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HRM & ASSOCIATES

TE ARA TIPUNA TRAIL – GISBORNE TO OPOTIKI

GEOTECHNICAL ASSESSMENT REPORT

INITIA REF P-001538 REV 2

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Contents

1. Introduction

1.1 General

This report has been prepared to provide geotechnical advice and recommendations for the proposed Te Ara Tipuna trail from Gisborne to Opotiki. A desktop study and a geotechnical site visit has been undertaken for the proposed trail to provide advice on potential geohazards along the route that may affect the planning and construction of the project.

The conclusions and advice presented in this report are based off a high-level desktop study of aerial imagery using Google Earth completed in June 2023 and a two-day site drive through in March 2023. The report is intended to support the Resource Consent Application for the project. Further geotechnical mapping and investigations will be required during the detailed design stage of the project to assess the constructability of the proposed route.

1.2 Proposed Development

1.2.1 General

Te Ara Tipuna is proposed to be a network of ara/accessways around the East Cape, for local communities and visitors to hike, bike, horse trek; and to provide connection and catalysts for businesses and employment offering services, provisions, and experiences.

Te Ara Tipuna will traverse the rohe of Ngāti Porou and of Te Whānau-ā-Apanui, allowing users to engage with some of the most beautiful, rugged, isolated land and waterways of Aotearoa, as well as experiencing cultural icons of marae and mountains, and the unique character of its local people and communities.

The track is proposed as a shared pathway involving various types of construction, depending on the local conditions, including boardwalks, simple wooden tracks, gravel tracks and way findings through paddocks. There will also be establishment of toilets and shelters throughout the network to provide amenities for users and potentially the construction of carparks at key points for day or multi-day trips.

The intention of the track is to provide a level of resilience to the East Coast by providing four-wheel drive/quad-bike type access to remote sections where State Highway 35 is prone to closure after significant weather events such as the recent Cyclone Gabriel event. Te Ara Tipuna has the potential to provide Civil Defence options for access in these events.

At the early stage of the project Civil Project Solutions (CPS) has developed a high level route for the track, which is shown in the figure below:

Figure 1-1: Provisional route for the Te Ara Tipuna trail.

In addition, the overall route has been split into walking days by the project team. They estimate that the track should be split into 26 days.

1.2.2 Ruatoria Route

A section of the Te Ara Tipuna Trail in Ruatoria has been chosen to showcase the potential track types of the overall trail. The Ruatoria Route is a 1 km section of four tiers of tracks (raised boardwalks, boardwalks, gravel and standard). The development will include approximately 100 m of raised boardwalks, 300 m of boardwalks, 200 m of gravel track and 440 m of standard track (see below).

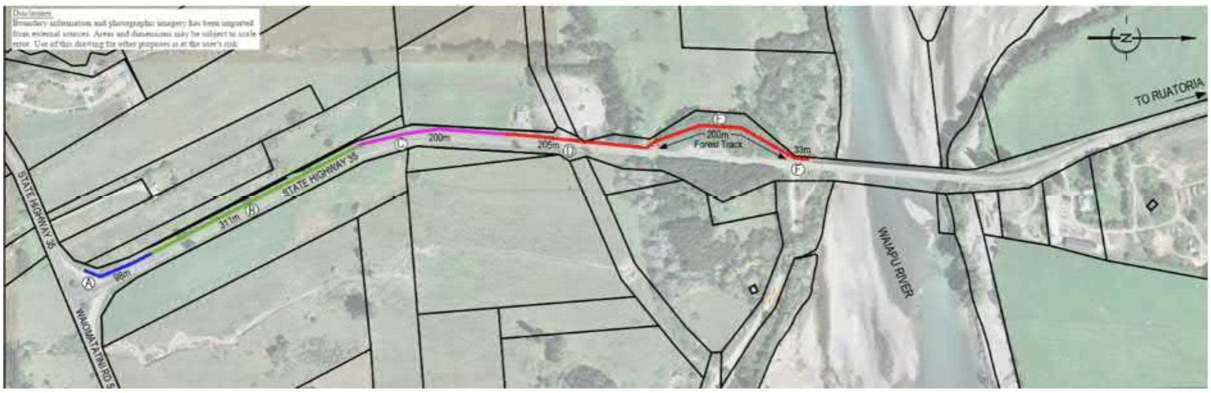

Figure 1-2: Ruatoria Route Layout.

1.2.3 Proposed Track Types

The Te Ara Tipuna Trail is proposed to consist of four different tiers of tracks that will be utilised in different sections of the trail. The four tiers of tracks are raised boardwalks, boardwalks, gravel and standard and a description of these are provided below. It is envisaged that the gravel and standard tier tracks will be utilised for a majority of the tracks which will involve minimal construction and maintenance compared to the raised boardwalks and boardwalks tier tracks. The raised boardwalk and boardwalk tier tracks are likely to be used around townships where usage will be greater.

Raised Boardwalk Tier Track

The track is a high quality raised wooden walkway, similar to that constructed between Waikanae and Midway Beach in Gisborne. The wooden walkway is likely to be supported on timber poles embedded approximately 300 – 500 mm below ground level. Figure 1-3 and Figure 1-4 below provides examples and a cross section of the proposed raised boardwalk track.

Figure 1-3: Example image of a proposed raised boardwalk tier track.

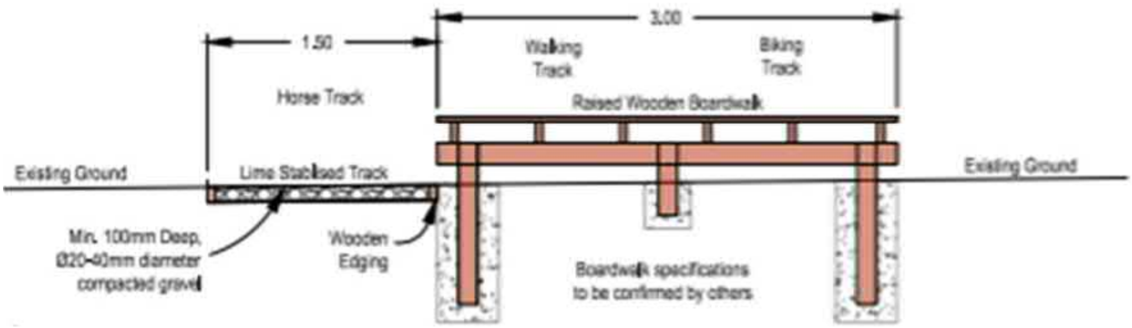

Figure 1-4: Typical cross section of a raised boardwalk.

Boardwalk Tier Track

This track is a wooden walkway that bears directly on the ground (i.e. is not raised). This type of track will not be as significant and visually appealing compared to a raised boardwalk track and may have some grassed sections. Figure 1-5 and Figure 1-6 below provide examples and a cross section of a proposed boardwalk tier track.

Figure 1-5: Example image of a proposed boardwalk tier track.

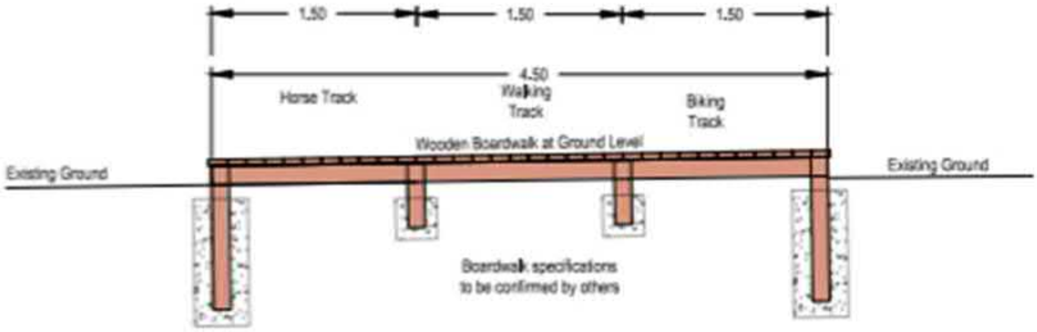

Figure 1-6: Typical cross section of a boardwalk tier track.

Gravel Tier Track

The gravel tier track will have an aggregate surface (100 mm of compacted aggregate) which is crowned in the middle walkway. The gravel track will provide a higher level of service than a farmland or beach track. Figure 1-7 and Figure 1-8 below provides examples and cross section of a proposed gravel tier track.

Figure 1-7: Example image of a proposed gravel tier track.

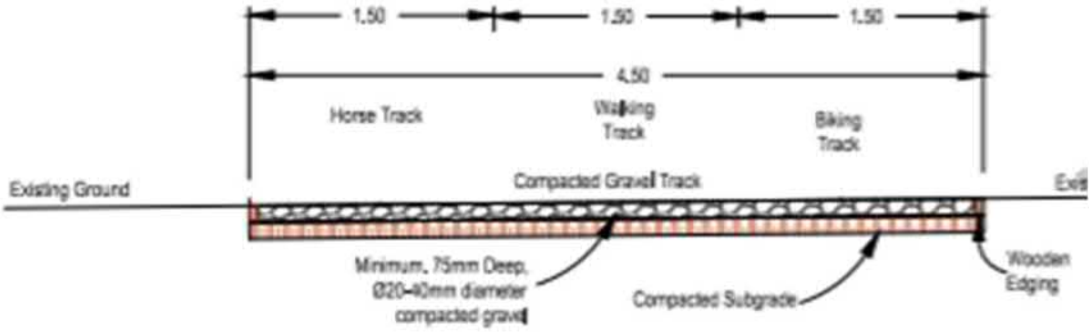

Figure 1-8: Typical cross section of proposed gravel tier track.

Standard Tier Track

A Standard Tier track is essentially formed within the natural landscape, requiring minimal change to current grades and supported with wayfinder posts. This track will typically be used through bush and farmland and may require the removal of vegetation and limited track sculpting. Figure 1-9 below provides a typical cross section of a Standard Tier track.

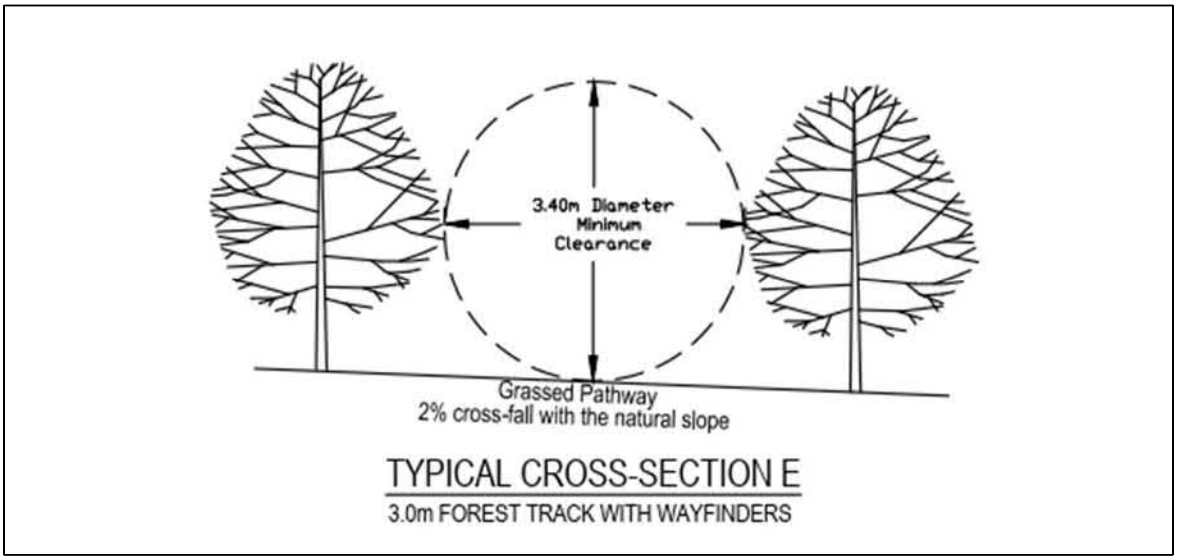

Figure 1-9: Typical cross section of a Standard Tier track.

1.2.4 Proposed Structures Along Te Ara Tipuna Trail

A number of structures will be constructed along the Te Ara Tipuna Trail to provide access across streams/rivers and to provide amenities to sections of the track that are not located in towns. The main structures proposed along the track are detailed below:

- New bridges to cross streams along the route, where the track was not able to use an existing bridge, or the stream is considered too deep to cross at the river mouth. These structures will require geotechnical input at the detailed design stage of the project.
- Clip on bridge sections for existing bridges that do not currently have a foot path or a not wide enough to accommodate cyclists, walkers and horses. Geotechnical input will not be required for these structures.
- Huts and shelters are proposed to be constructed along sections of the track. At this stage of the project no specific design has been provided on the size and type of such structures, however, it is envisaged that these will involve lightweight timber structures that will be

founded on timber poles. If the structures require a resource and/or building consent geotechnical input will be required at the detailed design stage of the project.

- Toilets are proposed to be constructed along the track and the size and type of these structures will likely vary from basic toilet structures in isolated areas to larger toilet blocks in towns. Requirement for geotechnical input will need to be assessed depending of the type and size of the structure at the detailed design stage.

2. Geology of the Region

2.1 Published Geology

The geology of the East Cape (Raukumara) region[1] is very complex with rapid changes in soil and rock type, many faults and in parts of the region major thrust sheets. The geology of the region is split into five major units based on their age and structural history:

- Late Jurassic to Early Cretaceous basement rocks of the Torlesse terrane.
- In-place Cretaceous to Oligocene sedimentary rocks.
- Early Cretaceous to Oligocene displaced sedimentary and igneous rocks of the East Coast Allochthon
- Miocene and Pliocene sedimentary rocks
- Quaternary sediments

A description of each of the major units is detailed below:

2.1.1 Late Jurassic to Early Cretaceous Basement (Unit 1)

The Late Jurassic to Early Cretaceous Basement rock typically consists of indurated sandstone and mudstone commonly referred to in New Zealand as 'greywacke'. The greywacke is part of the Torlesse Supergroup with forms the North Island axial ranges and much of the Southern Alps. The basement greywacke in the region outcrops as part of the Raukumara Range and is located in the northwestern section of the region. The greywacke forms the steep, heavily vegetated hill slopes that is seen along the western coastline of the region.

Greywacke rock is typically a strong rock when unweathered and is usually heavily fractured. Unweathered greywacke will stand at steep face angles and is relatively slow to weather/erode.. Once the rock becomes weathered and jointed, the rock decreases in strength and becomes susceptible to landslips as seen in the heavily fractured greywacke in the Waioeka Gorge. The defects, weathering and slope angle of the greywacke rock will determine the slope instability risk throughout the region, although it is considered significantly more stable than the other units in the region.

2.1.2 In-place Cretaceous to Oligocene Rocks (Unit 2)

The in-place Cretaceous to Oligocene rocks typically consists of many different subunits throughout the region. The main subunits are the Matawai group, which is comprised of moderately indurated sedimentary rocks, the Ruatoria group consisting of alternating fine-grained sandstone and mudstone, the Tinui group which is mudstone dominated and the Mangatu group which is comprised of glauconitic and calcareous mudstone and sandstone. The overall unit is typically located throughout the centre and northern parts of the regions.

Due to the variety of the rocks in this unit, the engineering properties are variable and thus different units are more susceptible to landslips. Units with high clay contents are found to be susceptible to failure by earth flow mechanisms. The harder rocks in the unit, where fractured are susceptible to gully erosion and slumping.

2.1.3 East Coast Allochthons (Unit 3)

The East Coast Allochthon rocks have been thrusted over the two older units that are detailed above. The main units in the East Coast Allochthon are the early Cretaceous to Eocene igneous rocks, early and late Cretaceous sedimentary rocks, late Cretaceous to Paleocene sedimentary rocks and Eocene and Oligocene sedimentary rocks. The rocks are typically found in the north and north-eastern parts of the region.

[1] Geological & Nuclear Sciences Limited. Geology of the Raukumara Area. Dated 2000.

Due to the rocks being thrusted into place, the sedimentary rocks are typically heavily sheared and fractured which can result in landslips occurring on shear planes at low angles. Intensely sheared and mixed lithologies are mapped as Melange, and reflect ancient soft sediment deformation and folding. . This unit is considered to be a stability risk and many large landslips have occurred in the Allochthon rocks. The igneous rocks in the unit are strong to very strong rocks and are stable at steep angles. When unweathered, these rocks are typically not prone to slope failures.

2.1.4 Miocene and Pliocene Rocks (Unit 4)

The Miocene and Pliocene rocks have been deposited in local basins controlled by uplift, faulting and subsidence. Two main groups that form the Miocene and Pliocene rocks are the older Tolaga Group and the younger Mangaheia Group. The Tolaga Group typically consists of massive to thinly bedded mudstones which are slightly calcareous. The Mangaheia group consists of up to 2000 m of shelly sandstone, sandstone and mudstone. The overall unit is typically located along the eastern coastline and some sections of the northern coast.

