS 1289 - Methods of testing soil for engineering purposes* and *AS 4133 - Methods of testing rocks for engineering purposes*. All materials with one or a combination of the above characteristics may be specified as 'unsuitable' without treatment.

2.1.2.2 Road corridor

For the purposes of earthworks within the road corridor, unsuitable material shall be identified and disposed of in accordance with Transport and Main Roads General Earthworks Specification (MRTS04).

- Unsuitable material shall include:
  - material from swaps, marshes and bogs
  - logs, stumps and perishable materials
  - material susceptible to spontaneous combustion
  - excavated material that has a Weighted Plasticity Index (WPI) greater than 4200 and/or a Plasticity Index greater than 50 (refer MRTS04)
  - dry or wet material to a depth of 300 mm or the depth of Subgrade treatment, whichever is greater, which, cannot be reasonably worked or conditioned to achieve specified requirements as well as all material removed which is unsuitable for compacting subsequent layers
  - material forming the foundation for a structure which has an allowable bearing pressure less than that nominated on the drawings
  - material forming the foundation for an Embankment which has an allowable bearing pressure or CBR less than three, based on Dynamic Cone Penetrometer using Test Method Q114B, or otherwise stated in Annexure MRTS04.1
  - material containing biosecurity matter, including noxious weeds and other matter which may adversely affect the local environment, except where these are treated in an appropriate manner – refer MRTS51 for contaminated land
  - stripped topsoil which is deemed not suitable as Planting Media and is not suitable for use elsewhere in the Works
  - building rubble, including concrete, asphalt and other materials except where broken down or otherwise treated and proved to be suitable for use
  - abandoned Public Utility Plant and any associated material

2.1.3 Non-conforming material

Non-conforming material refers to material that is deemed not to comply with criteria presented in the Earthworks Materials Specification (ETC-08-03) for rail earthworks and DTMR General Earthworks Specification (MRTS04) for road earthworks. Typically, these materials cannot be included in the Works without dispensation from the requirements of the earthwork's specifications, and are disposed of on-site, as appropriate, or transported off-site.

Non-conforming materials will be re-used within the rail earthworks where it can be demonstrated that they exhibit suitable engineering properties to not compromise the performance requirements of the Project. In some instances, non-conforming materials will require additional treatment in order to demonstrate suitability for reuse in the rail earthworks, in accordance with the Earthworks Construction Specification (ETC-08-04). Examples of non-conforming materials include highly reactive soils, which can stabilised (using lime, cement, polymers), incorporated into the core of a zoned embankment as Type C/D fill (Figure 2-1), and oversized materials, which can be considered for use as rock fill or rip-rap.

Opportunities for inclusion of non-conforming materials in both homogenous and zoned embankments within the rail earthworks (both with or without treatment) have significantly reduced spoil and beneficially improved the mass haul balance for the Project, consequently reducing the Projects reliance on imported fill.

2.2 Material reuse and disposal

Key principles of this Strategy are to provide measures to manage material:

- In a manner that minimises impacts on construction and operation activities and timing, as well as controlling costs.
- In accordance with identified sustainability initiatives for the Project, consistent with the Inland Rail Environment and Sustainability Policy
- In accordance with *Waste Reduction and Recycling Act 2011* (Qld) hierarchy
- In accordance with DTMR Part 2.7 – filling, excavation and ground disturbance Guide for Development in a Transport Environment: Rail Development in a Transport Environment: Rail (DTMR, 2015) and the Interim DTMR Soil Management Manual
- In accordance with State code 2: Development in a railway environment

The *Waste Reduction and Recycling Act 2011* provides a strategic framework for managing wastes by establishing a waste and resource management hierarchy, as follows:

a) Avoid or reduce

b) Reuse

c) Recycle

d) Recover energy

e) Treat

f) Dispose.

Table 2-2 details the management options for material generated by the Project. The management options are presented in order of preference, in accordance with the general principles of the *Waste Reduction and Recycling Act 2011*. The earthworks materials management framework is shown in Figure 2-3.

For the purposes of conservative evaluation for this Strategy, the generation, management, movement and use of material has been considered for the Project in isolation of adjoining projects in the Inland Rail Program. However, this Strategy encourages the identification of opportunities to minimise waste through the sharing of excess material between projects in the Inland Rail Program, where possible.

TABLE 2-2 EARTHWORKS MATERIALS MANAGEMENT OPTIONS

Options	Example
Avoid and reduce spoil	Reduce the amount of spoil generated by the Project by ensuring cuts are only to the extent required for safe and effective construction of the Project
Reuse within the rail corridor (with or without treatment)	Reuse within the Project footprint to establish formation, fill embankments and mounds. This is subject to the material complying with the Earthworks Material Specification and the reuse purpose (including treatment) being in accordance with the Earthworks Construction Specification.
Reuse for environmental works and land restoration (with or without treatment)	Reuse for environmental works, subject to the material complying with the required specifications intended for its purpose. Examples include: ▸ Reuse in the rehabilitation of native vegetation ▸ Reuse in flood mitigation works, e.g. modification of the Yelarbon levee ▸ Reuse for land reinstatement, e.g. the end-of-use closure of borrow pits used by the Project or the reinstatement of laydown facilities ▸ Reuse as landfill cover (day and intermediate covers) and final capping (where deemed suitable) at licensed facilities within a haulage route distance of 50 km from the point of generation or stockpiling ▸ Reuse of clean material to rehabilitate borrow sites in accordance with the CEMP. Clean material is defined as naturally occurring material that does not contain contaminants above adopted threshold levels, e.g. those published in the ASC NEPM.
Reuse on other development (with or without treatment)	Reuse for fill embankments and mounds on projects within a reasonable haulage distance from the source location, subject to the material complying with the required specifications intended for its purpose. Depending on the haulage distance, other projects in the Inland Rail Program should be prioritised in the first instance.
Dispose offsite (contaminated material and spoil)	Disposal of contaminated material or excess spoil as waste at an approved facility licenced to receive the material. Offsite disposal to landfill should only occur if the material is considered unsuitable for other uses in this hierarchy, e.g. due to geotechnical, contamination or saturation reasons.

2.2.1 Identified purposes for material reuse

Table 2-3 details what are traditionally the most technically feasible approaches to the treatment of unsuitable or non-conforming material to enable reuse within the rail alignment. These identified purposes will require further assessment during the detailed design phase to define whether they are technically feasible and cost effective for the Project.

TABLE 2-3 MATERIAL REUSE OPPORTUNITIES BY MATERIAL TYPE

Types of material	Description	Additional Treatment	Reuse Opportunity
Topsoil	The upper most layer of native material. Materials containing high organic content and/or vegetative matter.	Dispersive topsoil is to be ameliorated to ensure suitability for reuse.	All topsoil is to be separated and stockpiled for preservation and reuse in the staged reinstatement of work fronts.
Non-conforming general fill (Type E)	Material with WPI > 4,000 or CBR < 1%	Use of moisture conditioning and density control to manage shrink/swell. Use of lime/pulverised fuel ash additives on existing high swell materials to improve specification.	**Railway applications:** ▸ Reuse as general fill within the rail embankments (lower zone of zoned embankments, 3 m or below base of formation) or on outer zones (outside the 1:2 zone of influence for the rail line). ▸ Use excess rock material for scour protection at bridge and culverts, if suitable ▸ Batter slope protections, drainage works particularly catch banks, road maintenance access road and other maintenance access requirements. Construction of temporary works activities such as wider access roads, laydown areas, hard stands, temporary piling pads or bunds.
		With or without treatment depending on the environmental application.	**Environmental works and land restoration:** ▸ Reuse in the rehabilitation of native vegetation ▸ Reuse in flood mitigation works, e.g. modification of the Yelarbon levee ▸ Reuse for land reinstatement, e.g. the end-of-use closure of borrow pits used by the Project or the reinstatement of laydown facilities ▸ Reuse as landfill cover (day and intermediate covers) and final capping (where deemed suitable) at licensed facilities within a haulage route distance of 50 km from the point of generation or stockpiling ▸ Reuse of clean material to rehabilitate borrow sites. ▸ Supply of excess material to other developments near the Project for use as general/earth fill
Potentially contaminated material	Contaminated material will be confirmed through sampling and analysis of materials in accordance with the appropriate contamination methods and criteria, e.g. ASC NEPM.	Treatment options will depend on the type and extent of contamination, and will be assessed and subjected to a risk assessment. Potential treatment options, dependent on contaminant of concern, include: ▸ Biological treatment/bioremediation ▸ Chemical oxidation ▸ Soil stabilisation ▸ Physical treatment	Material that meets ASC NEPM contamination criteria for commercial/industrial land use setting and is deemed suitable from a geotechnical perspective will be considered for beneficial reuse or managed within the rail corridor (e.g. fill, capping, ballast or other beneficial reuse) where risks to human health and the environment can be mitigated and are cost effective.

Table notes:
CBR = California Bearing Ratio, WPI = Weighted Plasticity Index

A selective combination of the above-mentioned reuse opportunities have been adopted to minimise the volume of material that is designated as excess spoil for off-site reuse. For example, preliminary calculations based on the revised reference design indicate that the reuse of non-conforming general fill (Type E) within zoned embankments will result in an estimated reduction of spoil from 20 per cent of cut material to 5 per cent.

The reuse options that are adopted during construction will be dependent on the detailed mass haul at the conclusion of detailed design.

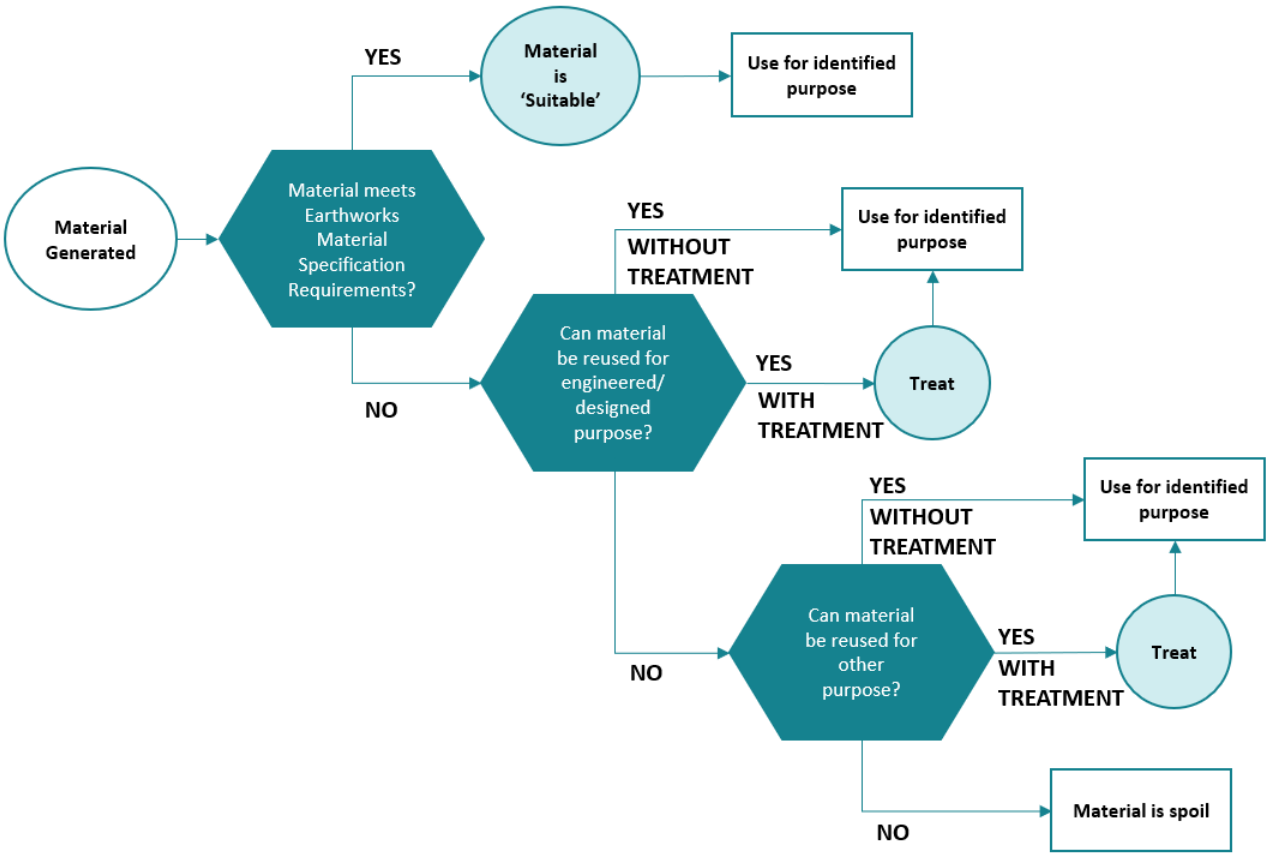


FIGURE 2-3 EARTHWORKS MATERIALS MANAGEMENT FRAMEWORK

2.2.2 Spoil

The volume of site won cut material and fill requirements for the Project earthworks has been determined using a 12D Design Model overlain with detailed geotechnical and soil investigation data (Table 2-5). This has enabled all materials that will be encountered by Project earthworks to be classified, as per Section 2.1.

Based on a review of the geotechnical investigation data within the B2G alignment, as presented in Appendix G1 and G2, approximately 1 per cent of subsurface strata encountered are of soil classifications which are considered to be 'inherently unsuitable' and not fit for usage, either directly or through treatment, within the Project extent (Section 2.1.2). As such, based on the Project Earthworks Material Management Framework (Figure 2-2), these 'inherently unsuitable' materials should be classified as 'spoil' for offsite reuse for environmental works or disposal to landfill. The remaining circa 99 per cent of subsurface strata encountered are of soil classifications which will generate either; 'suitable materials' for use within Project earthworks directly in accordance with Section 2.1.1, or 'non-conforming materials' (~20 per cent) which may be treated and/or preferentially located within the Project extent in accordance with the strategy outlined in Section 2.2. Detailed analysis of the proportion of subsurface strata exposed during cut operations which belong to each soil classification and the associated Project earthwork material classification (Table 2-1) is dependent on vertical alignment and will be developed through the detail design and construction mass haul. In order to account for the level of uncertainty which remains with respect to geotechnical investigation spacing, design development and the detailed design mass haul strategy, up to 5 per cent of total cut volume has been classified as spoil for offsite reuse within the Project material and movement strategy in Table 2-6.

Based on the proposed Earthworks Strategy, approximately 5 per cent of total cut volume is designated as off-site spoil, due to the presence of materials expected to be classified as 'inherently unsuitable'. All other site-won materials have been nominated as suitable, with or without additional treatment, for re-use within the rail or road corridors in accordance with the relevant material specifications, refer Section 2.1.

2.2.3 Disposal

Earthworks material classified as 'inherently unsuitable' are excess materials generated from the project for offsite disposal that cannot be beneficially reused for environmental or land restoration purposes. Material disposal is considered to be the least preferred option and will only be considered where material cannot be treated or otherwise reused. The disposal of spoil material to licensed facilities is costly due to transportation and landfill costs. It should also be noted that from 1 July 2023, the levy exemption for clean earth disposed to landfill under *Reduction and Recycling Act 2011* was removed. Clean earth is now charged at the general waste levy rate.

During detailed design and construction, the Project will seek opportunities to reuse as much material as possible in accordance with the earthworks materials management framework shown as Figure 2-3. Existing waste management facilities in proximity to the Project that have potential to accept waste from commercial operations are detailed in Table 2-4.

These facilities may also accept clean soil materials for use as day and intermediate covers and/or capping soils (if deemed suitable) and therefore could be considered a material reuse opportunity (Section 2.2.1). However, such acceptance is likely to attract a landfill gate fee.

TABLE 2-4 LANDFILLS IN PROXIMITY TO THE PROJECT

Facility	Type	Operator	Contact details	Environmental Authority
Toowoomba Waste Management Centre	Landfill and transfer station	TRC	155–175 Hermitage Road, Cranley QLD (07) 13 18 72	EPPR00625013
Millmerran Waste Facility	Landfill and transfer station	TRC	Owens Scrub Road, Millmerran QLD (07) 13 18 72	EPPR00625013 Landfill airspace is projected to be exhausted prior to commencement of construction for the Project. Available airspace will need to be confirmed in consultation with TRC as the detailed design progresses, post-EIS.
Goondiwindi Transfer Facility and Landfill	Landfill and transfer station	GRC (Proterra Group)	Rubbish Tip Road, Goondiwindi QLD (07) 4671 7400	EPPR00809313
Inglewood Landfill	Landfill	GRC (Proterra Group)	Inglewood-Texas Road, Inglewood QLD (07) 4671 7440	EPPR00809313
Yelarbon Landfill	Landfill	GRC (Proterra Group)	East of Sawmill Road, Yelarbon QLD (07) 4671 7440	EPPR00809313

2.3 Movement and transportation

Estimated bulk earthworks volumes are presented in Table 2-5. Balancing of the cut and fill volumes may result in surplus or deficit of bulk earthworks material, depending on further geotechnical investigations and adjustments made during detailed design, which supports the technical and economic feasibility of material treatment options.

The fill deficit for the Project will be met through the importation of appropriate material types from existing operational, licensed quarries or from the six (6) borrow pit locations proposed to be established for the Project.

A geotechnical assessment of material that will be sourced from cut has been undertaken by overlaying the 12D model for the Project's revised reference design with detailed geotechnical data. This preliminary assessment indicates that approximately 2.3 million cubic metres of material that is sourced from cuts and foundation excavation may be classed as non-conforming against the ARTC specification ETC-08-03. This is approximately 20 per cent of the total volume of material that will be generated from cut activities during construction.

The majority of non-conforming materials are proposed to be integrated into the earthworks in accordance with the material re-use strategies nominated in Section 2.2.1. This spoil material will be transported, via access tracks and temporary haul roads established within the rail corridor, from the point of generation to designated stockpiles in accordance with the CEMP until sufficient volume is accumulated to warrant off-site reuse or disposal. The transportation routes for the movement of cut-and-fill material, including off site spoil reuse locations, have been assessed in Appendix AA: Traffic Impact Assessment.

The preliminary estimates of cut and fill volumes, and material movement requirements for each section of the Project are presented in Table 2-6. A detailed assessment of material movement will form part of the mass haul assessment carried out in the detailed design phase of the Project. Detailed mass haul assessment will inform the need for, and confirm the viability of, proposed material reuse opportunities.

Construction access roads will be required within the rail corridor to allow construction crews to access work fronts. These have been collocated, where possible, with the permanent rail maintenance access road located within the rail corridor to minimise material requirements on the Project.

Outside of the rail corridor, construction access roads to the Project alignment including laydown areas, will be designed and constructed in accordance with relevant standards, which may require upgrades to existing public roads or formed gravel access tracks. All works will be designed with appropriate consideration to minimise disruption to landowners and public infrastructure.

TABLE 2-5 SUMMARY OF BULK PROJECT EARTHWORKS

Earthworks	Volume (m^3)	Breakdown		
Cut		**Spoil %**	**Spoil Volume (m^3)**	**Usable/reuse cut volume (m^3)**
Cut (rail)	11,368,000	5	568,000	10,800,000
Cut (road)	90,700	5	4,500	86,200
Total cut	**11,456,700**		**572,500**	**10,886,200**
Fill		**Usable/reuse cut volume (m^3)**	**Borrow volume (m^3)**	**Quarry volume (m^3)**
General (rail elements)	10,975,000	10,725,740	26,830	222,430
Structural (rail formation)	551,000	-	271,150	279,850
Capping (rail formation)	350,000	-	-	350,000
Fill requirement (rail corridor requirements)	11,876,000	-	-	-
Fill requirement (road elements)	802,300	160,460	-	641,840
Total Project fill requirements	**12,678,300**	**10,886,200**	**297,980**	**1,494,120**

Table notes:
1. Rail and road volumes account for all project earthworks within the respective footprints.
2. Assumes 1.4 bulking factor at each location for the purposes of estimating excavated material for earthworks.

