Dewatering and Settlement Monitoring Report

2020

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DEWATERING & SETTLEMENT MONITORING REPORT 2020

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EXECUTIVE SUMMARY

This Annual Dewatering and Settlement Monitoring Report is a requirement of the consent conditions for the Martha, Favona, Trio, Correnso and SUPA, MDDP and Project Martha mining projects, Waihi, New Zealand. Compliance monitoring and assessment of groundwater and settlement trends is reported for the period 1 January to 31 December 2020 and is in accordance with the current Dewatering and Settlement Monitoring Plan submitted to the Hauraki District and Waikato Regional Councils in May 2019.

On 16 July 2017, the Correnso groundwater take permit 124860 was replaced by the Project Martha groundwater take permit 139551. This allows dewatering to a lower level (500 mRL cf. 700 mRL).

New settlement triggers were applied during 2020 following the approval of Project Martha consents. Settlement survey results indicated that 97% (359/370) of marks graphed were within the predicted settlement ranges, based on the settlement resulting from mining activities. Eleven marks triggered further investigation. Most settlement marks triggered were above the Favona mining area where four Favona marks exceeded settlement predictions. The other seven triggered marks are located in the wider Waihi area and are not believed to be related to dewatering. No effects were observed at surface near these locations and nearby shallow piezometers have not displayed any associated affect. This is considered an acceptable number of marks triggered.

Martha Open Pit

Dewatering from the Martha Pit was discontinued on 04 May 2015 after a slip in the pit when access and power supply to the dewatering pumps became limited. Dewatering from within the Correnso underground mine was initiated on 18 May 2015. The Martha, Trio, Correnso and SUPA groundwater systems are hydraulically linked, and water levels are controlled by Correnso underground dewatering.

No drawdown effects caused by mine dewatering were indicated in monitoring bores and no tilt trends have developed during 2020 that can be attributed to dewatering operations.

The analysis of data has indicated that most settlement around Martha Pit had developed by the mid to late 1990s, but widespread small magnitude settlement has been ongoing and is likely to be related to dewatering of deeper structures within the andesite rock mass. Groundwater monitoring data does not show any widespread or significant dewatering of alluvium; of the upper portions of the younger volcanic materials; or dewatering of the upper layers of the andesite rock body which could lead to a greater magnitude of settlement.

No property damage complaints attributable to mine dewatering or settlement in response to mine dewatering were reported during 2020. Compliance was achieved with the consent conditions granted for the Martha Extended Project.

Favona

At the Favona mine, piezometer levels indicate continued dewatering of the vein system, with the water level maintained at approximately 800mRL mine datum by the end of 2020. Water levels in the country rock surrounding the vein system stand higher and are either not responding or responding slowly to dewatering.

During 2019, a separate flow meter to measure dewatering flow from Favona was installed.

Four Favona marks exceeded settlement prediction, fewer than 2019 due to updated maximum predicted settlement triggers applied during 2020.

A settlement trend exists over a 150 m wide area above the underground workings with a maximum total settlement of 347 mm (F18), of which up to 298 mm can be attributed to Favona mining activity. This is greater than the 80 mm initially predicted by URS (2002 Technical Report) to be due to dewatering. Settlement is attributed to a combination of depressurisation stress (primary

consolidation) associated with drawdown in the andesite rock and relaxation of the country rock as mining proceeded. Primary consolidation (the first time a mine is dewatered) is greater than a second cycle (subsequent dewatering activities). The Favona mine is outside of the Martha groundwater system; the Martha system was historically dewatered for a longer period and to greater depth and is currently undergoing a second period of dewatering.

Five tilt gradients attributable to Favona mining activity remain steeper than 1:1000; these are on farmland owned by the company and south of the residential area along Barry Road and have all been recorded in previous surveying events.

One piezometer in the Favona network breached the trigger level in 2020. This piezometer was affected by an underground drill hole in 2016 (subsequently grouted and sealed), and the 2020 trigger level breach is considered to reflect the piezometer continuing to stabilise from the earlier drop in pressure.

Compliance with the conditions of the Favona consents and Monitoring Plan was achieved.

Trio

Water levels were controlled by Correnso dewatering.

Correnso

The Correnso underground mine was granted consent and operations began on 20 December 2013.

Waikato Regional Council consents were granted in 2019 permitting the development of the Martha underground mine (Project Martha) and allowing groundwater levels to be lowered beyond the lowest level allowed for the mining of Trio. The Correnso water take permit was activated in July 2017, allowing dewatering to lower the groundwater down to 700 mRL (124860, Schedule One – General Conditions, Condition 1). At the end of 2020 the water level was at approximately 705 mRL.

New settlement trigger levels for Correnso were applied in 2017 and Project Martha superseded these in 2020. During 2020, no settlement mark in the Correnso Extensions Project Area (CEPA) displayed excessive settlement and no consent related groundwater trigger was activated. Compliance was achieved with the consent conditions granted for the Correnso Project.

SUPA

The Slevin Underground Project Area is essentially an extension of the Correnso mining area. Mining within the SUPA area began January 16, 2017. No new Waikato Regional Council consents were required for the activity which is covered by the existing WRC consent conditions. The HDC dewatering and settlement related conditions are similar to the WRC conditions for Correnso. No new monitoring or reporting is required as the existing networks adequately encompass SUPA.

MDDP

The Martha Drill Drives Project (MDDP) was granted consent on August 9, 2017. Mining in the MDDP began August 17, 2017 and was completed during 2019. The project involved the construction of two underground drill drives from the SUPA area towards Martha Pit. No specific HDC conditions relate to dewatering and settlement, rather it is covered by the existing WRC Correnso consent conditions. No new monitoring or reporting is required as the existing networks adequately encompass MDDP.

PROJECT MARTHA

Consents for Project Martha were granted on 01 February 2019. Joint HDC and WRC consents were activated on July 27, 2019 when blasting began in the project area. The WRC dewatering consent which allows dewatering below 700 mRL for Project Martha was activated on the 1st of January

2020. New dewatering bores were installed during 2020 to progressively lower the water level to enable Project Martha activities.

1 INTRODUCTION

This report is submitted to meet the requirements of various consents held by OGNZL related to Dewatering and Settlement. New consents have been issued for different projects as mining has progressed at Waihi with many having conditions and reporting requirements in common. A full list of conditions pertaining to Dewatering and Settlement are included in Appendix A. Consents for Martha, Favona, Trio, Correnso, SUPA, MDDP and Project Martha all require a Dewatering and Settlement Monitoring Plan. Below is a summary of the current consent requirements common to those consents:

The report shall, as a minimum, provide the following information:

a) The volume of groundwater abstracted;

b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of the future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions, this analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

d) Any contingency actions that may have been taken during the year; and

e) Comment on compliance with [any conditions] of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

f) The report shall be forwarded in a form acceptable to the Councils.

2 GEOLOGICAL SETTING

The mineralised veins of the Martha, Favona, Trio and Correnso gold deposits in Waihi are developed within Miocene age lava flows, intrusives and volcaniclastics of predominantly andesitic (and minor dacitic) composition (Figure 1). The andesites extend to depths greater than 600m below the surface and are extensively modified in places by weathering and hydrothermal alteration. The andesites are unconformably overlain by younger, unmineralised rhyolitic ignimbrites that cover much of the Waihi township. The ignimbrites drape over an eroded andesitic graben and horst landscape resulting in a volcaniclastic package that is highly variable in thickness (0 to >100m). Additionally, the ignimbrites exhibit variable textures, ranging from light weight, soft and pumice-rich horizons that are highly permeable to hard, resistant, welded ignimbrites that appear less permeable. Paleosols (buried soils) and sedimentary deposits, such as alluvium and boulder alluvium in places mark the tops of successive eruption sequences.

There is a discontinuous layer of recent alluvium beneath the Waihi township located in areas where old streams and river channels cut into the ignimbrites and andesite units (Figure 1). These alluvial deposits are extensive to the east of Waihi where they are associated with the drainage systems of the Ohinemuri River catchment.

The most common effect of hydrothermal alteration on the andesitic host rocks surrounding the veins is the alteration of primary feldspars to illite and smectite clays and the introduction of pervasive potassic feldspar. Illite and smectite clays generally cause the host rocks to lose their internal strength forming weaker and usually more friable rock. The extent of clay alteration is highly variable

and dependant on veining and host rock type. In Waihi the strongly clay altered zones are usually concentrated within close proximity to the veins or faults (eg within the hanging wall of Favona) and within the vein zones themselves (eg Martha, Correnso and Trio). Potassic alteration on the other hand generally increases the overall strength of the host rocks which often results in the rocks surrounding the veins being resistant to weathering and forming bluffs such as the Martha Hill (prior to mining of the Martha Open Pit) and Union Hill in Waihi. Paleo-weathering and hydrothermal alteration appear to have created an extensive low-permeability clay-rich horizon within the upper part of the andesite sequence. This horizon generally separates the andesites, hydrogeologically, from the younger overlying sequence of permeable rhyolitic ignimbrites. Exposure of the altered andesite in the southern wall of the Martha Pit indicates that the weathered clay horizon may extend up to 30m in thickness.