The Miocene and Pliocene vary in strength from extremely weak to moderately strong. Unweathered rock typically forms steep natural faces as seen in areas such as Tolaga Bay. The mudstone dominated rock are typically more susceptible to slope failures than the sandstone dominated rocks. Bedding plane failures and slumping are typical failures that occur in this unit. When the rocks become weathered, shallow failures in residual soil layers are common when combined with high rainfall events.

2.1.5 Quaternary Sediments (Unit 5)

Quaternary sediments have been deposited in the last 1.8 million years and occur in the region as alluvial plains, swamps, onshore coastal plains and landslide deposits. These sediments typically consist of soft peats and mud and unconsolidated sands and gravels. The materials are typically loose and soft in nature and are often susceptible to liquefaction and lateral spread in a seismic event. Quaternary sediments occur throughout the region, typically near the coast and river plains.

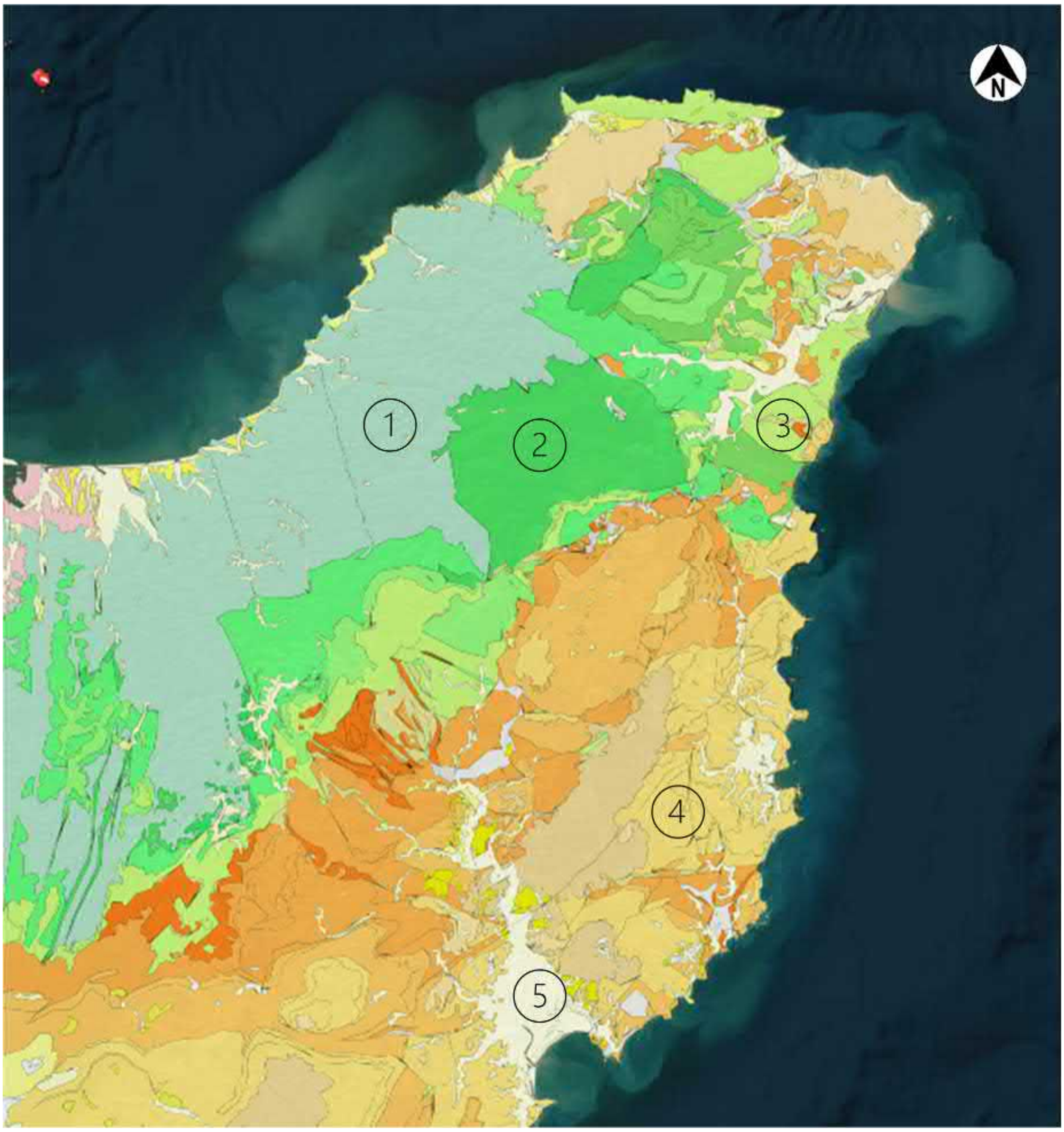

Figure 2-1: Geology map of the East Coast Region. Sourced From GNS Science.

Major Geology Units example locations on geology map:

1. Late Jurassic to Early Cretaceous Basement – greyish green
2. In-place Cretaceous to Oligocene Rocks – green
3. East Coast Allochthons – light green and light blue
4. Miocene to Pliocene Rocks – orange
5. Quaternary Sediments - cream

3. Geotechnical Hazards Overview

3.1 General

The East Cape region is prone to many geotechnical hazards due to the regions tectonic setting and exposure to coastal weather systems. These hazards are particularly relevant considering the predicted increase in frequency of significant weather events due to climate change and sea-level rise. The complex geological structures of the East Cape, together with typically weak rock types and steep topography results in landforms that are susceptible to landslips and coastal erosion. Areas of Quaternary sediment deposition in low lying valleys and coastal areas are prone to a potential liquefaction and lateral spread hazard when large seismic events occur.

Description of the typical hazards encountered in the East Cape region are detailed below.

3.2 Landslips

Landslips are the movement downslope of soil, rock or debris and are caused when the shear stresses within a slope exceed the shear strength of the materials that form a slope. The two main causes of landslips in the East Coast region are earthquake induced landslips, and landforms with weathered soil horizons and/or clay content susceptible to rainfall induced instability. Landslips occur on steep hillsides that are prevalent in the East Coast Region. The type and size of a landslip is dependent on the slope angle, underlying geology and intensity of the triggering event e.g. the large rainfall events in January/February 2023 caused widespread landslips over the region. These rainfall induced events are typically shallow soil horizon failures, however, they can involve large volumes of material and/or create damaging debris flows.

Deep seated landslip features are typically activated less frequently and may express slowly over time with ongoing creep movement and gradual progression of ground cracking. These features are however, usually larger in scale and much more challenging to repair/remediate. Risk of deep-seated landslips are typically identified by mapping ancient surface features and landforms, or geotechnical investigation of underlying rock structures, i.e. faults, bedding and defect orientations.

Landslips are a significant hazard to transport routes and can occur as an overlslip or an underslip. An overlslip occurs when the slope above a transport route fails, resulting in material covering the route and blocking traffic movement. Material will need to be removed by heavy machinery and the slope failure stabilised before the transport route can be opened. An underlslip occurs when the slope below a transport route fails which can result in a loss of material underneath the route and will require the road to be rebuilt which may involve retaining walls or significant engineering inputs to repair.

Due to the topography along the proposed Te Ara Tipuna Trail, landslips are considered to be the most significant and common hazard that will be encountered. Throughout the design, geotechnical input will be required to mitigate the risk of landslips that may occur above or below the proposed trail.

3.3 Liquefaction and Lateral Spread

Liquefaction occurs in saturated, loose granular soils under seismic loading, and it causes the soil to lose shear resistance. For liquefaction to occur, the material must have the potential to densify under cyclic loading, be saturated (e.g beneath the groundwater table) and be subjected to a seismic event. Liquefaction potential in the region is typically considered high due to being in a high-risk earthquake zone. Liquefaction can cause significant risk to structures such as buildings and bridges where the ground below loses strength causing damage to the structures.

Lateral spreading is generally defined as horizontal displacement of blocks of material towards an open slope face (e.g. stream banks) as a result of the underlying soils losing strength during a liquefaction event. The presence of a continuous liquefiable layer of sufficient thickness is required for significant spreading to occur. Lateral spread can stretch building foundations if not considered in design.

3.4 Active Faults

Active faults present a significant geohazard in the East Coast Region due to the proximity of the Hikurangi Margin located off the east coast of New Zealand. The two main hazards associated with active faults are strong ground shaking and surface deformation. Strong ground shaking can affect large areas of land as seen in the Christchurch and Kaikoura Earthquakes where is ground deformation due to fault rupture will only occur along the fault.

Secondary geohazards can also be caused by strong ground shaking. These include landslips and soil liquefaction.

3.5 Coastal Regression

Coastal regression is the loss of land of a beach dune or a coastal cliff due to wave action that is exerted onto the dune or cliff. Coastal regression of a beach dune is typically caused by storm events where wave energy is high causing sand to be eroded. Sea level rise will also cause further erosion in the dune environment.

Regression of coastal cliffs can be caused by storm events and through a prolonged period of wave action from a particular direction. The coastal cliffs typical regress through landslips/cliff collapse which is typically caused through wave action undercutting the base of the cliff, which results in the cliff collapsing. High rainfall events can also cause landslips on the higher elevation margins at the slope crest margin of coastal cliffs, in the same way that landslips occur inland.

4. Geotechnical Site Visit and Track Review

4.1 Geotechnical Site Visit

A senior geotechnical engineer and an engineering geologist from Initia undertook a preliminary site visit of the Te Ara Tipuna Trail alongside the project manager from CPS. The purpose of the site visit was to visit areas of the trail that have been identified by aerial photograph assessment as having potential geotechnical hazards that may affect the proposed track alignment. The site visit also enabled Initia to identify some hazards that were unable to be observed from aerial imagery and gain an understanding of how each part of the region has site specific risks and vulnerabilities that will need to be managed.

Whilst undertaking visual inspection of sections of the route, a drone was flown to gather imagery and undertake preliminary assessment of some problematic areas. The aim of gathering drone imagery was to assess potential route options such as the steep cliffs at the northern end of Tolaga Bay. Due to the size of the proposed track and isolated nature of the region, only a small section of the proposed track was able to be visually assessed whilst traversing the East Cape in two days. Further detailed site visits will be required throughout the detailed design stage to manage the risks throughout the trail.

4.2 Track Review

After the geotechnical site visit, an engineering geologist from Initia undertook a preliminary track review based on what was identified during the site visit and an initial desktop study of the track using Google Earth. The track review provided recommendations on areas of the proposed track that should be adjusted to avoid significant geotechnical hazards. Track changes were typically made to avoid surface features identified as likely landslips, and to adjust trails from mid slope to ridgelines to avoid creating instability risks due to excavations on slopes. It was also advised that track alignments directly above coastal seacliffs were to be moved inland, typically in the order of 50 m in order to create resilience for the track and eliminate the need for coastal and geotechnical engineering analysis.

The track reviews were provided to CPS and changes were made to the proposed route base on our recommendations.

It should be appreciated that the imagery on Google Earth is not current and there are likely to be further stability issues along the proposed track that could not be identified in the Google Earth review given the recent weather events.

5. Geotechnical Hazard Assessment

5.1 General

A preliminary geotechnical hazard assessment was undertaken to present potential hazards along each day of the Te Ara Tipuna Trail and the Hikurangi Loop Trail. A table has been created highlighting the below sections for each day:

- Mapped Geological Unit
- Topography of the Track Alignment
- Proposed Track Types
- Potential Geotechnical Hazards
- Key Areas of Geotechnical Hazards
- Geotechnical Input Required at the Design Stage
- Preliminary Risk Rating

The purpose of the table is to enable the client to understand what sections of the trail will require further geotechnical work at the design stage and area's that may have a higher perceived risk.

5.2 Geotechnical Hazard Assessment Table

A preliminary risk rating for each day has been provided based on a review of aerial imagery and the geotechnical site visit. The preliminary risk rating will be refined throughout the design stage of the project and will focus on site specific risks.

A description of the risk rating is provided below:

Low Risk Rating

Areas of the track that are considered a low risk are typically situated on flat alluvial plains or areas of gently sloping hills. These areas have not had any significant geotechnical risks identified and we do not expect to undertake geotechnical analysis at the detailed design stage. Geotechnical risks along these sections of the track will typically be able to be addressed through the construction stage and solutions are unlikely to affect the trail alignment or be costly. Although these areas will not require detailed geotechnical assessments, it would be prudent for site walkovers and/or an aerial imagery review be undertaken to confirm preliminary risk findings.

Moderate Risk Rating

Areas of the track that are considered a moderate risk are typically situated on moderately sloping hillslopes or near coastal seacliffs. These areas have potentially significant geotechnical risks, however, these risks are able to managed where alternate route selections are available. Geotechnical mapping and assessments will be required at the detailed design stage to ensure that the track alignment is not hindered by sections of potential instability. It is envisaged that areas of moderate risk will not require engineered solutions and the potential risk to the track can be managed through the detailed design process.

High Risk Rating

Areas of the track that are considered a high risk are typically situated on moderate to steeply sloping hillslopes that show evidence of significant historic instability. These areas have significant geotechnical risks and will require detailed geotechnical mapping and assessment to advise on track alignment where the geotechnical risk can be managed. High risk areas may require engineered solutions on parts of the track to increase stability of slopes where an alternative route is not practical.

Table 5-1: Geotechnical Hazard Assessment Table

Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
Day 1	– Unit 4 – Unit 5	– Moderately to steeply sloping hill country – Coastal Cliffs – Beach – Flat Farmland	– Existing Farm Tracks – Beach – Road and Road Shoulder – Existing Walking Track – Standard Tier Track	– Coastal erosion and seacliff stability – Slope stability of the 2 No. tracks heading to the ridgeline above the road	– Day 1 begins at Makorori Heads and continues along the beach before heading up moderately steep slopes onto farmland. The two coastal headlands along Day 1 are considered to be Key Areas and are marked on Figure 1538-G02 which have been identified as areas of potential coastal erosion. Further geotechnical assessment will be required pending the track alignment position in relation to the coastal seacliffs.	– Geotechnical slope stability and coastal regression assessment will be required for the two coastal headlands. – The two proposed paths through farmland on moderately steep slopes should be assessed for potential instability.	Moderate
Day 2	– Unit 2 (minor) – Unit 4 – Unit 5	– Moderately sloping hill country – Coastal Cliffs – Alluvial Plains – Flat Farmland	– Gold Tier Track – Road and Road Corridor – New Standard Tier Track	– Slope stability of ridgelines that the track follows. – Coastal erosion and seacliff stability – Liquefaction and lateral spread risk for proposed bridge structures	– Day 2 heads along the coastal sea cliffs on relatively flat farmland before following the ridgeline around a gully feature. A section of the track marked Day 2 Key area on Figure 1538-G03 has been identified as an area with potential instability. Further geotechnical assessment will be required	– Geotechnical slope stability assessment and site mapping will be required for the area of potential instability identified as a key risk along Day 2. A coastal regression assessment may be required pending the location of the track in relation to the sea cliffs	Moderate
Day 3	– Unit 4 – Unit 5	– Beach – Wetland – Alluvial Plain – Moderately to steeply sloping hill country	– Road and Road Shoulder – Beach – Standard Tier Track	– Slope stability of ridgelines that the track follows for a majority of the day. – Liquefaction and lateral spread risk for proposed bridge structures	– No specific area of the track has been identified as a significant geotechnical risk, however, the entire route that follows the ridgeline may have potential stability risks	– A geotechnical site walkover or review of drone imagery should be undertaken to confirm slope stability risk	Low to Moderate
Day 4	– Unit 4 – Unit 5	– Beach – Moderately sloping hill country – Alluvial Plains	– Beach – Standard Tier Track – Existing walking track – Road and Road Corridor	– Potential rock fall risk along beach section – Slope stability risk where the track crosses the moderately sloping hillslopes towards Tolaga Bay.	– Day 4 heads along the beach before traversing across hillslopes with evidence of instability. A section of the track marked Day 4 Key area on Figure 1538-G05 has been identified as an area with potential instability. Further geotechnical assessment will be required.	– Geotechnical slope stability assessment and site mapping required for the section of track that traverses the moderately sloping hillslope	Moderate
Day 5	– Unit 4 – Unit 5	– Beach – Moderately to steeply sloping hill country – Alluvial Plains	– Road and Road Corridor – Silver Tier Track – Existing walking track	– Slope stability of proposed track down from Earnest Reeve Walkway	– Day 5 starts in Tolaga Bay heading up Earnest Reeve Walkway and down a steep slope before following alluvial plains. A section of the track marked Day 5 Key area on	– Geotechnical slope stability assessment and site mapping will be required for the steep slopes	High

[1] Unit 1: Jurassic to Cretaceous Basement Greywacke rock, Unit 2: Cretaceous to Oligocene sandstone/mudstone, Unit 3: East Coast Allochthon sheared sedimentary rock and igneous rock, Unit 4: Miocene to Pliocene mudstone and sandstone, Unit 5: Quaternary Sediments.

Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
			– Standard Tier Track – Beach		Figure 1538-G06 has been identified as an area with a significant stability risk. Further geotechnical assessment will be required to determine a suitable route down from Earnest Reeve Walkway	identified as a key risk along Day 5.	
Day 6	– Unit 4 – Unit 5	– Beach – Moderately to steeply sloping hill country – Alluvial Plains	– Beach – Standard Tier Track – Road and Road Corridor – Existing Farm Track	– Slope stability risk through the moderately to steeply sloping hill country	– No specific section of the track has been identified as being a significant geotechnical risk and there is significant areas where the track alignment can be adjusted if instability is encountered	– A geotechnical site walkover or review of drone imagery should be undertaken to confirm slope stability risk	Low to Moderate
Day 7	– Unit 4 – Unit 5	– Beach – Moderately to steeply sloping hill country	– Existing Road and Road Corridor – Standard Tier Track – Beach – Existing Farm Track	- Slope stability risk along moderately to steeply sloping vegetated hills - Coastal erosion and sea cliff stability -	- Day 7 starts along Anaura bay before heading along coastal cliffs and then traverses through vegetated hillslopes. 2 No. sections of the track have been identified as key areas and are marked on Figure 1538-G08. Key area 1 is the section of track the follows the coastal seacliff and key are 2 is the section of track that follows the heavily vegetated hillslope. This area will require geotechnical assessment to determine a suitable route.	- Geotechnical slope stability assessment and site mapping will be required for the coastal cliff section and the heavily vegetated hillslopes. A coastal regression assessment may be required pending the location of the track in relation to the sea cliffs	Moderate to High
Day 8	– Unit 3 – Unit 4 – Unit 5	– Moderately to steeply sloping hill country – Alluvial Plains	– Existing Road and Road Corridor – Standard Tier Track	– Slope stability in heavily vegetated hills after Tokomaru Bay	– Day 8 starts along the coastline of Tokomaru Bay and proceeds to traverse along moderately to steeply sloping, heavily vegetated hill country. The entire section of the vegetated hill country is considered to be a potential instability risk and is marked on Figure 1538-G09 as Day 8 Key area. This area will require further geotechnical assessment to determine as suitable route.	– Geotechnical slope stability assessment and site mapping will be required to determine the stability risk through the vegetated hillslopes. Due to the remote nature of this section of the track, aerial imagery will likely be the most efficient way to assess stability.	Moderate to High
Day 9	– Unit 2 – Unit 3	– Moderately to steeply sloping hill country	– Existing Road and Road Corridor – Standard Tier Track	– Liquefaction and lateral spread risk for proposed bridge structures – Slope instability of track through moderately sloping vegetated hill country	– Day 9 traverses moderately sloping hill country that has evidence of large historic landslips. A section of the track marked Day 9 Key area marked on Figure 1538-G10 has been identified as an area with potential instability.	– Geotechnical slope stability assessment and site mapping will be required to determine the stability risk associated with the historic landslips	Moderate

[1] Unit 1: Jurassic to Cretaceous Basement Greywacke rock, Unit 2: Cretaceous to Oligocene sandstone/mudstone, Unit 3: East Coast Allochthon sheared sedimentary rock and igneous rock, Unit 4: Miocene to Pliocene mudstone and sandstone, Unit 5: Quaternary Sediments.

Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
Day 10	– Unit 2 – Unit 3 – Unit 4 (minor)	– Moderately to steeply sloping hill country – Gently sloping farmland – Alluvial Plains	– Standard Tier Track – Existing Farm Track – Existing Road and Road Corridor	– Liquefaction and lateral spread risk for proposed bridge structures – Slope instability along the river valley	– Day 10 follows a river valley before heading across farmland above a moderately sloping coastal cliff. No specific area of the track has been identified as being a significant risk	– A geotechnical site walkover or review of drone imagery should be undertaken to confirm slope stability risk	Low to Moderate
Day 11	– Unit 2 – Unit 3 – Unit 4 – Unit 5	– Gently to moderately sloping hill country – Alluvial Plains	– Standard Tier Track – Existing Farm track – Existing Road and Road Corridor	– Slope instability of track evident by historic slips along the proposed track alignment	– Day 11 traverses moderately steep hill country that has evidence of instability. A section of the track marked Day 11 Key area on Figure 1538-G16 has been identified as an area with potential stability risks and will require further geotechnical assessment	– Geotechnical slope stability assessment and site mapping will be required to determine an appropriate route through the hills that lead to Te Horo Marae	Moderate
Day 12	– Unit 3 – Unit 4 – Unit 5	– Gently sloping hill country – Alluvial Plains	– Existing Road and Road Corridor – Gold, Silver, Bronze and Standard Tier Tracks (Ruatoria Route)	– Instability of the road cutting detailed in the Ruatoria Route Report	– No specific area's along Day 12 trail have been identified as having significant geotechnical risks.	– No specific geotechnical visits or analysis will be required at the design stage	Low
Day 13	– Unit 4 – Unit 5	– Alluvial Plains – Moderately sloping hill country	– Existing Road and Road Corridor	– Liquefaction risk for proposed toilet/hut structures – Slope stability above and below the roadway	– No specific area's along Day 13 trail have been identified as having significant geotechnical risks.	– A site drive through to inspect the slopes above and below the roadway should be undertaken	Low
Day 14	– Unit 4 – Unit 5	– Moderately to steeply sloping hill country – River Valley – Wetland – Back dunes	– Existing Road and Road Corridor – Standard Tier Track – Existing walking tracks	– Slope stability of track whilst traversing moderately steep slopes towards the East Cape Lighthouse	– Day 14 follows a river valley before traversing up moderately steep slopes towards the lighthouse. A section of the track marked Day 14 Key area on Figure 1538-G20 has been identified as an area with potential stability risks and will require further geotechnical assessment	– Geotechnical slope stability assessment and site mapping will be required to determine an appropriate route through the hills towards the lighthouse	Moderate
Day 15	– Unit 3 – Unit 4 – Unit 5	– Back dunes – Beach – Alluvial Plains – Coastal Cliffs	– Existing Road and Road Corridor – Standard Tier Track	– Slope stability and rock fall risk from slopes above the roadway – Coastal erosion of roadway	– No specific area's along Day 15 trail have been identified as having significant geotechnical risks due to the trail typically following the roadway.	– It would be prudent to assess the risk of rockfall from the steep cliff above the roadway and the impact that may have on the trail. – Coastal erosion should be considered along this section of route, however, this will also be	Low to Moderate

[1] Unit 1: Jurassic to Cretaceous Basement Greywacke rock, Unit 2: Cretaceous to Oligocene sandstone/mudstone, Unit 3: East Coast Allochthon sheared sedimentary rock and igneous rock, Unit 4: Miocene to Pliocene mudstone and sandstone, Unit 5: Quaternary Sediments.

Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
						considered by Waka Kotahi	
Day 16	– Unit 3 – Unit 4 – Unit 5	– Dune System – Alluvial Plains – Moderately to steeply sloping hill country – Coastal cliffs	– Existing Road and Road Corridor – Beach – Standard Tier Track – Existing walking track	– Slope stability of proposed track alignment over hill to Hicks Bay	– Day 16 follows the alluvial plains and coastal dunes before traversing over a moderately steep hill to Hicks Bay. A section of the track marked as Day 16 Key area on Figure 1538-G22 has been identified as an area of potential instability requiring further geotechnical assessment	– Geotechnical slope stability assessment and site mapping will be required to determine an appropriate route over the hill to Hicks Bay. – The existing track down to Hicks Bay should be assessed for potential instability	Moderate
Day 17	– Unit 3 – Unit 5	– Dune System – Alluvial Plains – River Valley – Gently to moderately sloping hill country	– Existing Road and Road Corridor – Existing walking track – Bronze Tier Track	– Liquefaction and lateral spread risk for proposed bridge structures	– No area's of significant geotechnical hazards have been identified. – The position of the track in relation to the river should be considered at the design stage	– A geotechnical site walkover or review of drone imagery should be undertaken to confirm slope stability and erosion risk	Low
Day 18	– Unit 4 – Unit 5	– Gently to moderately sloping hill country – River Plains – River Valley	– Existing Road and Road Corridor – Standard Tier Track	– Slope stability of hillside along river valley	– Day 18 typically follows roadways before heading into a river valley. A section of the track marked Day 18 Key area on Figure 1538-G24 has been identified as an area of potential instability requiring further geotechnical assessment	– Geotechnical slope stability assessment and site mapping will be required to determine an appropriate route into the river valley	Low to Moderate
Day 19	– Unit 1 – Unit 2 – Unit 5	– Beach – Dune System – Gently sloping hill country	– Beach – Existing Road and Road Corridor –	– Liquefaction and lateral spread risk for any structures – Coastal erosion of Pacific Coast Highway	– No area's of significant geotechnical hazards have been identified.	– No specific geotechnical visits or analysis will be required at the design stage	Low
Day 20	– Unit 1 – Unit 5	– Flat farmland – Beach/Coastal flats – Gently sloping hill country	– Existing Road and Road Corridor – Existing walking tracks – Standard Tier Track	– Slope stability of proposed track alignment under the Pacific Coast Highway. – Coastal erosion of proposed track alignment under Pacific Coast Highway – Liquefaction and lateral spread risk for any structures	– Day 20 is relatively flat with some moderately steep pinch points along the proposed track underneath Pacific Coast Highway. A section of the track marked a Day 20 Key area on Figure 1538-G26 has been identified as an area of potential instability requiring further geotechnical assessment.	– Geotechnical slope stability assessment and potentially a coastal erosion assessment will be required for a section of the trail alignment underneath Pacific Coast Highway. – Coastal and geotechnical assessment of erosion rate at the coastal headland at the start of Day 20 will be required	Low to Moderate

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Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
						pending confirmed track alignment.	
Day 21	– Unit 1 – Unit 5	– Gently to moderately sloping coastal hills – Beach	– Existing Road and Road Corridor – Standard Tier Track – Beach – Existing Footpath	– Slope stability of proposed track alignment under the Pacific Coast Highway. – Coastal erosion of proposed track alignment under Pacific Coast Highway	– Day 21 is relatively flat with some moderately sloping coastal hills. A section of the track marked as Day 21 Key area on Figure 1538-G27, has been identified as an area of potential instability requiring further geotechnical assessment.	– Geotechnical slope stability assessment and potentially a coastal erosion assessment will be required for a section of the trail alignment underneath Pacific Coast Highway.	Low to Moderate
Day 22	– Unit 1 – Unit 5	– Coastal Flats – Dune System	– Existing Footpath – Existing Road and Road Corridor – Standard Tier Track	– Coastal erosion where the road is near the ocean – Liquefaction and lateral spread risk for any structures	– This section of the track is relatively flat and is located on competent rock that has typically low erosion rates. No areas of significant geotechnical hazards have been identified.	– Geotechnical site visits will likely not be required unless the track alignment changes.	Low
Day 23	– Unit 1 – Unit 5	– Moderately to steeply sloping hill country – River Plains – Beach	– Proposed Taxi Service	– Due to steep slopes, large river crossings and narrow roads this section of the track is proposed to use a taxi/shuttle service	– N/A	– If the taxi/shuttle system is to be removed and a route is to be cut along the hillslope, geotechnical investigation and mapping will be required	Low – if implementing the taxi/shuttle service High – if a track is proposed to be cut along the hill slope
Day 24	– Unit 1 – Unit 5	– Moderately to steeply sloping hill country – River Plains – Beach	– Proposed Taxi Service	– Due to steep slopes and narrow roads this section of the track is proposed to use a taxi/shuttle service	– N/A	– If the taxi/shuttle system is to be removed and a route is to be cut along the hillslope, geotechnical investigation and mapping will be required	Low – if implementing the taxi/shuttle service High – if a track is proposed to be cut along the hill slope
Day 25	– Unit 1 – Unit 5	– Beach – River Plains – Gently to moderately sloping hill country	– Beach – Existing Road and Road Corridor	– Coastal erosion of dunes/beach – Slope stability along road corridor	– No area's of significant geotechnical hazards have been identified	– Geotechnical site visit/walkover to inspect the slope stability of the slopes above the roads. Safety of roads and maintenance should be covered by Waka Kotahi	Low
Day 26	– Unit 5	– Dune Systems – Beach – River Plains	– Existing Motu Trails – Existing Road and Road Corridor	– Coastal erosion of dunes – Liquefaction and lateral spread risk for any structures	– No area's of significant geotechnical hazards have been identified	– No specific geotechnical visits or analysis will be required at the design stage	Low
Hikurangi Loop Track							

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Trail Day	Mapped Geological Unit[1]	Topography of the Track Alignment	Proposed Track Types	Potential Geotechnical Hazards	Key areas of Geotechnical Hazards	Geotechnical Input Required at the Design Stage	Preliminary Risk Rating
Day 1	– Unit 2 – Unit 3 – Unit 5	– River Valley – River Plains	– Standard Tier Track	– Liquefaction and lateral spread risk for any structures	– Day 1 of the Hikurangi Loop is relatively flat and has no areas of significant geotechnical hazards.	– No specific geotechnical visits or analysis will be required at the design stage, however, it would be prudent to visit this section of the track whilst assessing the remainder of the loop track	Low
Day 2	– Unit 2 – Unit 5	– Moderately to steeply sloping hill country	– Standard Tier Track	– Slope stability risk of the track along the ridgeline whilst traversing step slopes	– Day 2 traverses steep hillslopes that have evidence of historic slopes failures. The entire section of the track is considered a stability risk and requires further geotechnical assessment.	– Geotechnical slope stability assessment and mapping will be required at the design stage to assess a suitable route through the steep terrain.	Moderate to High
Day 3	– Unit 2	– Moderately to steeply sloping hill country	– Standard Tier Track	– Slope stability risk of the track along the ridgeline whilst traversing step slopes	– Day 3 continues to traverse steep hillslopes towards the summit of Mt Hikurangi. This section of the is typically vegetated and there is less evidence of historic slope instability. Due to the steep terrain the entire section of the track is considered a stability risk and further geotechnical assessment will be required	– Geotechnical slope stability assessment and mapping will be required at the design stage to assess a suitable route through the steep terrain.	Moderate
Day 4	– Unit 2 – Unit 5	– Moderately to steeply sloping hill country – River Valley	– Standard Tier Track	– Slope stability risk along the slopes at the beginning of Day 4 – Liquefaction and lateral spread risk for any structures	– Day 4 traverses down the hillslope and follows a river valley for the remainder of the day. No areas of specific geotechnical hazards have been identified on Day 4.	– No specific geotechnical visits or analysis will be required at the design stage, however, it would be prudent to visit this section of the track whilst assessing the remainder of the loop track	Low
Day 5	– Unit 2 – Unit 3 – Unit 5	– River Valley – River Plains	– Standard Tier – Existing Road and Road Corridor	– No specific hazards have been identified through Day 5	– Day 5 continues along the river valley and alluvial plain to the end of the loop track. No areas of specific geotechnical hazards have been identified on Day 5.	No specific geotechnical visits or analysis will be required at the design stage, however, it would be prudent to visit this section of the track whilst assessing the remainder of the loop track	Low

[1] Unit 1: Jurassic to Cretaceous Basement Greywacke rock, Unit 2: Cretaceous to Oligocene sandstone/mudstone, Unit 3: East Coast Allochthon sheared sedimentary rock and igneous rock, Unit 4: Miocene to Pliocene mudstone and sandstone, Unit 5: Quaternary Sediments.

6. Typical Engineering Solutions for High Risk Areas

6.1 General

Engineering solutions may be required along sections of the track to improve or eliminate slope stability risks. The extent, size and type of engineering solutions will be determined after site specific investigation and analysis. Due to the costly nature of designing and constructing engineered solutions, and an appreciation for the overall size of project, it is the aim of the project manager (CPS) and Initia to avoid significant engineered solutions where possible. Detailed geological mapping and track location refinement at the detailed design stage will aim to inform the design process and minimise the reliance on engineering structures/solutions.

If required, below are examples of engineering solutions that could be implemented throughout the track.

6.1.1 Retaining Walls

Retaining walls could be implemented to mitigate stability risks along the proposed track alignment. Walls can be used to support cut faces along steep slopes and can be installed as in ground walls to improve the down slope stability. Typical retaining walls that could be implemented are timber pole walls, geogrid reinforced walls and gravity stone walls. If walls are required for a section of the track, geotechnical investigation and analysis will be required. The retaining walls will be optimised at the specific design stage to utilise local materials where possible, and with the aim that they can be constructed by local contractors without requiring specialist equipment.

6.1.2 Soil Nail and Mesh

Soil nails and a combination of high tensile steel mesh with erosion matting can be installed locally on portions of oversteepend slopes to protect from this risk local slumping. This solution can be placed above portions of the track to mitigate overslip risks and below the track to mitigate underslip risks. The method will require geotechnical investigation and analysis. Specialist contractors will be required to undertake the work and thus costs are typically high.

6.1.3 Earthworks

Earthworks can be utilised to improve the stability of moderately sloping ground by battering or regrading the slope to more optimal slope angles. Drainage can also be implemented such as subsoil drains and horizontal drains which can aid in decreasing saturation of soils and lower pore water pressures from slope. It is unlikely that significant earthworks will be desired by the client as the project will aim to cause minimal disruption of the natural landscape.

7. Preliminary Pavement Design and Foundation Advice

7.1 General

Preliminary advice on pavement and foundation design for each track tier is provided below. Site specific testing and advice will be required at the design stage of the project.

