

Martha Mineral Zone Plan Change - Geotechnical Assessment

PSM125-296R

26 August 2021

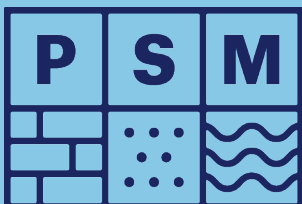


Table of Contents

1. Introduction.....	3
2. Scope of this Assessment.....	3
3. Overview of the Potential Changes Associated with MP5	3
4. Key Geotechnical Considerations	4
5. Pit Stability Management Systems	5
6. Design and Management of Pits	6
7. Mine Closure	7



1. Introduction

OceanaGold New Zealand (OGNZ) plan to expand the surface mining of the Martha Pit, via the Martha Phase 5 (MP5). This expanded pit will entail surface mining activities outside the currently defined extent of the Martha Mineral Zone. However, the existing regulatory framework around the Martha Pit has to be changed first in order to allow a resource consent application for this mining to be considered. The changes to the regulatory framework comprise a plan change application by OGNZ to the Hauraki District Plan to provide for an expansion of the Martha Mineral Zone.

This plan change, once completed, will allow a resource consent application to be lodged for the expanded open pit mining in MP5.

It is understood the future resource consent application to be sought for the expansion of surface mining activities in the Martha Pit, will likely result in major earthworks being undertaken around the pit in order to provide for its expansion.

This report presents a geotechnical assessment, which addresses the requirements of the plan change to the Martha Mineral Zone and the subsequent resource consent application to allow the mining to proceed.

2. Scope of this Assessment

A draft pit crest outline for MP5 has been provided by OGNZ to inform the scope of the proposed plan change. The proposed plan change will entail rezoning of all land parcels required to accommodate the expanded pit and ancillary activities, including noise bunds and surface facilities areas. This includes expanding the extent of the Martha Mineral Zone in the vicinity of Moresby Avenue, Pitt Street, Haszard Street and Seddon Street.

This report:

1. Provides an overview of all the key considerations for pit slope stability in any future expansion of the Martha Pit.
2. Sets out all the relevant potential geotechnical changes associated with MP5 and provides an assessment of their relative scale and significance.
3. Describes how the existing open pit mining of the Martha Pit has been managed from a geotechnical perspective.
4. Describes the engineering study process followed by OGNZ for the design of MP5.
5. Describes the mitigation measures required to address the key considerations for pit slope stability.
6. Presents conclusions and recommendations.

3. Overview of the Potential Changes Associated with MP5

There have now been four pits excavated at Waihi:

- Licensed Pit (the original open pit which commenced in 1989),
- Extended Pit,
- South Stability Cutback (SSC), which was originally aimed at pit closure; and
- East Layback (Pit 66D).

All these pits entailed cutting back all or large segments of the earlier existing pit walls.

There is a responsibility on miners to maximise the recovery of the available ore resource. In order to achieve this, successful mining entails managing the ore recovery and ensuring pit wall stability to allow the ore to be recovered safely. It is generally impractical to remove all risk from mining and consequently the aim is to ensure any instabilities that occur during mining remain inside the pit and are manageable.

One of the complexities with open pit mining at Waihi is that for a period approaching 80 years, underground mining proceeded in what is now considered to be a completely uncontrolled ground stability manner. In addition, like many historic mining areas records to enable detailed geotechnical analysis were very poor. This is the legacy that was inherited as part of the open pit mining at Waihi.

All instabilities to date in the Martha Pit, both large and small, have occurred in sections of the rock mass substantially affected by the historical underground workings. Analysis of the north wall failure, which occurred in April 2016, has shown it is also linked to the historical underground mining. However, it is also important to note that all instabilities to date have remained within the existing pit crest, which was in keeping with the overall intent.

Both the SSC and East Layback pits were designed to achieve more stable conditions by moving the new pit walls as far as practical outside the rock mass zone affected by the historical underground workings. This process has generally been successful as demonstrated by the performance and success of the SSC and the East Layback. The same approach has also been consented in relation to the North Wall via the Project Martha MP4 consent which OGNZ holds but has not yet completed.

The indicative layout for the MP5 pit walls is close to the current walls and therefore the conditions and performance of the existing pit may be used to inform the assessment of the MP5. Consequently, the expansion of the current pit and the change to the Martha Mineral Zone Plan will entail:

- Similar changes to those that have already taken place many times since the start of open pit mining at Martha in 1989; and
- Is not considered to be a step change, rather an evolution in the open cut mining at Waihi.