In the vicinity of the Martha vein zone the groundwater is largely concentrated within old underground mine workings, faults and veins where the historical mine workings act as effective conduits allowing inflow of groundwater water from the area surrounding the current Martha Open pit.

Principal veins and faults at both Martha and Favona dip to the south-east while the Correnso vein strikes north-north-west with an easterly dip (Figure 1). The Trio-Union-Amaranth veins are located on a paleotopographic high, informally referred to as the Union Horst that separates the Martha vein system from the Favona-Moonlight vein systems.

There is a hydrogeological connectivity between the Martha vein system and the Trio-Union-Amaranth vein system thought to be facilitated by the connecting Correnso structure. This was demonstrated historically by the rise and fall of ground water levels in the Union Hill shaft in unison with the rise and fall of water levels in the Martha open pit. There is only a very weak hydrogeological connectivity between the Martha system with the Favona system, shown by a lack of mutual response in the measured ground water levels. The zone of separation of the two groundwater systems is not well defined but may be due to a fault boundary, either the No 9 fault or the Favona footwall fault (Figure 1), both of which are north to northeast trending and have a perceived strike extent exceeding 1km.

Groundwater inflow is, predominantly, controlled by infiltration from overlying layers and through outcrops of ignimbrite in the beds of streams and at the ground surface. The rhyolitic ignimbrite sequence is considered to be compressible and has accounted for most of the dewatering induced settlement around the mine site. This is indicated by settlement magnitude generally corresponding to the thickness of and the magnitude of dewatering in these materials.

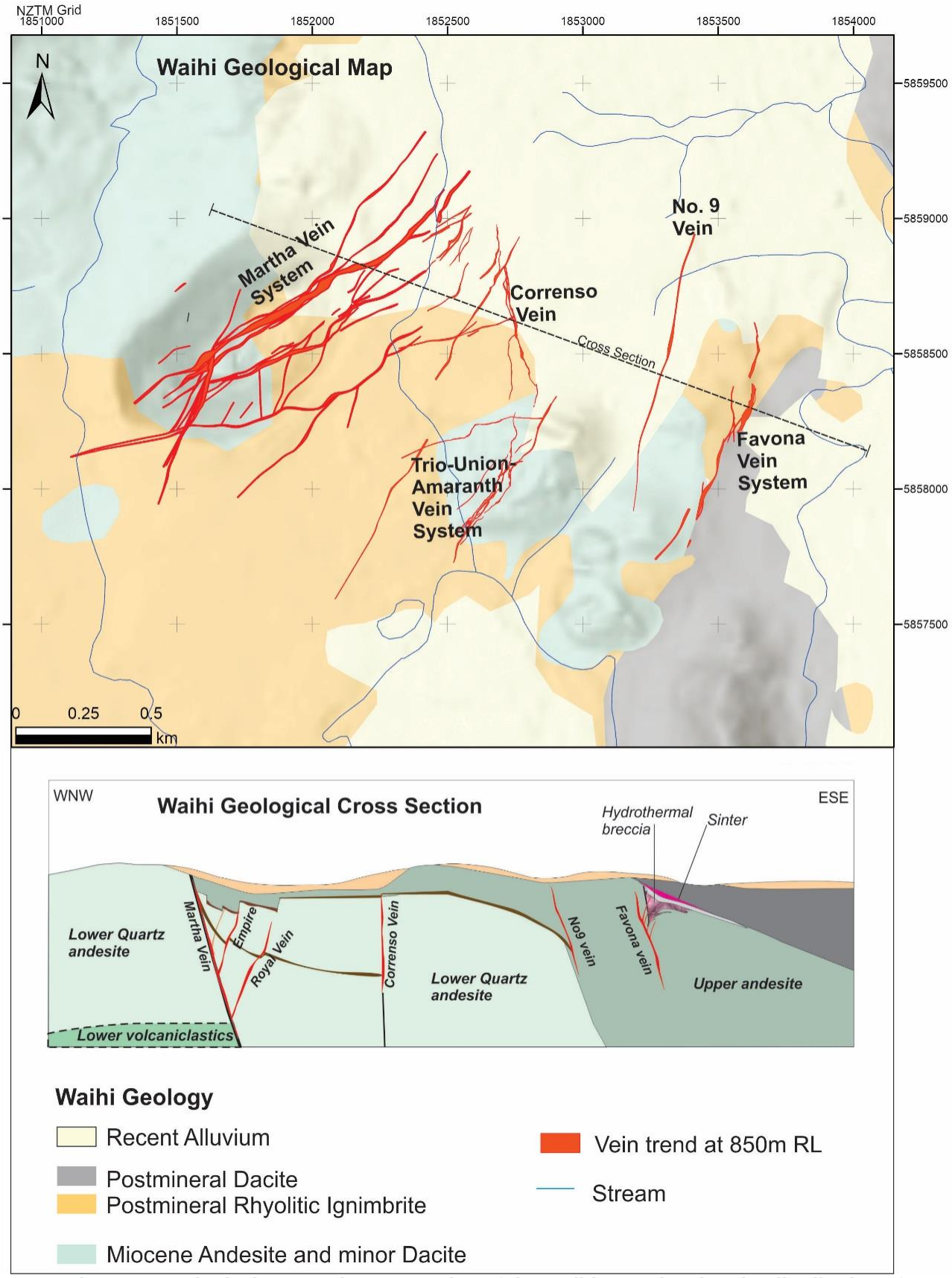


Figure 1: Geological map and cross section of the Waihi area showing the distribution of quartz veining and dominant geological rock units.

3 MINING ACTIVITIES

The main features of the mining activities during 2020 (in relation to dewatering and settlement) are described in the following sections.

3.1 Martha Open Pit

Access to Martha Pit during 2020 has been restricted due to the North Wall slip. No works were undertaken in the pit during 2020. The pit remains in care and maintenance.

3.2 Underground

3.2.1 Development

2020 saw development in the Correnso Upper, Daybreak Upper, Correnso Deeps, and Trio Deeps mine areas (Figure 2 & Figure 3). Exploration drives and access development was also carried out into the Martha Project area. Throughout 2020, 8,382 m of both capital and operating development advance occurred, with the breakdown as follows:

- 7,301 m of capital development in the access drives in Martha Underground
- 1,081 m of operating level development located in Correnso Upper and Louis.

2020 saw approximately 125,000 tonnes of ore being extracted from stopes, primarily from the Upper and Lower Correnso areas.

3.3 Future Mining Activities

Production for 2021 will be focused on the Upper Correnso area (~942 mRL) initially and will then move into the Edward section of Martha Underground in the second half of the year. For a full outline of planned activities for the 2020/2021 period, refer to the Annual Work Programme July 2020 – June 2021.

3.4 Waste rock management

Waste rock is managed in two ways; underground stockpiling and backfilling into stopes and placement on temporary stockpiles on the surface.

On the surface, a short-term stockpile is maintained immediately behind the mill area, enabling easy access for backloading. Larger or longer-term volumes may be stored at the Favona 'Polishing Pond' Stockpile (near the water treatment plant polishing pond). Waste rock placement at this stockpile started in early February 2007 and the site has also been utilised for interim placement of Martha ore. Before undertaking stockpile construction, the Favona Underground Mine Settlement, Dewatering and Water Quality Monitoring Plan was prepared, and approved by Waikato Regional Council (WRC). A separate Favona Water Quality Monitoring Report is prepared mid-year and submitted to WRC.