TABLE 2-6 MASS HAUL MATERIAL MOVEMENT BREAKDOWN

Mass haul material movement	Volume (m^3)
Area 0 (NSW/QLD Border Ch30.6km to B2G 0.00km)	
Cut to fill	4,200
Cut to fill to Area 1 (export fill)	12,900
Import fill from Area 2	224,000
Import structural fill from borrow pits	23,000
Import structural fill from quarry	16,800
Import capping from quarry	12,500
Cut to spoil (offsite environmental reuse)	900
Area 1 (Ch 0.0km to Ch 40.0km)	
Cut to fill	59,000
Import fill from Area 2	399,000
Import fill from Area 0	12,900
Import structural fill from borrow pits	113,000
Import structural fill from quarry	200,300
Import capping from quarry	67,000
Cut to spoil (offsite environmental reuse)	3,000
Area 2 (Ch 40.0km to Ch 73.1km)	
Cut to fill	1,928,700
Cut to fill to Area 0 (export fill)	224,000
Cut to fill to Area 1 (export fill)	399,000
Cut to fill to Area 3 (export fill)	9,000
Import general fill from quarry	56,900

Mass haul material movement	Volume (m^3)
Import structural fill from borrow pits	71,000
Import structural fill from quarry	80,400
Import capping from quarry	64,400
Cut to spoil (offsite environmental reuse)	134,800
Area 3 (Ch 73.1km to Ch 100.0km)	
Cut to fill	234,000
Import fill from Area 2	9,000
Import fill from Area 4	458,000
Import structural fill from borrow pits	64,100
Import structural fill from quarry	21,000
Import capping from quarry	45,000
Cut to spoil (offsite environmental reuse)	12,300
Area 4 (Ch 100.0km to Ch 148.8km)	
Cut to fill	1,488,900
Cut to fill to Area 3 (export fill)	458,000
Cut to fill to Area 5B (export fill)	93,700
Import structural fill from quarry	178,700
Import capping from quarry	68,400
Cut to spoil (offsite environmental reuse)	107,600
Area 5A (Ch 148.8km to 184.0km)	
Cut to fill	2,512,200
Cut to fill to Area 5B (export fill)	671,700
Cut to fill to Area 6 (export fill)	905,700
Import structural fill from quarry	371,600
Import capping from quarry	58,500
Cut to spoil (offsite environmental reuse)	215,610
Area 5B (Ch 184.0km to 203.0km)	
Cut to fill	1,755,300
Import fill from Area 4	93,700
Import fill from Area 5A	671,700
Import general fill from borrow pits	26,800
Import general fill from Quarry	148,500
Import structural fill from quarry	41,000
Import capping from quarry	27,000
Cut to spoil (offsite environmental reuse)	92,400
Area 6 (203.0km to B2G end)	
Cut to fill	129,800
Import fill from Area 5A	905,700
Import general fill from quarry	17,000
Import structural fill from quarry	11,800
Import capping from quarry	7,200
Cut to spoil (offsite environmental reuse)	6,800

2.4 Storage and stockpiling

Excavated material (cut) will be directly transported to a point of reuse (fill) where practicable and within the constraints of construction requirements to avoid or minimise stockpiling and double handling requirements. Where immediate reuse is not possible, the material will be stockpiled within the construction footprint. Material stockpiles will be located as far away from receiving water bodies as practicable and positioned to avoid disruption to overland flow paths.

Stockpiles will be located as close as possible to the source of the excavated material or its intended destination and will be stockpiled by separable material type in accordance with the CEMP and final Soil Management Plan.

Laydown areas have been identified along the length of the Project footprint and are listed in Table 2-7. These laydown areas are situated, where possible, to facilitate direct access to/from the rail corridor. The laydown areas have various primary functions, such as for the storage of plant and materials, establishment of site offices or as an area to be used in support of constructing structures, such as bridges. Regardless of primary function, laydown areas have potential to be used for the temporary stockpiling of material, if required.

TABLE 2-7 LAYDOWN AREAS NOMINATED FOR THE PROJECT

ID	Location	Chainage (km)	Size (m^2)
NS2B–LDN031.0	Kildonan Road	31.0	33,000
NS2B–LDN032.5	Kildonan Road	32.5	161,000
NS2B–LDN033.2	Kildonan Road	33.2	7,000
NS2B–LDN035.6	Eukabilla Road	35.6	88,000
B2G–LDN000.9	Georges Lane (extension)	0.4	126,000
B2G–LDN006.3	Yelarbon–Kurumbul Road	6.2	10,000
B2G–LDN016.0	Yelarbon–Kurumbul Road	16.0	26,000
B2G–LDN020.3	Yelarbon–Kurumbul Road	20.4	8,000
B2G–LDN025.9	Yelarbon (south)	25.8	21,000
B2G–LDN025.9	Yelarbon (north)	25.9	12,000
B2G–LDN030.0	Suttons Road	30.0	11,000
B2G–LDN037.6	Springborg Road	37.6	12,000
B2G–LDN049.8	McDougalls Crossing Road	49.70	30,000
B2G–LDN052.8	Cremascos Road	52.8	11,000
B2G–LDN054.2	Cremascos Road	54.3	54,000
B2G–LDN055.4	Cremascos Road	55.4	33,000
B2G–LDN060.4	Bybera Road	60.5	27,000
B2G–LDN065.8	Lovells Crossing Road	65.8	25,000
B2G–LDN067.6	Thornton Road	67.6	10,000
B2G–LDN069.0	Thornton Road	68.8	41,000
B2G–LDN073.0	Millmerran–Inglewood Road	72.9	8,000
B2G–LDN074.0	Millmerran–Inglewood Road	74.2	148,000
B2G–LDN081.0	Wongavale Yugibar Road	81.1	27,000
B2G–LDN088.0	Millmerran–Inglewood Road	88.1	29,000
B2G–LDN091.8	Site track off Millmerran–Inglewood Road	91.9	15,000
B2G–LDN093.8	Millmerran–Inglewood Road	93.8	13,000
B2G–LDN098.0	Millmerran–Inglewood Road	97.9	31,000
B2G–LDN100.6	Millmerran–Inglewood Road	100.7	3,000
B2G–LDN104.5	Partons Road	104.6	26,000
B2G–LDN112.1	Millwood Road	112.2	26,000
B2G–LDN115.6	Millmerran–Inglewood Road/Heckendorf Road via LDN 116.00	115.7	14,000
B2G–LDN116.0	Heckendorf Road	116.2	94,000
B2G–LDN120.2	Blackwell Road	120.2	104,000

ID	Location	Chainage (km)	Size (m^2)
B2G-LDN123.6	Scragg Road	123.7	20,000
B2G-LDN123.8	Scragg Road	123.8	11,000
B2G-LDN126.9	Schwartens Road	126.9	7,000
B2G-LDN128.2	Owens Scrub Road	128.4	27,000
B2G–LDN129.5	Foxwood Road	129.4	119,000
B2G-LDN130.0	Owens Scrub Road	130.0	27,000
B2G-LDN130.6	Owens Scrub Road	130.6	168,000
B2G-LDN130.4	Owens Scrub Road	130.7	89,000
B2G–LDN138.5	Hall Road	138.6	116,000
B2G–LDN139.0	Hall Road	139.2	304,000
B2G–LDN140.2	Millmerran Leyburn Road	141.6	76,000
B2G–LDN141.3	Millmerran Leyburn Road	142.6	12,000
B2G–LDN143.0	Gilgai Lane	144.4	9,000
B2G–LDN144.6	Gilgai Lane	146.0	142,000
B2G–LDN147.1	Fysh Road	148.4	4,000
B2G–LDN149.0	Gore Highway	150.1	47,00
B2G–LDN150.5	Dieckmann Road	152.1	132,000
B2G–LDN150.9	Ware Street	152.1	5,000
B2G-LDN152.9	Madelaine Street	153.3	6,000
B2G–LDN153.1	Gore Highway	154. 6	91,000
B2G–LDN161.0	Yarralea Road	162.3	63,000
B2G–LDN163.3	Roche Road	164.7	5,000
B2G–LDN164.3	Murlaggan Road	165.6	24,000
B2G–LDN165.6	Kahler Road	166.9	7,000
B2G–LDN169.6	Gore Highway	171.0	30,000
B2G–LDN171.0	Oakey Pittsworth Road	172.3	7,000
B2G–LDN172.0	Lochaber Road	173.3	16,000
B2G–LDN172.6	Lochaber Road	173.8	19,000
B2G–LDN173.5	Paint Mine Road	174.8	17,000
B2G–LDN175.5	Linthorpe Road	176.9	69,000
B2G–LDN179.0	Geitz Road via Linthorpe Valley Road	180.2	22,000
B2G–LDN183.0	Bushy Lane	184.3	20,000
B2G–LDN183.8	Biddeston Sourthbrook Road	185.1	16,000
B2G–LDN185.0	Gore Highway	186.5	30,000
B2G–LDN188.2	Athol School Road	189.5	76,000
B2G–LDN192.3	via Athol Road	193.6	30,000
B2G–LDN196.2	Toowoomba–Cecil Plains Road via existing side road	197.4	4,000
B2G–LDN197.0	Toowoomba-Cecil Plains Road	198.3	4,000
B2G–LDN198.1	Brimblecombe Road	199.4	4,000
B2G–LDN198.7	Brimblecombe Road	200.0	3,000
B2G–LDN203.0	Warrego Highway	204.3	4,000
B2G–LDN204.2	Chamberlain Road	205.5	35,000
B2G–LDN206.3	Leesons Road	207.6	30,000
B2G-LDN206.9	Draper Road	208.2	81,000
N/A	Whetstone Material Distribution Centre	44.8	21,262
N/A	Turallin Facility	127.0	200,000

2.5 Biosecurity

2.5.1 Weed hygiene

Activities associated with the management of material may provide pathways for the spread of weed species. The *Biosecurity Act 2014* (Qld) regulates certain listed weed species and imposes a general obligation on persons to prevent or minimise the impact of bio-security risks on human health, social amenity, the economy and the environment. The Act prescribes certain weed species as being bio-security matter. The following measures will be implemented through the CEMP for the Project:

- Identify weed species in the area through pre-construction surveys and consultation with local government authority Pest Management Officers, local bush care groups and supporting landholders
- Ensure that weed impacted topsoil is not reused in rehabilitation works, unless it is treated and sterilised in an appropriate manner
- Use designed access tracks for transportation of material and avoid weed impacted areas, where practicable
- Clean equipment such as boots, vehicles, plant and machinery when leaving weed impacted areas
- Implement weed hygiene protocols and washdown procedures for construction vehicles
- Dispose of weed material in appropriate waste receptacles within designated locations.

2.5.2 Fire ants

Fire ants are a restricted pest under the *Biosecurity Act 2014* (Qld). Fire ant biosecurity zones are in place in areas of Queensland to restrict the movement of materials that could spread fire ants. Under the *Biosecurity Act 2014*, individuals and organisations whose activities involve the movement or storage of fire ant carriers (which includes soil) have a general biosecurity obligation to take all reasonable steps to ensure they do no spread fire ants. The *Biosecurity Regulation 2016* prescribes procedures to be followed when moving or storing a fire ant carrier. The Project is not located within a fire ant biosecurity zone. However, materials delivered to site may originate from a fire ant biosecurity zone, as such measures will be implemented to ensure soil movement complies with Queensland biosecurity requirements for managing the spread of Red imported fire ants.

2.6 Rehabilitation

Land disturbed during the construction stage will be rehabilitated at the completion of works, in a manner that maximises the potential for successful land rehabilitation and considers soil conservation.

A site-specific Rehabilitation and Landscaping Management Plan will be developed as a component of the CEMP to guide the approach to rehabilitating disturbed areas. The plan will reflect the Project's construction program, Project approval conditions and industry best practice. Rehabilitation will occur progressively throughout the construction phase to reduce the impact of the Project on the surrounding environment.

The Plan will be developed in consultation with local councils and affected communities, including Traditional Owners, and will establish:

- Location-specific objectives for rehabilitation, reinstatement and/or stabilisation. Outside of the Project rail corridor, lot-specific and township-specific (e.g. Yelarbon, Pampas, Brookstead, Pittsworth) rehabilitation and landscaping requirements may apply and will be developed in collaboration with the relevant landowner, local council or DTMR. Where the rail corridor passes through landscapes of importance to Traditional Owners, consultation will be undertaken (including with the Bigambul Native Title Aboriginal Corporation) to develop mitigation to 'care for Country'. Within the Project rail corridor, maintaining operational safety and rail formation stability will be the driving factors.
- Procedures, timeframes, performance objectives and responsibilities for rehabilitation, reinstatement and/or stabilisation works (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved).
- How the stabilisation and rehabilitation works consider site-specific soils, the finalised Soil Management Plan, and any flooding and geomorphology requirements or mitigations.
- How the objectives align with relevant recovery plans, threat abatement plans, conservation advice or policy guidance for target species in areas identified for rehabilitation
- Actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, while minimising the duration of exposure in disturbed areas
- Rehabilitation requirements, such as:
  - milling and removal of bitumen pavement

- removal of any decommissioned culverts
- tyning and ripping of base and sub-base material
- application of soil ameliorants
- topsoiling and/or compost blanket
- stabilisation and rehabilitation (e.g. planting and/or seeding)

- How the stabilisation and rehabilitation works consider native flora species endemic to the Darling Downs and Toowoomba regions or other suitable species appropriate to the landscape context and nursery/seed stock sources
- How strategic revegetation will consider fauna connectivity requirements at identified biodiversity corridors and incorporate habitat features (e.g logs, rocks, artificial habitats), necessary vegetation buffers and plantings to encourage and facilitate movement of wildlife towards crossing structures
- Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas
- Corrective actions if the outcomes of rehabilitation, reinstatement and/or stabilisation are not achieved.

3. Part B: Draft Soil Management Plan

This Draft Soil Management Plan has been developed following detailed soil investigation of the Project alignment, and the development of 1:10,000 soil mapping, as presented in Appendix J: Soil Assessment Report of the revised draft EIS.

The objectives of the Draft Soil Management Plan are to provide a framework and measures that will minimise the loss or degradation of soil resources attributable to the Project and to enable soils to be returned to as near as practical to their pre-existing soil conditions by applying the principles of:

- Avoiding, minimising, or mitigating impacts to soils
- Maintaining topsoil quantity and quality
- Restoring land use and capability
- Returning the land to a stable, safe, and non-polluting landform (i.e. no subsidence or major erosion) with no greater management inputs than those required prior to land disturbance
- Minimising the generation of dust from soil disturbing activities.

To achieve the above objectives and procedures, the following management strategies are recommended for earthworks:

- Avoid or otherwise minimise the volume of excess material generated:
  - Optimise civil earthworks design through value engineering and detailed design to achieve as close to a net balance in earthworks as possible
  - Accurately outline boundaries and depths of cut and fill works to limit the volume of material needing to be managed
- Reuse excess material for works within the permanent footprint (i.e. additional landscaping)
- Reuse excess material for restoration of modified landform within the temporary footprint
- Reuse of excess material for other developments (i.e. neighbouring construction activities), with priority given to other adjoining Inland Rail projects
- Dispose of spoil (material with no reuse potential) offsite as waste at an appropriate facility (i.e. landfill).

This Draft Soil Management Plan, including the soil management measures will be progressively updated as further site-specific information becomes available in line with the CEMP and other Project requirements.

3.1 Soil types and soil horizon identification

In texture contrast soils, there are often two components to topsoil:

- A1 horizon: this has an accumulation of organic matter (darker than underlying horizons) and contains most of the biological material (e.g. grass seeds, humus) and nutrients. In some instances, the A1 horizon may have been eroded away, so will be absent.
  - The depth of the A1 horizon may vary anywhere from 20 mm to 100 mm deep.
- A2 horizon: underlies the A1 horizon and is paler in colour than the A1 horizon with less organic matter and fewer nutrients.
  - In many texture contrast soils the A2 horizon may be bleached and this material is of less value as a medium to support plant growth. However, it generally does not have properties that inhibit plant growth such as salinity and alkalinity, though material with high silt and fine sand contents may have undesirable physical properties when disturbed.

In summary, topsoil in texture contrast soils contains A1 and A2 material with the A1 horizon material providing the biological material (e.g. grass seeds, humus) and nutrients and the A2 horizon material providing a physical substrate. These soil materials also tend to be more unstable and erodible when disturbed and will need additional management measures.

Texture contrast subsoils in this region generally (though not always) consist of materials that are not well suited to plant growth. Subsoils (those beneath the topsoil) may be moderately to strongly sodic, moderately to highly saline, strongly alkaline or acid, and are mostly poorly structured clays, all properties that are not conducive to plant growth. They can be differentiated from topsoils by their clay textures and generally stronger colours that include grey, brown, or yellow and often with mottles. The intent is to ensure these materials are reinstated at depth under a sufficient (depth and quality) layer of topsoil where their impact on plant establishment is minimised.

Identifying A horizon material in clay soils is more difficult, particularly when the subsoils are dark coloured. A horizons and B horizons are often identified using soil structure where the A horizon has unaccommodated peds (individual natural soil aggregate consisting of a cluster of primary particles) and the B horizon accommodated peds. A horizon depth may vary from only 20 mm to around 100 mm or more. In practice, depth functions of properties such as pH, salinity, and sodicity indicate that clay material to depths of at least 500 mm does not inhibit plant growth in almost all clays. That is, although clay material can be difficult to manage, it is possible to salvage topsoil to at least around 300 mm.

The heavy clay soils can be identified by the gilgai microrelief and clay surface textures. In dry periods, wide, deep cracking may be evident, and the surface may be self-mulching (crumbly) or have a cracked, crusty appearance (surface crust).

The texture contrast soils mostly have a hard-setting surface though sandy surface soils may have a loose surface condition. The topsoil textures are sands and loams with an abrupt to clear change to the clay subsoils. Topsoil stripping depth may vary across the study area from 100-150 mm to 200-300 mm, or more in some cases.

A suitably experienced environmental advisor or operator is to determine, within the parameters outlined in Table 3-2, what the maximum topsoil stripping depth should be and the depth recorded and conveyed clearly to the plant operators.

3.2 General soil management measures

This section describes general soil management measures applicable to rail infrastructure construction and land disturbance activities. These activities include vegetation clearing, topsoil stripping, subsoil excavation, windrowing/stockpiling and site rehabilitation.

General soil management measures, that are not specific to soil type, are presented Table 3-1 and aligned with the applicable stage of the Project (detailed design, pre-construction activities, early works and construction works, including rehabilitation).

TABLE 3-1 PROPOSED GENERAL SOIL MANAGEMENT MEASURES

Delivery phase	Aspect	Proposed management measures
Detailed design	Erosion and sediment control	Cut batter angles will be appraised during detailed design, based on material strengths and other geotechnical properties. Stability analysis will be required to assess the factor of safety of these cut slopes. The appropriateness of this gradient and erosion protection will require confirmation through trials and further testing, as part of the detailed design.
		Surfaces of batters are to be designed to be left with a rough texture, generally in line with contours, to facilitate retention of placed topsoil on the batters whilst grass cover is established.
		To the greatest extent practicable, slopes are to be designed to facilitate sheet flow movement of water across them to the nearest drainage line/watercourse to minimise concentration of flow and creation of rill and gully erosion and ponding.
		Scour protection at cross-drainage locations will be designed to achieve site-specific erosion threshold velocities to facilitate long-term stable, safe, and non-polluting landforms.
	Soil management	Gypsum or other suitable replacement ameliorants are to be incorporated into the design to structurally stabilise to treat soils with sodicity/dispersion issues.
		Lime or other suitable replacement ameliorants determined during the detailed design stage are to be incorporated into embankment design and soil stability methodologies to raise soil pH of acidic soils from strongly acid or worse to a range between slightly acid to slightly alkaline.
		Fertilisers and composted manure or other composted organic materials are to be incorporated into the design to improve soil structure, texture, and fertility to facilitate vegetation establishment at rehabilitation.
		Suitably sized areas are to be designated within the Project footprint for the appropriate separation, storage and management of soil materials (topsoil, upper subsoil, lower subsoil).
		Heavy cracking clays with large mounds and depressions (e.g. melonhole gilgai) will be avoided, where possible, given the difficulty of managing these materials to prevent degradation of rail infrastructure. Where this is not possible, alternative engineering design methods will be required to minimise their impact to the rail infrastructure. These methods will need to be individually developed for the site-specific conditions that are presented.
Pre-construction activities and early works, and construction stages	Stripping procedure	A detailed stripping procedure will be developed to ensure topsoil and subsoil stripping are conducted in a manner that preserves and maintains their integrity for reinstatement and rehabilitation of all soil units. The stripping procedure should cover at least the following: ▸ The different mapped soil units and their general identifiable characteristics ▸ Topsoil and subsoil stripping depths and indicators of depths ▸ Bulk density and/or penetrometer results ▸ Windrowing/stockpiling procedures ▸ Amelioration procedures ▸ Reinstatement procedures.