7.2 Raised Boardwalk Tier

This track will be a raised timber boardwalk supported on short timber poles embedded approx. 300 mm – 500 mm (below any topsoil). Scala Penetrometer testing will be required to assess embedment depth of the poles. All foundations should be extended below any topsoil, organics or soft material which may be present with the depth range of the pole foundations.

Specific design may be required for structures that are elevated more than 1 m above ground level. Slope stability in addition to the potential consequential effects of the liquefaction (loss of bearing or lateral spread) would need to be considered.

7.3 Boardwalk Tier

The boardwalk tier track can be constructed at grade following stripping and removal of topsoil and any soft organics from the surface. If the subgrade is found to be wet and soft at the surface during construction, it would be prudent to complete a small undercut and lay a 100 mm layer of aggregate to mitigate potential settlements of the wooden boardwalk. As the track will be constructed at grade, it will be important to ensure drainage is considered to avoid erosion and softening of the subgrade.

Subgrade CBRs will be assessed at the design stage based on geotechnical testing and the corresponding ground conditions.

7.4 Gravel Tier Track

As with the boardwalk track, a gravel track will require the removal of all topsoil and soft organics at the surface and placement of 100 mm of aggregate. The aggregate should be compacted with a small compactor to lock/bind the aggregate together. Compaction testing of the aggregate will not be required, however, it is recommended that the track is inspected by the civil engineer to ensure that the track surface is graded sufficiently, and surface water runoff is collected and diverted to avoid erosion of the surface.

Subgrade CBRs will be assessed at the design stage based on geotechnical testing and the corresponding ground conditions.

7.5 Standard Tier Track

The Standard Tier Track will not require any engineering input for design. It is recommended that cuts into slopes are avoided where possible. If cuts are required, a geotechnical engineer should inspect the cut and assess if any retaining may be required.

8. Further Work

8.1 General

Throughout the detailed design and construction of the trail, geotechnical input will be required at different stages to investigate, analyse, and provide construction monitoring services. Presented below are preliminary requirements for the design and construction stage of the project. We understand that the track would be constructed in stages, and the overall Te Ara Tipuna trail will not be completed for many years.

8.2 Design Stage

8.2.1 Track Site Mapping and Alignment Advice

At the design stage it is critical that sections of the trail with potential geotechnical hazards are inspected, and geological mapping is undertaken to refine the track alignment. It is expected that any of the sections of track that are located on moderately to steeply sloping ground will need to be inspected to assess the stability risk of the proposed track. It would be prudent for aerial imagery and topographical survey of the track to be undertaken using a drone which will benefit geological mapping of the alignments.

At the design stage, Initia will assess what areas of the track will need site visits, and if any investigation or further design will be required.

8.2.2 Track Structures Considerations

Track structures that require Resource and Building Consents will require geotechnical investigation, analysis and a separate report to support the consenting processes and requirements. Shelters and huts along the trail will likely require basic geotechnical investigations such as hand auger and Scala Penetrometer testing. Bridges will require more significant geotechnical testing comprising machine borehole and cone penetration tests which will be required to assess the ground conditions for pile foundations and to assess liquefaction and lateral spread risks.

Initia will assess the geotechnical requirement for each structure on a case by case basis and provide advice on how to proceed at the appropriate time.

8.2.3 Slope Stability Assessment and Investigation

It is the aim of Initia to minimise the need for significant geotechnical investigation and design solutions by avoiding areas with high stability risks, however, in sections of the track, an engineered solution may be required to proceed with the desired track alignment. If an engineered solution is required such as a retaining wall, soil nails/mesh, and/or large scale earthworks, then geotechnical site specific investigations will be required to assess the subsoil conditions, undertake a slope stability assessment and to provide an appropriate design solution. The design of such engineered solutions will be highly dependent on the local ground conditions at each site.

If tracks are to be located above a coastal seacliff and the track is inside an identified coastal hazard zone, a coastal and geotechnical assessment will be required to assess potential erosion rates and stability of the coastal seacliff. Investigation and geological mapping may be required to assess the potential stability and erosion rate of the seacliffs.

8.3 Construction

8.3.1 Trail Construction Considerations

It is essential that at the construction stage of the project that a geotechnical engineer undertake periodic observations and testing to confirm the ground conditions are consistent with the inferred ground conditions based on testing undertaken along the corresponding section of the track.

Preliminary testing and observation guidelines are provided below and are to be confirmed and refined for applicable sections of the track at the design stage:

1. Observations should be made along sloping sections of the track to confirm there is no visible evidence of slope instability.
2. Observations should be made to confirm topsoil has been stripped from the track location. Appraisal of any soft spots should be undertaken after topsoil is removed.
3. Scala Penetrometer testing should be undertaken at 10 m intervals along the proposed Raised Boardwalk Tier Track. Testing should meet the required engineering specification that will be assessed and provided at the design stage.

8.3.2 Track Structures Construction

Geotechnical construction observations will be required for all track structures that required a resource and building consent. Observation requirements will be determined at the design stage and will be dependent on the type of structure.

9. Conclusions

This geotechnical report has been prepared to support the preliminary track alignment and Resource Consent application for the Te Ara Tipuna Trail. The following key conclusions for the Te Ara Tipuna Trail are detailed below:

Conclusions:

1. The track is located in an area of complex geology with typically steep topography throughout the region and thus has many associated geotechnical hazards.
2. This assessment report is based on a desktop study with limited visual observation and accuracy constraints of available aerial imagery. The risk assessment advice provided should be considered preliminary in nature to inform a staged approach to the design, and to estimate the scope of future geotechnical assessments.
3. The main geotechnical hazards for the Te Ara Tipuna Trail is slope instability through moderately to steeply sloping hill country found throughout the region. Liquefaction and lateral risk will need to be considered for structures built on Quaternary sediments.
4. Based on the initial desktop study and site visit, the track is considered to be geotechnically feasible with the correct geotechnical consultation through the design stage.
5. Geotechnical site mapping and assessment with be required throughout the design stage to refine the track alignment and mitigate geotechnical risks.
6. It is not envisaged that significant engineering solutions will be required to create the Te Ara Tipuna Trail.
7. Geotechnical investigation, reporting and analysis will be required for any structure requiring a resource and building consent.

10. Applicability

This report has been prepared for our client, HRM & Associates, with respect to the brief provided to us. The advice and recommendations presented in this report should not be applied to any other project or used in any other context without prior written approval from Initia Limited.

Report prepared by:

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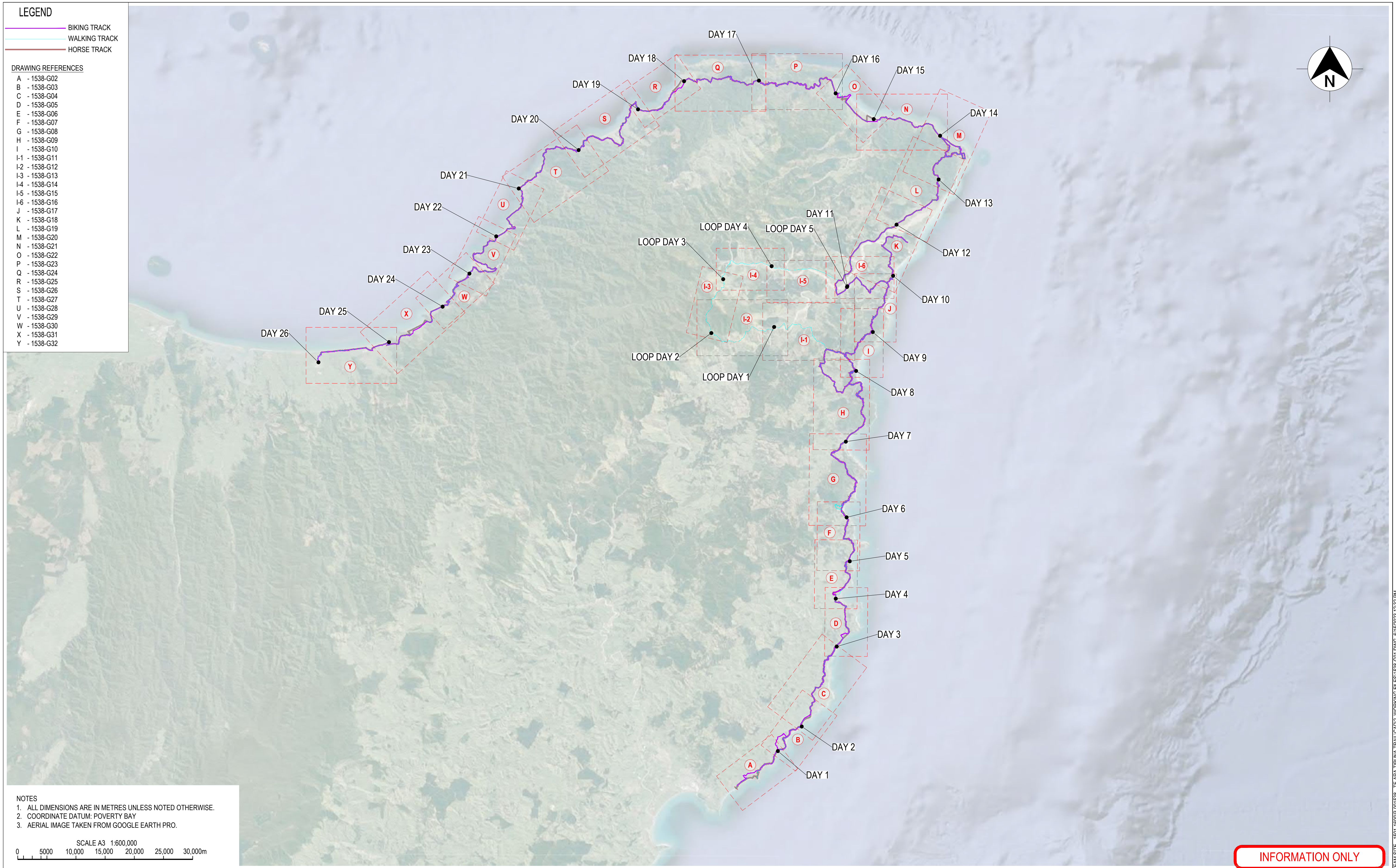
Report reviewed by:

Andy Pomfret
Senior Geotechnical Engineer

Document control record

Report Title	Te Ara Tipuna Trail – Gisborne to Opotiki Geotechnical Assessment Report				
Initia Project Reference	P-001538				
Client	HRM & Associates				
Revision	Date	Revision detail	Author	Reviewer	Approved by
1	16-06-2023	Draft	Q. Sorensen	B. Roy	A. Pomfret
2	23/06/23	Resource Consent	Q. Sorensen	A. Pomfret	A. Pomfret
Current Revision	2				

Appendix A Figures



LEGEND

- BIKING TRACK
- WALKING TRACK
- HORSE TRACK

DRAWING REFERENCES

A - 1538-G02
B - 1538-G03
C - 1538-G04
D - 1538-G05
E - 1538-G06
F - 1538-G07
G - 1538-G08
H - 1538-G09
I - 1538-G10
I-1 - 1538-G11
I-2 - 1538-G12
I-3 - 1538-G13
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S - 1538-G26
T - 1538-G27
U - 1538-G28
V - 1538-G29
W - 1538-G30
X - 1538-G31
Y - 1538-G32

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY
3. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO.

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Rev	Revision Description	Designed	Drawn	Checked
B	REVISED ISSUE (21/06/2023)	QS	GG	QS
A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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HRM & ASSOCIATES

TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
OVERALL PLAN
(SHEET LAYOUT)

Initia Project ref: P001538

Figure Number: 1538-G01

Revision: B

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LEGEND

- BIKING TRACK
- WALKING TRACK
- HORSE TRACK

KEY PLAN
SCALE : NTS

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE AND LIDAR CONTOUR TAKEN FROM LINZ DATA.

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A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 1 PLAN

Initia Project ref: P001538
Figure Number: 1538-G02
Revision: B

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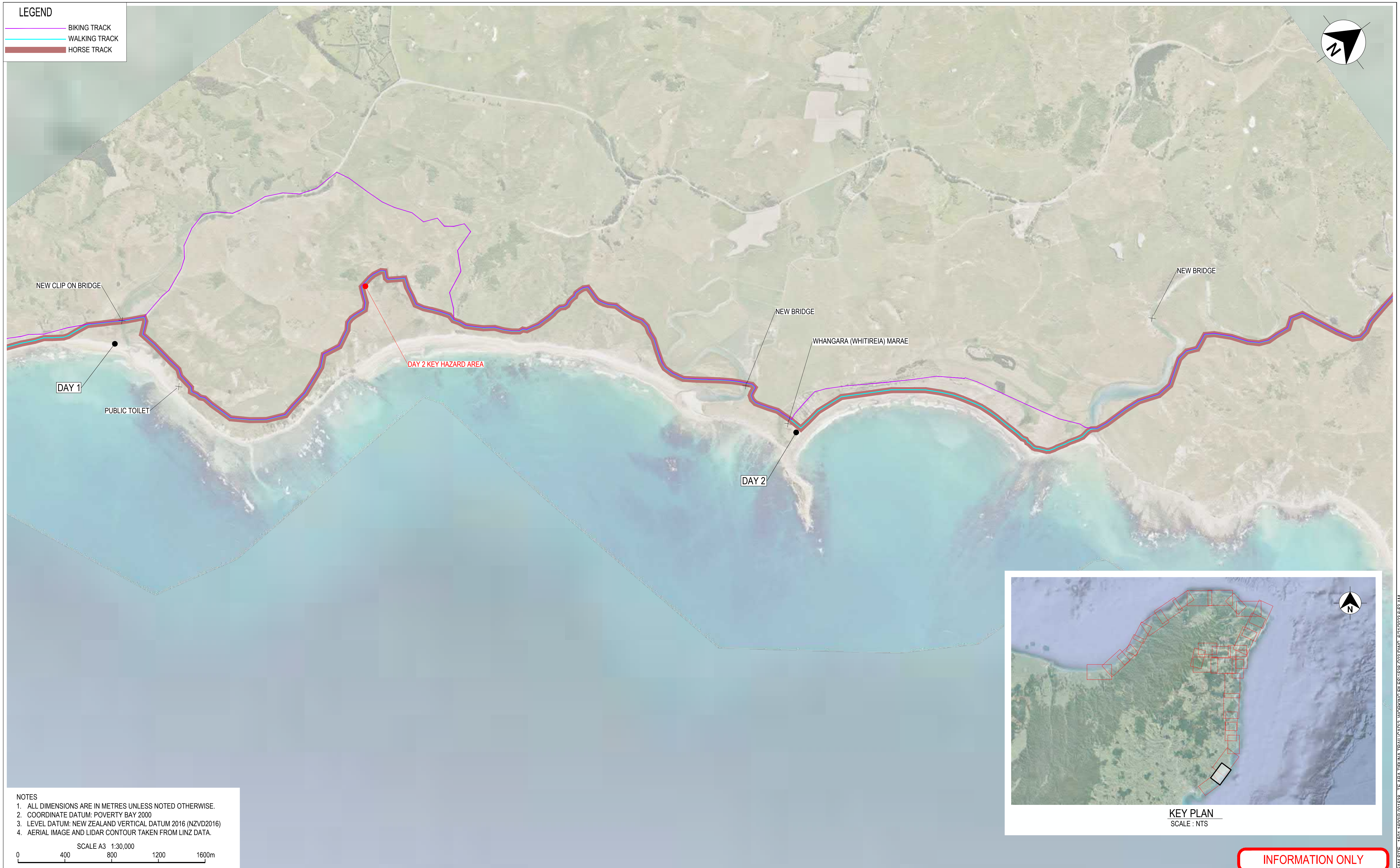

NOTES
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3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE AND LIDAR CONTOUR TAKEN FROM LINZ DATA.

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A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION DAY 2 PLAN

Initia Project ref: P001538
Figure Number: 1538-G03
Revision: B

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KEY PLAN
SCALE : NTS

NOTES
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3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION DAY 3 PLAN

Initia Project ref: P001538
Figure Number: 1538-G04
Revision: B

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KEY PLAN
SCALE : NTS

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE AND LIDAR CONTOUR TAKEN FROM LINZ DATA.