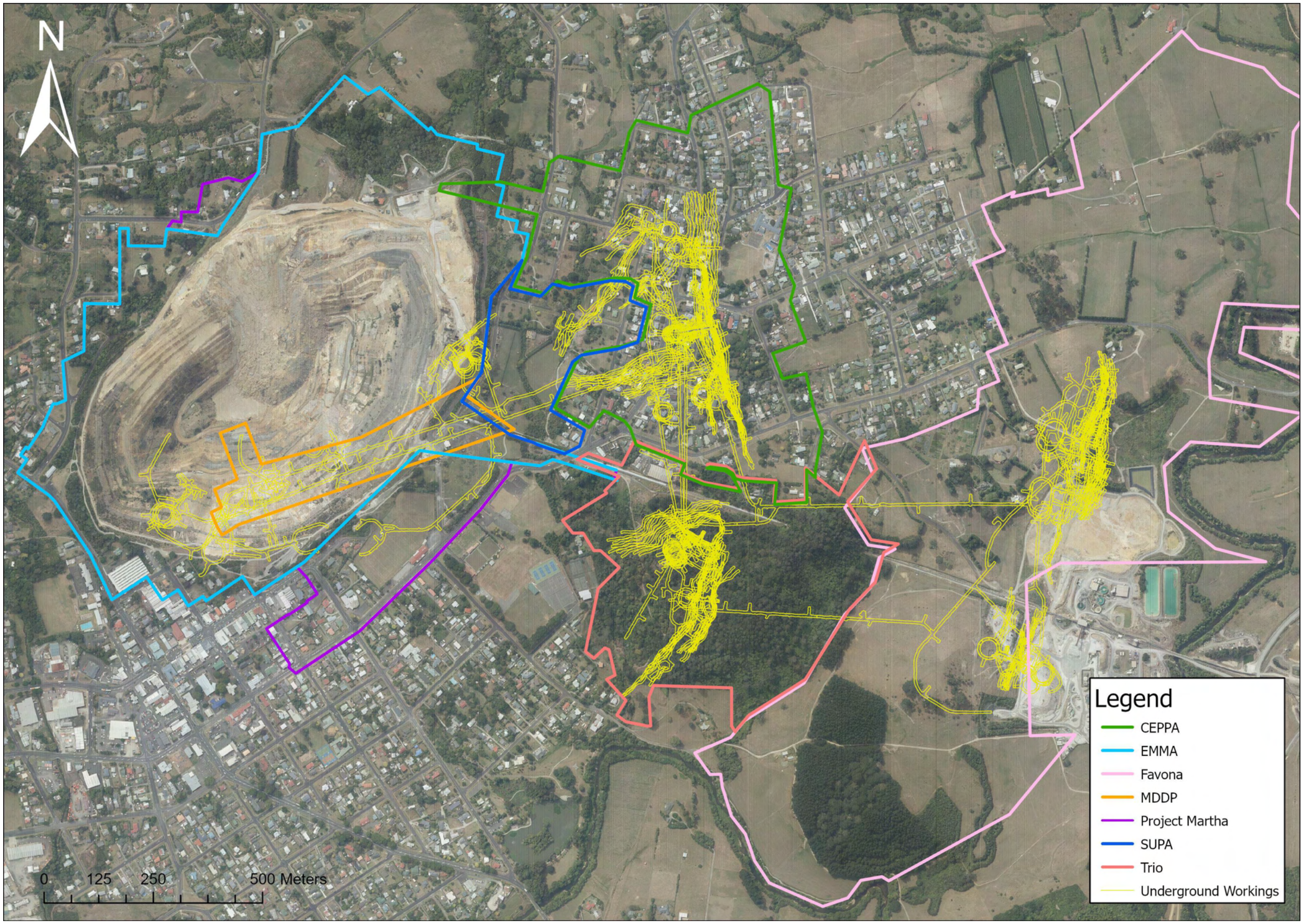


Figure 2: Current workings and boundaries

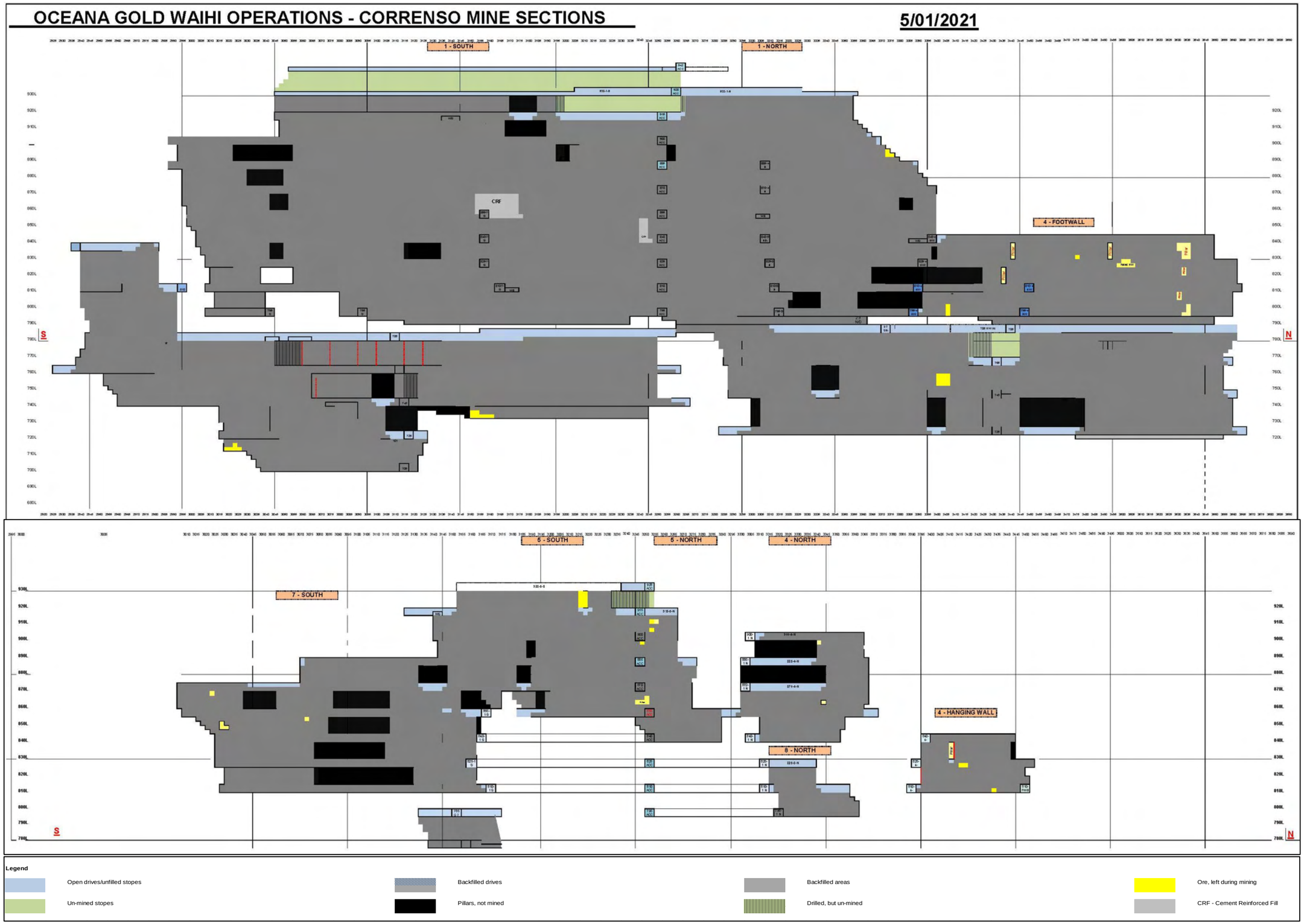


Figure 3: Mine Sections of Correnso Operations (Development and Backfilling)

4 DEWATERING

Table 1 shows the annual combined abstraction rate from Martha, Favona, Correnso and Trio. Figure 4 shows groundwater take rates and water levels and Figure 6 and 7 show the current pump arrangement for underground dewatering.

During 2020, four dewatering pumps in two bores (800 PC1 and 800 PC2) were installed from the 800 mRL level to lower water levels for Project Martha development. Dewatering to 500 mRL is permitted under the Project Martha consent. Dewatering water from these bores is connected to the existing Correnso dewatering line. Water levels began to be drawn down using these pumps during 2020, though were not lowered beyond 700 mRL (Figure 5).

Table 1 - Martha, Favona, Trio & Correnso Mines Annual Dewatering Volumes and Rates

Year	Total mine take (m^3)	Average pump rate (m^3/day)	Service water pumped underground (m^3)	Total Mine take minus Service Water (m^3)
2015 (May 18th onwards)	1,338,760	5,871	60,727 (23 Sep onwards)	1,278,033
2016	2,911,046	7,954	181,466	2,729,580
2017	3,637,734	9,996	219,198	3,418,536
2018	4,285,048	11,511	262,227	4,022,821
2019	3,153,288	8,639	254,859	2,898,429
2020	2,687,124	7,342	173,290	2,513,834

At the request of a peer reviewer, a standalone flow meter for the Favona dewatering line was installed in December 2019, abstraction rates from Favona are shown in Table 2.

Table 2 - Favona Mine Annual Dewatering Volumes and Rates

Year	Favona Mine take (m^3)	Average pump rate (m^3/day)
2019	1,637 (first reading 12 December 2019)	125
2020	14,313	39

Note: for continuity, Favona abstraction volumes are also included in 'Total mine take' numbers reported in Table 1.

4.1 Future Dewatering

The Project Martha dewatering consent, which allows dewatering to no lower than 500 mRL. Underground water levels were not drawn below 700 mRL in 2020 but will be progressively lowered during 2021. The target pumping rate when the system is 37 L/s at each of the four pumps. Water levels are projected to be lowered by an additional 40 m in 2021. Water levels in the dewatering bores are currently being measured weekly using a water level dip meter. Pressure transducers will be installed during 2021 to collect continuous water level readings.

