

RDA Consulting

GEOTECHNICAL • CIVIL • ENVIRONMENTAL



GEOTECHNICAL DESK STUDY – SOUTH MATUARA

JOB TITLE	GORE DISTRICT PLAN GEOTECH REVIEW
ADDRESS	SOUTH MATAURA
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52665 TPG Gore DP Review – South Maitaura

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1. INTRODUCTION

1.1. BACKGROUND

RDA Consulting was engaged by the Gore District Council to undertake a concept level geotechnical desktop assessment for potential re-zoning of designated areas from rural to Industrial and lifestyle zones. The desktop study focuses on the geotechnical suitability of the designated rural land with an overall scope to identify possible geotechnical constraints that could have implications for development.

1.2. SCOPE

The initial scope of work for the geotechnical assessment of the potential locations to be rezoned includes study on the following:

- Desktop review of existing databases for natural hazards potentially affecting the selected areas. Typically, this would be for liquefaction and lateral spreading, flooding, earthquake susceptibility, slope stability, rockfall, debris flows, erosion, and subsidence.
- Man-made hazards, such as historic mine workings or refuse tips are known in some of these areas, additional database searches for these and aerial photo databases would also be undertaken.
- Review of preselected property files of interest, based on initial desktop review.
- Detailing the underlying geology and known fault locations.
- Database searches of the New Zealand Geotechnical database and Environment Southland's "Beacon" database for any relevant information, such as groundwater and Geotechnical conditions.
- Reporting and preliminary risk analysis, and whether areas are more suitable for a particular land use (Industrial vs Lifestyle).

After issuing of the initial report, the client asked for the investigation area to be increased to extend further south. This report has been amended to include the extended investigation area.

2. SOUTH MATAURA STUDY AREA

The Gore District Council have identified six areas of interest, where the potential rezoning of land, from rural to industrial and residential lifestyle, may be suitable. The study areas are located around the townships of Gore, Mataura and Mandeville. The six study areas have been named: Whiterigg, Mandeville, Reaby Road, South Gore, Charlton Road, and South Mataura. Each area has been individually assessed.

This report concentrates on South Mataura study area (Figure 1).



Figure 1: An aerial photograph of the South Mataura study area. Ponds seen in area are often the result of past coal mining activity.

2.1. SITE INFORMATION

The South Mataura study area is located at the southernmost end of the Mataura Township. The area is bounded on the eastern perimeter by Main Street (SH1), the northern perimeter by McIlwraith Road and the southern perimeter by Craig Road. The general area is flat and level ground. Residential property is located within some areas, the majority is currently agricultural land.

Mining and quarrying activity has occurred in the past, and while no coal mining appears to be currently in operation, minor quarrying of gravel may still be being undertaken.

The site is to be rezoned to industrial or lifestyle.

2.2. HISTORICAL MINING

Few records exist of the past mining activity that was undertaken; however, it is noted that small scale open pit mining mostly occurred in the late 19th century. Due to the limited information that has been obtained, the true extent of the mining activity that was carried out is limited, and unless extensive ground investigations are undertaken, cannot be accurately represented.

Mining records obtained from the Gore District Council (Appendix A), show at least two underground mines and a series of open cast mines, running north-south the length of the proposed area adjacent SH1. The mines are designated M100, M113 and M118. Georeferencing of the past mining activity, from the mining records and aerial photographs (Figure 2) has allowed the general extent of the open cast and underground mining activity to be ascertained, and is outlined in Figure 3. Two underground mines are indicated on the plans west of the opencast pits, north and south of the Glencoe Highway. It appears no other underground mining has been undertaken, however, at the southernmost extent, an excavation that appears similar to a mining portal has been constructed which may indicate either the presence or plan to conduct underground mining. However, no further information in the area was found to indicate underground mining was undertaken.

Surface evidence from mining activity can be seen in the aerial photographs of the area and clearly show the mine workings from the previous opencast mines. An aerial photograph taken in 1938, when the mine was in operation, shows the extent of the workings at that time (Appendix A). A small existing quarry in the centre of the study area appears to be currently in operation, however this is unknown.



Figure 2: Georeferencing of the underground mine workings for the northern extent of the Study area, no other underground mining was found during this review.