SCALE A3 1:30,000
0 400 800 1200 1600m

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
B	REVISED ISSUE (21/06/2023)	QS	GG	QS
A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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HRM & ASSOCIATES

TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION DAY 4 PLAN

Initia Project ref: P001538
Figure Number: 1538-G05
Revision: B

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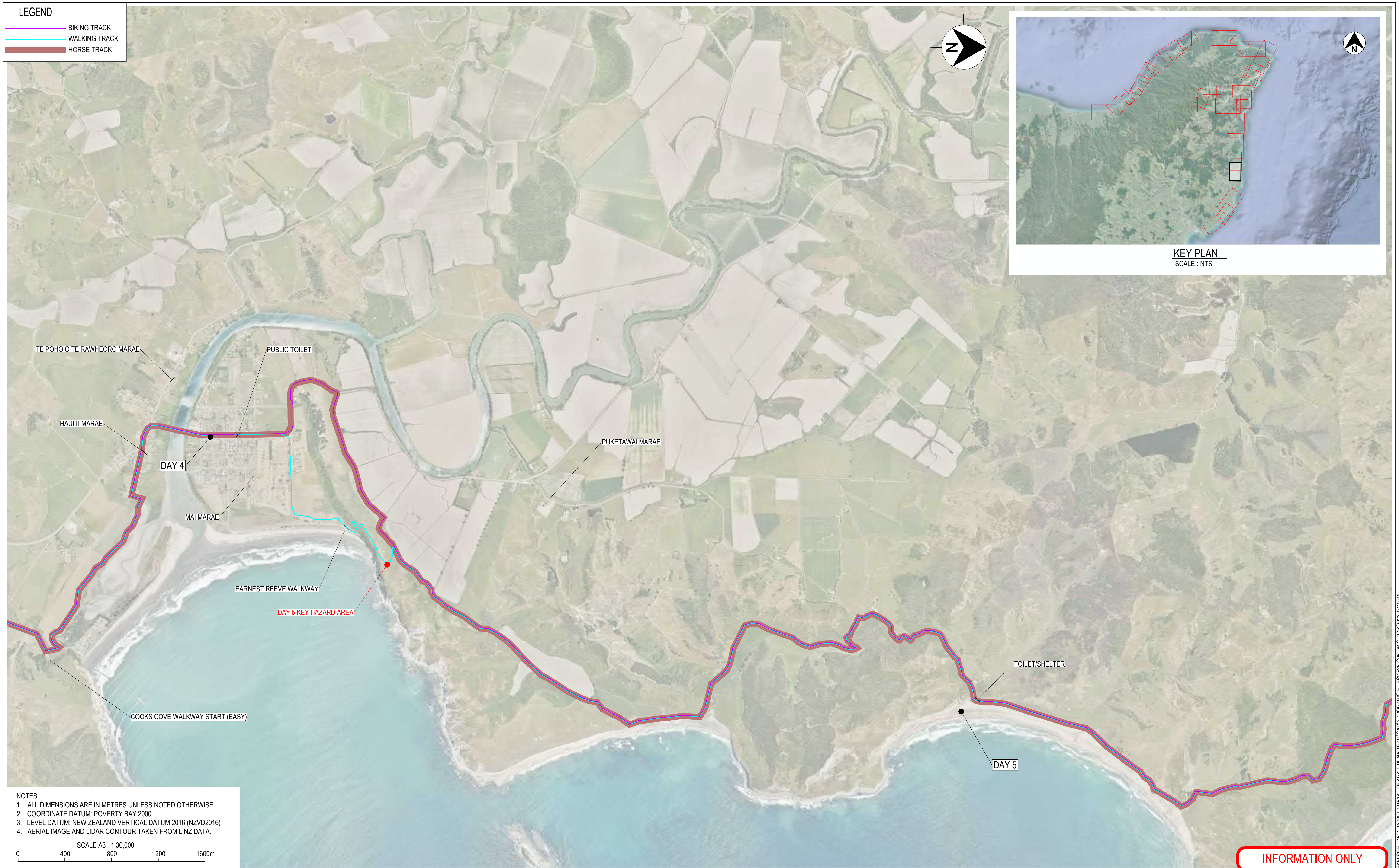
- WALKING TRACK
- HORSE TRACK



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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 5 PLAN

Initia Project ref: P001538

Figure Number: 1538-G06

Revision: B

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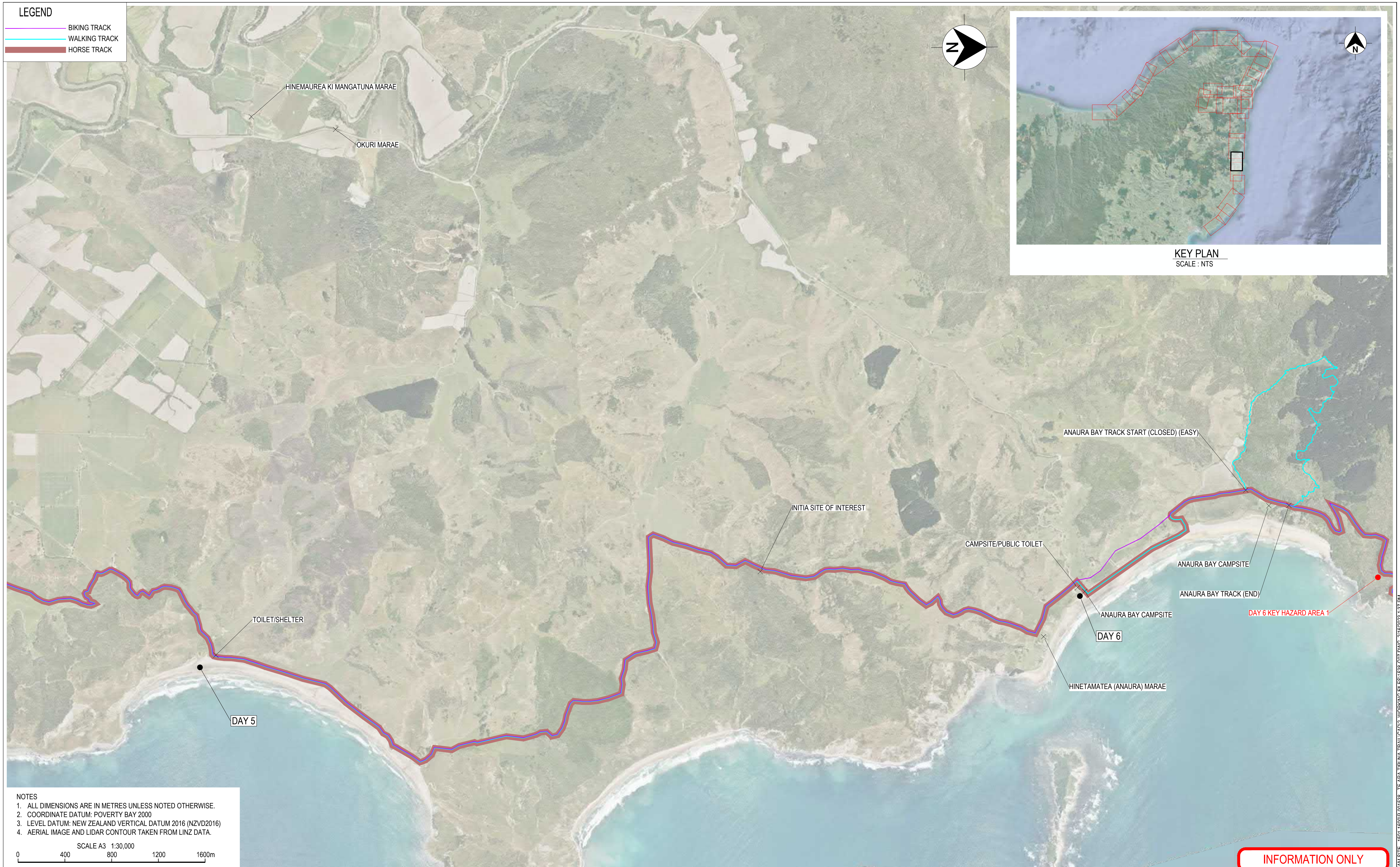

KEY PLAN
SCALE : NTS

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 6 PLAN

Initia Project ref: P001538
Figure Number 1538-G07
Revision B

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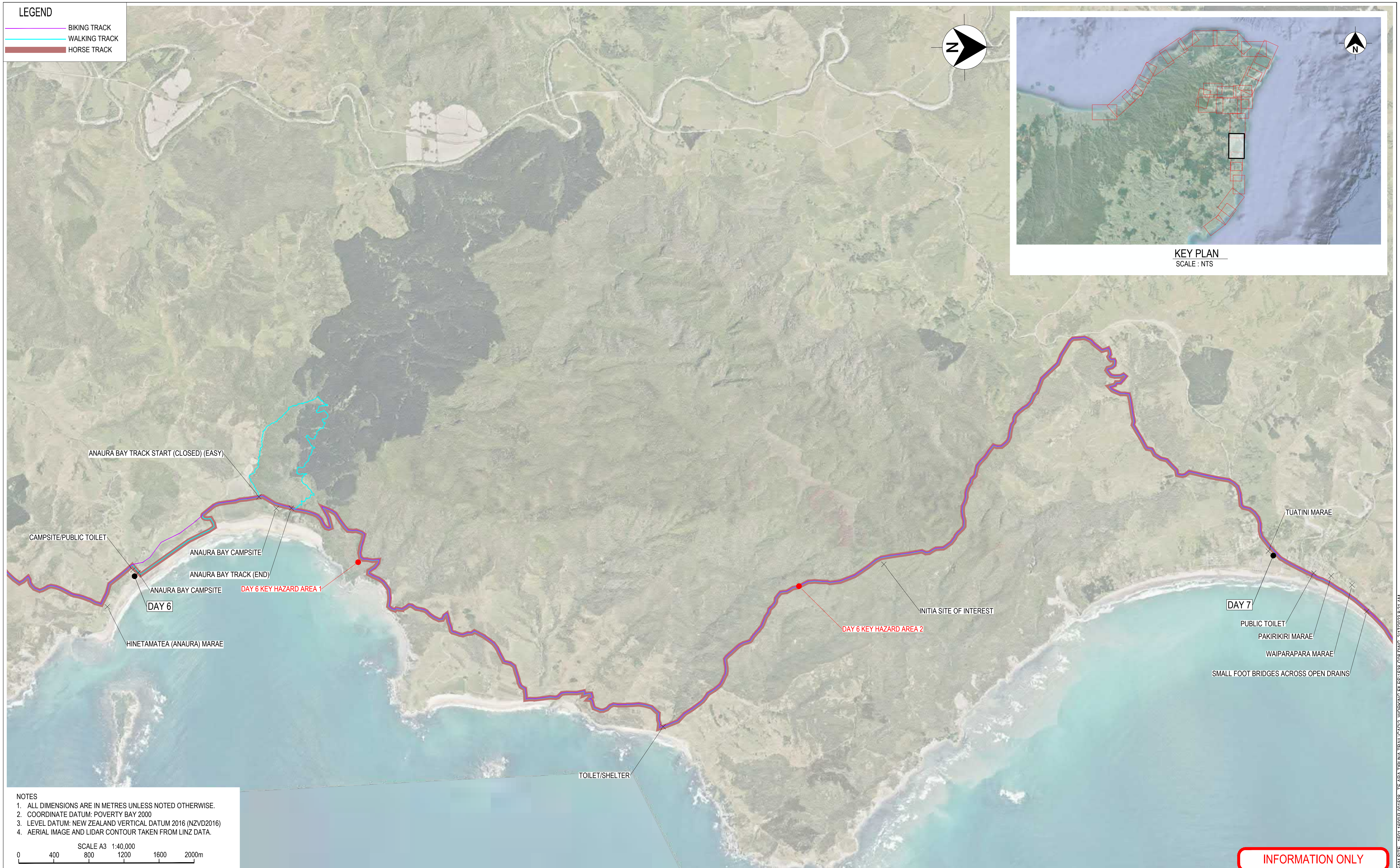
- HORSE TRACK



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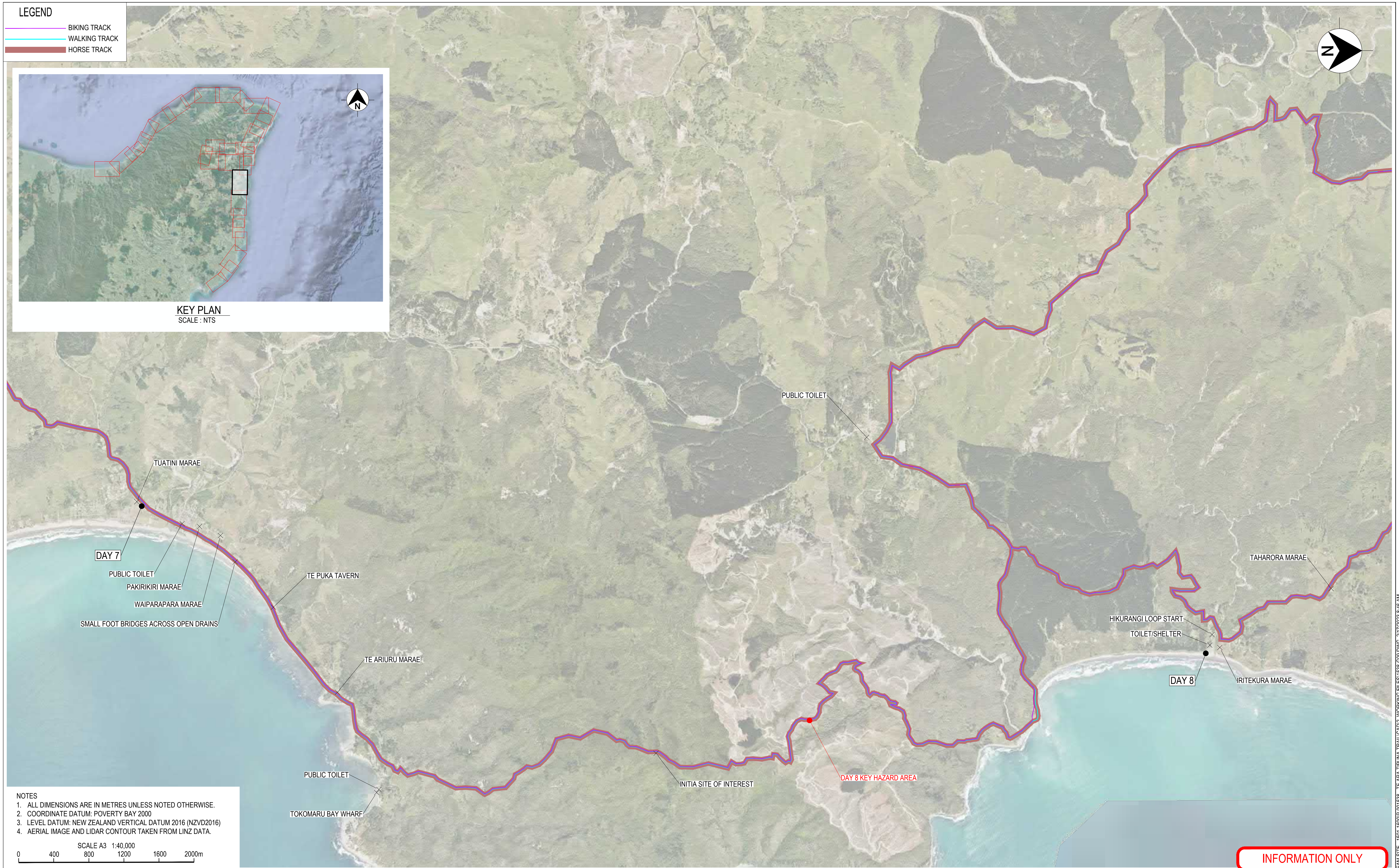
TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 7 PLAN

Initia Project ref: P001538

Figure Number 1538-G08

Revision B



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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 8 PLAN

Initia Project ref: P001538

Figure Number 1538-G09

Revision B

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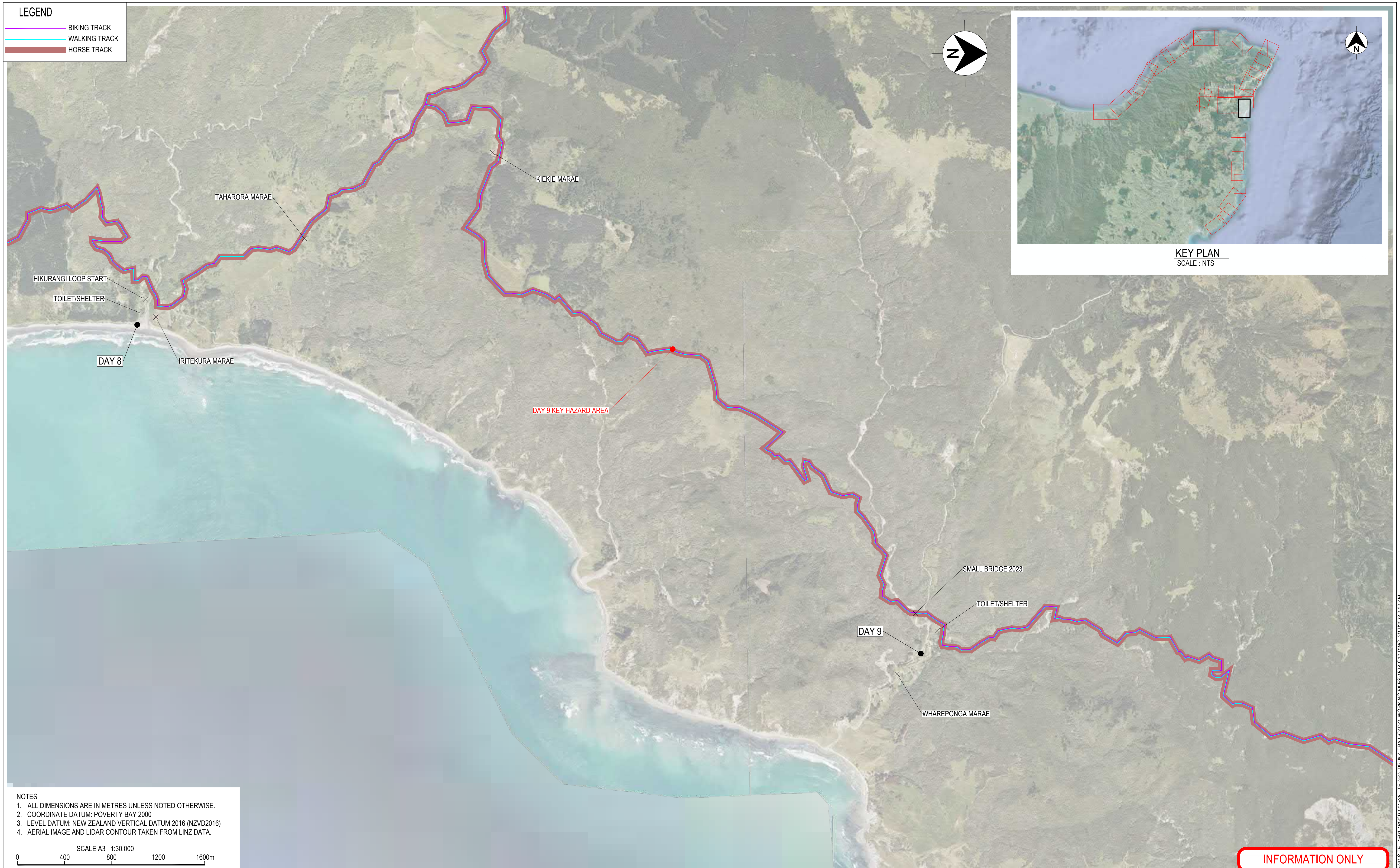