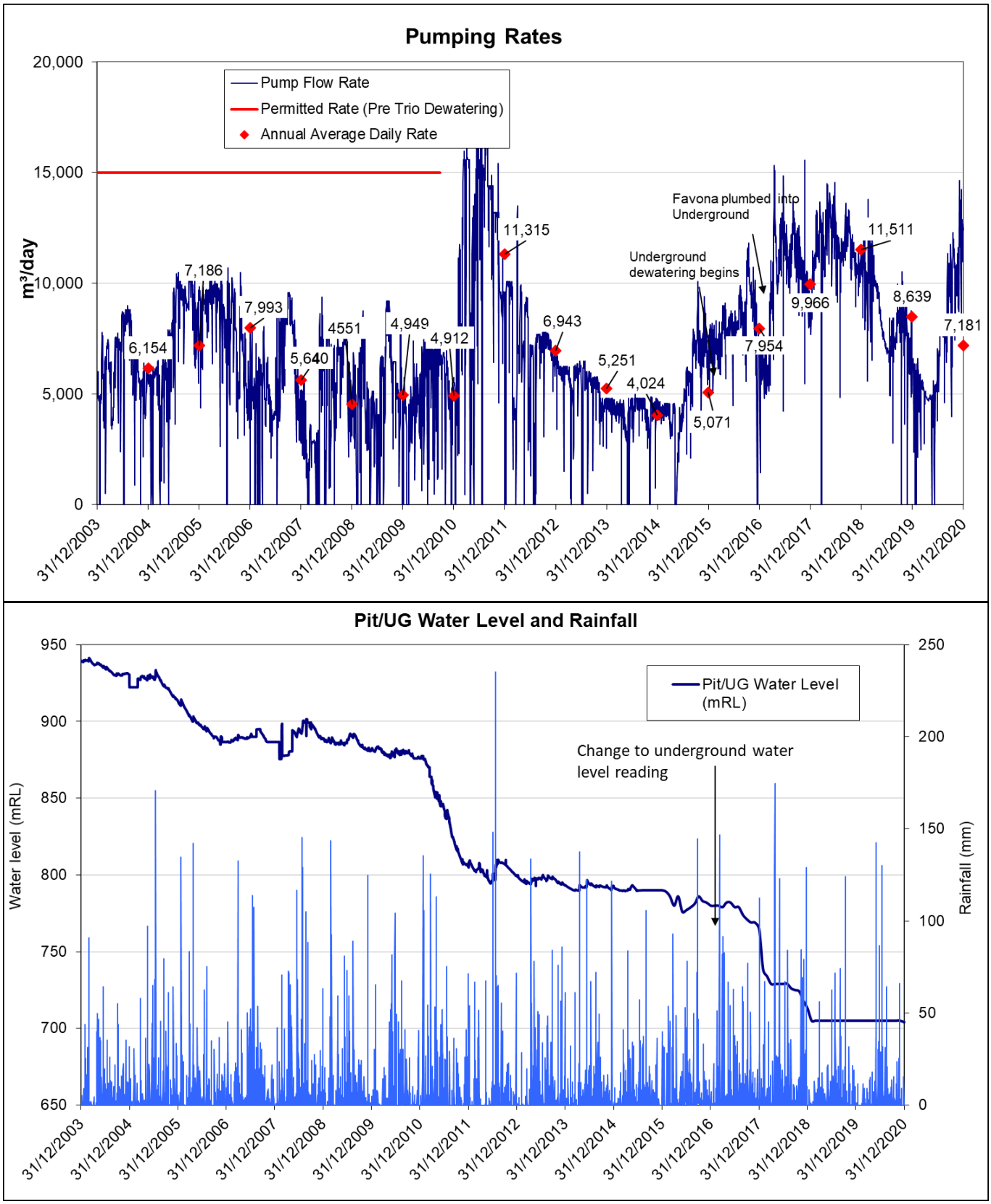
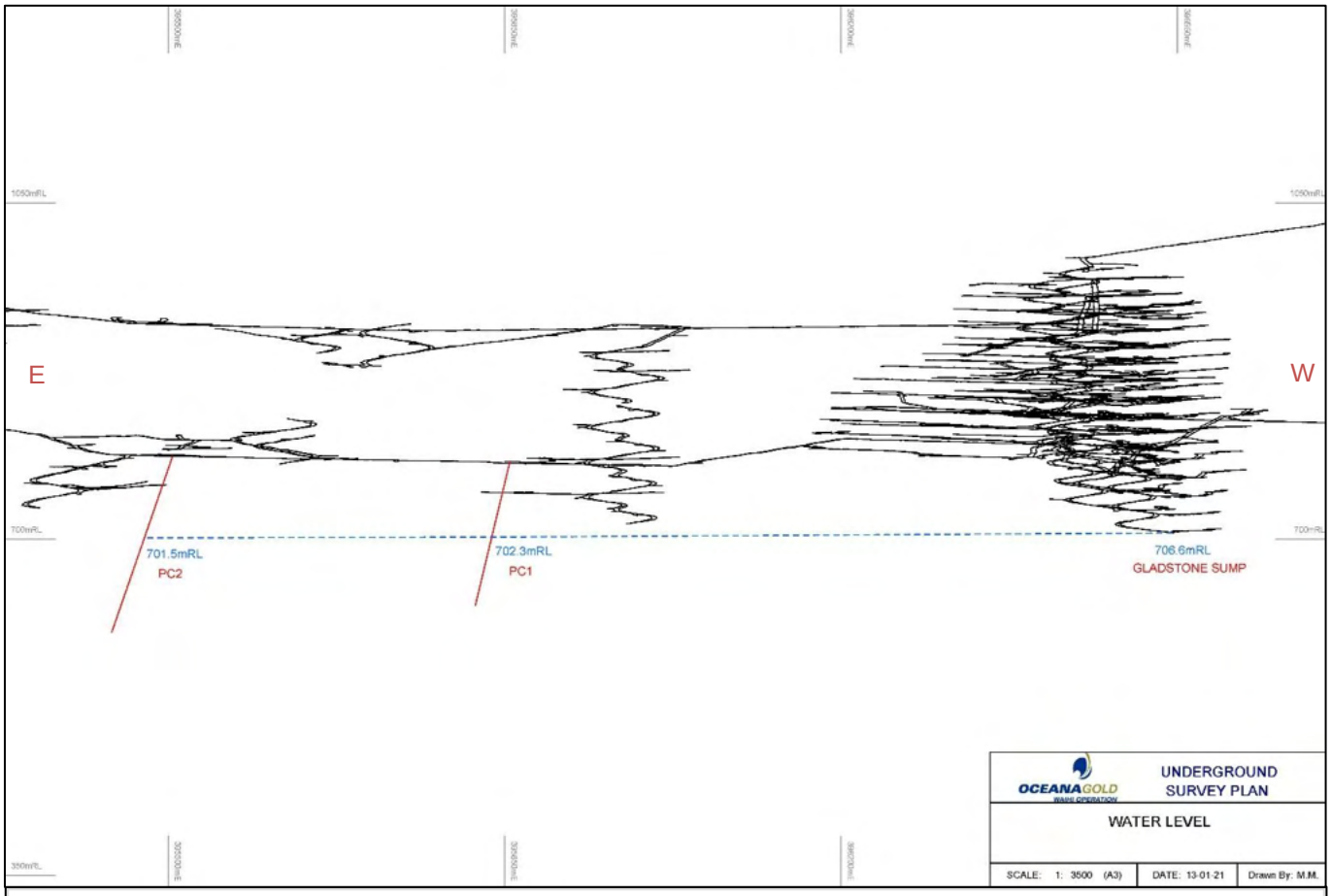


Figure 4: a) Martha Mine/Correnso dewatering rates, and b) Dewatering water level and rainfall