Delivery phase	Aspect	Proposed management measures
	Soil management	The Soil Management Plan will be updated and finalised as required as more site-specific information becomes available to allow more precise management requirements targeted to specific soils and their physical and chemical properties. The finalised plan will determine the suitability and manage the risks of the Project's topsoils and subsoils in accordance with applicable regulatory guidance such as the Interim DTMR Soil Management Manual, Soil Management Manual Appendix 2 soil forms, DTMR Soil Group classifications map and CSIRO Clay Minerology Maps, and with reference to the baseline data and soil unit mapping presented in Appendix J: Soil Assessment Report (detailed soil investigation report). Individual Project sections may require a location-specific Soil Management Plan depending on the complexity of the section and construction methodology, e.g. range and distribution of geological units, landforms, and soil units, and number and complexity of Soil Conservation Plans.
	Weed management	The Project's Biosecurity Management Plan, as a component of the CEMP, is to be developed to include consideration for management of weed outbreaks on windrowed/ stockpiled soil.
	Erosion and sediment control	The Project's Erosion and Sediment Control Plan, as a component of the CEMP, will be developed to guide development of area-, site-, or section-specific requirements and will include erosion hazard assessments and ESC details, updated and maintained as required throughout the Project's construction. Erosion and sediment control devices will be constructed/installed in accordance with the International Erosion Control Association's (IECA) guidelines (IECA, 2008) and assessed/monitored to: ▸ Minimise disturbance and erosion of soil ▸ Control or divert surface drainage entering the rail corridor and at isolated work sites.
		Windrows/stockpiles of cleared vegetation and soil will be oriented to avoid diversion or concentration of overland flows thereby minimising potential for erosion.
		Temporary batters will be of appropriate gradient, with consideration for natural angle of repose of the soil material, to facilitate stability of windrowed/stockpiled materials.
		Adequate compaction of subsoil material will be required to prevent subsurface water flowing through voids and fissures in dispersive materials that can potentially lead to tunnel erosion. This will assist in minimising soil loss from disturbed and windrow/stockpile areas.
		Erosion and sediment control measures and areas receiving concentrated flows will be inspected on a regular basis, replaced or reinstated where damaged, and emptied following rainfall events, where required.
	Soil tracking register	A soil tracking register, or similar, will be developed to enable the depth, volumes and location of origin and the location of stockpiling of topsoil and subsoil material to be recorded. This will enable materials to be returned to the location of origin during site rehabilitation works, in a manner that is generally consistent with pre-disturbance condition.

Delivery phase	Aspect	Proposed management measures

	Rehabilitation monitoring	The Project's Rehabilitation and Landscaping Management Plan will be developed as a component of the CEMP to include soil rehabilitation requirements including:
		▸ Milling and removal of temporary hard surfaces
		▸ Tyning and ripping of base and sub-base material
		▸ Application of soil ameliorants
		▸ Topsoiling and/or compost blanket
		▸ Soil stabilisation
		  ▸ The low strength soils will be tested to ensure an accurate amount of soil stabiliser/ameliorant is used
		  ▸ Lime deliveries will be managed to ensure minimal storage onsite. When required, storage will be in accordance with standard practices
		▸ Procedures, timeframes, measurable performance objectives, and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas
		▸ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved.

	Stripping procedure	Topsoil will be re-spread to be generally consistent, where possible, with the depth that was stripped from that specific soil unit, as recorded in the soil tracking register.
	Soil management	Hollow logs and tree trunks will be removed, prior to vegetation clearing and topsoil stripping, consistent with salvage and relocation of microhabitat features, to avoid being co-mingled with topsoil during earthworks. Hollow logs and tree trunks will be retained, and stockpiled separate to be reinstated, or immediately placed in designated areas, as potential habitat for native fauna in accordance with the Biodiversity Management Plan, as a component of the CEMP.
		Where consistent with the CEMP, native vegetation free of weed species will be mulched and windrowed/stockpiled so it is available for use during construction as mulch berms, or spreading over exposed soil areas, or over topsoil windrows/stockpiles.
		Plant movement will be planned to ensure that structural degradation/compaction of the soil will be minimised during stripping, windrowing/stockpiling, and/or re-spreading.
		Topsoil from identified soil mapping units will be stripped and windrowed/stockpiled separately.
		Topsoil will be stripped to the maximum specified depth (Table 3-2), as confirmed to plant operators by a suitably qualified Environmental Monitor, with every effort made to preserve as much topsoil as possible.
		Topsoil windrows/stockpiles should not exceed two m in height to minimise degradation of topsoil, maintain biological capital, and maintain fertility to the extent practicable.
		Uncontaminated, natural subsoil will be excavated and stockpiled separately and downslope from its topsoil to prevent mixing with/ contamination of its topsoil.
		Uncontaminated excess subsoil will be windrowed/stockpiled separately for reburial during reinstatement works, or for other infrastructure uses (Section 2.2.1).
		All soils located within the existing Queensland Rail rail corridor will be considered contaminated unless proven otherwise through sample testing to ensure proper management, treatment, or disposal of the contaminated soils

Delivery phase	Aspect	Proposed management measures
		Potentially contaminated soil (e.g. soil from Environment Management Register-listed properties) will be managed under the direction of a Suitably Qualified Person in accordance with the Contaminated Land Management Plan, a component of the CEMP, to ensure compliance with the EP Act and ASC NEPM. Construction works will seek to minimise soil disturbance in areas listed on the Environment Management Register. Opportunities to treat and re-use within the rail corridor will be assessed and where it cannot be treated and re-used will be disposed at a licensed facility and a soil disposal permit will be obtained.

		Use of soil ameliorants will be best assessed site by site depending on the activity, hazard, landform, and properties of the soil materials. General recommendations for use in low-risk settings are as follows:
		▸ Gypsum or other soil conditioners that can treat soil will be incorporated within the top 300 mm of soil materials to be treated. Other soil conditioners may be used as substitutes for gypsum provided that sufficient volumes are applied to treat the soil to the same standard as gypsum.
		▸ For exchangeable sodium percentages (ESPs) typical of lower subsoil material, gypsum application rates to reduce the ESP to below six are from 0 to 26 t/ha/100 mm between 300 to 600 mm below ground level (BGL) and 0 to 30 t/ha/100 mm between 600 to 1,500 mm BGL.
		▸ The addition of gypsum or other soil conditioners will be best undertaken prior to stripping by spreading on the soil surface.
		▸ A second application of gypsum or other soil conditioners may be required prior to rehabilitation.
		▸ Laboratory analysis through a National Association of Testing Authorities/Australian Soil and Plant Analysis Council laboratory of windrowed/stockpiled material will be undertaken prior to amelioration and reinstatement to ensure appropriate amelioration to improve likelihood of rehabilitation success. A range of samples will be collected and bulked from each windrow/stockpile for every mapped soil unit for analysis.
		▸ Analyses will be appropriate for the type of soil to be reinstated, e.g. topsoil, upper subsoil, and lower subsoil. Analyses should include some or all the following, but not necessarily be restricted to:
		  ▸ Soil pH (1:5 soil/water)
		  ▸ Electrical conductivity (EC) (1:5 soil/water)
		  ▸ Exchangeable cations (including calculations for exchangeable cation percentages, cation exchange capacity (CEC), and calcium to magnesium ratio (Ca:Mg))
		  ▸ Emerson aggregate test
		  ▸ Bicarbonate extractable (Colwell) and total phosphorus
		  ▸ Nitrate and total nitrogen
		  ▸ Organic matter and total organic carbon
		  ▸ Carbon to nitrogen ratio
		▸ Mixing of gypsum or other soil conditioners into soil windrows/stockpiles prior to reinstating the soil from its windrow/stockpile back to its original location will be done using a trommel screen for best results; however, other methods may be used, although this may compromise rehabilitation success. If, however, reinstatement has already been undertaken, gypsum can be incorporated from the surface by discing or scarifying.
		▸ The quality of gypsum or other soil conditioners (e.g. % gypsum or equivalent calcium %, particle size, moisture content, contaminants) will be checked and confirmed through a laboratory by the contractor for each major batch to be delivered prior to use.

Delivery phase	Aspect	Proposed management measures
		The following management measures are proposed for sections of the Project that are located on floodplains: ▸ Limit concentration of water, focus on reducing velocities by encouraging concentrated flows to spread out over the floodplain through location of infrastructure and diversion bunds) ▸ Maintain vegetative ground cover for as long as possible prior to earthworks, using tackifiers or spreading mulch, and/or hydromulching/seeding immediately post earthworks, will be considered ▸ Construction equipment (i.e. bulldozers and excavators) can create wheel or track ruts in soil that can lead to concentrated flows and an increase in erosion. Manually ripping and levelling deep ruts or ensuring they are at right angles to the direction of flow can minimise their impacts.
		Subsoil (B horizon) material will not to be spread over topsoil (A horizon) material. Where subsoil has been split into upper subsoil and lower subsoil due to high levels of salts or other highly concentrated/elevated compounds/elements, lower subsoil will be separate from topsoil by the upper subsoil.
		Additional nutrients (specifically nitrogen and phosphorus-based fertilisers, depending on the type of revegetation planned) or conditioners (e.g. composted organic matter, gypsum, fly ash, or lime) may be required in some areas to improve topsoils, stabilise the subsoils, and support vegetation regrowth during stockpiling and rehabilitation. This will be determined with reference to Table 3-2 to the nearest relevant representative soil profile, or otherwise by laboratory analysis of stockpile samples.
		General management measures applicable to all soil management units (SMUs): ▸ Avoid major soil disturbance during periods of high erosive rainfall events by monitoring developing weather conditions ▸ All soils have the potential to produce dust depending on moisture content, vegetative cover, and vehicular traffic, though soils with high silt and fine sand contents are likely to be more susceptible than those with medium to coarse sand and clay. Minimise dust production on susceptible soils by regular watering during construction activities and through traffic management. ▸ Vegetation clearing to be undertaken with minimal disturbance to topsoil thereby preventing topsoil from being mixed with vegetation/mulch windrows/stockpiles ▸ Topsoil stripping will be to the maximum specified depth (as confirmed by the Environmental Monitor) ▸ Every effort will be made to preserve as much topsoil as is possible following vegetation clearing ▸ Topsoil, subsoil, and parent material will be stripped in separate operations to prevent mixing of each material with any of the others ▸ An experienced Site Environment Advisor to monitor, record, and communicate topsoil stripping depth. They will maximise the harvesting of topsoil and ensure maximum topsoil is retained and subsoil is not stripped with topsoil. ▸ Topsoil and subsoil from different soil management units are to be windrowed/stockpiled separately and identified (GPS located and signed) to prevent contamination of different topsoil and subsoil materials ▸ Do not place structures, apart from those used in erosion and sediment control, in locations that interfere with the natural flow of water, particularly in riparian zones and floodplains ▸ Where nitrogen, phosphorous and potassium (N, P and K) fertiliser is to be applied to topsoils to assist in establishing a protective vegetative cover, suitable rates are to be determined from laboratory analyses of topsoil materials, as specified in earlier management measures ▸ Runoff diversion structures will be required on sloping land to prevent concentrated overland flow. This will be particularly important for SMU 4.2.3.2 on slopes ≥1%. These will be installed in accordance with site specific ESCPs.
	Stockpile management	Where practicable and subject to the CEMP, gaps of 20 m will be left between the ends of windrows/stockpiles at appropriate intervals to allow for drainage and the movement of vehicles and fauna.
		Establish a good (>95%) cover of vegetation and/or mulch on windrows/stockpiles that are to be retained greater than 3 months to minimise surface soil erosion.

Delivery phase	Aspect	Proposed management measures
		Where possible, no windrow/stockpile will be retained for more than 12 months as this will greatly limit the availability of nutrients and seeds contained within the stored topsoil.
		Where windrows/stockpiles are retained for greater than 12 months, samples from each topsoil windrow/stockpile will be analysed through a National Association of Testing Authorities/Australian Soil and Plant Analysis Council laboratory for: ▸ Soil pH (1:5 soil/water) ▸ EC (1:5 soil/water) ▸ Exchangeable cations (including calculations for exchangeable cation percentages, CEC, and calcium to magnesium ratio) ▸ Emerson aggregate test ▸ Bicarbonate extractable (Colwell) and total phosphorus ▸ Nitrate and total nitrogen ▸ Organic matter and total organic carbon ▸ Carbon to nitrogen ratio.
	Rehabilitation	Progressive reinstatement of disturbed areas will commence as soon as practicable following completion of construction activities in a designated area to minimise the extent of time that sub-soils are left exposed and materials are stockpiled.
		Subsoil will be compacted to the original bulk density or as close as possible to the un-disturbed soil state based on pre-disturbance bulk density and/or penetrometer results.
		Topsoil re-spreading will be undertaken in a manner which promotes a suitable seed bed for revegetation.
		Topsoil will be lightly compacted to prevent topsoil loss from the rehabilitated areas.
		Landform will be reinstated to avoid areas of localised ponding following rain events.

3.3 Specific soil management measures

This section describes management measures applicable to the Project by grouping similar mapped soil units (MSUs) into SMUs. The soils data that forms the basis of the soil management measures have been collected to enable mapping at 1:10,000 scale. A combination of desktop and field assessment identified approximately 60 MSUs, many of which could be grouped given their similarities in slope class or level of pedological development. These were then grouped into 18 SMUs. In some circumstances these have been combined to form complex MSUs and SMUs.

A description of the identified SMUs and specific management measures as well as corresponding MSUs is provided in Table 3-2. Mapping of the SMUs for the Project footprint is shown in Figure 3-1.

The soil management measures specified here are relevant to SMUs that have been mapped along the Project alignment. Local soil characteristics will be considered when planning and undertaking earthworks for the Project. This planning may require reference to representative profile physical and chemical data. More detailed assessments of site-specific soil properties may also be warranted to finalise the detailed design and soil management planning for high-risk infrastructure components (e.g. raising of the Yelarbon levee).

An Environmental Monitor with experience in identifying the different soil materials discussed in the Soil Assessment Report (see Appendix J: Soil Assessment Report) should be engaged to more precisely inform and direct construction activities on the ground.

TABLE 3-2 SOIL FEATURES AND MANAGEMENT MEASURES FOR SOIL MANAGEMENT UNITS

Soil management unit	Mapped soil unit	Soil features	Management measure

A1	1.1.1.1a
	1.2.1.1a
	1.3.1.1a
		▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding
		▸ Topsoils have light medium to medium heavy clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet)
		▸ Topsoils range from moderately acid to strongly alkaline and generally have very low to moderate salinity, are non-sodic to strongly sodic, and have deficient to low, some balanced, Ca:Mg ratios, which may make some susceptible to dispersion
		▸ Topsoils are eutrophic and have moderate to high fertility, ranging generally from very low to extremely high across the various nutrients
		▸ Subsoils are neutral to very strongly alkaline, sometimes dropping back to strongly acid in the deeper subsoil, very low to very high salinity, are non-sodic to strongly sodic at depth and have deficient to low Ca:Mg ratios, which means they are likely susceptible to dispersion
		▸ With low to very high cation exchange capacity and low to very high exchangeable Ca and moderate to very high exchangeable Mg levels and clay mineralogy, these subsoils may be dispersive
		▸ Emerson Aggregate Test (EAT) results include 4, 6, 7, and 8, indicating these layers are unlikely to be dispersive, and 1, 2, 3a, 3b, and 5, indicating these layers are likely to be slightly to very highly dispersive
			▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping is to be undertaken to 300 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth.
			▸ If soils are encountered where the salinity in the subsoil reaches >0.96 dS/m or where the pH is <5.0 by 600 mm, consideration should be given to harvesting and separately stockpiling the upper subsoil (from 300 to 600 mm) from the lower subsoil (600 mm+) so the upper subsoil can be reinstated as a buffer between the topsoil and deep, considerably less suitable, subsoil material.
			▸ Gypsum, at approximately 2 t/ha/100 mm, should be applied to topsoil to improve soil structure, stability, and workability; however, in some instances up to 9 t/ha/100 mm may be required.
			▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 0 to 26 t/ha/100 mm between 300 to 600 mm BGL and 0 to 30 t/ha/100 mm between 600 to 1,500 mm BGL.
			▸ With fertility levels ranging widely across the various nutrients, the soils are considered moderately to highly fertile, as such rehabilitation will be enhanced by the addition of 0 to 4 t/ha/100 mm of lime to those topsoils that are acid as well as composted manure and fertiliser.
			▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
			▸ The following management measures are recommended for Project works involving floodplains soils potentially saline and susceptible to erosion:
			  ▸ Limit concentration of water, focus on reducing velocities by encouraging concentrated flows to spread out over the floodplain (location of infrastructure, diversion bunds.)
			  ▸ Construction works on floodplains provide a high-risk of erosion due to the nature of the works. Management practices, such as maintaining vegetative ground cover for as long as possible prior to earthworks, using tackifiers or spreading mulch, and/or hydromulching/seeding immediately post earthworks will be considered
			▸ Construction equipment (e.g.. bulldozers, excavators) can create wheel or track ruts in soil that can lead to concentrated flows and an increase in erosion. Manually ripping and levelling deep ruts or ensuring they are at right angles to the direction of flow can minimise their impacts.

Soil management unit	Mapped soil unit	Soil features	Management measure
A2	2.1.1.1a 2.2.1.1a 2.3.1.1a	▸ These clayey soils occur on elevated plains, gently undulating plains, and gently undulating rises such that some areas adjacent to drainage depressions and floodplains may be subject to flooding ▸ Topsoils have light to medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils range from neutral to moderately alkaline and generally have very low to moderate salinity, are non-sodic, and have low to high Ca:Mg ratios, which may make some susceptible to dispersion ▸ Topsoils are eutrophic and have high fertility, ranging generally from very moderate to extremely high across the various nutrients ▸ Subsoils are slightly to strongly alkaline, very low to extreme salinity, are non-sodic to sodic at depth and have low Ca:Mg ratios, which means they may be slightly susceptible to dispersion ▸ With moderate to high cation exchange capacity and high to very high exchangeable Ca and high to very high exchangeable Mg levels and clay mineralogy, these subsoils may be slightly dispersive ▸ EAT results include mostly 4, indicating these layers are unlikely to be dispersive, and an occasional 2 and 5, indicating these layers are likely to be slightly to moderately dispersive	▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping is to be undertaken to 300 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum should not be required to improve soil structure, stability, and workability of the topsoil; however, approximately 2 t/ha/100 mm may be applied pre-stripping where conditions are difficult. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 0 to 6 t/ha/100 mm between 300 to 600 mm BGL and 0 to 8 t/ha/100 mm between 600 to 1,500 mm BGL. ▸ With fertility levels being largely high across the various nutrient types, the soils are considered highly fertile, as such rehabilitation will be enhanced by the addition of small additions of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
A3	3.1.1.1a 3.2.1.1a 3.3.1.1a 3.4.1.1a 3.6.1.1a	▸ These clayey soils occur on drainage depressions, slopes, ridges, and crests of the rises and low hills of the Great Dividing Range, and the drainage depressions and lower slopes may be subject to occasional flooding ▸ Topsoils have light to medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils range from slightly acid to strongly alkaline and generally have very low to moderate salinity (occasionally may be up to high), are non-sodic, and have deficient to low Ca:Mg ratios, which may make some susceptible to dispersion ▸ Topsoils are eutrophic and have high fertility, ranging generally from mostly moderate to extremely high across the various nutrients ▸ Subsoils are neutral to very strongly alkaline, very low to very high salinity, are mostly non-sodic, some sodic, at depth and have deficient to low Ca:Mg ratios, which means they may be susceptible to dispersion ▸ With high to very high cation exchange capacity and mostly high to very high exchangeable Ca and very high exchangeable Mg levels and clay mineralogy, these subsoils are unlikely to be dispersive but there may be some dispersion in some instances	▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping is to be undertaken to 300 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum should not be required to improve soil structure, stability, and workability of the topsoil; however, approximately 2 t/ha/100 mm may be applied pre-stripping where conditions are difficult. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 0 to 1 t/ha/100 mm between 300 to 600 mm BGL and 0 to 120 t/ha/100 mm between 600 to 1,500 mm BGL. ▸ With fertility levels being largely high across the various nutrient types, the soils are considered highly fertile, as such rehabilitation will be enhanced by the addition of small additions of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