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 9 PLAN

Initia Project ref: P001538

Figure Number 1538-G10

Revision B

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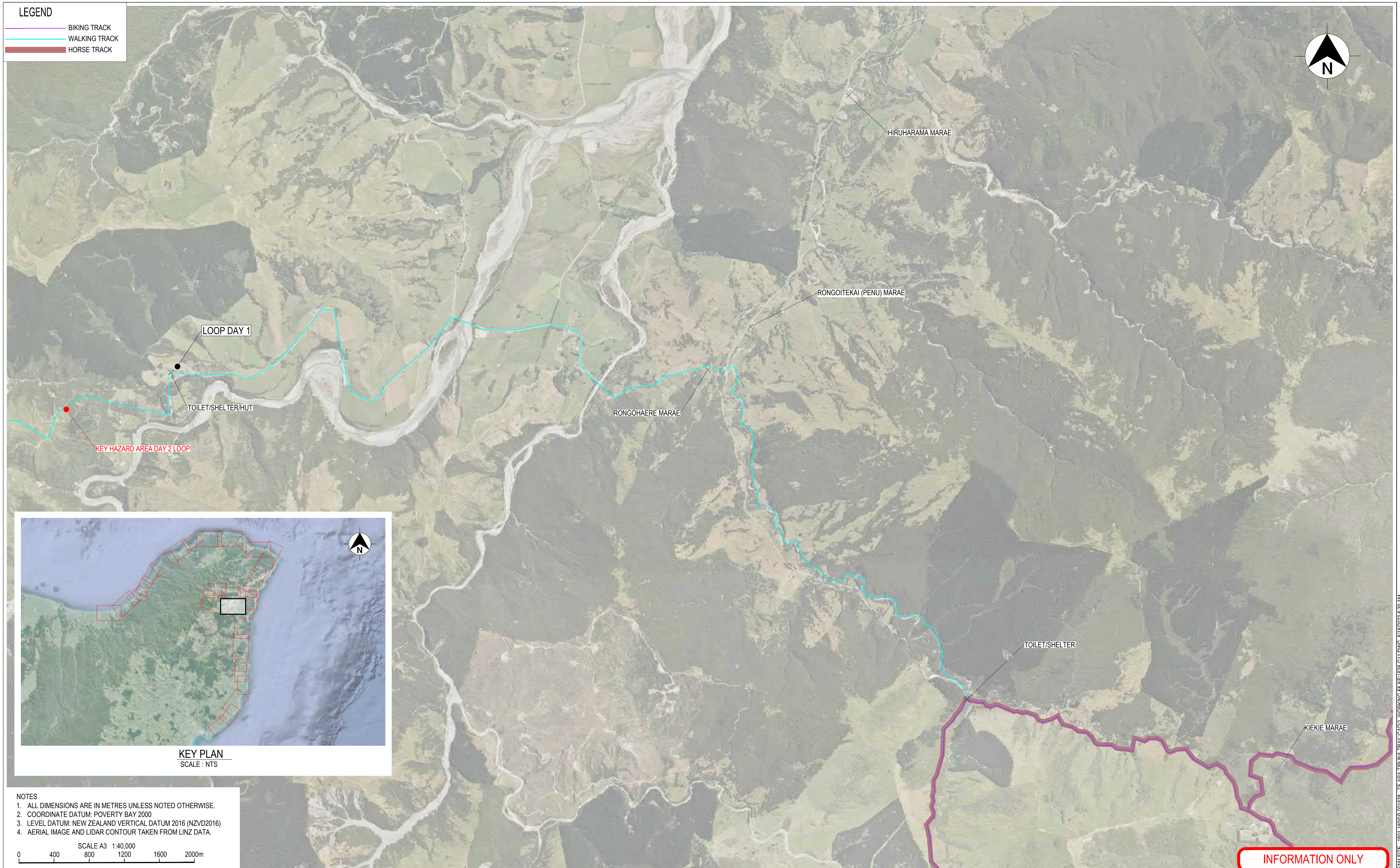

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 1 PLAN

Initia Project ref: P001538
Figure Number: 1538-G11
Revision: B

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 2 PLAN

Initia Project ref: P001538
Figure Number: 1538-G12
Revision: B

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- BIKING TRACK
- WALKING TRACK
- HORSE TRACK

NOTES

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 3 PLAN

Initia Project ref: P001538

Figure Number: 1538-G13

Revision: B

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KEY PLAN
SCALE : NTS

NOTES
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 4 PLAN

Initia Project ref: P001538
Figure Number: 1538-G14
Revision: B

NOTES
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 5 PLAN - SHEET 1

Initia Project ref: P001538
Figure Number: 1538-G15
Revision: B

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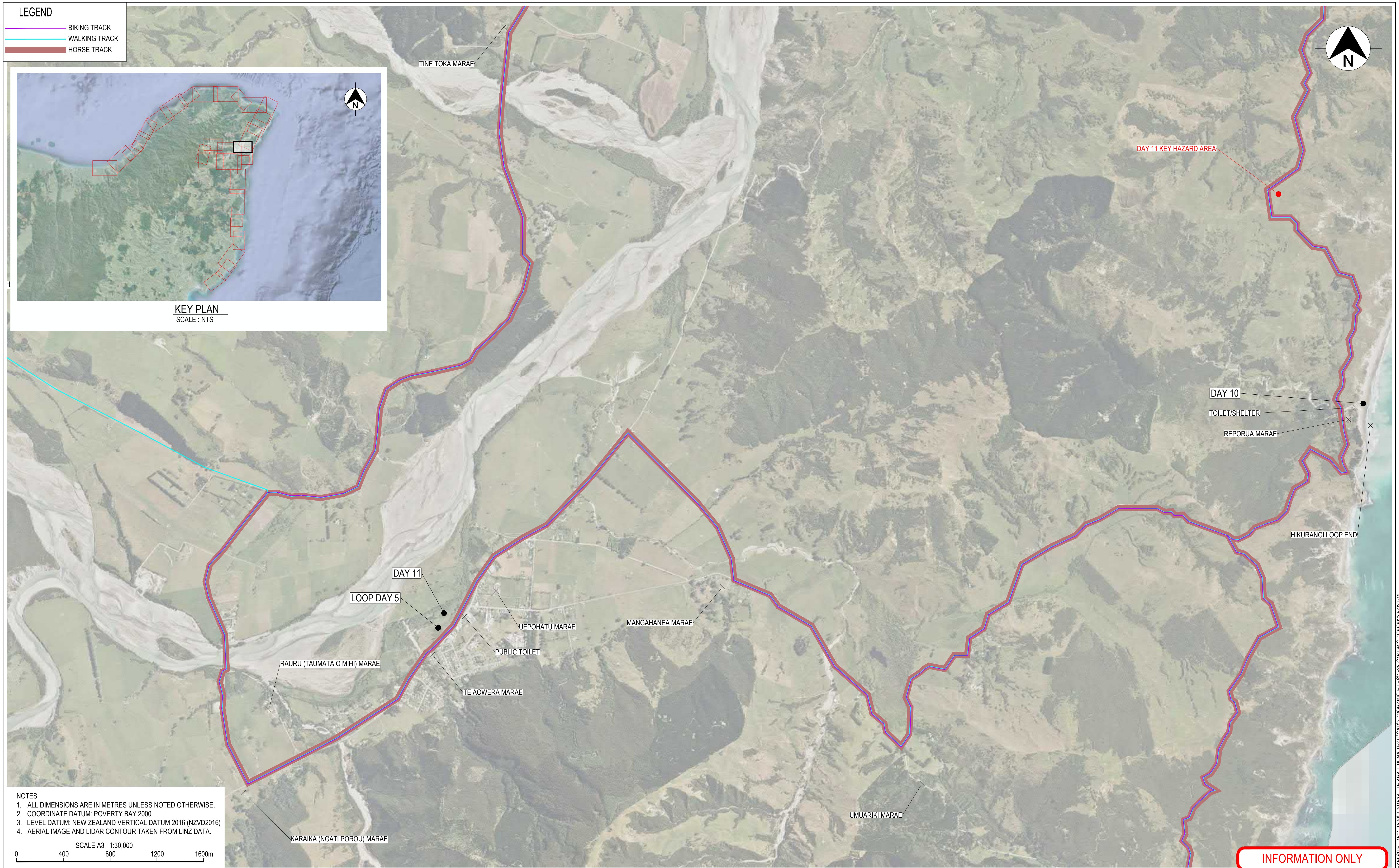

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
LOOP DAY 5 PLAN - SHEET 2
AND DAY 11 PLAN

Initia Project ref: P001538

Figure Number: 1538-G16

Revision: B

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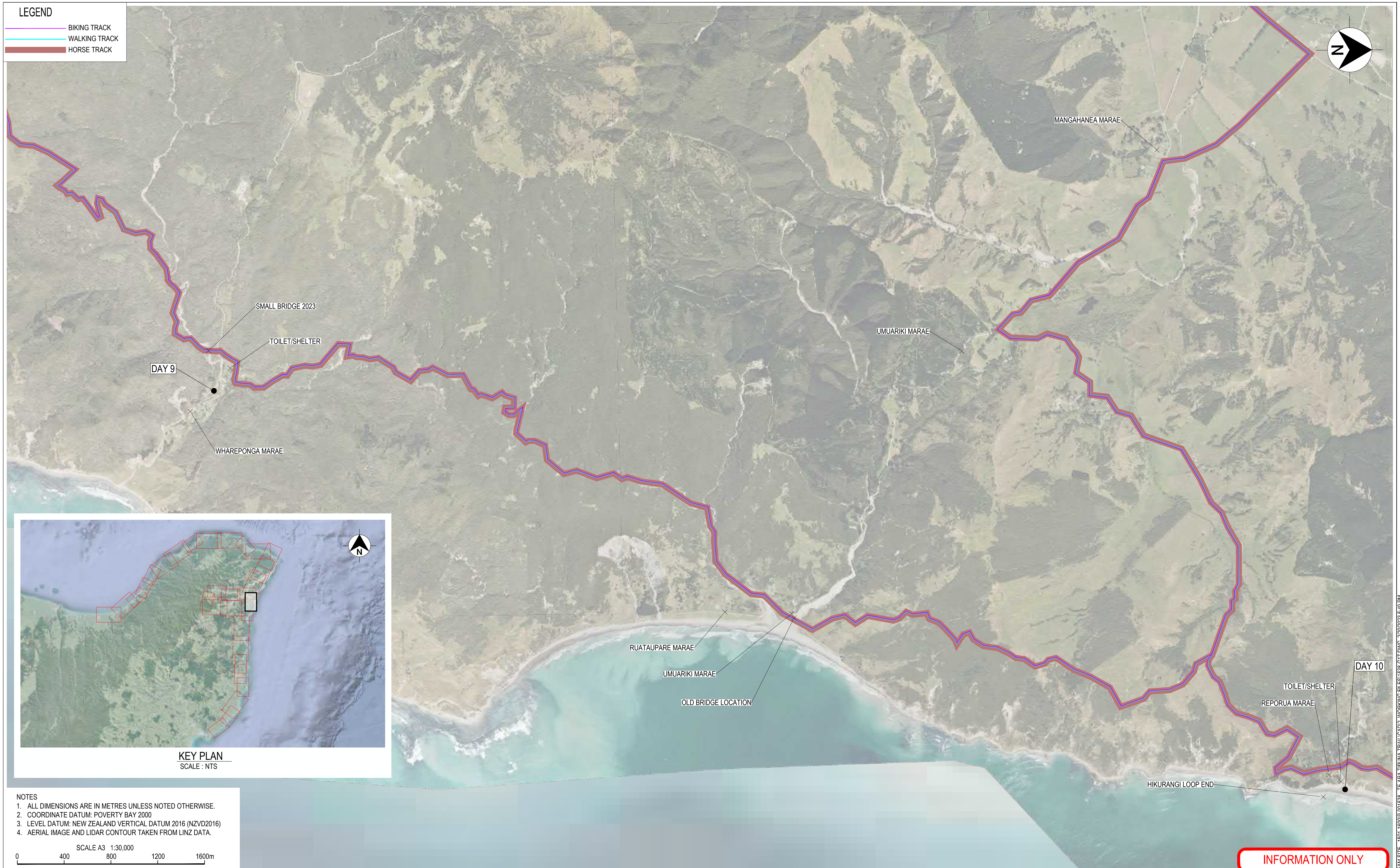

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 10 PLAN

Initia Project ref: P001538
Figure Number 1538-G17
Revision B

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 12 PLAN

Initia Project ref: P001538
Figure Number 1538-G18
Revision B

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LEGEND

- BIKING TRACK
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- HORSE TRACK

KEY PLAN
SCALE : NTS

NOTES
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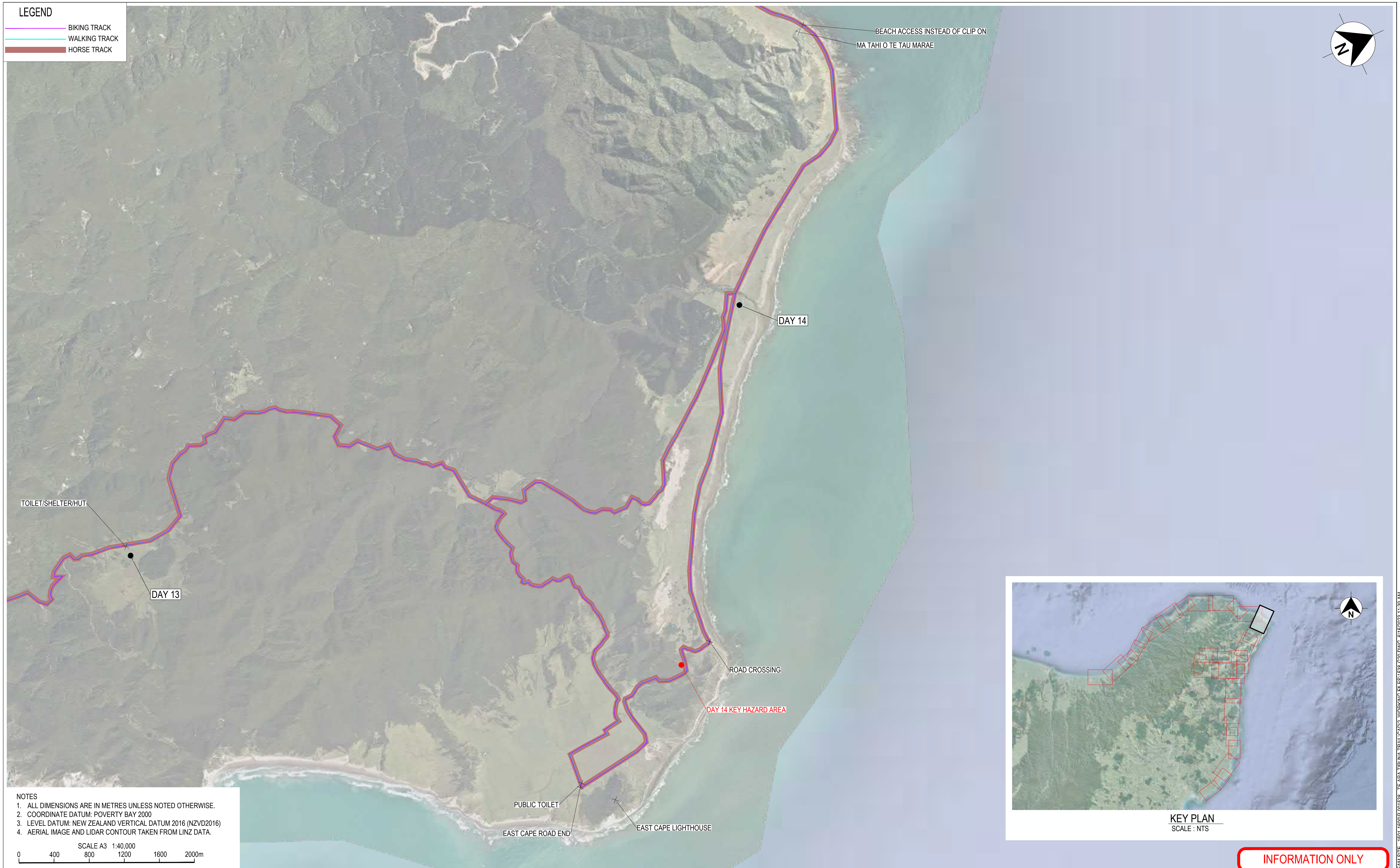
TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION DAY 13 PLAN