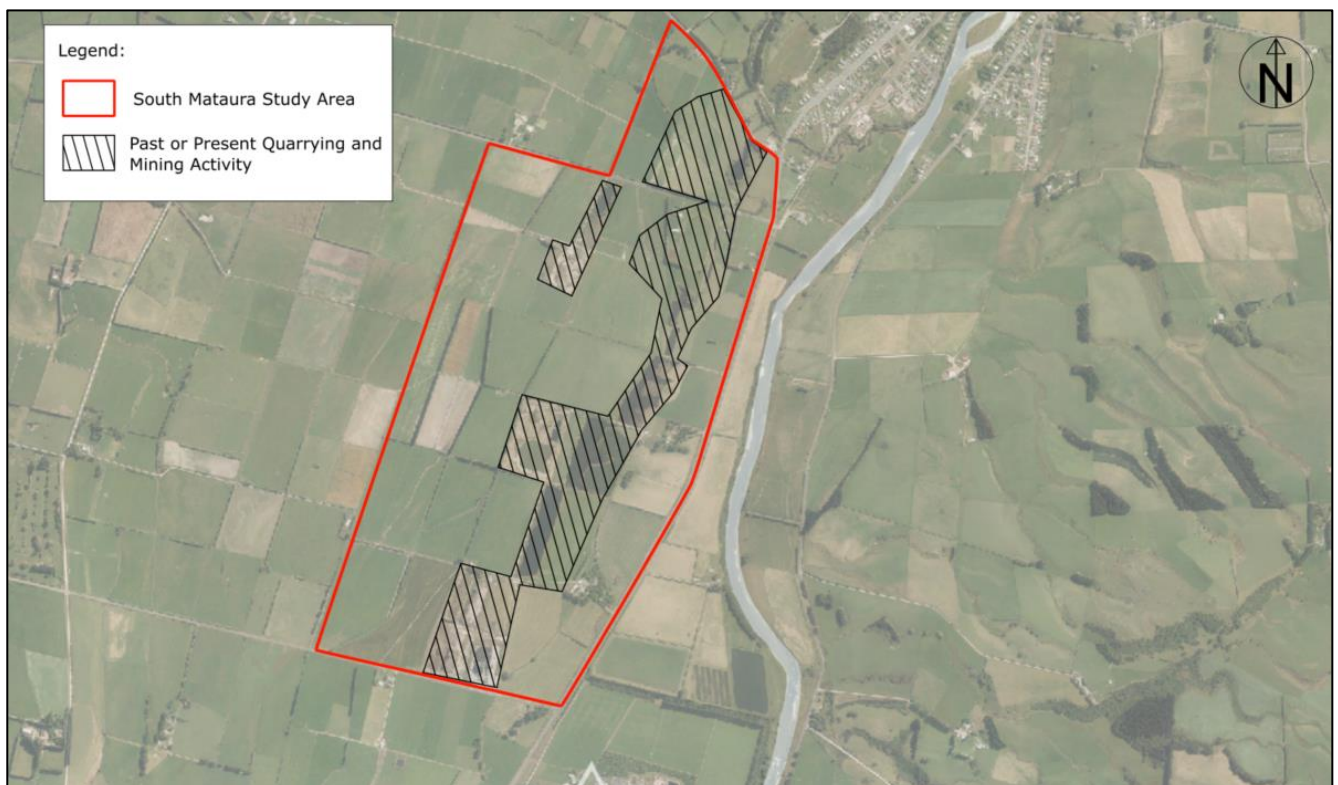


Figure 3: The estimated extent of mining activities, including underground. Also included is the possible extent of more recent quarrying activity.

3. GEOLOGICAL OVERVIEW

3.1. GEOLOGY

The geology within the study area is mapped as comprising of two units, Late Pleistocene river deposits and Gore Lignite Measures sandstone. Descriptions of the different geological are outlined below and their extent is shown in Figure 4.