Soil management unit	Mapped soil unit	Soil features	Management measure
		▸ EAT results include 4, 6, and 7, indicating these layers are unlikely to be dispersive, and 2, 3a, 3b, and 5, indicating these layers may be slightly to highly dispersive	
A4	4.1.1.1a	▸ These clayey soils occur on large, relatively flat, residual sandstone materials adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Topsoils have clay loam to light medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils range from slightly acid to neutral and generally have low salinity, are sodic to strongly sodic, and have low Ca:Mg ratios, which means they are likely susceptible to dispersion ▸ Topsoils are eutrophic and have low fertility, ranging generally from very low to moderate across the various nutrients ▸ Subsoils range from slightly to very strongly alkaline then mostly grading to slightly to strongly acid in the deeper subsoil, moderate to extreme salinity, are strongly sodic at depth and have deficient to low Ca:Mg ratios, which means they are highly likely susceptible to dispersion ▸ With low to high cation exchange capacity and very low to high exchangeable Ca and moderate to very high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results include 6, indicating these layers are unlikely to be dispersive, and 2 and 3b, indicating these layers are likely to be moderately to highly dispersive	▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping is to be undertaken to 100 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ If soils are encountered where the salinity in the subsoil reaches >0.96 dS/m or where the pH is <5.0 by 500 mm, consideration should be given to harvesting and separately stockpiling the upper subsoil (from 100 to 400 mm) from the lower subsoil (400 mm+) so the upper subsoil can be reinstated as a buffer between the topsoil and deep, considerably less suitable, subsoil materials. ▸ Gypsum, at approximately 4 t/ha/100 mm, should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 7 to 9 t/ha/100 mm between 100 to 400 mm BGL and 6 to 13 t/ha/100 mm between 400to 1,500 mm BGL. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered have low fertility, as such rehabilitation will be enhanced by the addition of high rates of composted manure and fertiliser ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
A5	5.1.1.1a 5.2.1.1a 5.3.1.1a	▸ These clayey soils occur on drainage depressions and slopes of the rises and low hills of the Walloons Coal Measure, and the drainage depressions and lower slopes may be subject to occasional flooding ▸ Topsoils have light medium to medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils are slightly alkaline and generally have low salinity, are non-sodic, and have low Ca:Mg ratios, which suggests they are not susceptible to dispersion ▸ Topsoils are eutrophic and have high fertility, ranging generally from moderate to high across the various nutrients ▸ Subsoils are strongly to very strongly alkaline, moderate to high salinity, are sodic to strongly sodic, and have deficient to low Ca:Mg ratios, which means they are likely susceptible to dispersion ▸ With moderate to high cation exchange capacity and low to high exchangeable Ca and high to very high exchangeable Mg levels and clay mineralogy, these subsoils may be dispersive	▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping is to be undertaken to 300 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ Given the heavier texture clays, gypsum, at approximately 2 t/ha/100 mm, should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 5 to 9 t/ha/100 mm between 300 to 1,500 mm BGL. ▸ With fertility levels moderate to high across the various nutrient types, the soils are considered highly fertile, as such rehabilitation will be enhanced by the addition of small amounts of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

Soil management unit	Mapped soil unit	Soil features	Management measure
		▸ EAT results include 8, indicating these layers are unlikely to be dispersive, and 1 and 2, indicating these layers are likely to be highly to very highly dispersive	
B	1.1.1.1b 1.2.1.1b 4.1.1.1b	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains subject to flooding ▸ May have moderately deep to deep melonhole gilgai with strong shrink swell properties ▸ Topsoils have light to medium heavy clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils are moderately acid (depression) to neutral (mound), have very low to moderate salinity, are non-sodic to sodic, and have deficient to low Ca:Mg ratios, which means they are unlikely to be susceptible to dispersion ▸ Topsoils are eutrophic and have moderate fertility, ranging generally from low to extremely high across the various nutrients ▸ Subsoils range from moderately to very strongly alkaline dropping back to neutral to strongly acid in the deeper subsoil, are moderately to extremely saline, are strongly sodic, and have deficient to low Ca:Mg ratios, which likely means they are likely susceptible to dispersion ▸ With moderate to very high cation exchange capacity and low exchangeable Ca and high exchangeable Mg levels and clay mineralogy, these subsoils may be dispersive ▸ The moderately deep to deep gilgai present a significant problem for topsoil stripping, especially as depth functions show high salinity and sodicity in the mounds at shallower depths than in the depressions. Topsoil stripping becomes difficult or impossible with the better-quality soil material in the depressions at depths below the low-quality material in the mounds. Topsoil may need to be harvested using excavators or similar ▸ EAT results include 6, indicating these layers are unlikely to be dispersive, and 1, 2 and 3b, indicating these layers are likely to be slightly to very highly dispersive	▸ The strong microrelief means these soils are often not suitable for traditional topsoil stripping. Where there is moderate to strong gilgai expression, topsoil stripping should be down to 300 mm in the gilgai depressions and only down to 100 mm on the gilgai mounds. Where gilgai expression is diminished (low), topsoil stripping across both mounds and depressions may be undertaken to a maximum depth of 150 mm to minimise saline and sodic material being stripped with the topsoil. The Environmental Monitor is to confirm and record stripping depth. ▸ If soils are encountered where the salinity in the subsoil reaches >0.96 dS/m or where the pH is <5.0 by 600 mm, consideration should be given to harvesting and separately stockpiling the upper subsoil (from 300 to 600 mm) from the lower subsoil (600 mm+) so the upper subsoil can be reinstated as a buffer between the topsoil and deep subsoil materials. ▸ Gypsum at approximately 3 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 4 to 10 t/ha/100 mm between 100 to 600 mm BGL and 1 to 13 t/ha/100 mm between 600 to 1,500 mm BGL. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition of 0 to 1 t/ha/100 mm of lime to those topsoils that are acid, composted manure, and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

Soil management unit	Mapped soil unit	Soil features	Management measure
C1	1.1.1.2d 1.2.1.2d	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Some occurrences of these soils are used for cropping and may have originally been MSUs 1.1.3.2a/b/1.2.3.2b ▸ Topsoils have clay loam to light clay textures and, therefore, soil workability may make stripping difficult when soils are wet ▸ Topsoils are generally mildly acid to mildly alkaline, have very low to low salinity, range from non-sodic to sodic, and have low Ca:Mg ratios, which means some topsoils will not be susceptible to dispersion while some will be ▸ Topsoils are eutrophic and have low to moderate fertility, ranging generally from low to very high across the various nutrients ▸ Subsoils range from neutral to very strongly alkaline, moderately to very highly saline, and sodic to strongly sodic at depth, and have deficient to low Ca:Mg ratios suggesting they will be dispersive ▸ With mostly low to moderate cation exchange capacity and generally low to high exchangeable Ca and generally moderate to high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results are 4, 5, and 8, indicating these layers are unlikely to be dispersive, and 1 and 2, indicating these layers will be moderately to very highly dispersible	▸ If topsoil stripping is required for construction purposes, then stripping may be undertaken to 300 mm from the soil surface in most soil units; however, some only to 100 mm. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum at approximately 2 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability, particularly where topsoil stripped is 200 to 300 mm in depth. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 4 to 8 t/ha/100 mm from 300 to 1,500 mm. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered poorly to moderately fertile, as such rehabilitation will be enhanced by the addition composted manure, and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
C2	1.1.1.2k 1.2.1.2k	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Topsoils have clay loam to light clay textures and, therefore, soil workability may make stripping difficult when soils are wet ▸ Topsoils are generally slightly acid to slightly alkaline, have very low salinity, range from non-sodic to strongly sodic, and have mostly deficient to low Ca:Mg, occasionally balanced, ratios, which means most topsoils will likely be susceptible to dispersion ▸ Topsoils are eutrophic and have low to moderate fertility, ranging generally from very low to very high across the various nutrients ▸ Subsoils are neutral to very strongly alkaline, moderately to very highly saline, sodic to strongly sodic, and have deficient to low Ca:Mg ratios suggesting they will be dispersive ▸ With low to moderate cation exchange capacity and very low to moderate exchangeable Ca and moderate to high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results are 7, indicating these layers are unlikely to be dispersive, and 1, 2, 3a, and 3b, indicating these layers will be slightly to very highly dispersible	▸ If topsoil stripping is required for construction purposes, then stripping may be undertaken to 300 mm from the soil surface; however, some only to 100 to 150 mm. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum at approximately 0 to 6 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 10 to 15 t/ha/100 mm from 300 to 600 mm and 3 to 20 t/ha/100 mm from 600 to 1,500 mm. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered poorly to moderately fertile, as such rehabilitation will be enhanced by the addition of moderate amounts of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

Soil management unit	Mapped soil unit	Soil features	Management measure
C3	1.1.1.2m 1.2.1.2m 4.1.1.2	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Topsoils have clay loam to light clay textures and, therefore, soil workability may make stripping difficult when soils are wet ▸ Topsoils are generally moderately acid to neutral, have very low to moderate salinity, range from non-sodic to strongly sodic, and generally have deficient to low Ca:Mg ratios, which means these topsoils will mostly be susceptible to dispersion ▸ Topsoils are eutrophic and have low to moderate fertility, ranging generally from low to high across the various nutrients ▸ Subsoils range from neutral to strongly acidic, are very low to very highly saline, and non-sodic to strongly sodic, and generally have deficient to low Ca:Mg ratios suggesting they will be dispersive ▸ With very low to moderate cation exchange capacity and very low to moderate exchangeable Ca and very low to high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results are 7, indicating these layers are unlikely to be dispersive, and 1, 2, and 3b, indicating these layers will be slightly to very highly dispersible	▸ If topsoil stripping is required for construction purposes, then stripping may be undertaken from 150 to 300 mm from the soil surface. The Site Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum at approximately 0 to 5 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 1 to 11 t/ha/100 mm from 300 to 1,500 mm. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered poorly to moderately fertile, as such rehabilitation will be enhanced by the addition moderate amounts of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
C4	1.1.1.2y 1.2.1.2y	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Topsoils may have been eroded away. Where present, they have sandy loam to clay loam textures and, where absent, the surface soil may have clay loam to light medium clay textures depending on whether the A2 is still present or the B2 horizon is exposed. Where the B2 horizon is close to or at the surface, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils, where present, are generally slightly to moderately alkaline, have low salinity, are generally strongly sodic, and have low Ca:Mg ratios, which means these topsoils will mostly be susceptible to dispersion ▸ Topsoils are mesotrophic to eutrophic and have low fertility, generally low across the various nutrients ▸ Subsoils, which may be at the surface, are moderately to strongly alkaline, have generally high to very high salinity, and are strongly sodic, and have calcium deficient to magnesium deficient Ca:Mg ratios, suggesting they will be dispersive ▸ With very low to high cation exchange capacity and very low to moderate exchangeable Ca and very low to high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive	▸ If topsoil stripping is required for construction purposes and there is topsoil present, then stripping may be undertaken to approximately 100 to 200 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum should be applied to topsoil pre-stripping at approximately 2 to 5 t/ha/100 mm to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 4 to 43 t/ha/100 mm from 200 to 1,500 mm. ▸ With fertility levels being quite low across the various nutrient types, the soils are considered poorly fertile, as such rehabilitation will be enhanced by the addition significant amounts of composted manure and fertiliser ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

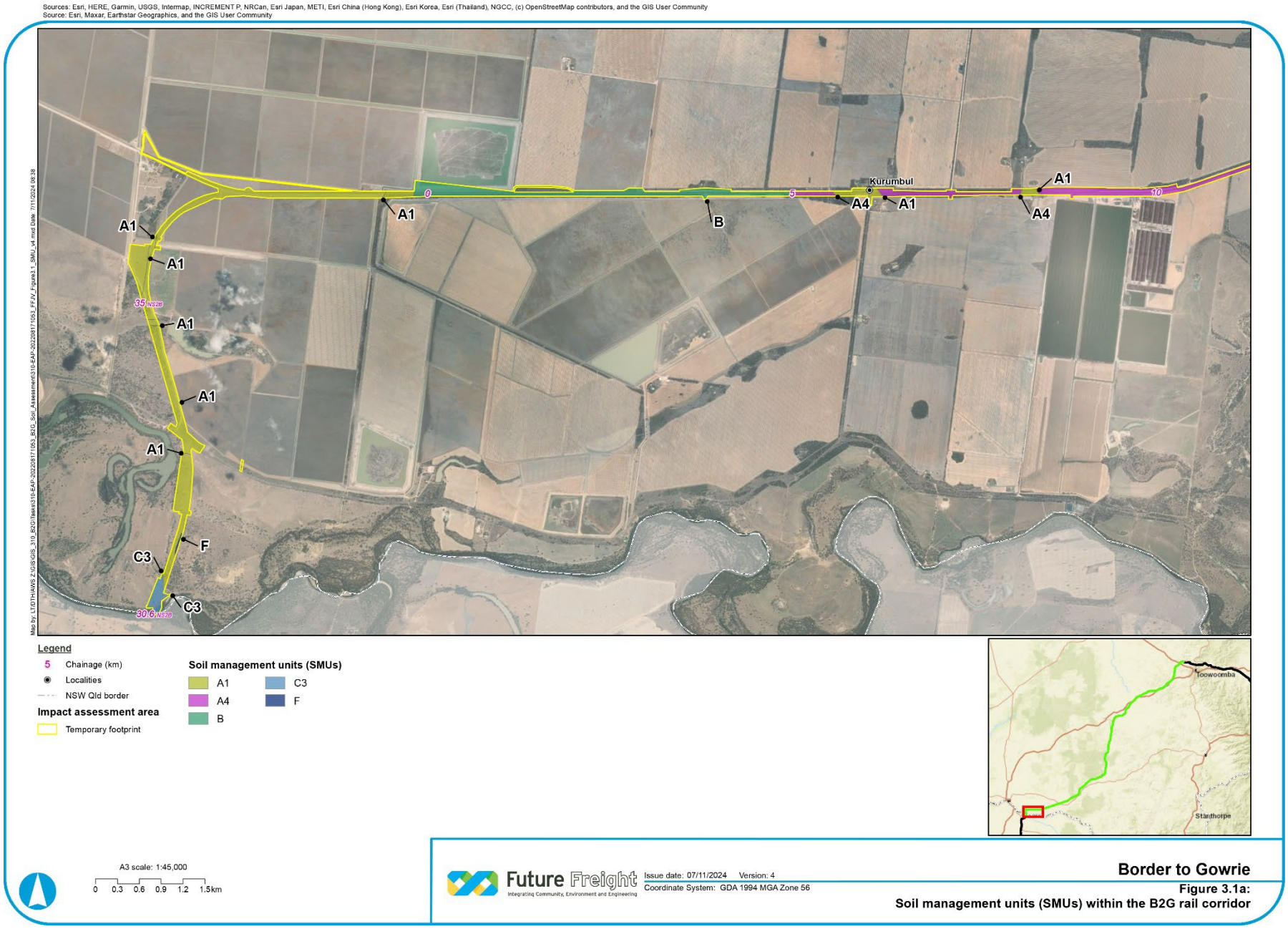
Soil management unit	Mapped soil unit	Soil features	Management measure
		▸ EAT results are 1, 2, and 3b for all layers, indicating they will be slightly to very highly dispersible	
C5	1.2.1.2w 1.3.1.2w	▸ These clayey soils occur adjacent to major creeks and rivers on terraces and floodplains, and are subject to flooding ▸ Some occurrences of these soils are used for cropping and may have originally been MSUs 1.1.3.2a/b/1.2.3.2b ▸ Topsoils have clay loam textures and, therefore, soil workability may make stripping difficult when soils are wet ▸ Topsoils are generally slightly alkaline, have low salinity, are generally non-sodic, and have low Ca:Mg ratios, which means most topsoils will not be susceptible to dispersion ▸ Topsoils are eutrophic and have moderate fertility, ranging generally from low to very high across the various nutrients ▸ Subsoils are moderately to very strongly alkaline, moderately to very highly saline, and sodic to strongly sodic at depth, and have low Ca:Mg ratios suggesting they will be dispersive ▸ With moderate to very high cation exchange capacity and generally high to very high exchangeable Ca and generally high to very high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results are 1 and 2, indicating these layers will be moderately to very highly dispersible	▸ If topsoil stripping is required for construction purposes, then stripping may be undertaken from 200 to 300 mm from the soil surface; however, some may only be to 100 mm. The Environmental Monitor is to confirm and record stripping depth. ▸ Despite being non-sodic, but with an Emerson class of 2, gypsum, at approximately 2 t/ha/100 mm, should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 7 to 16 t/ha/100 mm from 300 to 1,500 mm. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
D	3.2.1.2 3.3.1.2 3.6.1.2 5.1.1.2 5.2.1.2 5.3.1.2	▸ These clayey soils occur on plains, gently undulating plains, and gently undulating rises, and are only likely to be subject to flooding on the plains ▸ Topsoils have clay loam to light clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils are generally moderately acid to moderately alkaline, have very low to low salinity, are non-sodic to sodic, and have low Ca:Mg ratios suggesting they are unlikely to be dispersive ▸ Topsoils are eutrophic and have moderate fertility, ranging generally from low to very high across the various nutrients ▸ Subsoils are slightly acid to strongly alkaline, have very low to very high salinity, are non-sodic to strongly sodic at depth, and have deficient to low Ca:Mg ratios suggesting some of these soils are likely to be dispersive ▸ With very low to high cation exchange capacity and low to slightly low exchangeable Ca and generally high exchangeable Mg levels and clay mineralogy, some of these subsoils are likely to be dispersive ▸ EAT results include mostly 4, 7, and 8, indicating these layers are unlikely to be dispersive, and 1, 3b, and 5, indicating these layers will likely be slightly to highly dispersive	▸ If topsoil stripping is required for construction purposes, then stripping may be undertaken to 300 mm from the soil surface in most soil units; however, some only to 200 mm. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum at approximately 1 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion in those soils identified as potentially dispersive. The quantity of gypsum required ranges from 0 to 8 t/ha/100 mm from 300 to 1,500 mm depending on the soil unit. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition of 1 t/ha/100 mm of lime to those topsoils that are acid, composted manure, and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