Initia Project ref: P001538
Figure Number: 1538-G19
Revision: B



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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 14 PLAN

Initia Project ref: P001538

Figure Number: 1538-G20

Revision: B

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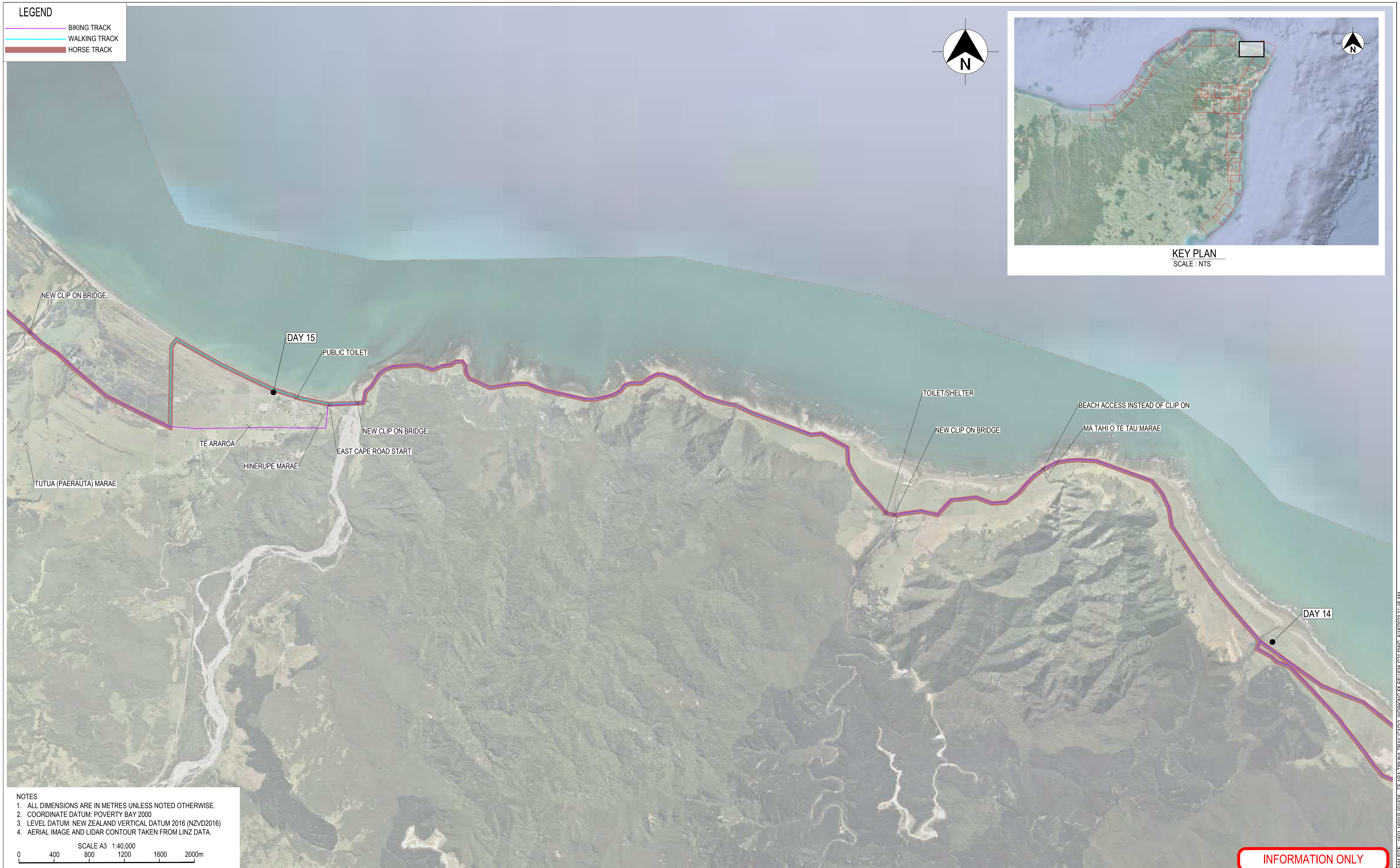

KEY PLAN
SCALE : NTS

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GEOTECHNICAL INVESTIGATION
DAY 15 PLAN

Initia Project ref: P001538
Figure Number: 1538-G21
Revision: B

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4. AERIAL IMAGE AND LIDAR CONTOUR TAKEN FROM LINZ DATA.

SCALE A3 1:30,000
0 400 800 1200 1600m

Rev	Revision Description	Designed	Drawn	Checked
B	REVISEDISSUE (21/06/2023)	QS	GG	QS
A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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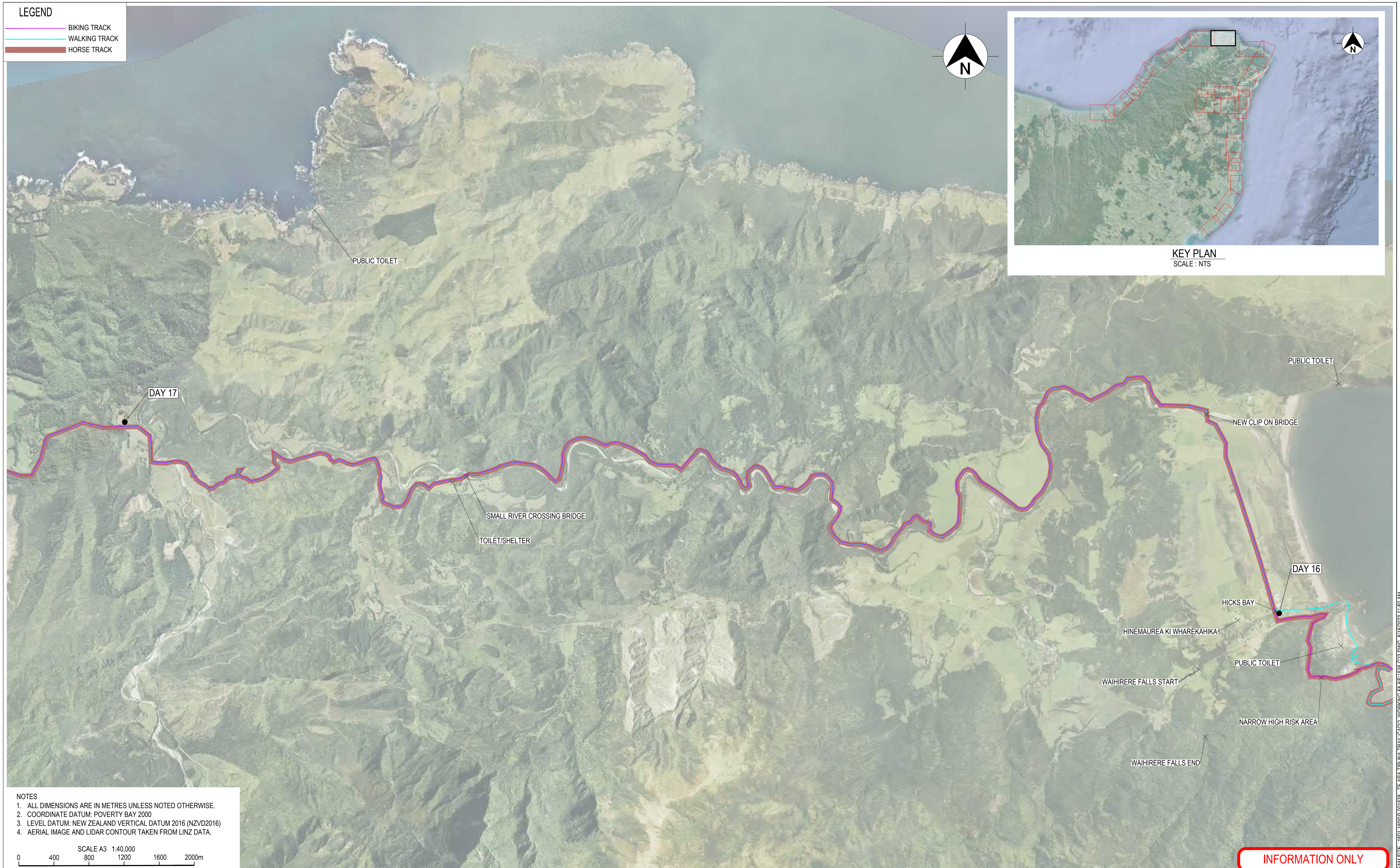
HRM & ASSOCIATES

TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 16 PLAN

Initia Project ref: P001538
Figure Number: 1538-G22
Revision: B



NOTES
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2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
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SCALE A3 1:40,000
0 400 800 1200 1600 2000m

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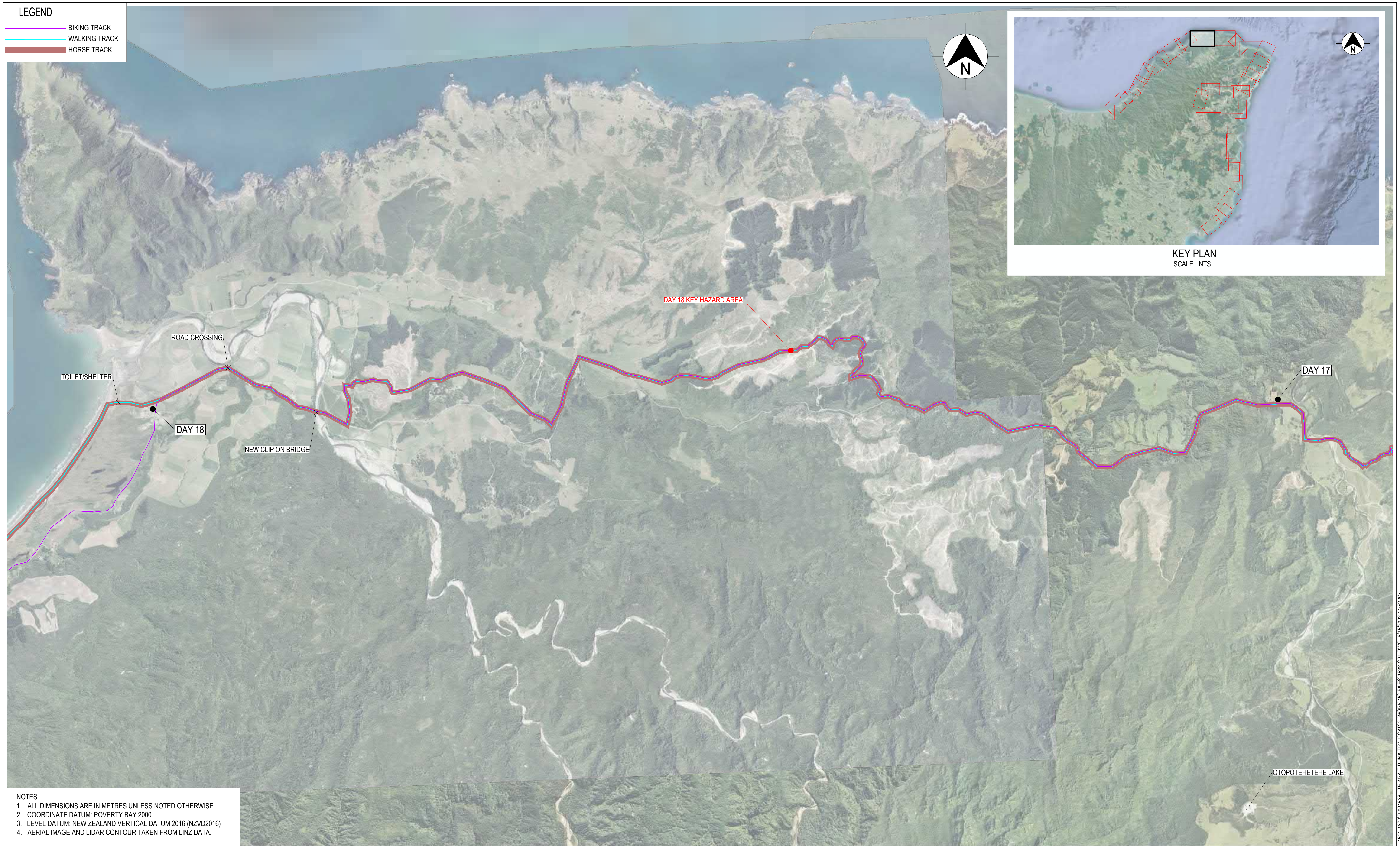
TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 17 PLAN

Initia Project ref: P001538
Figure Number: 1538-G23
Revision: B



NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 18 PLAN

Initia Project ref: P001538
Figure Number 1538-G24
Revision B

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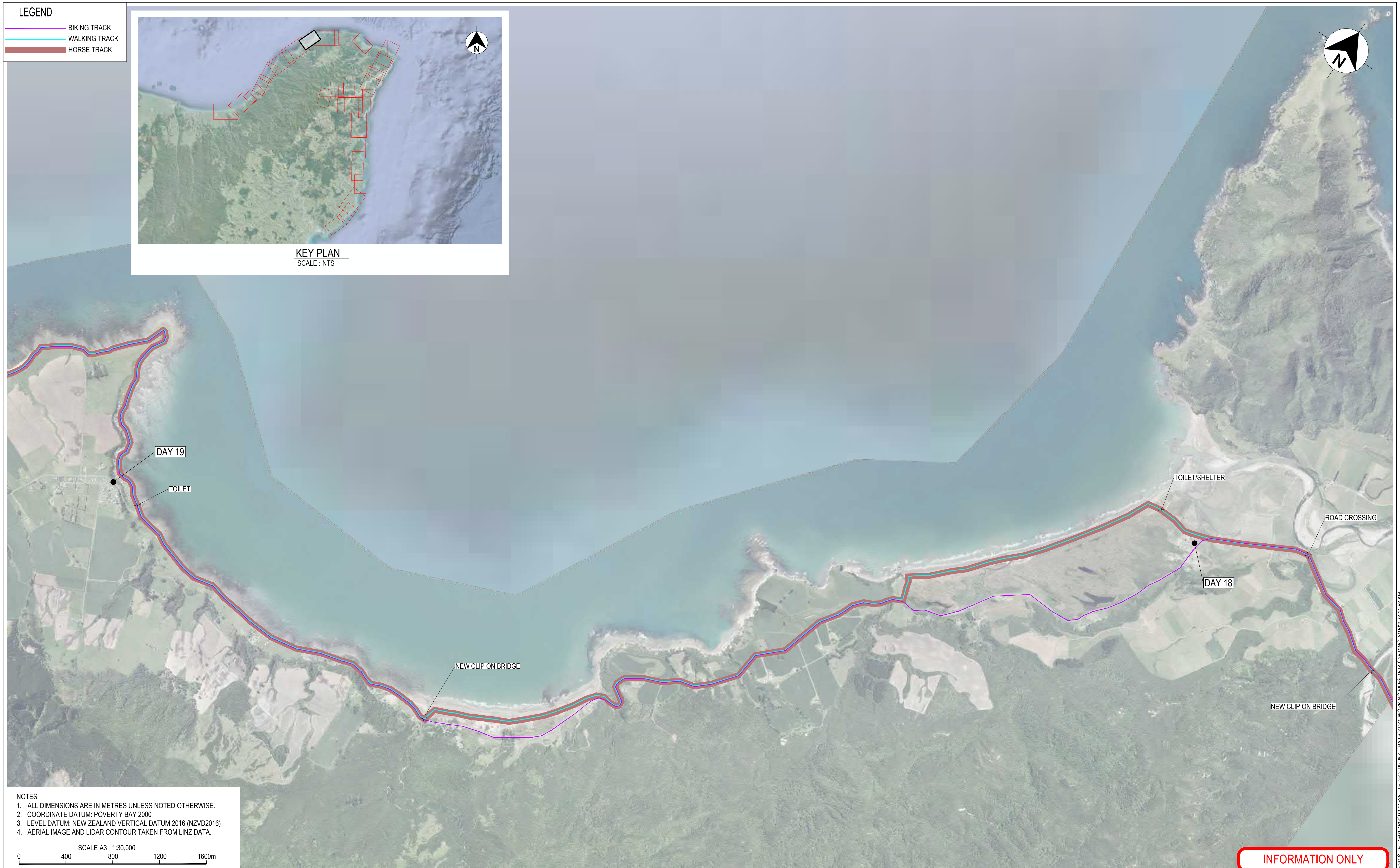