- Gore Lignite Measures sandstone (East Southland Group) – Neogene sedimentary rocks consisting of sandstone with lignite and carbonaceous mudstone; mudstone; claystone and minor conglomerate.
- Diamond Peak Group sandstone (Eastern Province) – fine sandstone and siltstone with rare conglomerate tuff and grit beds.
- (Middle Pleistocene) river deposits – Alluvial deposits consisting of deeply weathered greywacke, quartz gravel, silt sand and clay.
- (Late Pleistocene) river deposits – Alluvial greywacke gravel and sand overlain by loess.

The Pleistocene gravel deposits overlie Tertiary sediments of the East Southland Group (Gore Lignite Measures and Chatton Formation). These deposits are more than 200 metres thick in places and are comprised of thick layers of mudstone interspersed with layers of lignite sand and gravel (Environment Southland, 2022).

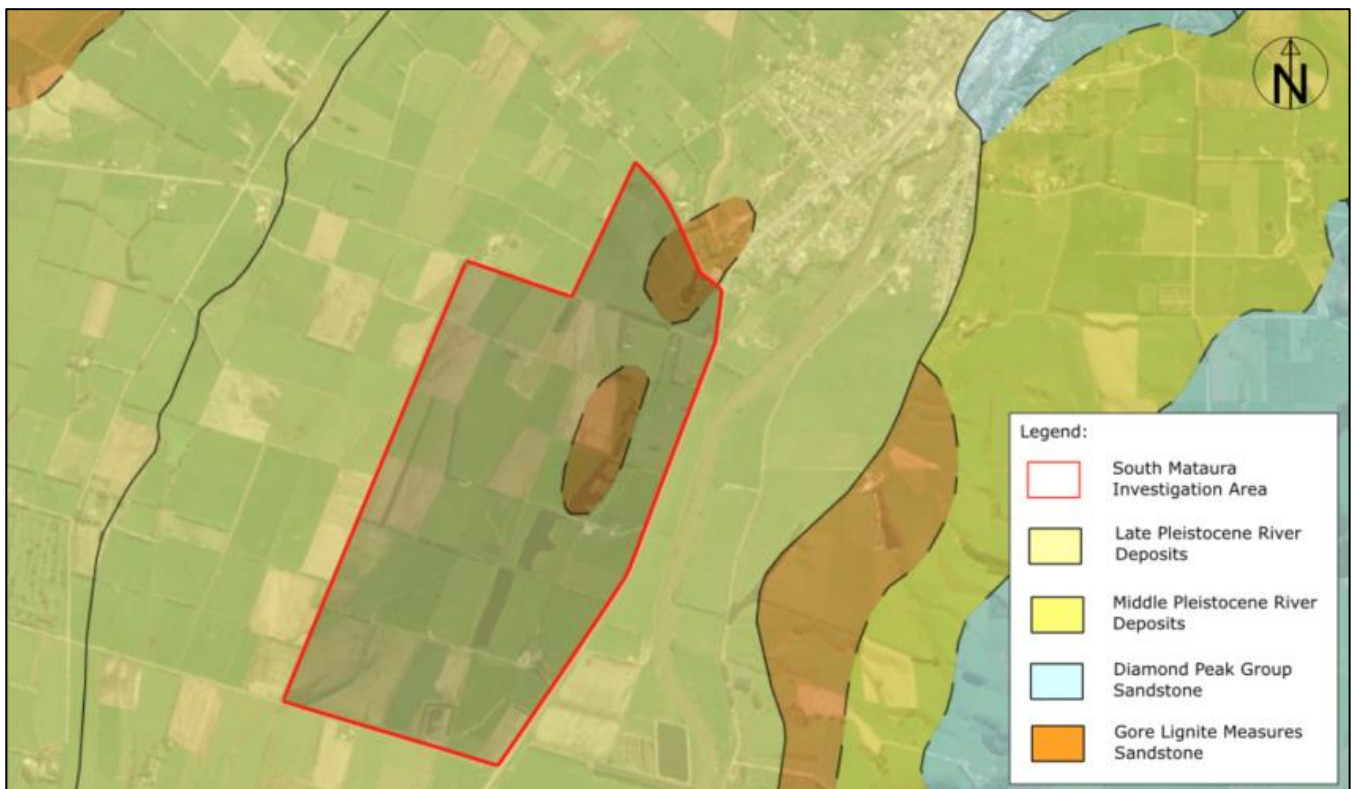


Figure 4: GNS 1:250k geology map of the South Maitara study area.