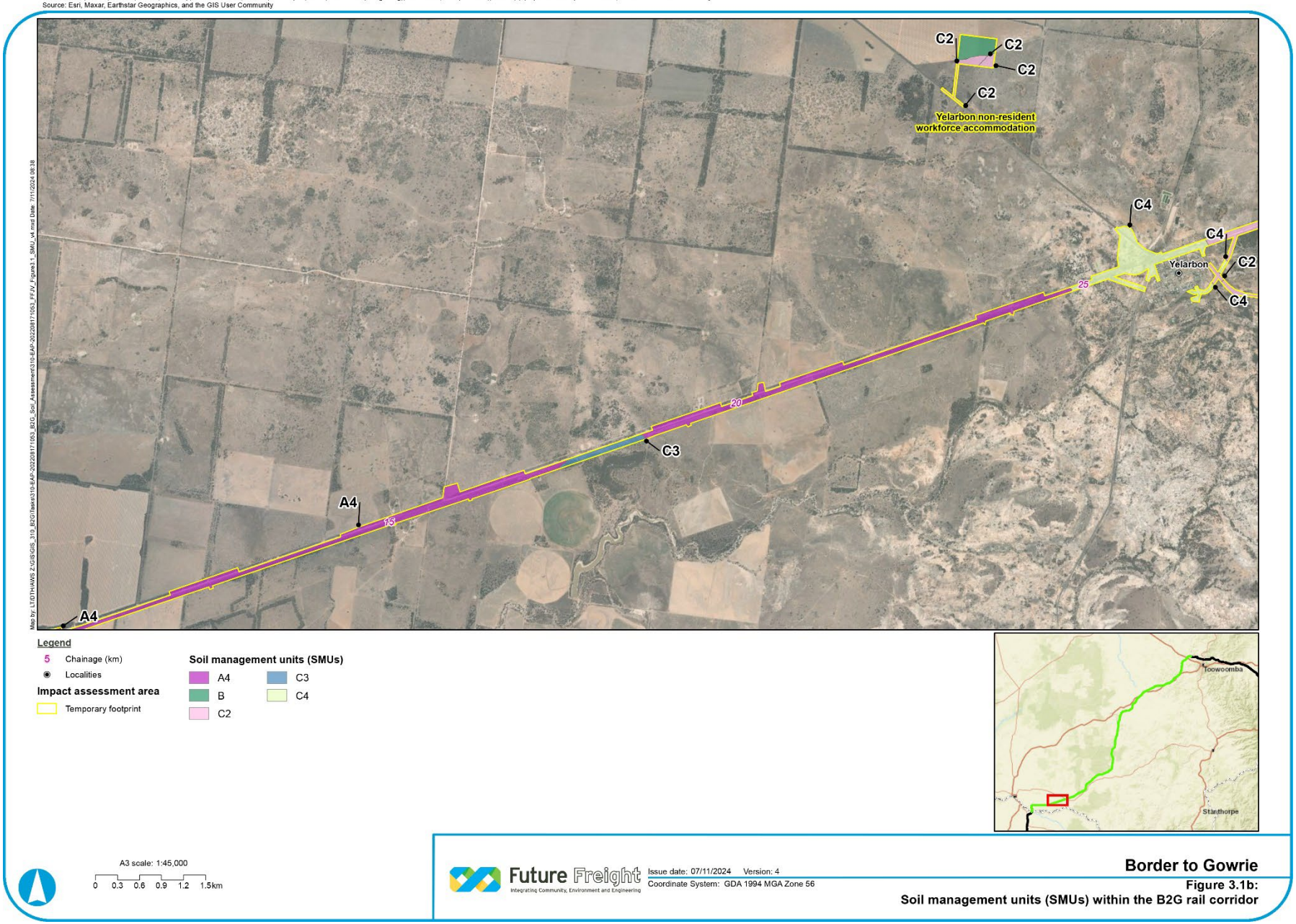
Soil management unit	Mapped soil unit	Soil features	Management measure
E	3.1.1.3 3.2.1.3 3.3.1.3 3.4.1.3 3.6.1.3	▸ These clayey soils occur on the basaltic uplands on level and very gently inclined areas adjacent to drainage depressions that may be subject to occasional flooding as well as on slopes, ridges, and crests not subject to flooding ▸ Topsoils have light to medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils range from strongly acidic to slightly alkaline, are very low to low salinity, are non-sodic, and have low Ca:Mg ratios, suggesting they may have the potential to be slightly dispersive ▸ Topsoils are eutrophic and have moderate to high fertility, ranging generally from low to extremely high across the various nutrients ▸ Subsoils are neutral to moderately alkaline, very low to moderately saline, non-sodic to sodic at depth, and have deficient to low Ca:Mg ratios suggesting they may be slightly dispersive ▸ With moderate to very high cation exchange capacity and slightly low to acceptable exchangeable Ca and high exchangeable Mg levels and clay mineralogy, some of these subsoils may be dispersive ▸ EAT results include 5, 7, and 8, indicating these layers are unlikely to be dispersive, and 3a and 3b, indicating these layers are likely be slightly dispersive	▸ These soils are not well suited to topsoil stripping due to the clayey textures. If topsoil stripping is required for construction purposes, however, then stripping may be undertaken to 300 mm from the soil surface. The Environmental Monitor is to confirm and record stripping depth. ▸ Gypsum at approximately 1 t/ha/100 mm should be applied to topsoil pre-stripping to improve soil structure, stability, and workability. ▸ Application of gypsum to subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 1 t/ha/100 mm to 9 t/ha/100 mm depending on the soil's location and depth of disturbance. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately to highly fertile, as such rehabilitation will be enhanced by the addition of small amounts of composted manure and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
F	1.1.2.1/ 1.1.2.2 1.2.2.1/ 1.2.2.2 5.4.2.1/ 5.4.2.2 5.5.2.1/ 5.5.2.2 5.6.2.1/ 5.6.2.2	▸ These soils include deep to very deep sands, loams, and clay loams adjacent to major creeks and rivers on terraces and floodplains, which may be subject to flooding ▸ These soils also include very shallow to shallow sands, loams, and clay loams on moderately step to precipitous slopes, which are not subject to flooding ▸ Their profiles are likely to be strongly to moderately acid ▸ The deep to very deep soils have very low to low fertility with most of their nutrients contained within the top 100 mm ▸ The very shallow to shallow soils have moderate fertility; however, would benefit considerably with ameliorants ▸ The clay fraction of the subsoils is dispersive; however, the limited fraction, particularly in the sands and loams, mean the dispersion will be minimal ▸ The deep to very deep soils generally have low nutrient content, low PAWC, low organic carbon, and high infiltration rates ▸ The very shallow to shallow soils generally have moderate nutrient content, very low PAWC, high organic carbon, and low to moderate infiltration because of their location on steep slopes ▸ High potential for leaching of nutrients	▸ In deep to very deep sands, loams, and clay loams topsoil will be stripped to a depth of 200 mm; however, topsoil (a valuable resource) could be stripped to greater depths dependent on individual profiles. The Environmental Monitor is to confirm and record stripping depth. ▸ In very shallow to shallow sands, loams, and clay loams topsoil will be stripped to immediately above the parent material (underlying sandstone), generally a depth of 200 mm, but may be more or less, depending on the profile depth; however, topsoil could be stripped to greater depths dependent on individual profiles. The Environmental Monitor is to confirm and record stripping depth. ▸ The sandy soil materials throughout the profiles allow for flexibility in the use of these materials. ▸ Once disturbed these soil materials are likely to become noncoherent and vulnerable to soil erosion. Care should be taken to avoid exposure of these materials to concentrated overland flow (including on steep slopes where concentrated flows come off crests above these soils) or erosive flood events. ▸ Additions of gypsum at 1 t/ha/100 mm, lime between 2 to 3 t/ha/100 mm, composted manure, and fertiliser at regular intervals pre- and post-reinstatement will assist in maintaining suitable pH levels and nutrient content and availability during rehabilitation.

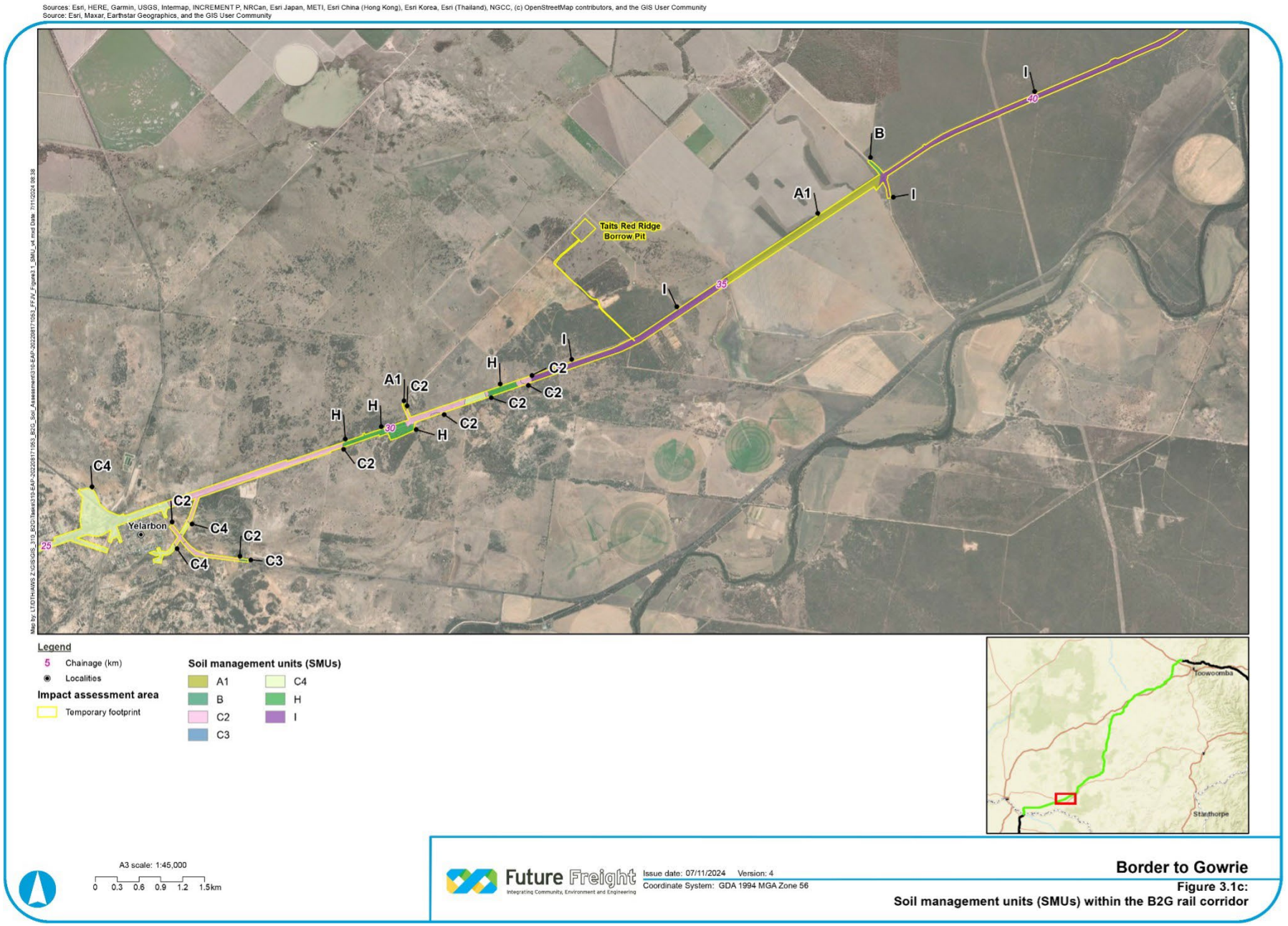
Soil management unit	Mapped soil unit	Soil features	Management measure
		▸ They have low dust potential given the low proportion of finer particles ▸ The deep to very deep soils have EAT results of 5 for most of the profile, indicating these layers are unlikely to be dispersive, and 2 in the lower subsoil, indicating these layers may be highly dispersive, although, given the low clay percentage, the dispersion will be minimal ▸ The very shallow to shallow soils have EAT results of 8 in the subsoil, indicating these layers are unlikely to be dispersive, and 3b in the topsoil, indicating these layers may be slightly dispersive, although, given the low clay percentage, the dispersion will be minimal	▸ Given the sandy textures of these soils, despite some layers indicating dispersive, this is unlikely to be significant.
G	5.1.3.1b 5.2.3.1b 5.3.3.1b 5.4.3.1b 5.6.3.1a 5.6.3.1b	▸ These texture contrast soils occur on elevated level plains, gently undulating plains, and gently undulating rises and are generally unlikely to flood ▸ Topsoils have sandy to loamy textures such that topsoil material should be readily identified from subsoil material ▸ Subsoils have sandy, light to medium clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet) ▸ Topsoils are moderately to strongly acidic, have very low salinity, sodic to strongly sodic, and have deficient to low Ca:Mg ratios, suggesting they are likely to be dispersive ▸ Topsoils range from mesotrophic to eutrophic and have moderate fertility, ranging generally from low to very high across the various nutrients ▸ Subsoils are strongly acidic, have very low to low salinity, are sodic to strongly sodic, and have deficient Ca:Mg ratios, suggesting they are likely to be dispersive ▸ With very low to low cation exchange capacity and very low exchangeable Ca and high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results include 5, 7, and 8, indicating these layers are unlikely to be dispersive, and 3a and 3b, indicating these layers are likely be slightly dispersive	▸ Topsoil will be stripped to the maximum extent possible without stripping any subsoil. Indicatively, this could be to approximately 500 mm but may only be to 100 mm for MSUs with only a thin topsoil layer (e.g. MSU 5.6.3.1a). The Environmental Monitor is to confirm and record stripping depth. ▸ Application of gypsum to the subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 1 to 6 t/ha/100 mm depending on the soil unit and its location along the rail corridor. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition of 2 to 3 t/ha/100 mm of lime to those topsoils that are acid, composted manure, and fertiliser.
H	1.1.3.2a 1.1.3.2b 1.2.3.2b	▸ These texture contrast soils occur on alluvial plains and terraces adjacent to creeks and rivers, and are subject to flooding ▸ Some occurrences of these soils are used for cropping and may appear and behave as MSUs 1.1.1.2/1.2.1.2, so may need to be managed as though they are MSUs 1.1.1.2/1.2.1.2 ▸ Topsoils have sandy to loamy textures such that topsoil material should be readily identified from subsoil material ▸ Subsoils have light to medium, sandy clay textures and, therefore, soil workability may make stripping difficult (particularly when soils are wet)	▸ Topsoil will be stripped to the maximum extent possible without stripping any subsoil. Indicatively, this could be to approximately 500 mm but may only be to 100 mm for MSUs with only a thin topsoil layer (e.g. MSU 1.1.3.2a). The Environmental Monitor is to confirm and record stripping depth. ▸ Application of gypsum to the subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 2 to 14 t/ha/100 mm depending on the soil and its location along the rail corridor.

Soil management unit	Mapped soil unit	Soil features	Management measure
		▸ Topsoils are very strongly acidic to neutral, very low salinity, are non-sodic to strongly sodic, and have low to balanced Ca:Mg ratios, suggesting may be dispersive ▸ Topsoils are eutrophic and have moderate fertility, ranging generally from low to high across the various nutrients ▸ Subsoils are slightly acidic to very strongly alkaline, have very low to high salinity, are sodic to strongly sodic, and have deficient to low Ca:Mg ratios ▸ With low to moderate cation exchange capacity and low to acceptable exchangeable Ca and high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results include 4 and 8, indicating these layers will not be dispersive, and 1, 2, and 3b indicating these layers are likely to be slightly to very highly dispersive	▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition 1 t/ha/100 mm of gypsum to those topsoils that are dispersive, 1 to 3 t/ha/100 mm of lime to those topsoils that are acid, composted manure, and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.
I	4.2.3.2b 5.1.3.2a 5.1.3.2b 5.2.3.2a 5.2.3.2b 5.3.3.2b 5.4.3.2b 5.6.3.2b	▸ These texture contrast soils occur on elevated plains, gently undulating plains, and gently undulating rises, and are generally not subject to flooding ▸ Topsoils have sandy to loamy textures such that topsoil material should be readily identified from subsoil material, although not necessarily in every situation ▸ Subsoils generally have loamy to sandy medium clay textures and, therefore, soil workability may make stripping difficult (particularly when the clay soils are wet) ▸ Topsoils are very strongly acidic to moderately alkaline, very low salinity, are non-sodic to strongly sodic, and generally have low Ca:Mg ratios, suggesting they may be dispersive ▸ Topsoils are eutrophic and have low fertility, ranging generally from very low to moderate across the various nutrients ▸ Subsoils are moderately acidic to very strongly alkaline, have very low to very high salinity, are strongly sodic, and have deficient to low Ca:Mg ratios, suggesting they will be dispersive ▸ With very low to low cation exchange capacity and generally low to very low exchangeable Ca and high to very high exchangeable Mg levels and clay mineralogy, these subsoils are likely to be dispersive ▸ EAT results include 6, 7, and 8, indicating these layers may not be dispersive, and 1, 2, 3a, 3b, and 5 indicating these layers will be slightly to very highly dispersive	▸ Topsoil will be stripped to the maximum extent possible without stripping any subsoil. Indicatively, this could be to approximately 500 mm but may only be to 100 mm for MSUs with only a thin topsoil layer (e.g. MSU 5.1.3.2a). The Environmental Monitor is to confirm and record stripping depth. ▸ Application of gypsum to the subsoil pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required ranges from 1-9 t/ha/100 mm depending on the soil and its location along the rail corridor. ▸ With fertility levels ranging widely across the various nutrient types, the soils are considered moderately fertile, as such rehabilitation will be enhanced by the addition of 1 to 8 t/ha/100 mm of gypsum to those topsoils that are dispersive, 1 to 2 t/ha/100 mm of lime to those topsoils that are strongly acid, composted manure, and fertiliser. ▸ Care should be taken to avoid exposure of excavated material to erosive flood events or to avoid interference with the normal flow of water.

Soil management unit	Mapped soil unit	Soil features	Management measure
J	5.1.3.3b 5.2.3.3b 5.3.3.3b	▸ These texture contrast soils occur on level to gently inclined slopes of plains to gently undulating rises and are generally not subject to flooding ▸ These soils are generally used for forestry and grazing with limited clearing ▸ Topsoils have sandy textures such that topsoil material should be readily identified from subsoil material ▸ Subsoils generally have light to medium, sandy clay textures and, therefore, soil workability may make stripping difficult (particularly when the soils are wet) ▸ Topsoils are strongly acidic, have very low ECEC, low Ca:Mg ratio and high K:Mg ratio, and, despite having a good base status, have very low to low fertility across the various nutrients ▸ Upper subsoil is slightly to moderately alkaline, has low salinity, moderate ECEC, and, despite being deficient in Ca, is non-sodic ▸ Lower subsoil is strongly alkaline, has moderate salinity, moderate ECEC, is deficient in Ca, and, as a result, is sodic ▸ With low to moderate cation exchange capacity and low exchangeable Ca, high exchangeable Mg, and high exchangeable Na levels, and clay mineralogy, the lower subsoils may be dispersive, upper subsoil is unlikely to be dispersive ▸ Emerson aggregate test include 4, indicating this layer is unlikely to be dispersive, and 3b, indicating these layers are likely to be slightly dispersive	▸ Topsoil will be stripped to the maximum extent possible without stripping any subsoil. Indicatively, this could be to approximately 250 mm but may only be to 100 mm. The Environmental Monitor is to confirm and record stripping depth. ▸ Application of gypsum to the lower subsoil of these soils pre-stripping is recommended to mitigate dispersion. The quantity of gypsum required is 1 t/ha/100 mm. ▸ With nutrient levels very low to low across the various nutrient types, the soils are considered largely infertile, as such rehabilitation will be enhanced by the addition of 1 t/ha/100 mm of gypsum, 1 to 2 t/ha/100 mm of lime to reduce the acidity, composted manure, and fertiliser.

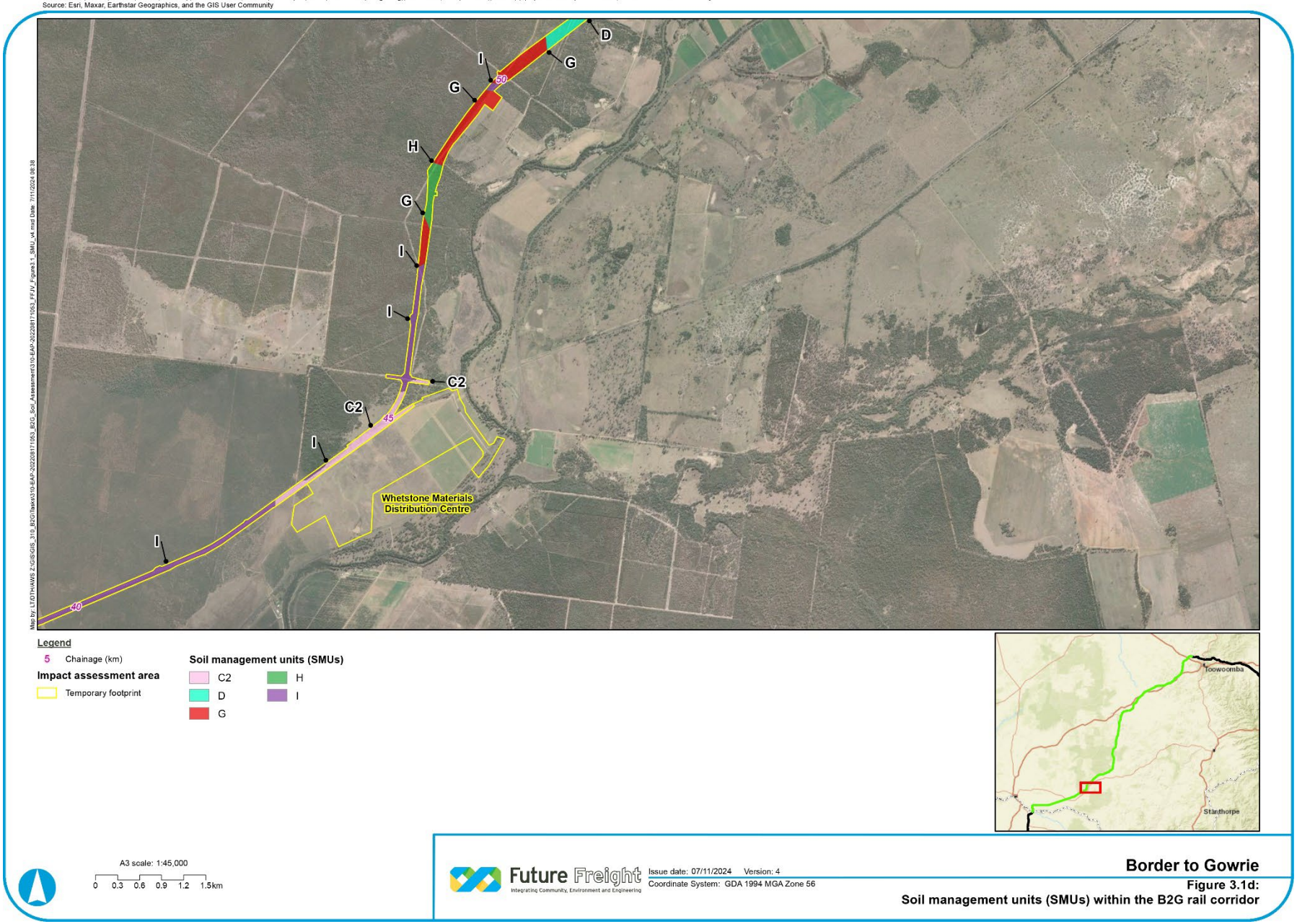

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Kurumbul
A1
A4
B
C3
F
0
5
10
35 WSZs
30 WSZs
Legend
Chainage (km)
Localities
NSW Qld border
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
A4
B
C3
F
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1a:
Soil management units (SMUs) within the B2G rail corridor