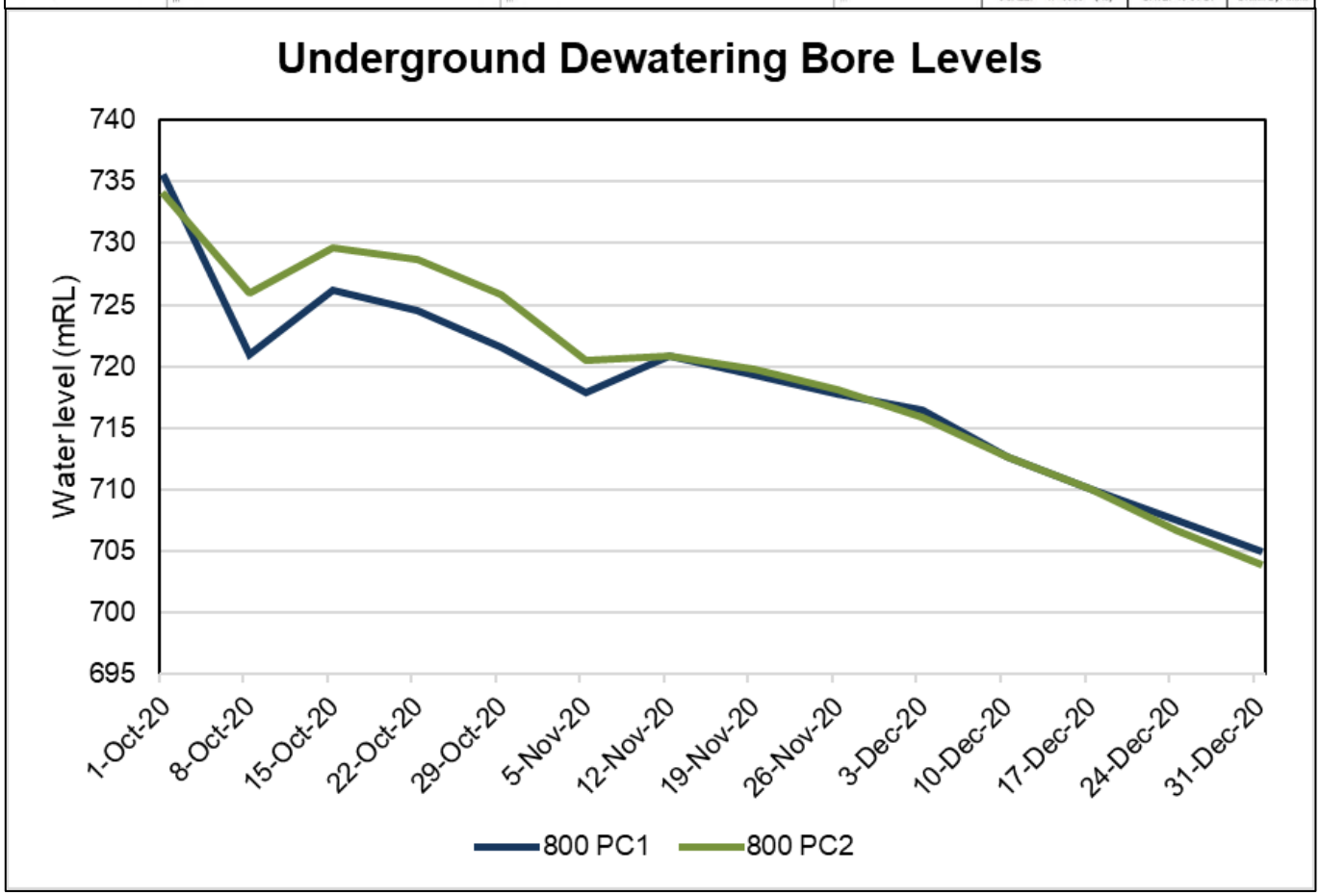


Figure 5: a) Project Martha dewatering bore locations, and b) 2020 dewatering bore water levels