3.2. SURFACE SOIL

The surface soils are designated by Environment Southland as Ardlassa, Gore and Jacobstown. The soils are derived from alluvial greywacke and shist. Jacobstown soils are poorly drained and are generally more silt dominated. Ardlassa and Gore soils are sand, and gravel dominated and are well draining. The varying soil types, and differing drainage properties, will likely create perched water tables, in some areas.

3.3. MORPHOLOGY

The land is generally characterised as being that of flat agricultural land, however, the land has been modified by mining activity, particularly on the eastern side of the study area, adjacent SH1. The mining activity has created open pits, that have since flooded. Drainage systems run throughout the farmland and adjacent roads, and a small waterway runs to north of Glencoe Highway. There are indicators that the watercourse has been modified and straightened.

3.4. GROUNDWATER

The area is considered within the Lower Maitara Groundwater Management Zone (GMZ) by Environment Southland. The Maitara GMZ contains an unconfined aquifer system hosted in the alluvial gravel. Groundwater depths generally range from 1 to 6 metres below the surface. Groundwater varies seasonally in the order of 1 to 2 metres. Higher groundwater levels are typically associated with winter months, with lowest levels in early autumn. The sand and gravel layers within the Tertiary lignite measure sediments contain a limited groundwater resource. Artesian discharge from lignite measure aquifers was recorded by historical investigations in the Waimumu area.

Most soils in the Lower Maitara GMZ are deep, fine-grained, and poorly drained soils, this has resulted in the use of artificial drainage on flatter-lying areas (Environment Southland, 2022).

Many wells and exploration boreholes have been drilled within the study area, only two were found with groundwater recorded, these show groundwater between 1.0 and 2.0 metres below ground level.

Groundwater can affect slope stability, consolidation settlement and liquefaction potential. Accurate groundwater levels should be established as part of site-specific assessments.

4. GEOTECHNICAL HAZARDS

Several geotechnical hazards have been identified within the study area. Minor hazards that are not identified, such as rockfall and debris flow are considered to be negligible due to the geomorphology and geology. The assessment is considered general and more specific localised hazards will exist in differing zones within the study area.

4.1. IDENTIFIED HAZARDS

4.1.1. LIQUEFACTION POTENTIAL

The Environment Southland B overlay shows the site to have negligible risk of liquefaction. The mapped geology, coal mining, and nearby well information, suggest that alluvial gravels are present across the study area. Underground mining would also suggest that soils that provide the most potential for liquefaction, such as sand, are not generally present. RDA Consulting have conducted site investigations in the area, these have often encountered very dense gravels, and have concluded that these have a low potential liquefaction risk. Therefore, the widespread potential risk of liquefaction is considered negligible.

4.1.2. SEISMIC SHAKING

No faults have been identified within the study area by GNS in the 1:250k geological map, although, alluvial sediments can mask faults that have not ruptured during the Pleistocene. However, the risk of fault rupture for the area remains negligible. Seismic risk is typically mitigated for structures by prudent design in accordance with the NZ Building code (NZS3604) and Building act requirements.

We note the seismic model and fault database model for southland is under review and that the data sets for faulting hazards are of low data resolution and are not likely to represent actual fault locations, return periods, and activity status presently. Therefore, caution on the southland seismic model needs to be used.

4.1.3. FLOODING

The entire study area is designated by Environment Southland as being within the Maitara River significant floodplain (Figure 5) and is susceptible to large flood events.