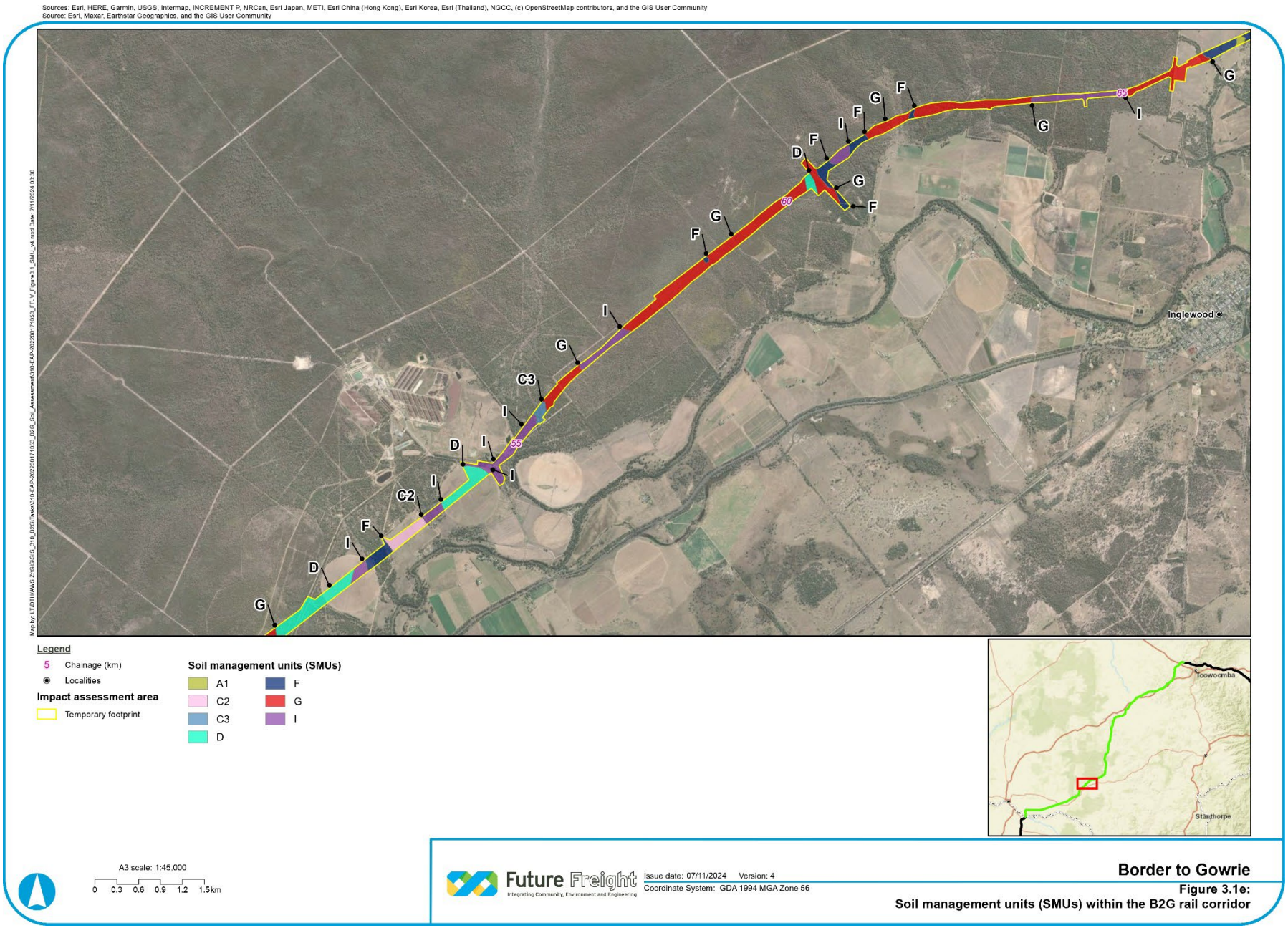

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
C2
C2
C2
C2
Yelarbon non-resident workforce accommodation
C4
C4
C2
C4
Yelarbon
25
20
15
C3
A4
A4
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A4
B
C2
C3
C4
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1b:
Soil management units (SMUs) within the B2G rail corridor

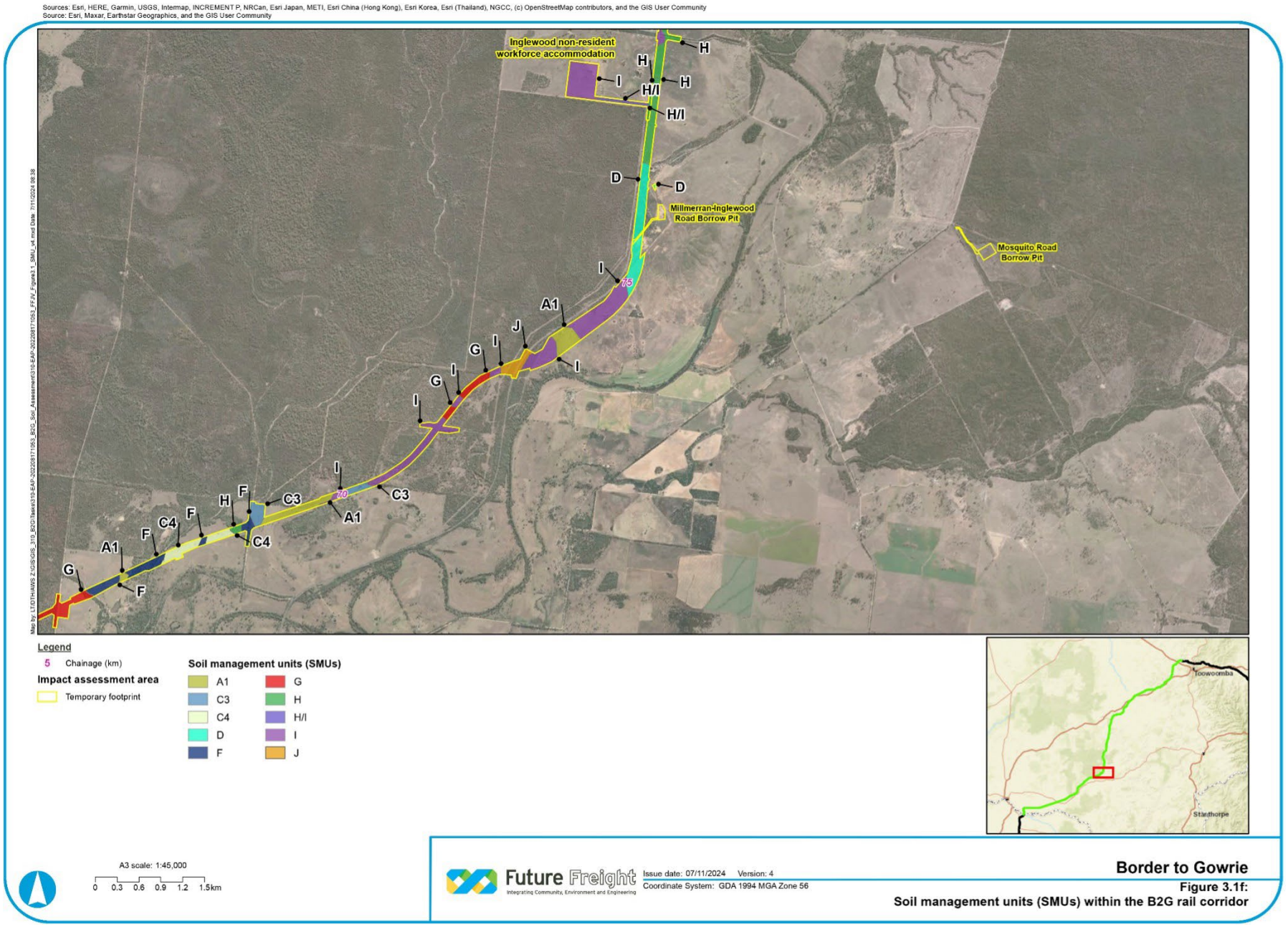


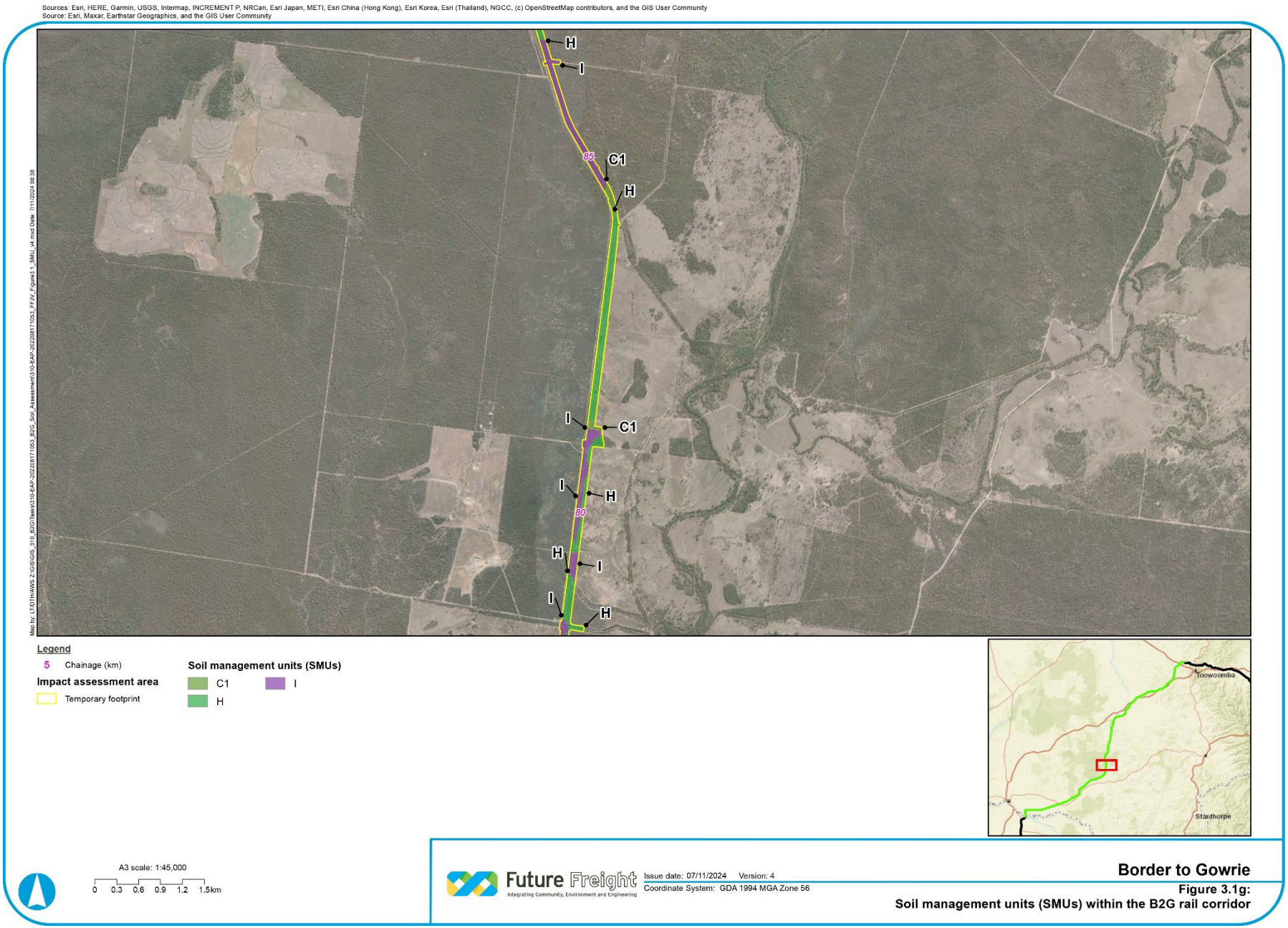
Border to Gowrie

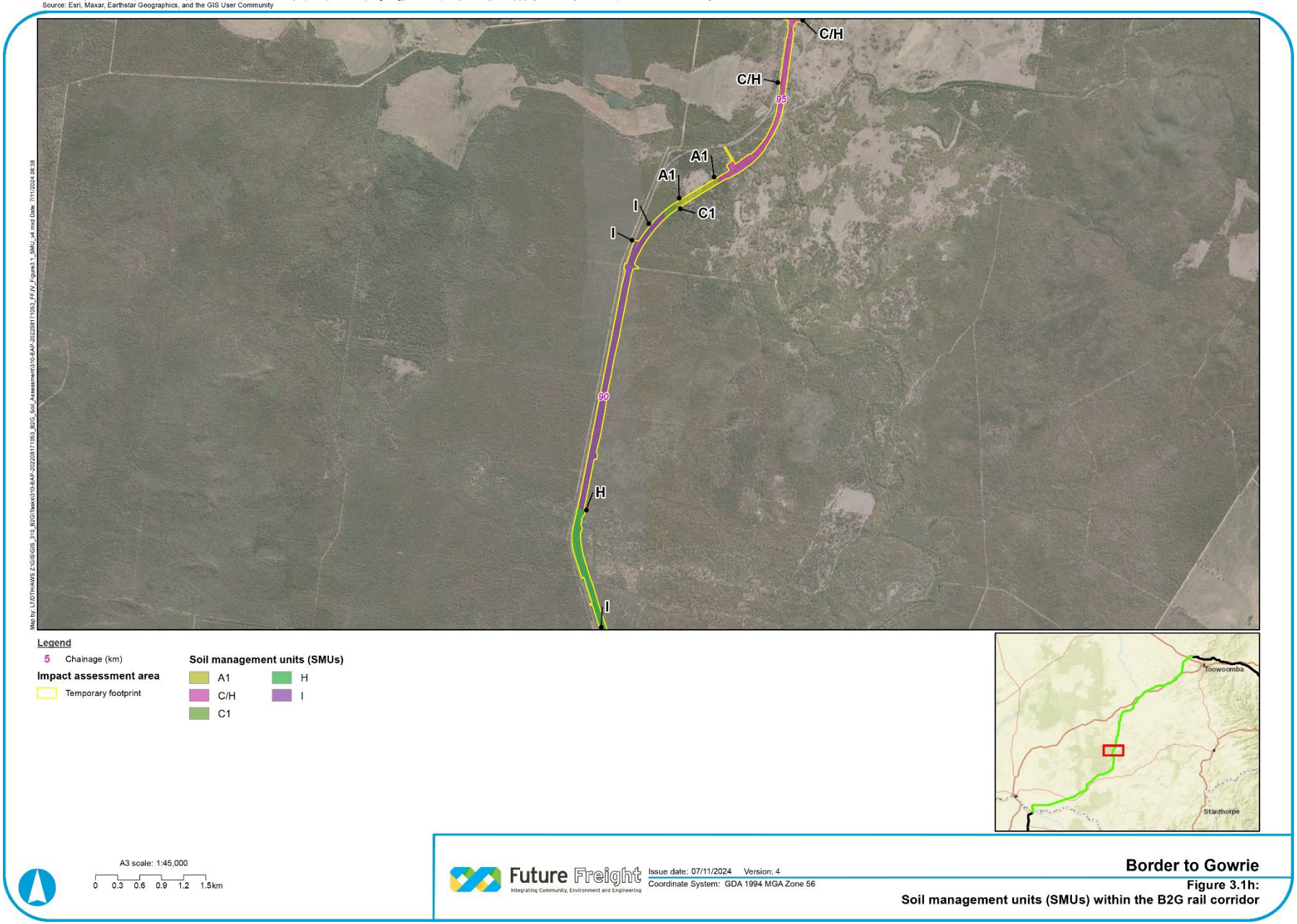
Figure 3.1c:
Soil management units (SMUs) within the B2G rail corridor

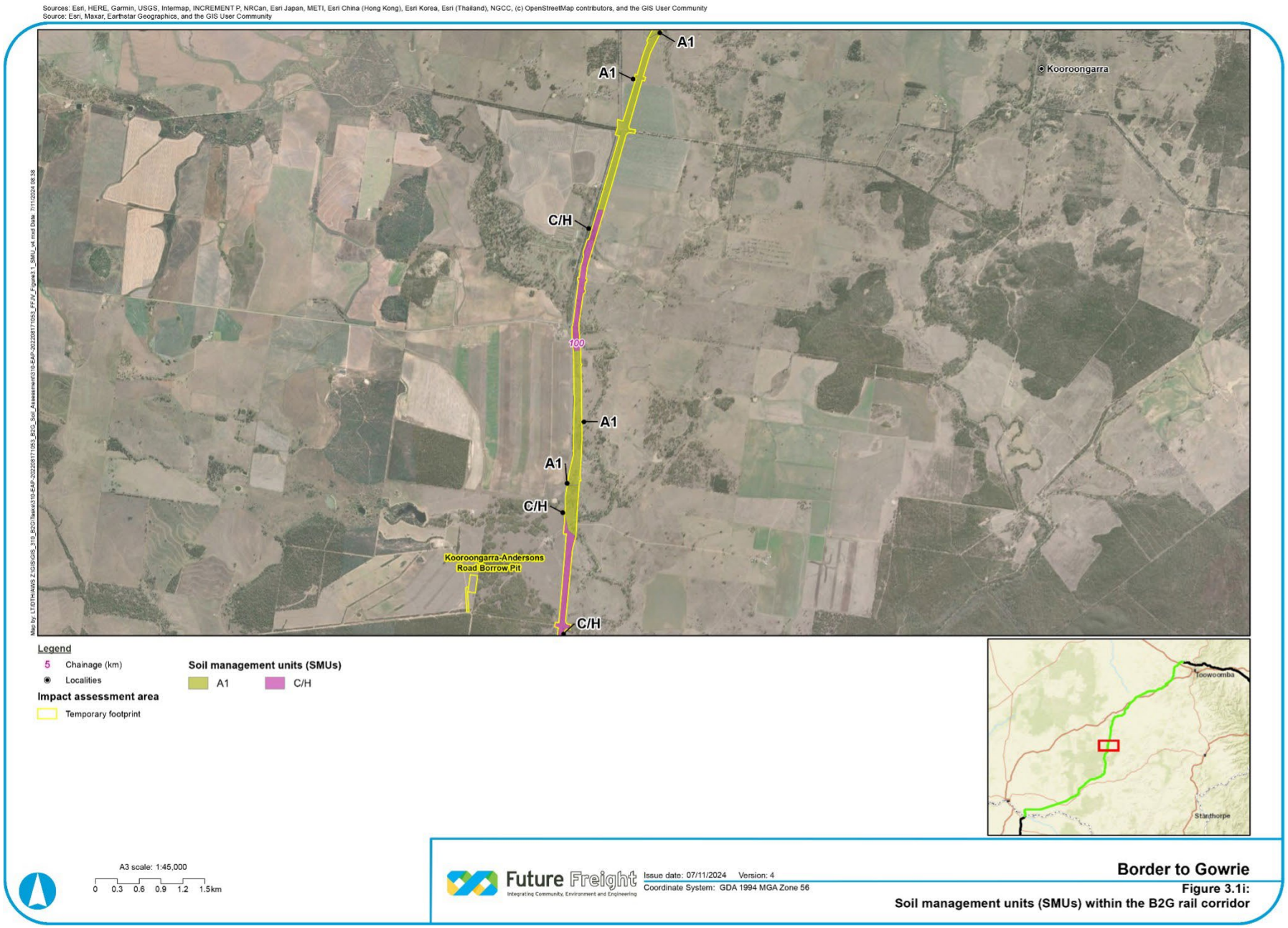

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817\053_FFJV_Figures\1_SMU_v4.mxd Date: 7/11/2024 08:38
D
G
I
50
G
H
G
I
I
C2
C2
45
I
I
40
Whetstone Materials Distribution Centre
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
C2
D
G
H
I
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1d:
Soil management units (SMUs) within the B2G rail corridor