Hence the proposed MP5 pit is generally a continuation of that stabilisation process because the cutback incorporates the removal of the north wall failure and moves many of the pit walls further outside the rock mass zones affected by the historical underground mining.

The Martha Pit is essentially a temporary or time-limited land use. The pit must be remediated (by filling with water to create a lake) and is not designed to be a permanent open void, which also influences the pit slope design.

4. Key Geotechnical Considerations

In terms of general open pit mining, MP5 and the earlier pits excavated at Waihi, all classify as small to medium scale mines, and this is an important factor when considering geotechnical risks and any planned mine expansion.

All the pits to date at Waihi have been excavated in what is in effect an urban environment. This has meant there were very strict controls and limits on mining practices, which includes:

- Mining proceeds in 2.5 m vertical lifts, compared to conventional open pit mining which is usually in the range from 10 to 15 m high lifts;
- Very small diameter blast holes are used and the individual blast sizes are strictly controlled to limit blast vibrations away from the pit; and
- The mining equipment sizes are also much smaller than conventional open pit mines.

The combined effect of these factors is that the mining at Waihi is tightly controlled, and its character is closer to a conventional civil excavation than to a traditional open cut mine.

There are a number of other positive elements associated with the potential expansion of the Martha Pit via MP5, including:

- There is now a long history and technical understanding from mining in the materials within the current Martha Pit;
- There is good drilling coverage in most areas, which means the geological model of the rocks to be mined in MP5 is well defined;
- The planned cutback slopes are relatively close to existing pit walls, which further reduces the risks of geological surprises and gives greater confidence in prediction of conditions in the new walls;
- A very accurate model has been developed by OGNZ for the historic underground workings and this model has been validated further with extensive exploration drilling and new underground development in some areas;

- Many of the MP5 pit walls will be even further outside the disturbance envelopes from the historic underground mining; and
- The pit walls are largely depressurised, that is the groundwater level in the main rock mass has been lowered to below the pit floor and hence will not be a potential destabilising factor.

The key potential changes associated with the potential expansion of the Martha Mineral Zone, and the potential future expansion of surface mining via MPS, that need to be incorporated into future geotechnical and mining considerations comprise:

1. Moving away from the current pit towards the north and south the upper materials, mainly weathered rocks and more recent geological layers, may be of poorer quality than in the current pit walls.
2. There is an increased likelihood of shallow groundwater tables in these upper materials.
3. Although the geological structure has proven to be generally favourable to date, the north wall failure has highlighted that the structure orientations in the rock masses around Waihi may vary. This means as the pit shell size increases the risk of intersecting other structure orientations also increases and this will need to be covered by the Pit Slope Management Plan.
4. The pit will be deeper and will encounter more of the historic underground workings in the lower east wall. The potential impacts of this will need to be investigated and remedial treatment options developed as required as part of engineering studies for MP5.
5. The general increase in the slope heights associated with MP5 will result in increased stresses on the rock mass. The larger open pit will also be closer to other historic underground workings like the Royal Lode. Consequently, there could be increased zones of relaxation outside the pit crest, and this will need to be incorporated into the Buffer Zones.
6. Buffer Zones were incorporated into the Extended Pit and comprise a zone around the whole pit outside the pit crest where some small-scale movements could occur due mainly to relaxation of the rocks towards the pit void. This has been observed, monitored and managed as part of the mining for many years. New Buffer zones will need to be defined as part of the engineering studies for MP5. New land uses within the Buffer Zone area that will be defined around the MP5 pit crest need to be controlled so that activities that are sensitive to small-scale movements associated with the relaxation of the rocks towards the pit void (such as permanent buildings) are located outside the Buffer Zone.
7. The total pit life, before the mine is flooded with water to stabilise all pit walls, will be increased 2037.

5. Pit Stability Management Systems

Open pit mining commenced in 1987 and from early in the operations, the pit stability has been managed with a multi-layered hierarchical set of controls as part of the Pit Slope Management Plan. In order to manage the uncertainties and risks associated with the stability of the mining operations, over the past 32 years at Waihi a comprehensive set of systems and processes has been developed and employed in the Martha Pit.