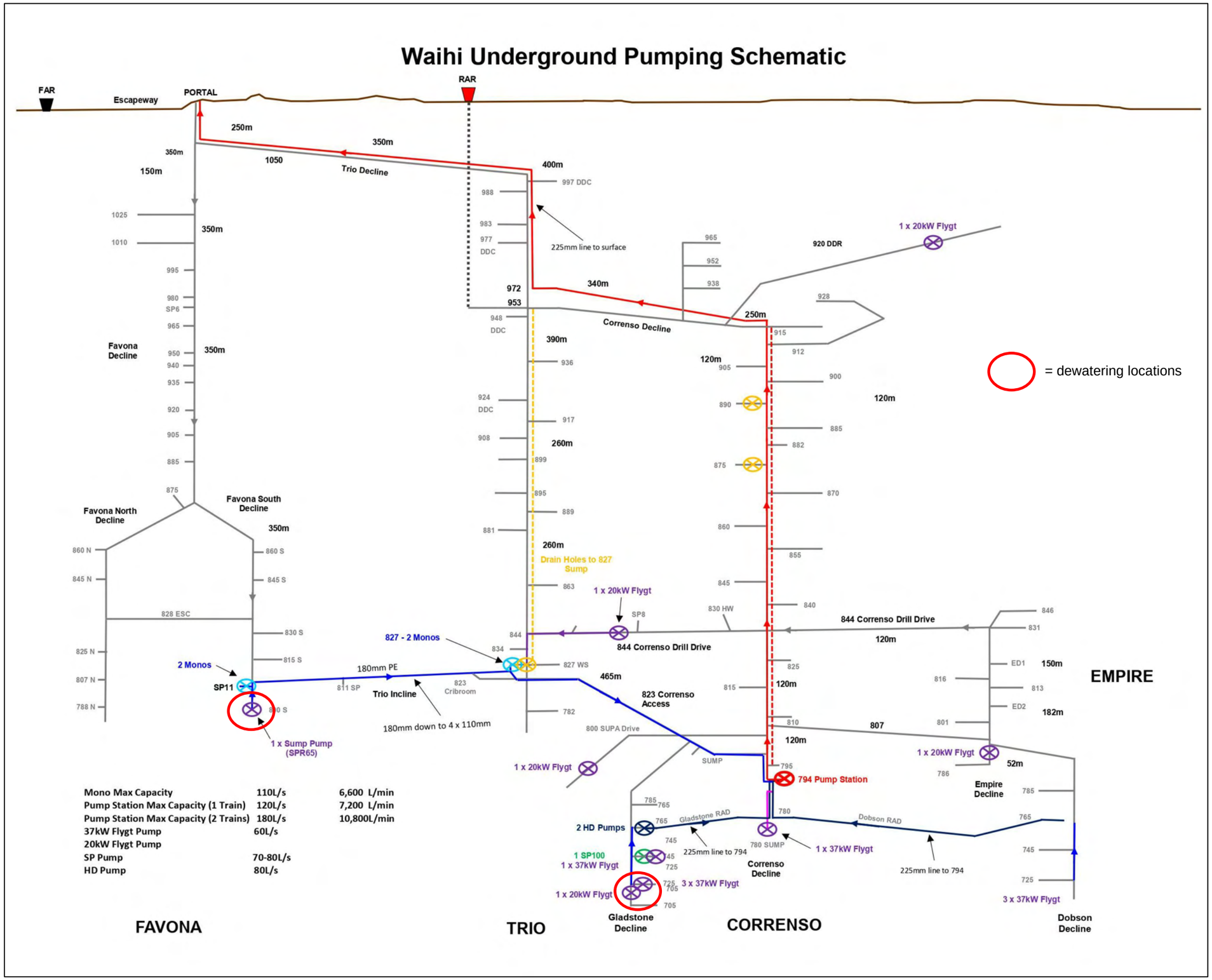


Figure 6: Underground Pumping Schematic December 2020

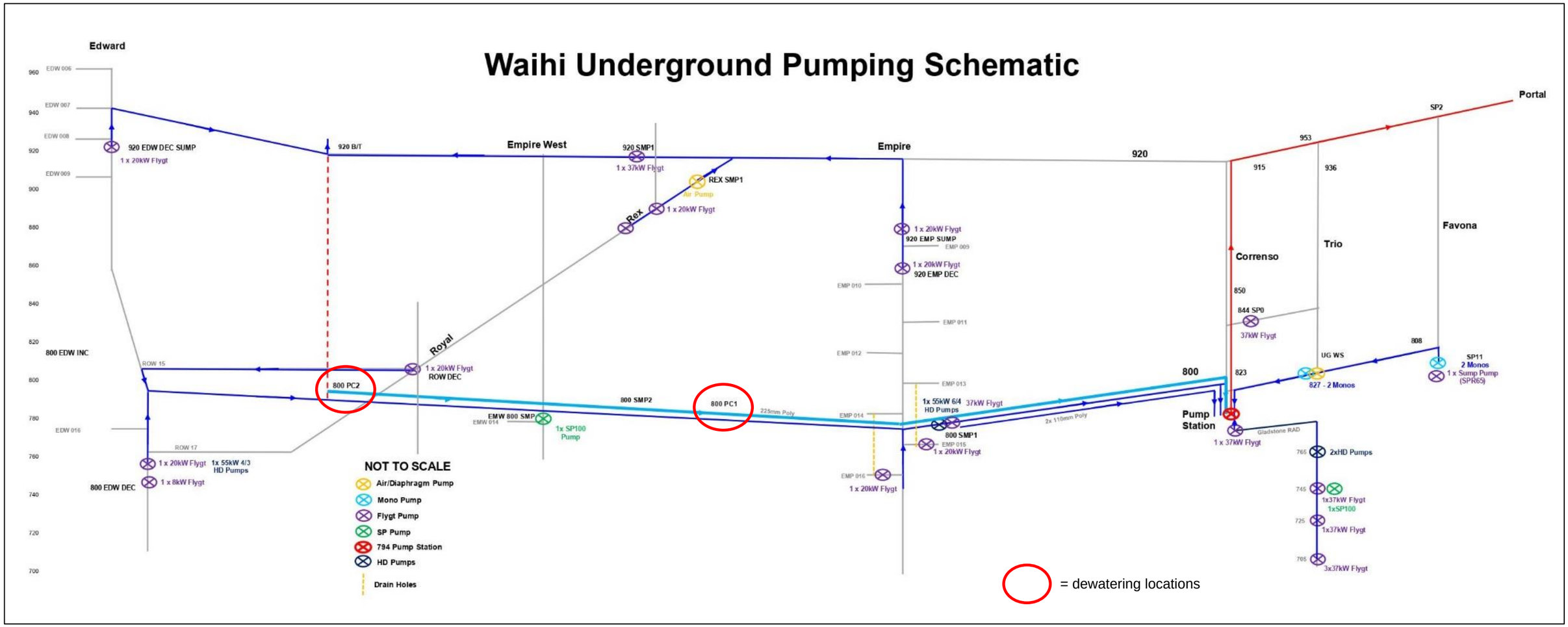


Figure 7: Underground Pumping Schematic - New borehole pumps commissioned 2020

5 GROUNDWATER MONITORING

This section is provided to meet Conditions 13 a, b and c of the Martha consent, Conditions 2a, 4b, and 4c Schedule 2 of the Favona consent, Conditions 6(ii) and (iii) of the Trio Development consent (referred to by the Trio Underground Mine Consent 6.1.1), Condition 35 of the Correnso Underground Mine Consent and Condition 29 of the SUPA Consent. It includes:

- Data from monitoring undertaken during the previous year including groundwater contour plans (derived from the data) in respect of the piezometer network.
- Identification and interpretation of any environmentally important trends in dewatering behaviour or groundwater profile. Existing trends identified prior to end of 2020 will not be discussed in depth unless there has been a significant change or trigger reached.

5.1 Method

OGNZL has maintained a piezometer network within and around Martha Mine since 1987 and Favona Mine since 2004. Additional Correnso/SUPA piezometers were installed in 2011, 2014 and 2016. P106 was drilled and four vibrating wire piezometers installed in that drill hole during 2017. It is located to the north west of Martha Pit (Figure 8). Seven Project Martha piezometers were added to the network during 2019 and a further three were completed during 2020 (Figure 33). Table 3 lists the piezometers currently operational that are assigned to each of the three main geological units.

Table 3 - Current Waihi Piezometer Network

Alluvium	Depth (mRL)	Younger Volcanics	Depth (mRL)	Martha Andesite	Depth (mRL)	Favona Andesite	Depth (mRL)
~~DM21-1 dry~~	~~1103~~	BH6-1	1052	BH11	1074	~~P60 ** dry~~	~~1075~~
~~DM31-1~~	1112	BH7-1	1078	~~P1-1 dry~~	~~1065~~	~~P61~~	1076
~~DM71~~	1114	BH8-1 dry	1048	P2-1 dry	974	P64-D dry	1062
~~DM81-1~~	~~1117~~	BH9-1	1073	P2-2	1034	P75	979
~~DM82-1~~	~~1114~~	BH12	1090	~~P4-1~~	~~994~~	P76-D	1055
~~DM83-1~~	~~1116~~	~~P1-2~~	~~1091~~	P7-1	988	P77-D	1031
~~DM85-1~~	~~1115~~	P2-3	1073	P8-2	1044	P78-D	1052
P2-4	1111	P4-2	1047	P8-1	975	P79-D	1047
~~P4-3*~~	~~1093~~	P7-2	1039	P9-1	1036	P87-D	1024
P8-4	1113	P7-3	1080	~~P62 dry~~	~~1021~~		
~~P9-3~~	~~1108~~	P8-3	1092	P69-S	1114		
P63-S*	1111	~~P9-2~~	~~1084~~	P69-D	1063		
P76-S*	1109	P27-1	1073	WC201-1	1058		
P77-S*	1110	P63-1	1070	WC201-2	1077		
P78-S	1103	P64-I	1086	WC201-3	1096		
P87-S	1110	P76-I	1072	WC202-1	1031		
WC201-4	1103	P77-I and P77-I2	1045	P90-3	982		
WC201-5	1109	P78-I	1051	P91-4	970		
~~WC202-4 dry~~	~~1099~~	P79-I	1066	P92-3	965		
~~WC202-5 dry~~	~~1112~~	P79-S	1061	P93-4	974		
P90-1	1096	P87-I	1090	P94-4	976		
P91-1	1105	~~WC202-2~~	1069	P95-3	1000		
P92-1	1114	P90-2	~~1048~~	P100-3	981		
P93-1	1102	P91-2	1019	P100-4	956		
P94-1	1108	P91-3	1096	P101-4	1037		
P101-1	1102	P92-2	1010	P102-4	1026		
P102-1	1108	~~P93-2~~	1000	P106-1	1100		
		P93-3	~~1091~~	P106-2	1060		
		P94-2	1014	P106-3	1010		
		P94-3	1094	P106-4	974		
		P95-1	1016	P111-2	1088		
		P95-2	1090	P111-3	1055		
		P100-1	1030	P112-2	1035		
		P100-2	1066	P112-3	997		
		P101-2	996				
		P101-3	1083				
		P102-2	1068				
		P102-3	1078				
		P107	1054				
		P108	1090				
		P109	1115				
		P110	1090				
		P111-1	1097				
		P112-1	1100				
		P113	1057				
		P114	1063				
		P115	1054				
		P116	1103				
			1098				

* - at or just below the contact with weathered young volcanics
** - collapsed piezometer

WC – Pneumatic piezos
~~P93~~ – Strikethrough indicates failed or lost piezometer

All piezometers are monitored on a monthly basis as required by the consent conditions. The water levels are translated to the mine datum reference level to enable comparison between bores or areas. Where installed, vibrating wire piezometers record values at daily intervals with the data downloaded monthly.

5.2 Inspection and Maintenance

The piezometer dip-meter is maintained in good working condition. A calibration of the dip-meter tape against a reference tape is carried out annually by Hydrologic NZ Ltd. The dip-meter tape is replaced if the difference against the reference tape is more than 0.1%. The dip-meter was calibrated in January 2020.

The consent conditions require an inspection of the piezometer installations and appraisal of the piezometer network every two years. In effect, inspections of the piezometer network are undertaken more frequently, with the piezometer monitoring procedure requiring 6-monthly sounding to the bottom of all standpipe piezometers to identify any with excess silt and mud.

The piezometer designs have screens which allow water inflow into the pipe. Piezometers that are most impacted by sediment are on a flushing schedule, with flushing of silted boreholes occurring in November of 2019. Piezometers P8-2 and P7-2 have showed little change after multiple flushing attempts.

5.3 Groundwater Results

The Waihi town piezometer network currently has 52 dipped piezometers and six pneumatic piezometers. An additional 14 data loggers connected to 41 vibrating wire piezometers are also included in monitoring Waihi East and south of Martha Pit (Figure 8). On the north east side of the pit, seven real time data loggers are installed in wells, these were installed to investigate the source of a seepage and data collection is ongoing. Groundwater contour plans have been updated for the three principal geological units: alluvium (plus shallow groundwater in weathered younger volcanic materials); younger volcanics (including ignimbrite); and andesite. The groundwater plans are presented in Figure 9, Figure 11 and Figure 14 respectively. Discussion of results for each unit follows.

Only the andesite contour map includes data from the vibrating wire piezometers. Alluvium and younger volcanics contour maps have not included vibrating wire piezometers as the vertical gradients evident do not provide a unique water level.

5.3.1 Changes to monitoring network 2020

- Three new piezometer locations were added to the network for Project Martha monitoring during 2020 (P112, P115 and P116).