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
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SCALE A3 1:30,000

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A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 19 PLAN

Initia Project ref: P001538
Figure Number: 1538-G25
Revision: B

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LEGEND
- BIKING TRACK
- WALKING TRACK
- HORSE TRACK

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: POVERTY BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
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0 400 800 1200 1600 2000m

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 20 PLAN

Initia Project ref: P001538
Figure Number 1538-G26
Revision B

NOTES
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GEOTECHNICAL INVESTIGATION
DAY 21 PLAN

Initia Project ref: P001538
Figure Number: 1538-G27
Revision: B

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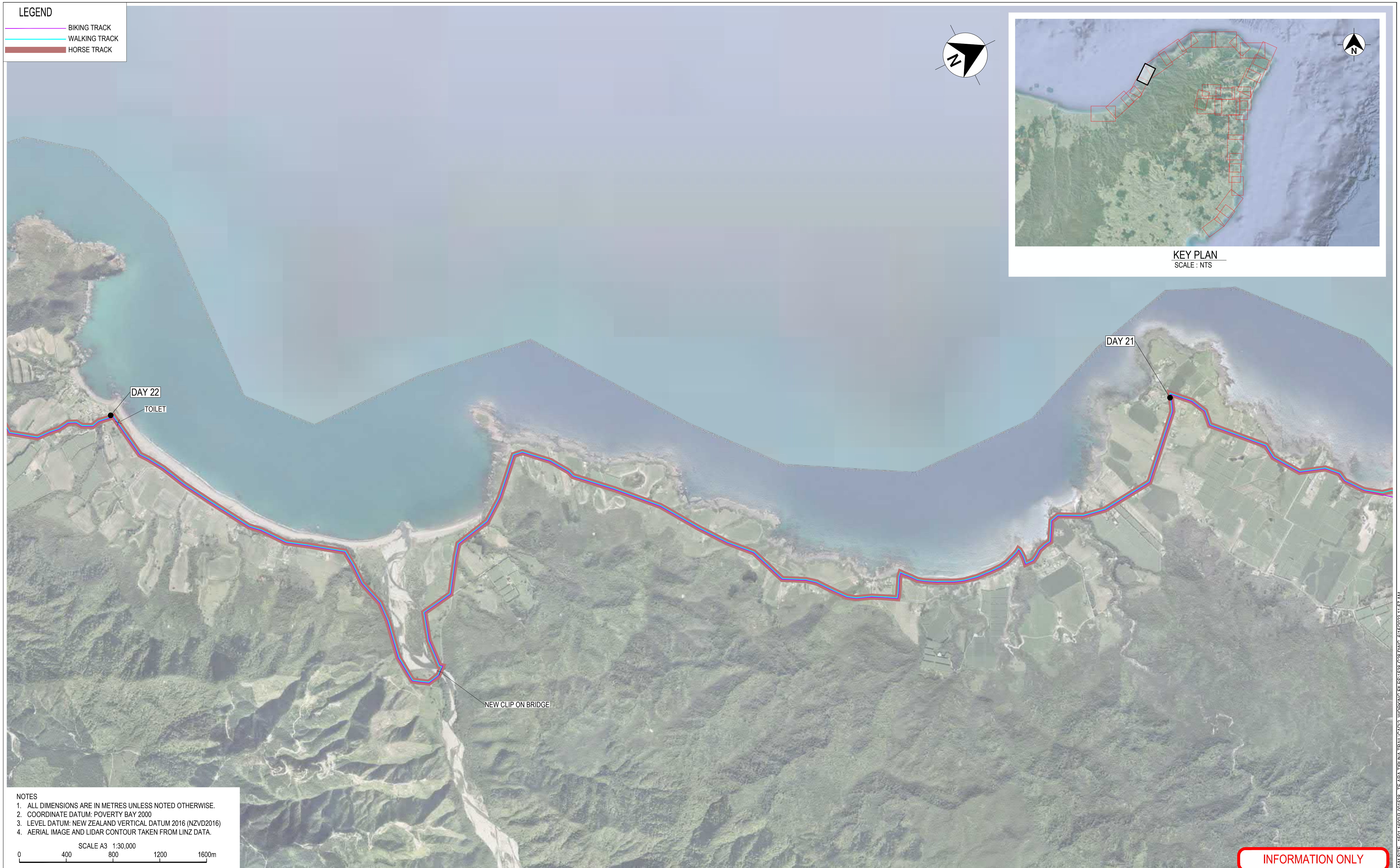
LEGEND

- BIKING TRACK
- WALKING TRACK
- HORSE TRACK



KEY PLAN
SCALE : NTS

NOTES
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2. COORDINATE DATUM: POVERTY BAY 2000
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0 400 800 1200 1600m

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A	FIRST ISSUE (23/02/2023)	QS	GG	QS

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 22 PLAN

Initia Project ref: P001538
Figure Number: 1538-G28
Revision: B

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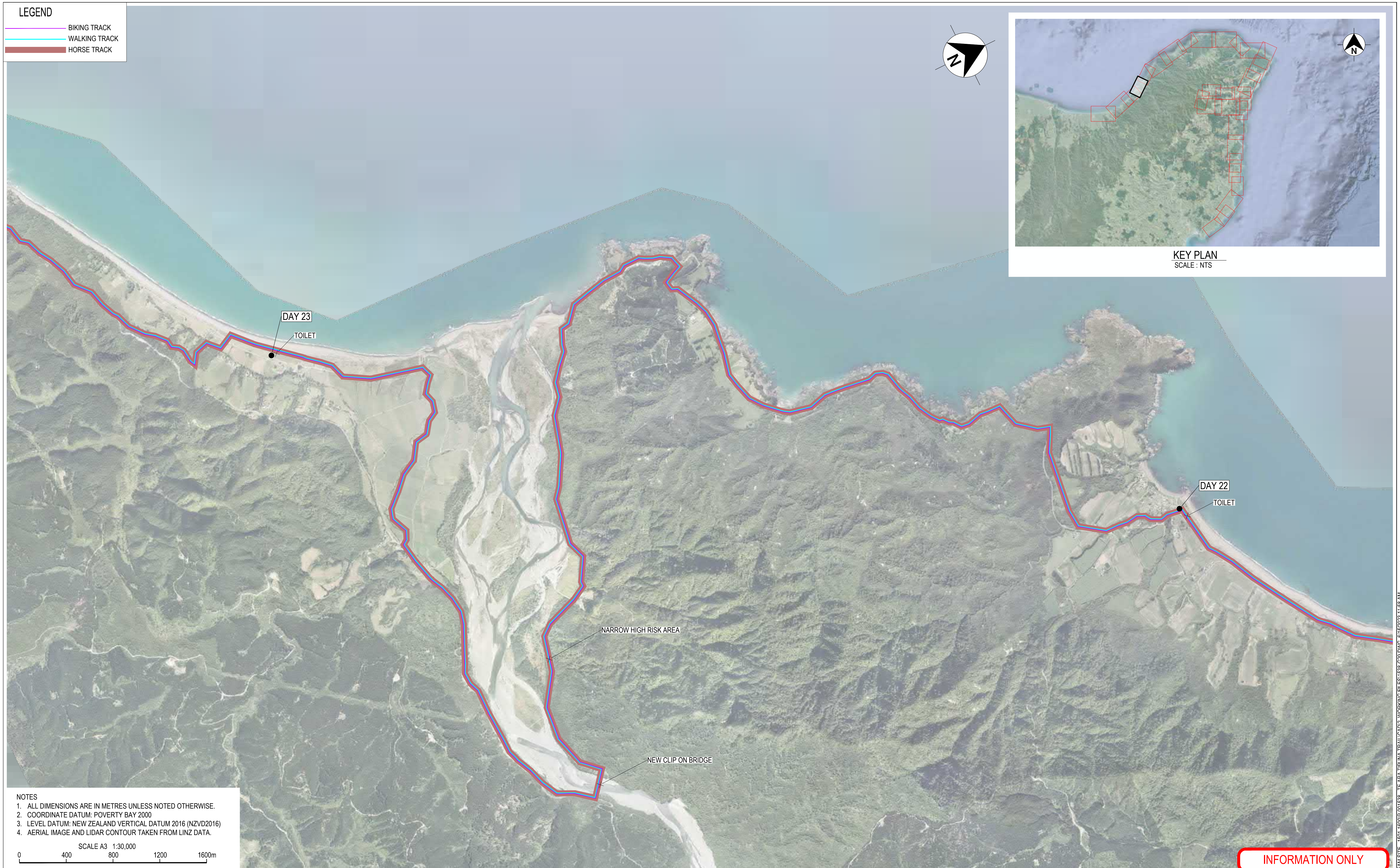

NOTES
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 23 PLAN

Initia Project ref: P001538
Figure Number 1538-G29
Revision B

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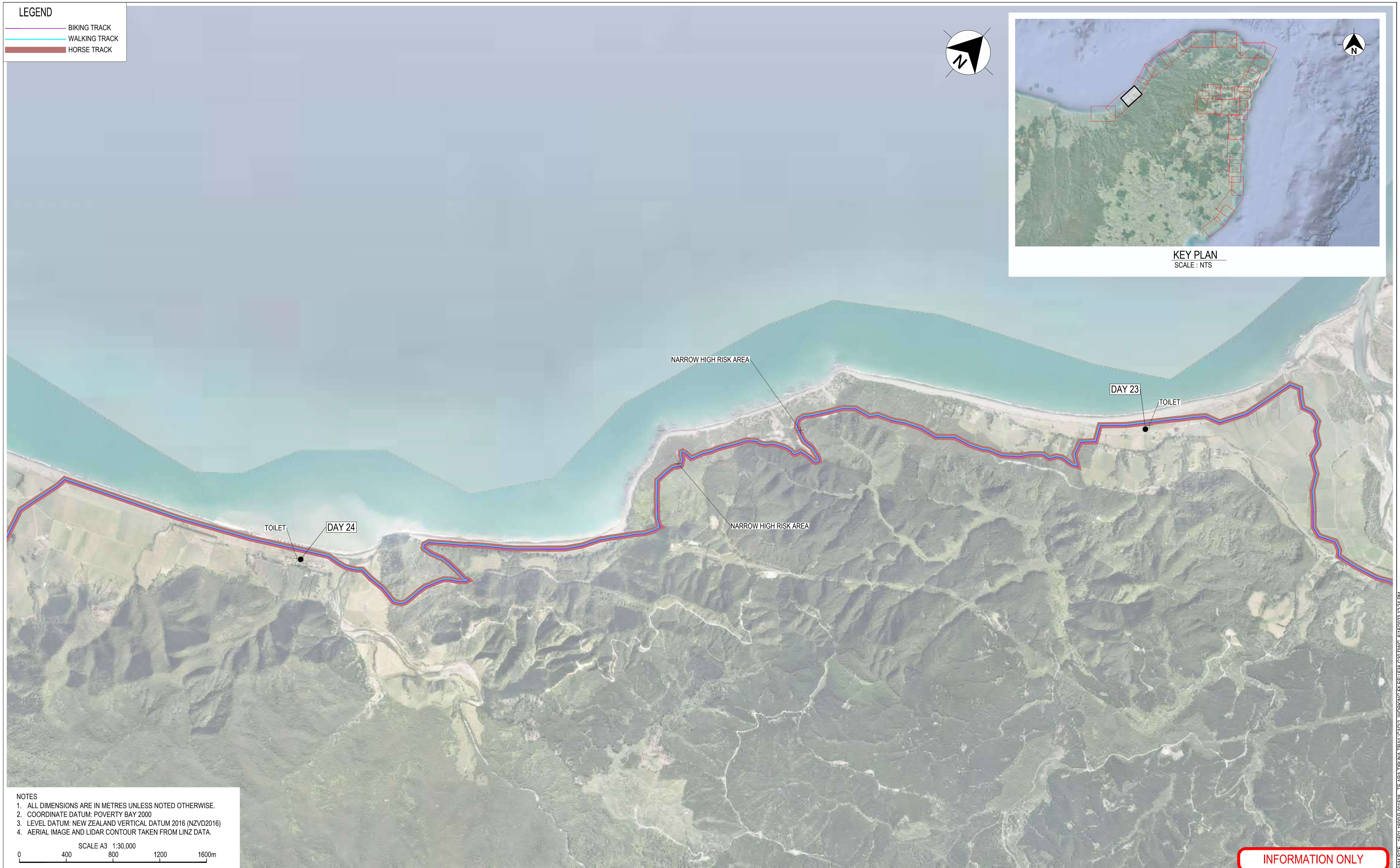

NOTES
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 24 PLAN

Initia Project ref: P001538
Figure Number 1538-G30
Revision B

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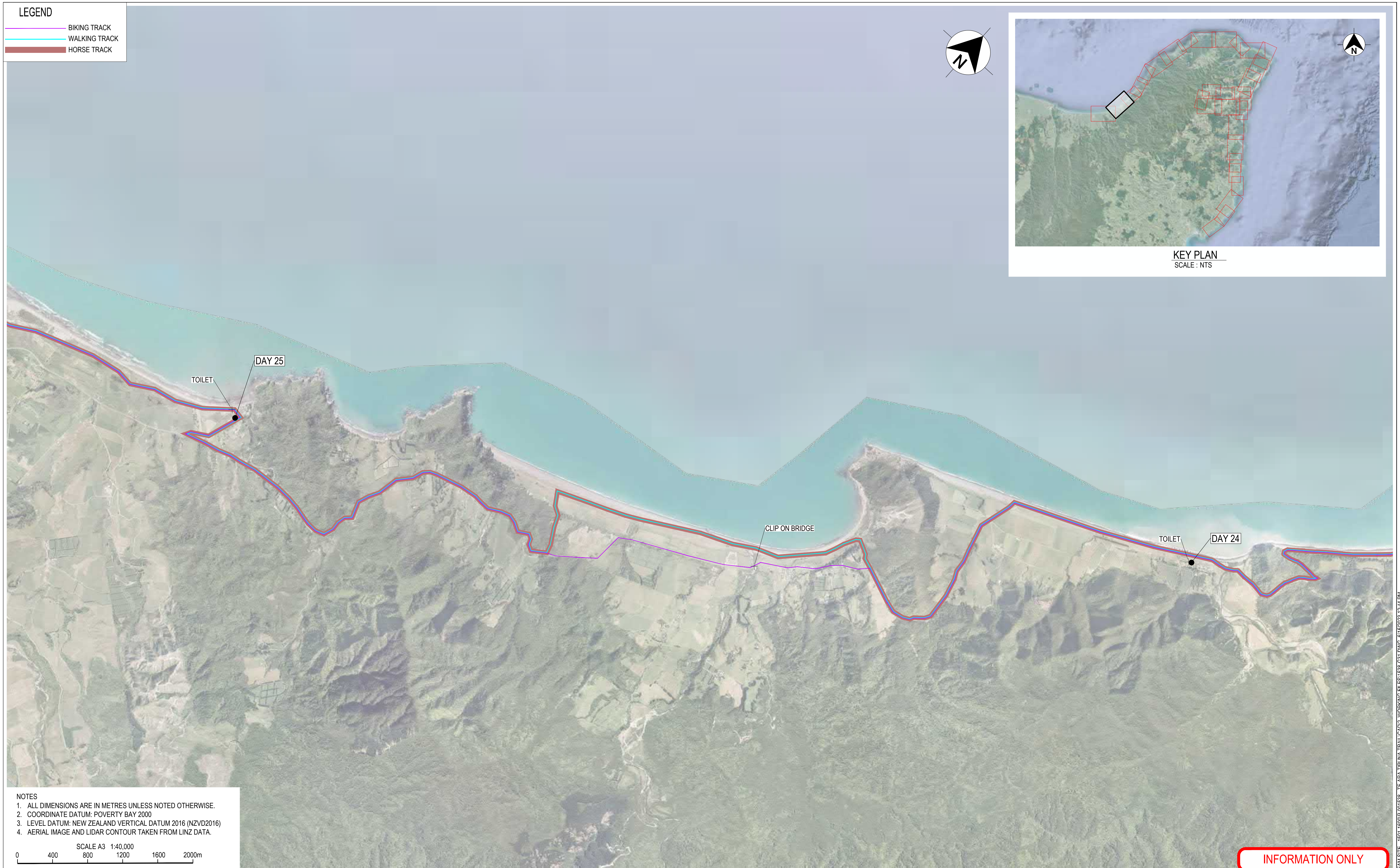
LEGEND

- BIKING TRACK
- WALKING TRACK
- HORSE TRACK



KEY PLAN
SCALE : NTS

NOTES
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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 25 PLAN

Initia Project ref: P001538
Figure Number: 1538-G31
Revision: B

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TE ARA TIPUNA TRAIL - GISBORNE TO OPOTIKI

GEOTECHNICAL INVESTIGATION
DAY 26 PLAN

Initia Project ref: P001538

Figure Number: 1538-G31

Revision: B

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