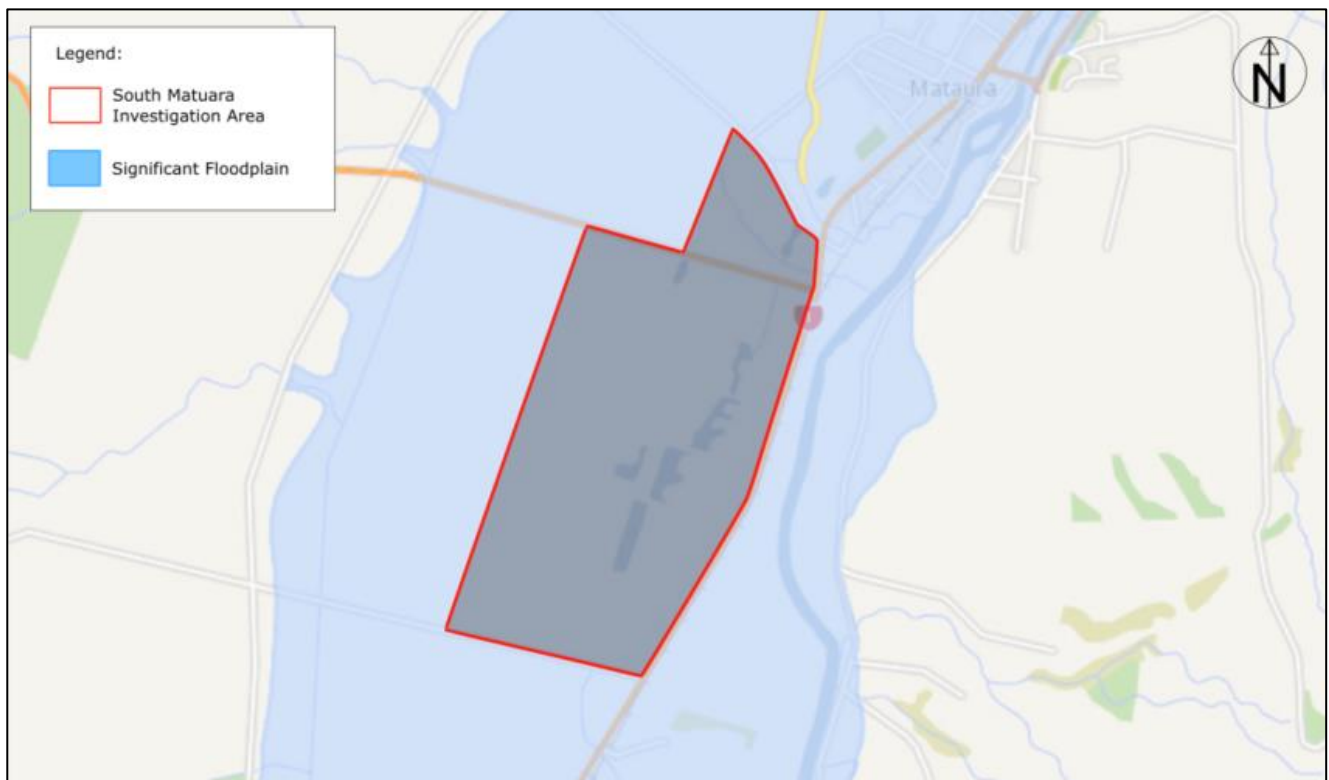


Figure 5: Environment Southland's Beacon flood hazard map.

4.1.4. SLOPE STABILITY

There is no significant elevation change within or on the nearby perimeter that would permit large scale slope instability. Minor localised, instability may occur around depressions or where earthworks, including road and mine cuttings may have over steepened faces. The cuttings around the old mine workings are likely to have steep faces.

4.1.5. SUBSIDENCE

Subsidence associated with mining activities is to be expected. Underground mining may have caused instability in the above soils that are, at present, not showing any surface expression. While most subsidence is likely to have already occurred, future earthworks, construction, and development conditions may contribute to subsidence and collapse of underground mine workings.

4.1.6. LAND CONTAMINATION

An area has been identified on the HAIL register by Environment Southland (SLUS number 20191040). The HAIL category lists the site as "A8. Livestock dip or spray race operations; E7. Mining industries", and is shown in .

No other registered contaminated sites are present on Environment Southland SLUS register. However, other mining activities have occurred within the designated zone boundaries. Mining is often a cause of soil contamination and caution should be advised. Mining and quarrying activities where open pits are left open have often been used for refuse for the local population. While there are no records of disposal for the study area, the likelihood that the site was used to discard refuse should be considered.



Figure 6: HAIL contaminated land identified from Environment Southland's Beacon website.

4.1.7. SETTLEMENT

Quarrying and mining activities often relocate soil and rock into stockpiles or back into other open pits. The immediate area around these sites may have extensive non-engineered fill. Where stockpiling and fill has occurred from quarry and mine activity, settlement maybe ongoing, however, due to the time occurred since cessation of activity, primary settlement may have occurred.