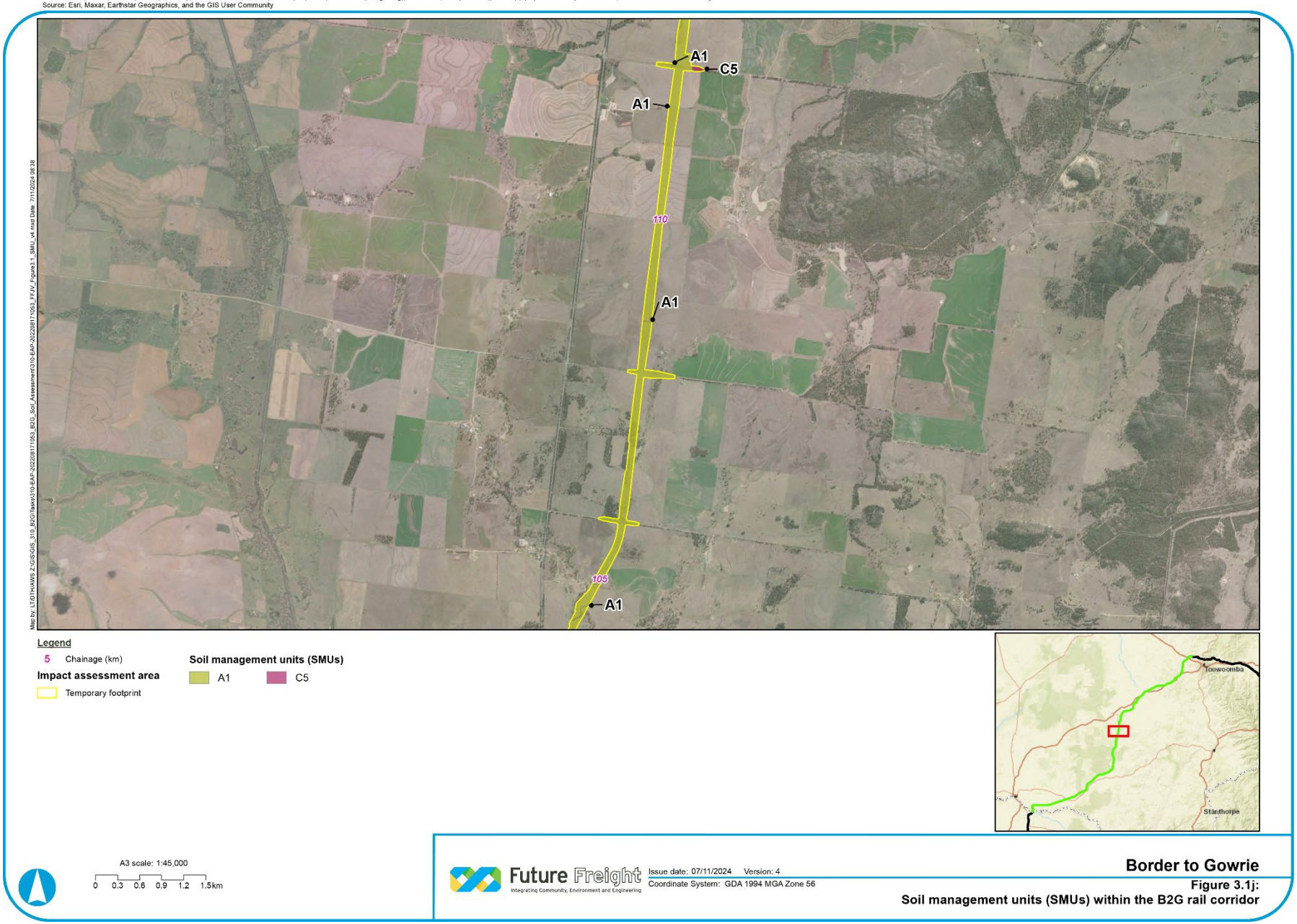

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817T053_FFJV_Figures3.1_SMU_v4.mxd Date: 7/11/2024 08:38
Inglewood
Toowoomba
Stanthorpe
Legend
Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C2
C3
D
F
G
I
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1e:
Soil management units (SMUs) within the B2G rail corridor

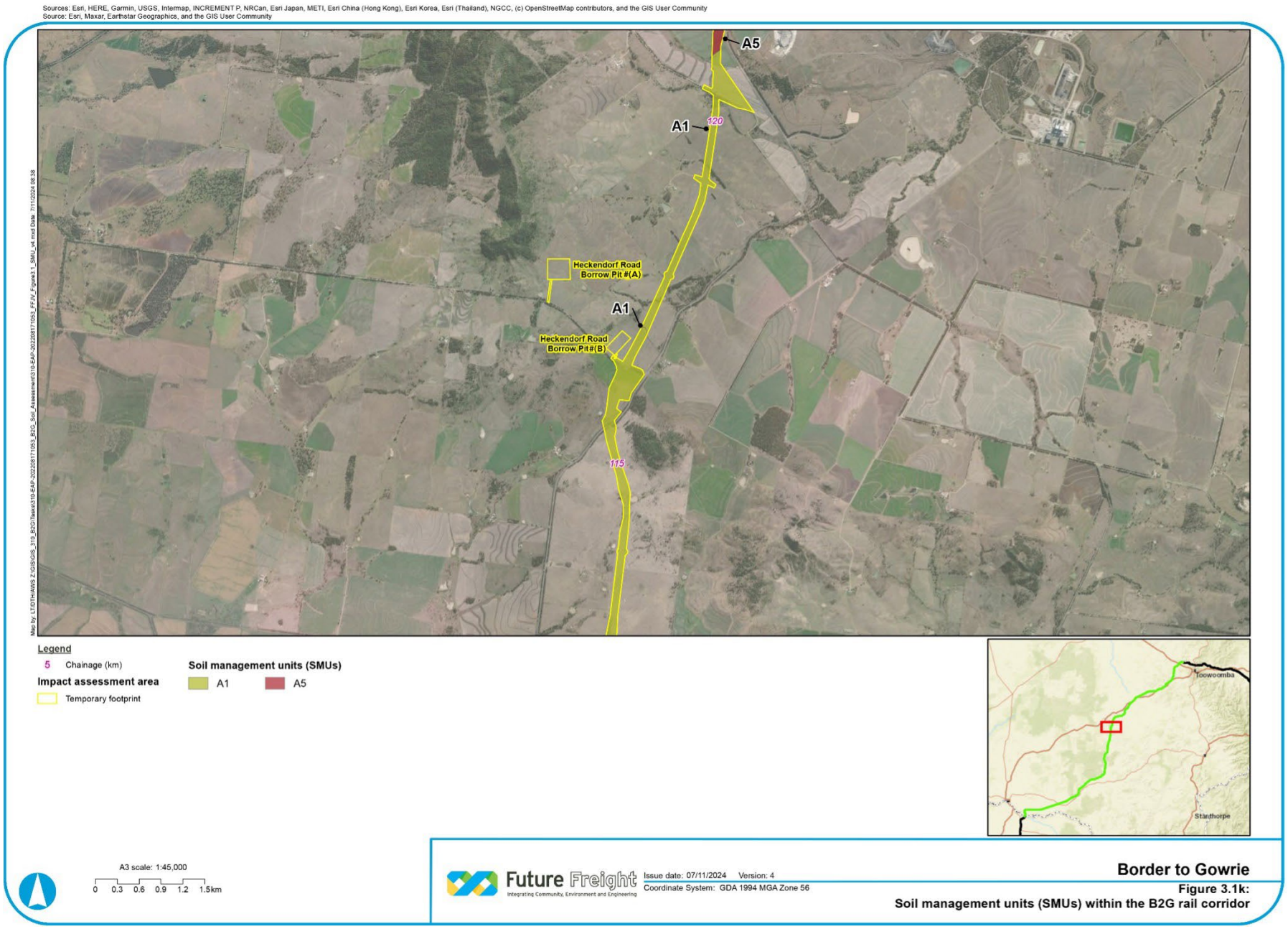

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Inglewood non-resident workforce accommodation
Millmerran-Inglewood Road Borrow Pit
Mosquito Road Borrow Pit
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C3
C4
D
F
G
H
H/I
I
J
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1f:
Soil management units (SMUs) within the B2G rail corridor

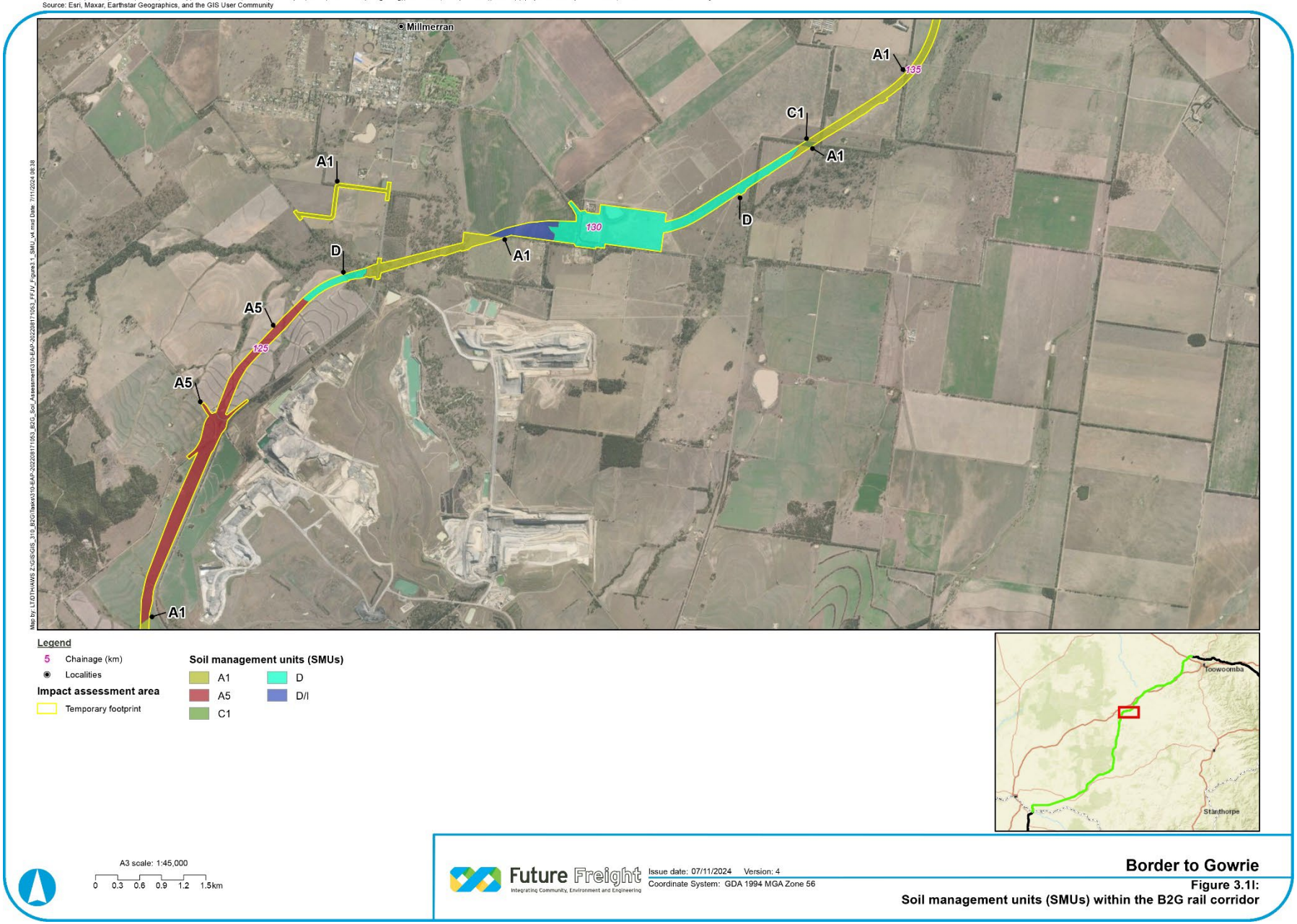

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817T053_FFJV_Figures3-1_SMU_v4.mxd Date: 7/11/2024 08:38
H
I
85
C1
H
I
C1
I
H
80
H
I
I
H
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
C1
I
H
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1g:
Soil management units (SMUs) within the B2G rail corridor

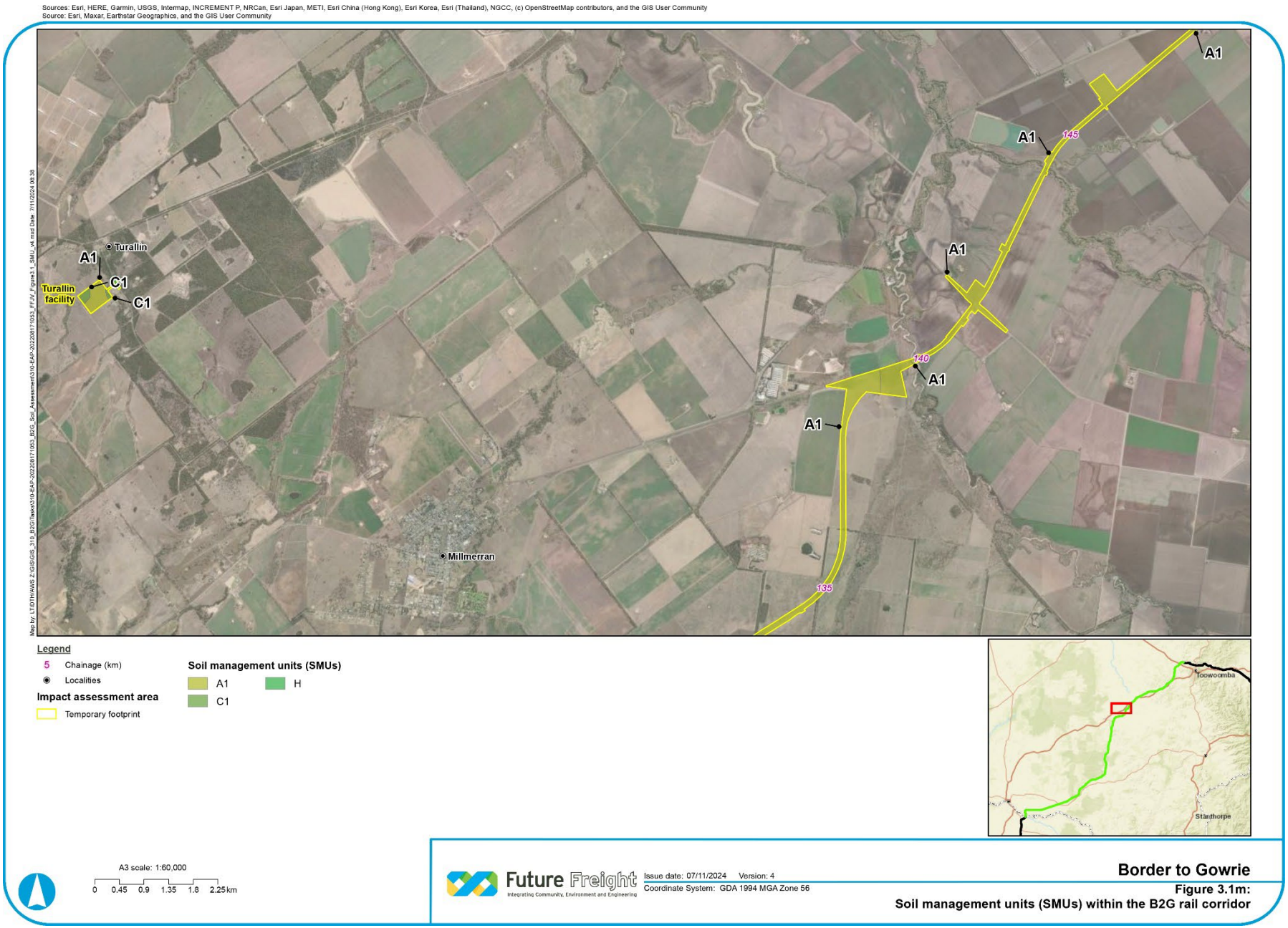

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
C/H
C/H
95
A1
A1
I
C1
I
90
H
I
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C/H
C1
H
I
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1h:
Soil management units (SMUs) within the B2G rail corridor

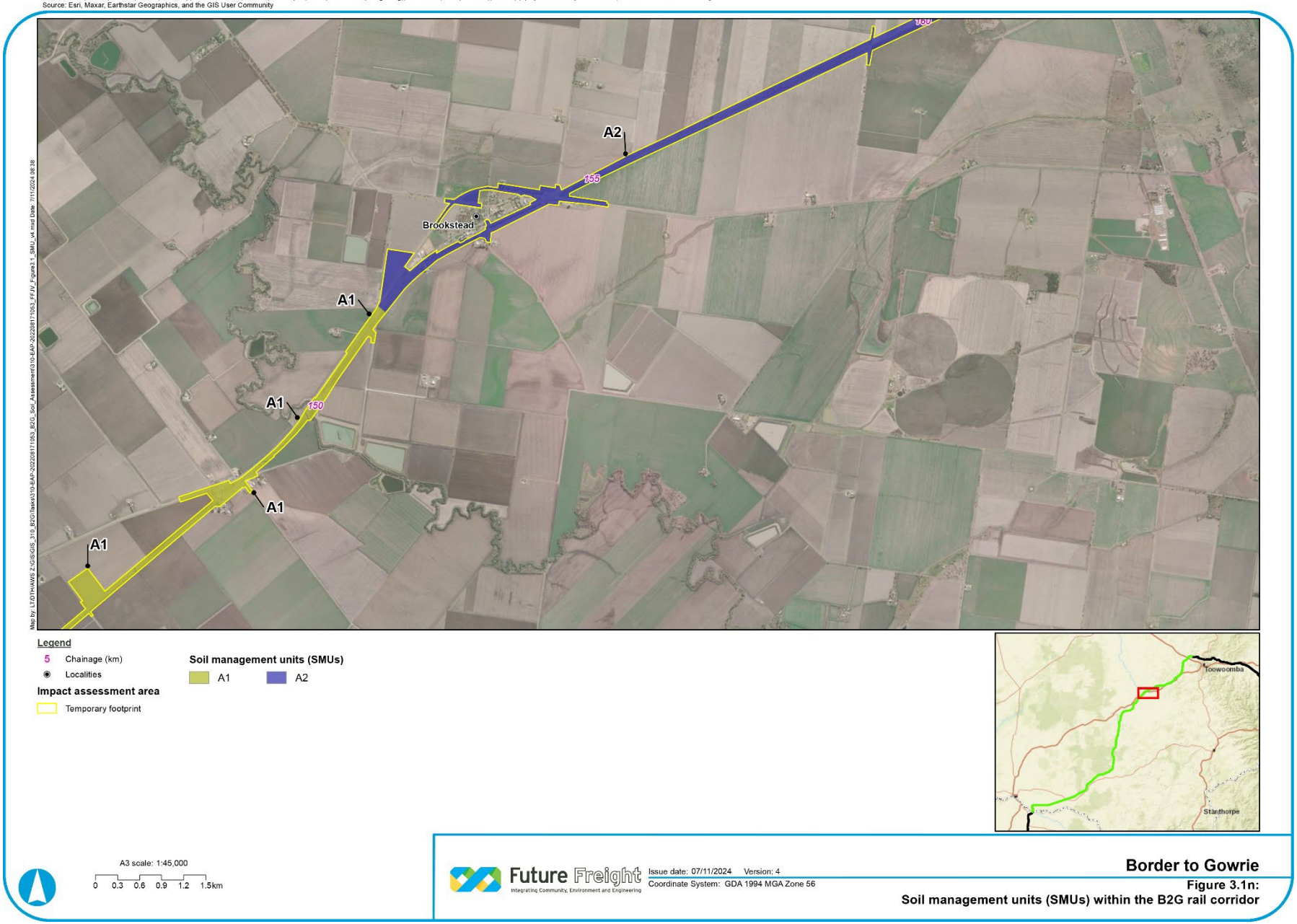

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
A1
A1
Kooroongarra
C/H
100
A1
A1
C/H
Kooroongarra-Andersons Road Borrow Pit
C/H
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C/H
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1i:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
A1
C5
A1
110
A1
105
A1
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C5
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1j:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
A5
A1
120
Heckendorf Road Borrow Pit #(A)
A1
Heckendorf Road Borrow Pit#(B)
115
Legend
5 Chainage (km)
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
A5
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1k:
Soil management units (SMUs) within the B2G rail corridor