Figure 8: Waihi Piezometer Network 2020

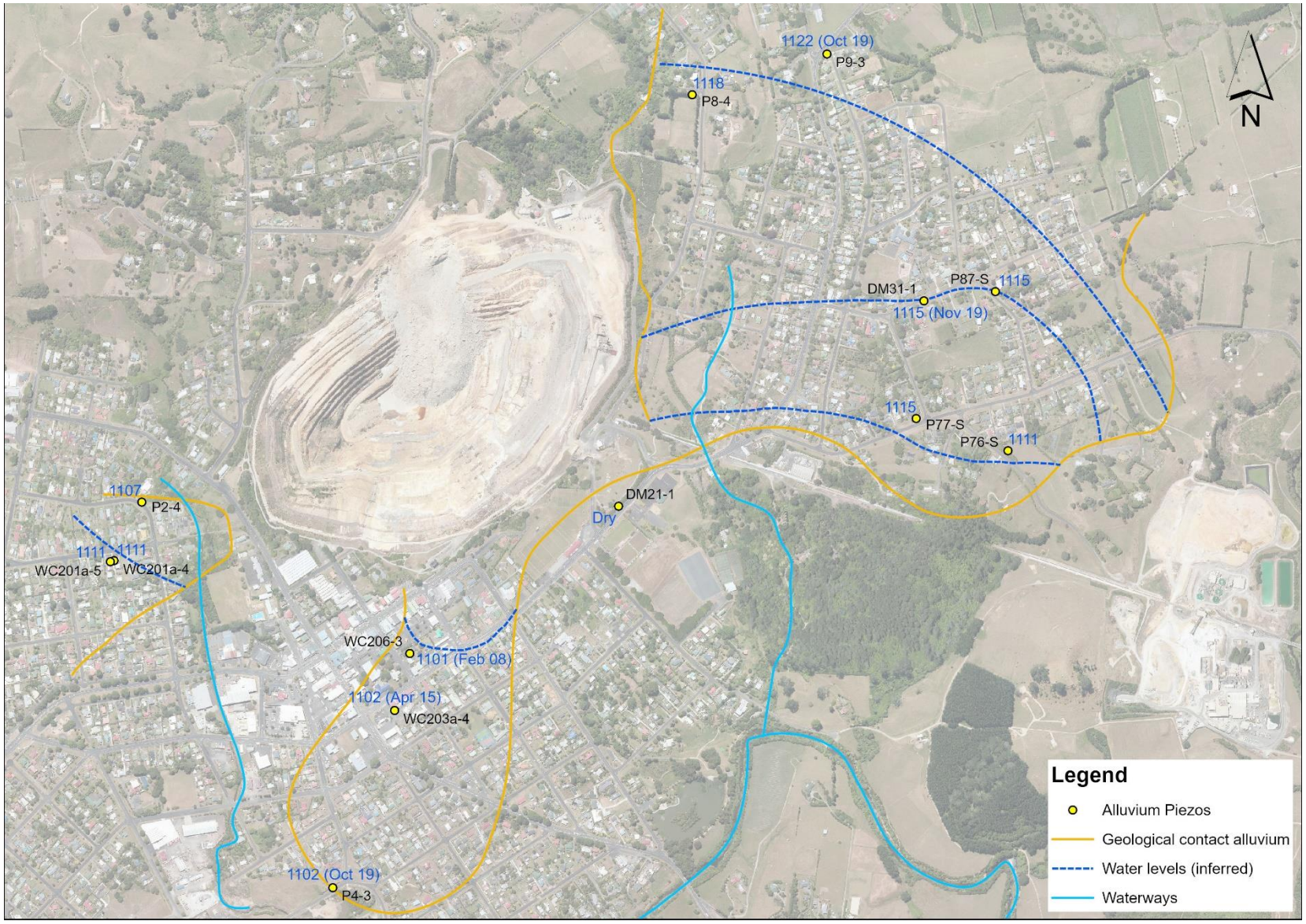


Figure 9: Alluvium water level contours

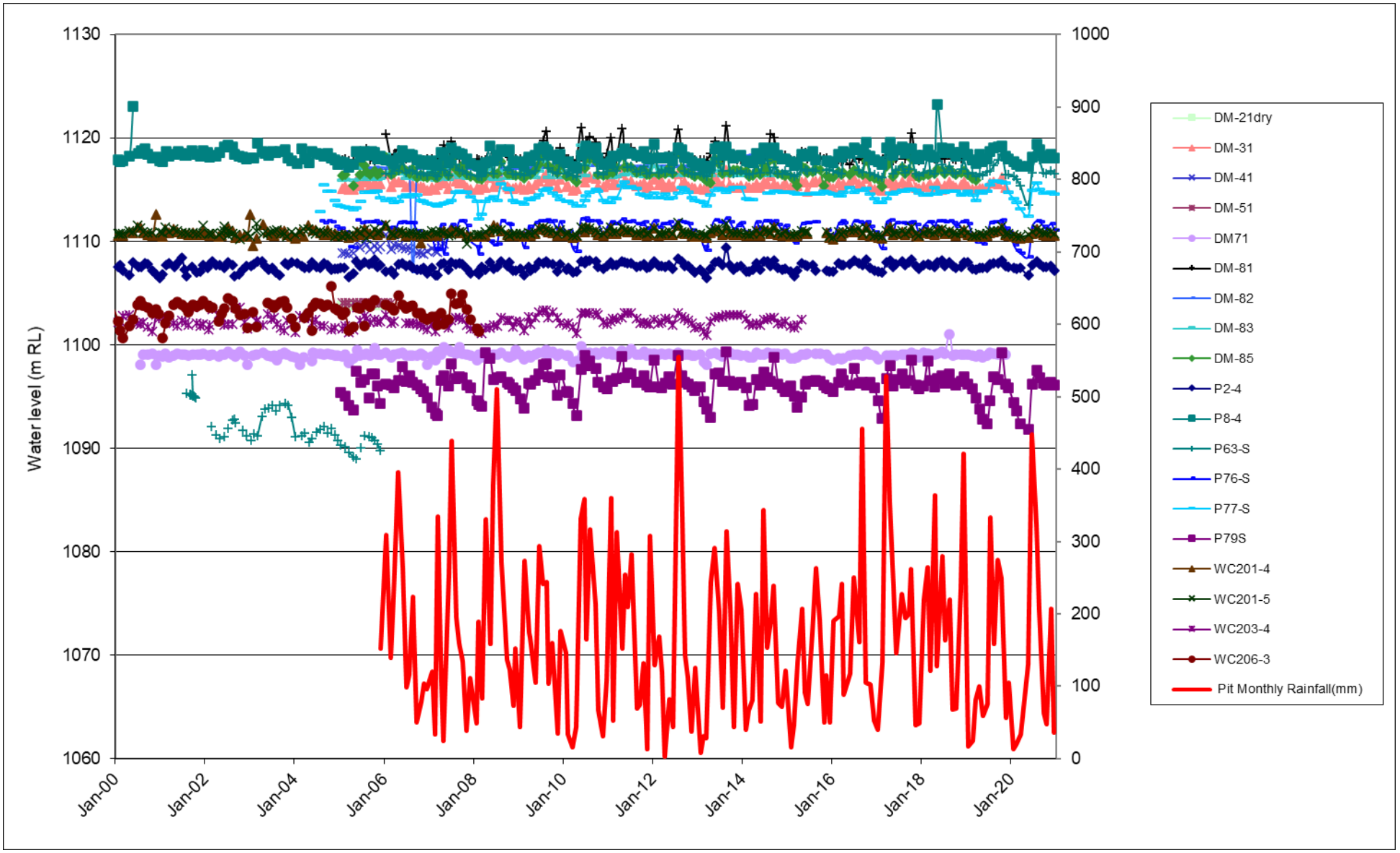


Figure 10: Groundwater Level Trends – Shallow Groundwater (Alluvium & Weathered Contact of Young Volcanics)

5.3.2 Shallow Groundwater

Figure 9 shows the inferred contours for shallow groundwater in alluvium and in weathered younger volcanic materials and shows the water level trends over time. The overall contour pattern and the trend plots demonstrate that the shallow groundwater system remains essentially unaffected by dewatering of the surface and underground mining operations. Shallow groundwater levels are controlled, principally, by rainfall infiltration, low surface soil permeability and natural and assisted drainage to surface water systems.

Contouring of the lobe southwest of Martha Mine (Figure 9) has been restricted by the loss of access to the wells at sites WC203 and WC206. For the purposes of completing the contour plan it was assumed that groundwater levels in the alluvium at these locations remained the same as in previous years.

5.3.3 Younger Volcanics

Groundwater contours in the deeper portions of the younger volcanic materials below the shallow groundwater system are shown on Figure 11 and trends are graphed on Figure 12.

The younger volcanic materials infill topographic depressions in the surface of the andesite rock body in which the open pit and underground mines are constructed.

Groundwater level change and the associated consolidation of the varying thickness of these relatively weak younger volcanic materials is considered to be responsible for much of the settlement and for the settlement patterns around Martha and Favona mines.

The dewatering pattern in the younger volcanics around Martha Mine indicates drainage towards the open pit. The limited groundwater discharge at the contact of the younger volcanic materials with the underlying andesite in the pit (see Figure 11 and 12) suggests drainage is affected by features other than the contact (which defines a paleovalley in the andesite). The most likely additional drain point is a substantial block cave evident in the pit wall. This block cave, referred to as the Milking Cow, was active during historical underground operations and resulted in substantial settlement of the ground surface, down-folding of fill and younger volcanic strata and close fracturing of the welded ignimbrite layers.