The site has been used for agriculture for an extended period, it is possible that non-engineered fill will have been placed to level the land, create access ways, and to cover refuse holes. Non-engineered fill can be prone to settlement and instability. It is appropriate to deal with any non-engineered fill during planning, development, and construction.

Areas where the ground has remained undisturbed are expected to have only minor settlement as a result of development proposals.

4.2. GEOTECHNICAL HAZARD RISK ASSESSMENT

A summary of the potential risk of the identified geotechnical hazards has been undertaken (Table 1). While the risks for subsidence and settlement from historical mining are high, areas clearly away from mining activities will have lower potential risk, however, there is a possibility that some mining activity has not been identified.

Table 1: A summary of the potential risk of each geotechnical hazard identified.

Geotechnical Hazard	Low Potential Risk	Medium Potential Risk	High Potential Risk
Liquefaction	X		
Seismic Shaking	X		
Flooding			X
Slope Stability	X		
Debris Flow	X		
Subsidence from Mining			X
HAIL Land Contamination		X	
Settlement		X	

5. DEVELOPMENT CONSIDERATIONS

5.1. MINE AND QUARRY WORKINGS

Underground mining imparts major geotechnical challenges on developments overlying them, this is particularly present on the eastern extent of the study area. The old underground workings were extensive and while information has been provided, it may not be complete. The open pits are mostly still visible where ponds are seen, but some areas have been backfilled and the land levelled. The areas where mining has been undertaken, especially underground mining, would require extensive geotechnical investigation to enable most construction. This may include excavation, drilling and geophysics.

5.2. NON-ENGINEERED FILL

Where old workings have been filled, the fill material used is generally unknown and may consist of hazardous materials and refuse. Much of the fill, however, is likely to have been sourced from the nearby underground and open cast mining activities. The potential for non-engineered fill on agricultural land is likely to be negligible in the study area, however, there is expected to be non-engineered fill near watercourses that have been modified.

Development of structures and infrastructure on fill may result in further settlement. Development requires site specific investigations and structures may require Specific Engineering and Design.

5.3. FLOODING

The potential flood risk is high, and therefore before further planning, flood and hydrology assessments should be completed ahead of any potential development to ascertain any likely flood level, frequency, and extent.

5.4. GENERAL CONSTRAINTS

Other geotechnical hazards within the study area are generally negligible, with the quarry and mine areas noted in Figure 3 of most concern. Outside these areas development constraints are considered minimal. However, there is a risk that not all mining activities undertaken on the site have been identified.

Most of the land is considered geotechnically suitable for development, but with various degrees of engineering control required to remedy or mitigate the risk or impact of geotechnical hazards.

6. LAND USE PREFERENCE

No preference, for either lifestyle or industrial, is given from a geotechnical point of view. However, some industrial sites should consider potential groundwater runoff into local water courses, and contamination in major flood events. The area is considered suitable for lifestyle development with consideration given of the outlined mining activity above. Large hardstand areas and larger developments often associated with industrial sites will increase the risk of development upon previously mined land and non-engineered fill.

7. LIMITATIONS

The findings contained in this report are based upon topography maps, geological maps, natural hazard maps, historic mining data, and engineering experience and consideration of geotechnical issues encountered within the area previously. Inferences about the nature and continuity of geohazards are made using geological principles and engineering judgement. However, it is possible that ground conditions over the site may vary and therefore it is not possible to guarantee that all hazards have been identified.

This report has been prepared for the project area provided to RDA Consulting by the clients brief and no responsibility is accepted for the use of any part of this report in other contexts or for any other purposes. Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

8. REFERENCES

- Environment Southland (2022). Beacon website. <https://maps.es.govt.nz/>
- GNS Science (2022). Active fault database. <https://data.gns.cri.nz/>
- MBIE (2021). MBIE, Earthquake geotechnical engineering practice guidelines. Modules 1-5
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APPENDIX A. PLANS AND PHOTOS

1. Historic Mining Plans
2. Aerial Photos





12 February 1938



18 February 1962



23 February 1983



4 January 2012