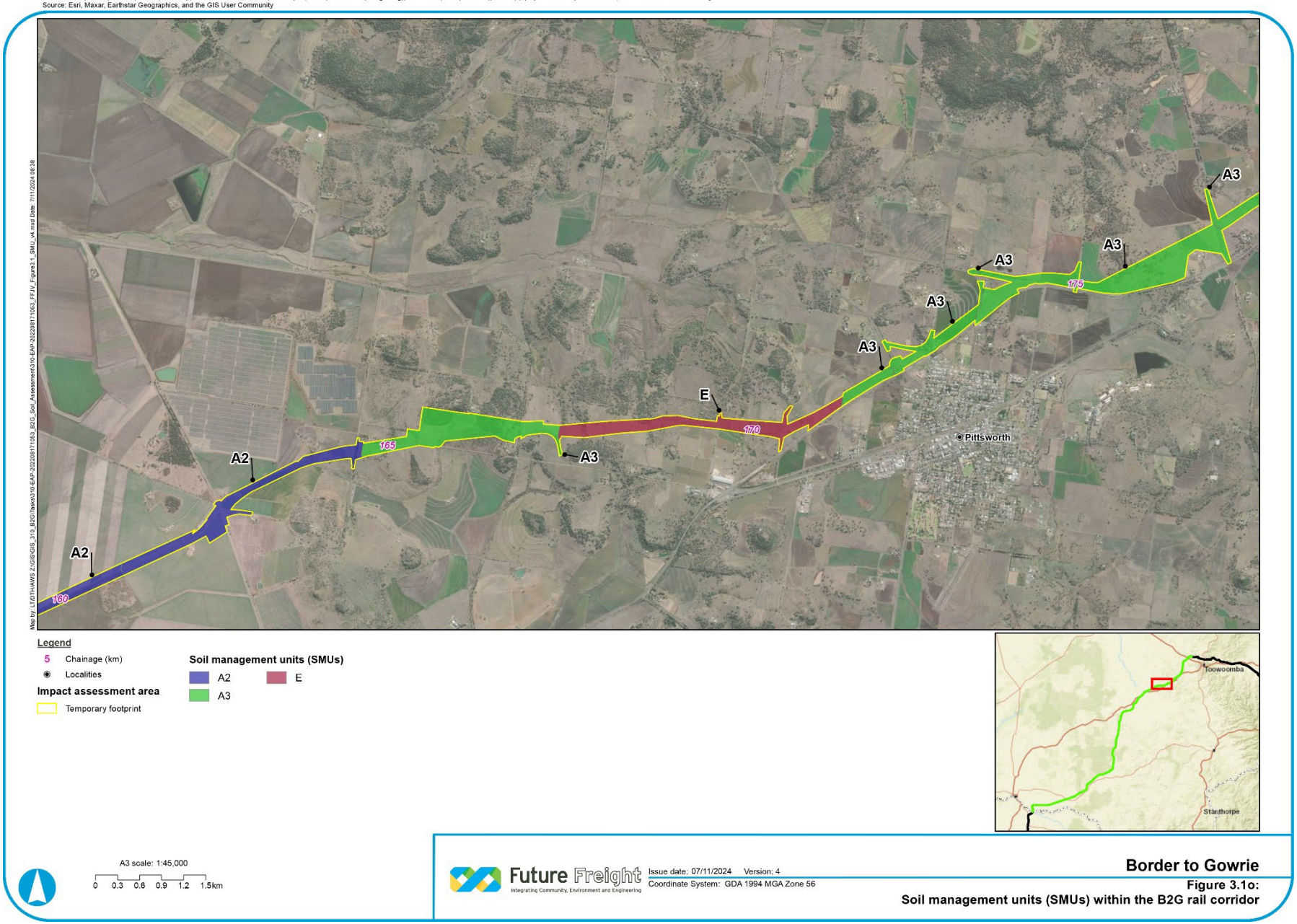

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Millmerran
A1
135
C1
A1
A1
D
130
A1
D
A5
125
A5
A1
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
A5
C1
D
D/I
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1I:
Soil management units (SMUs) within the B2G rail corridor

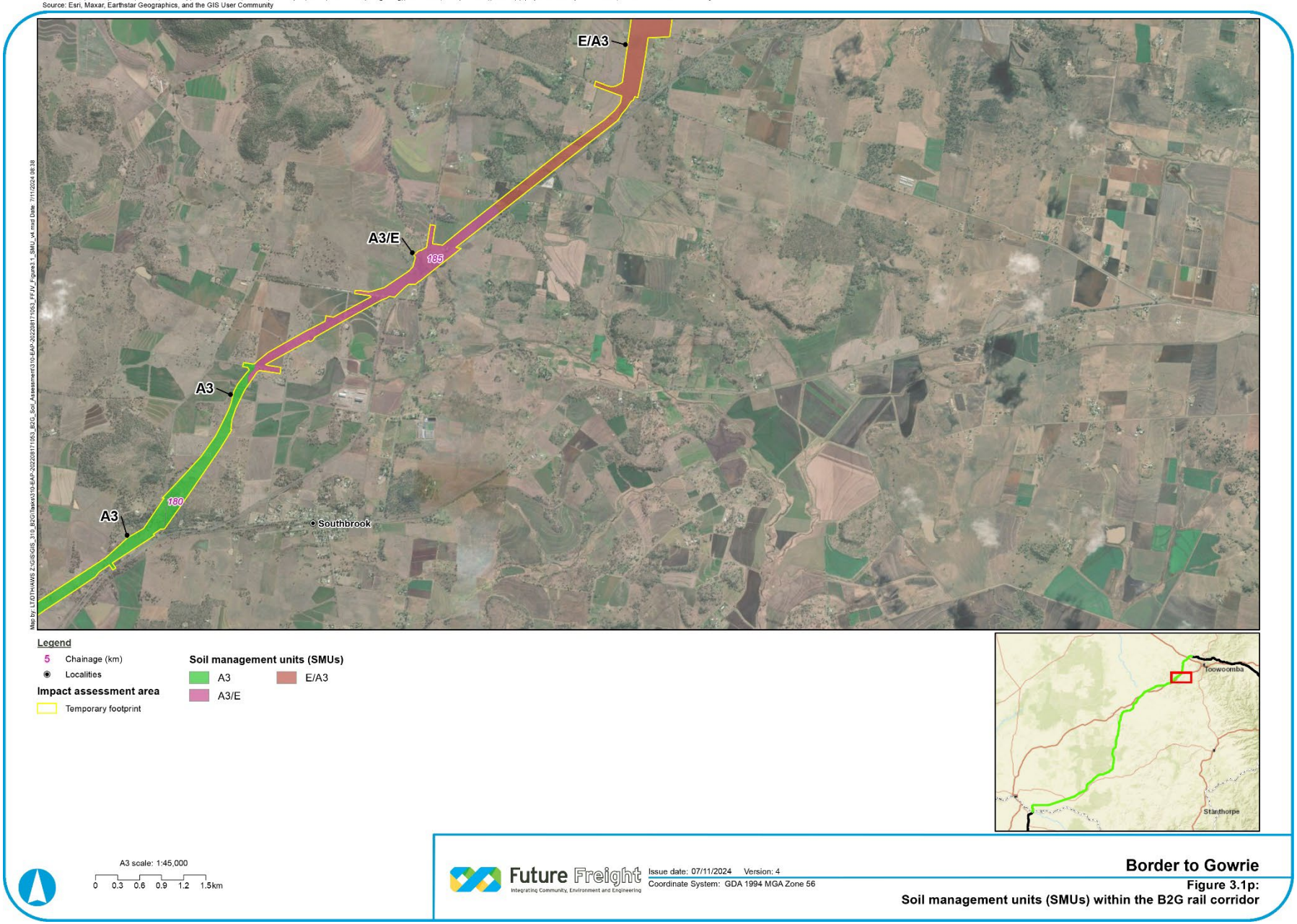

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817\053_FFIV_Figures\1_SMU_v4.mxd Date: 7/11/2024 08:38
Turallin
Turallin facility
Millmerran
A1
C1
H
145
140
135
Legend
Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A1
C1
H
Toowoomba
Stanthorpe
A3 scale: 1:60,000
0 0.45 0.9 1.35 1.8 2.25 km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1m:
Soil management units (SMUs) within the B2G rail corridor

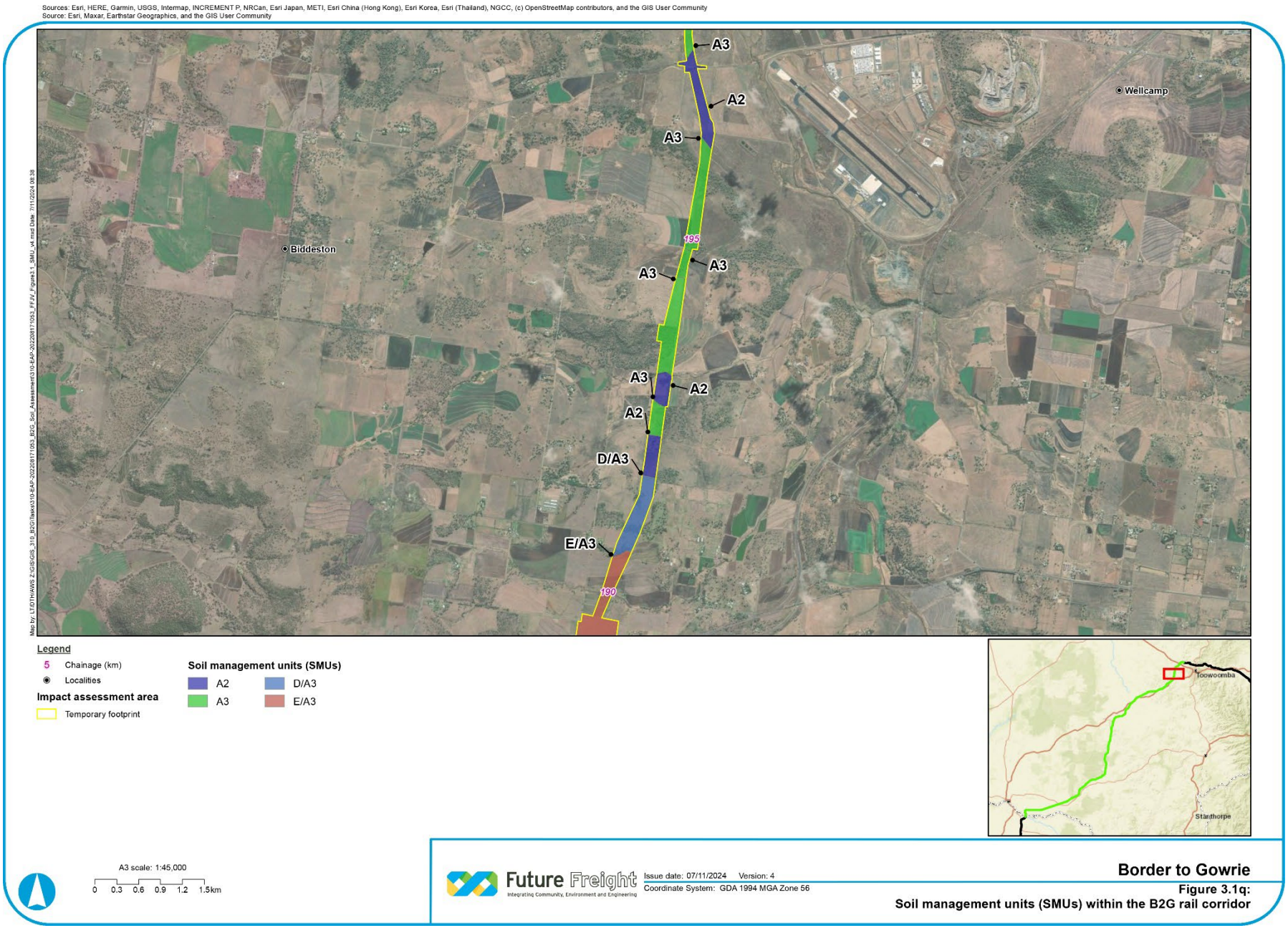


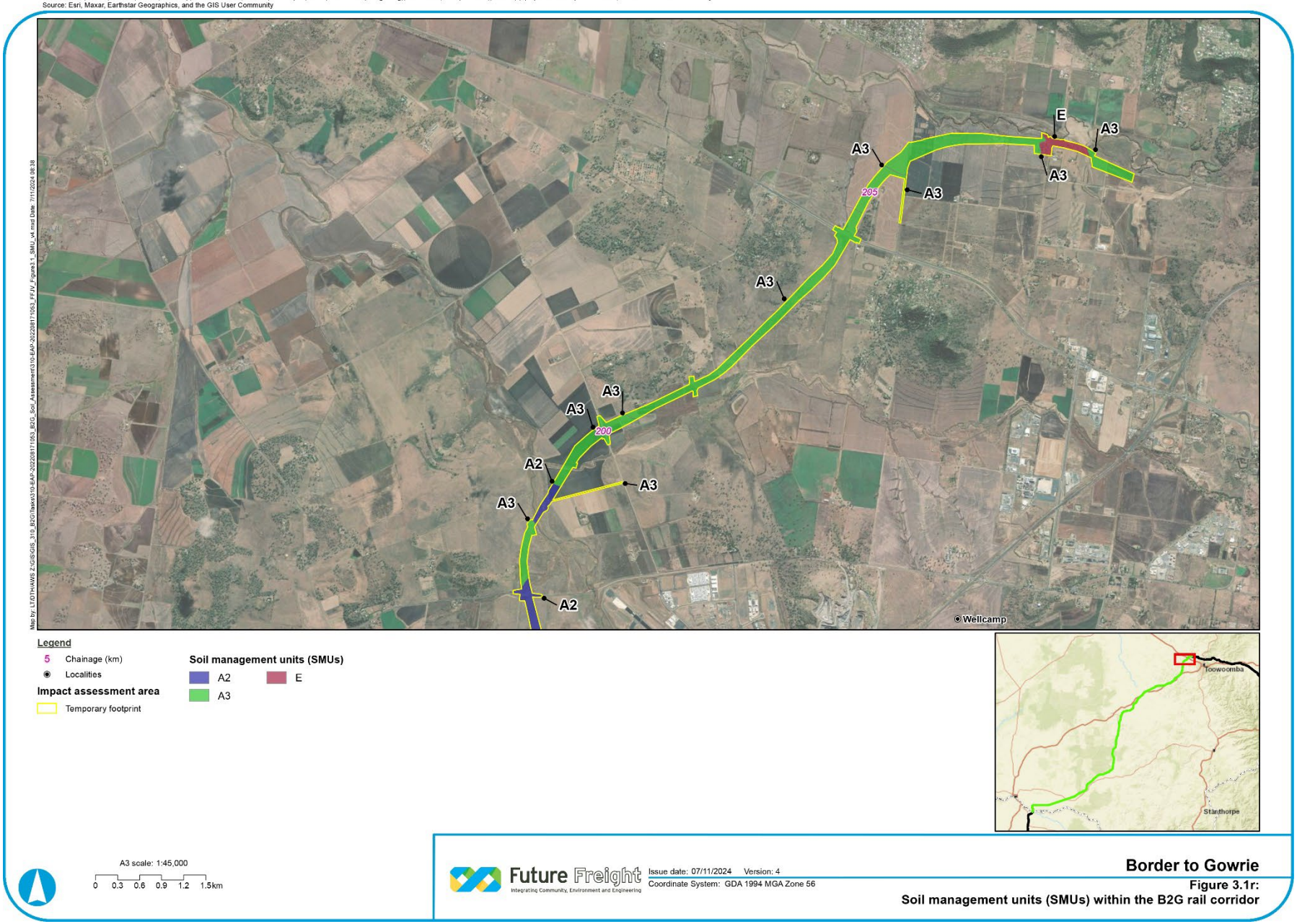
Border to Gowrie

Figure 3.1n:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817T053_FFIV_Figures3.1_SMU_v4.mxd Date: 7/11/2024 08:38
A2
A3
E
165
170
175
160
Pittsworth
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A2
A3
E
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1o:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
E/A3
A3/E
185
A3
A3
180
Southbrook
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A3
E/A3
A3/E
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1p:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTIDTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817T053_FFIV_Figures3.1_SMU_v4.mxd Date: 7/11/2024 08:38
A3
A2
A3
Wellcamp
Biddeston
195
A3
A3
A3
A2
A2
D/A3
E/A3
190
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A2
A3
D/A3
E/A3
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1q:
Soil management units (SMUs) within the B2G rail corridor


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Map by: LTOTHAWS Z:\GIS\GIS_310_B2G\Tasks\310-EAP-20220817\053_B2G_Soil_Assessment\310-EAP-20220817\053_FFIV_Figures\1_SMU_v4.mxd Date: 7/11/2024 08:38
A3
A2
E
205
200
Wellcamp
Legend
5 Chainage (km)
Localities
Impact assessment area
Temporary footprint
Soil management units (SMUs)
A2
A3
E
Toowoomba
Stanthorpe
A3 scale: 1:45,000
0 0.3 0.6 0.9 1.2 1.5km
Future Freight
Integrating Community, Environment and Engineering
Issue date: 07/11/2024 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
Border to Gowrie
Figure 3.1r:
Soil management units (SMUs) within the B2G rail corridor

4. Inspections, monitoring and reporting

Inspections, monitoring and reporting will be undertaken to document compliance with imposed conditions, within the CEMP. Where monitoring and reporting determines that the existing management measures are not effective, corrective and preventative measures will be developed and implemented as soon as practicable.

The primary objective of inspection, monitoring and reporting is to assess the compliance of the Project with the CEMP and determine the effectiveness of mitigation measures. Land resource components of inspection, monitoring and reporting ensure soil has been appropriately managed during all activities associated with the Project. This includes adopting appropriate remediation where targets are not met. The CEMP will include requirements for inspections, monitoring and reporting to ensure compliance with imposed conditions and other Project-specific plans, including parameters to be monitored, targets for those parameters, and the frequency of monitoring. Monitoring programs will be developed for the pre-construction and early works and construction stages of the Project. Monitoring activities will be conducted by a person who is suitably trained, qualified and experienced and carried out in accordance with relevant guidelines and industry best practice, Suggested parameters, targets, and frequency in relation to monitoring requirements for soils are provided in Table 4-1.

TABLE 4-1 OUTLINE MONITORING PLAN: SOILS

Parameters and targets – topsoil depth	▸ The quantities of rehabilitation topsoil should be balanced against stored stockpile inventories ▸ Topsoils should be recorded prior to being stripped and be re-spread over scarified or ripped subsoils such that the final depth matches the pre-disturbance depth.
Parameters and targets – exposure of subsoil	▸ Subsoil material is not to be reinstated at shallower depths than the pre-disturbance topsoil depth. In some soils, such as SMUs A, B, C, D, G, H, and I, the lower subsoil material may be significantly more sodic, saline, and/or acidic or alkaline and should be separately stripped from the upper subsoil so that it can be reinstated with the upper subsoil separating the lower subsoil from the topsoil. Typically, this is lower subsoil material that has an ESP >30, $EC_{1:5}$ >0.56 dS/m, or Cl^- >800 mg/L, and pH <5.0 or >9.0 as this material should not be within 300 mm of the surface where it naturally did not occur pre-disturbance ▸ No evidence of accelerated erosion on the construction site or at locations downstream due to increased runoff from construction activities ▸ Structures designed to control runoff and trap sediment are functioning correctly ▸ No evidence of sediment deposited from construction activities.
Parameters and targets – runoff water quality	▸ Upstream and downstream monitoring in accordance with the Surface Water Management Plan and monitoring program.
Frequency	▸ During construction, weekly inspections of integrity of structures or immediately following a rainfall event that has runoff ▸ Monitoring for soil subsidence and erosion will continue, as described in the CEMP ▸ Monitoring intervals for rehabilitation indicators to be detailed in the Rehabilitation and Landscaping Management Plan.

5. Corrective actions

A non-conformance and corrective action procedure will be developed for managing non-conformances in accordance with the CEMPs, approvals and legislative requirements. The procedure will be implemented after the identification of non-conformances during site inspections, environmental audits and through other mechanisms, such as the complaints register. The procedures will include:

- Classification of what constitutes non-conformance
- Investigation requirements
- Identification and implementation of corrective and preventative actions
- Assigning adequate resources and timelines for completion of corrective and preventative actions
- Reporting requirements (internally and externally)
- Process for closing out non-conformances
- Requirements for and the maintenance of a non-conformance register
- Processes for the regular review and status of non-conformances.

The non-conformances and corrective actions may trigger the requirement for a review and modification of practices onsite. These changes in onsite work practices will be reflected in amendments to the CEMPs.

Examples of corrective actions are:

- Undertaking necessary revegetation and/or weed management to preserve topsoil windrow/stockpile properties
- Reinstating windrows/stockpiles that have been disturbed, slumped, or eroded to reinstate separation distances, prevent contamination, and reinstate volumes
- Cleaning, repairing, re-positioning, or replacing erosion and sediment control devices whenever inspections indicate they are ineffective
- Amending the type, position and arrangement of erosion and sediment controls to improve performance
- Removing deposited sediment where inspections of adjoining roadways, access tracks, waterways, and properties indicate the presence of sediment from the site is accumulating in sediment traps
- Undertaking corrective earthworks where subsidence has occurred
- Modifying onsite sediment controls to prevent future off-site migration of sediment
- Adding ameliorants, such as gypsum, to reduce soil dispersion
- Adding ameliorants such as composted organic matter and/or N, P, and K fertilisers to maintain topsoil fertility levels for rehabilitation.

6. Reporting

Construction compliance reports will be prepared periodically by ARTC during construction in accordance with the agreed compliance report process detailed in the CEMP.

Reporting will include:

- A summary of monitoring data and interpretation of the results
- An evaluation of compliance with the CEMP
- Details of non-compliance events, including a description of the incident, resulting effects, corrective actions, revised practices to prevent a recurrence, responsibility and timing
- Reporting of complaints, including the number of complaints, description of issues, responses and corrective actions
- Inspection results of installed erosion and sediment control devices, as per the ESCPs and specific soil management measures.

7. Awareness and training

Earthmoving plant operators will be made aware of different SMUs and the differentiation between topsoil and subsoil through toolbox talks or other specific environmental training.

Supervision will be provided as part of the construction stage earthworks to ensure that stripping operations are conducted in accordance with the soil management parameters detailed in the final Soil Management Plan/s. This will ensure that topsoil material is effectively segregated, and the quality of the stripped topsoil is not reduced through mixing with subsoil or other unsuitable soil material.