At the highest level the processes comprise:

1. Annual technical Peer Reviews of both the geotechnical and groundwater aspects. These reviews are carried out by independent, third-party, international, technical specialists, who visit the mine, review specially prepared annual reports and provide direct feedback to OGNZ and Hauraki District Council/Waikato Regional Council.
2. All the pit slope designs are carried out by international, specialist mining geotechnical engineers (PSM) under contract to OGNZ. It is important to note that the same personnel from PSM have now been involved for 26 years at Waihi.
3. These pit slope designs are checked and reviewed a number of times each year during operations against the exposed conditions and the monitoring data by the pit designers.
4. The groundwater aspects are the responsibility of specialist groundwater consultants, who provide direct support to the OGNZ site geotechnical engineer and OGNZ site environmental officer.

At the mine site level, OGNZ employs a geotechnical engineer, who is responsible for all the day to day geotechnical work in the pit including:



- a) Lithological mapping,
- b) Structural geological mapping,
- c) Installation of monitoring equipment,
- d) Remediation treatment of unsuitable ground conditions,
- e) Daily review of all monitoring data,
- f) Daily inspections of exposed conditions and
- g) Liaison with pit designers and groundwater engineers as required.

All of the site geotechnical work takes place under the Ground Control Management Plan, which defines the basis for how the existing mining operations in the Martha Pit are managed on a day-to-day basis. The Ground Control Management Plan is a live document and updated as required to suit the ground conditions as they are encountered.

At the lowest level the Martha Pit is monitored on a continuous basis using robotic theodolites and monitoring survey points mounted on all pit walls. This system allows millimetre scale measurement of any pit movements. These monitoring points extend from the pit crest to the pit floor and form a comprehensive overall movement monitoring system.

In addition to this overall movement monitoring, additional instrumentation has also been employed for more specialised requirements including:

1. Continuous ground radar monitoring.
2. Inclinometers to measure millimetre scale displacements at depth behind the pit walls.
3. Surface wireline extensometers with electronic alarms.
4. Open standpipe piezometers.
5. Vibrating wire piezometers.

6. Design and Management of Pits

The existing consents include an Annual Peer Review process, which comprises international experts in mining geotechnics and groundwater. These experts meet annually, review the pit performance, review all data and information collected over the previous year and provide written reports on the outcomes of the Annual Peer Review. The outcomes from the Annual Peer Review are then implemented by OGNZ.

Detailed design studies have been undertaken for all the four previous pits excavated at Waihi. A further detailed engineering study would need to be undertaken for any further pit expansion of the Martha Pit (MP5). This design study when completed will be reviewed by an independent, international, mine geotechnical specialist on behalf of Hauraki District Council. This is a separate person to that engaged in the Annual Peer Review process.

The potential expansion of the pit crest in the Martha Pit will also require the imposition of a range of mitigation measures, which will need to be detailed and considered as part of any future resource consent application. Measures may include:

1. Excavating the upper pit slope walls at flatter overall slopes.
2. The monitoring of groundwater levels and the use of horizontal drains.
3. Mapping of the geology and geotechnical conditions of all walls as they are exposed.
4. The review and peer review of the geology and structure of the pit on a regular basis (including by the Annual Peer Review that occurs at present).
5. Modelling of interactions between underground workings and pit stability.
6. Defining new buffer zones for any expansion of the pit crest.
7. The pit walls will be mapped as mining progresses and all potentially poor zones with significant risk of deterioration over time will be identified and incorporated into the geological model of Martha pit.

The requirements for such measures would need be considered as part of preparing the pit stability assessment as part of any future resource consent application, and as part of the details of any Pit Slope Management Plan (and associated peer review processes).

Given that any resource consent application for the expansion of the Martha Pit will be a discretionary activity even with the expansion of the Martha Mineral Zone, it is considered that there is sufficient scope to consider the need for such measures as part of that process, as was the case for MP4.



7. Mine Closure

Because of the urban setting of Martha Pit a very important consideration is mine closure. Various plans have been developed by OGNZ to convert the Martha Pit after closure and completion of flooding to a recreational lake and surrounding recreational reserve. These plans will need to be updated for the MP5 pit and will also need to be supported by the requisite engineering studies to ensure a safe and stable landform is achieved and any risks to people are in accord with accepted societal norms.

For and on behalf of
PELLS SULLIVAN MEYNINK



TIMOTHY DANIEL SULLIVAN
CHAIRMAN