Prior to the start of dewatering at Martha Mine, groundwater levels in all rock units were similar. With the onset of mine dewatering, water levels in the veins and historic workings were drawn down. Groundwater levels in the various rock units below the shallow aquifer showed increasing vertical separation until about the mid to late 1990's. Thereafter, the water levels (in other than the veins and workings) stabilised and have remained stable since. This pattern is demonstrated in monitoring wells at site P2. With piezometer P2-1 following the vein water levels until water level dropped below the piezometer tip, P2-2 the upper andesite water levels P2-3, younger volcanic rock water levels and P4-2 alluvium (shallow aquifer) (Figure 14).

Piezometers P1-1 and P1-2 were lost in early 2016 due to public carpark resurfacing.

The development of the settlement pattern has shown a similar behaviour with an initial higher rate of settlement followed by a much-reduced rate of settlement once groundwater levels in the upper rock layers stabilised. These patterns are discussed in the following sections.

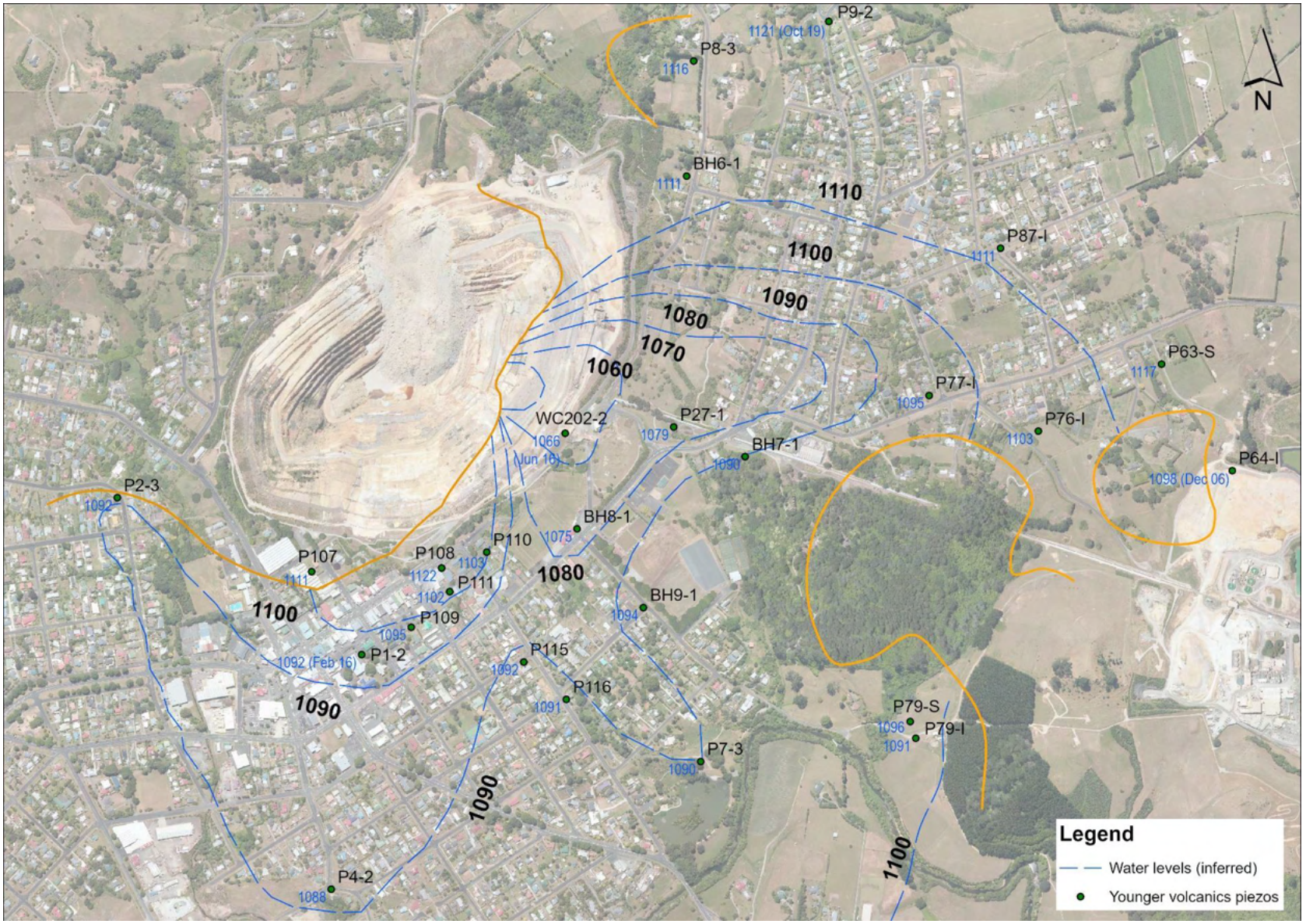


Figure 11: Deeper Younger Volcanic Water Level Contours

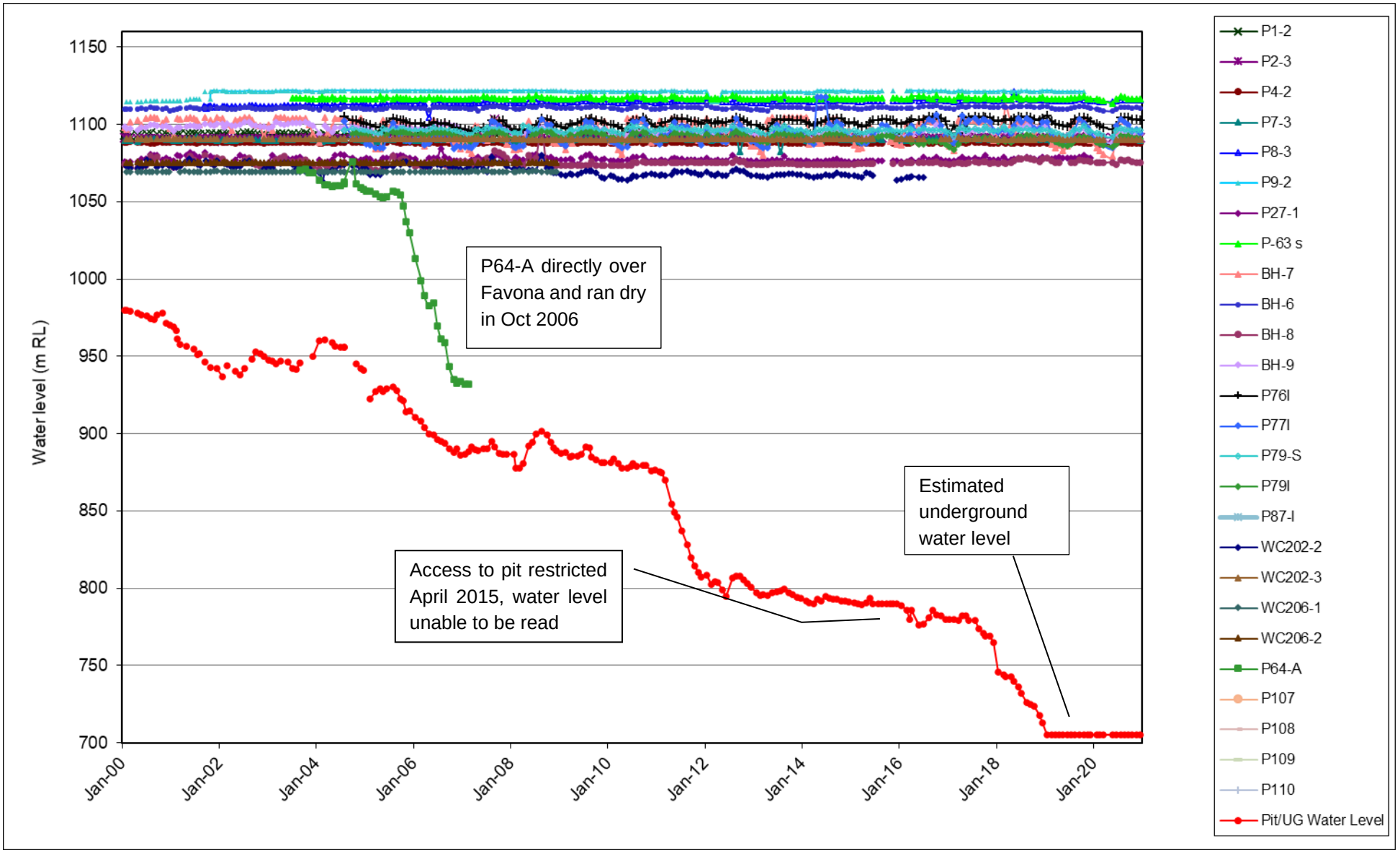


Figure 12: Groundwater Level Trends - Deeper Younger Volcanic Materials

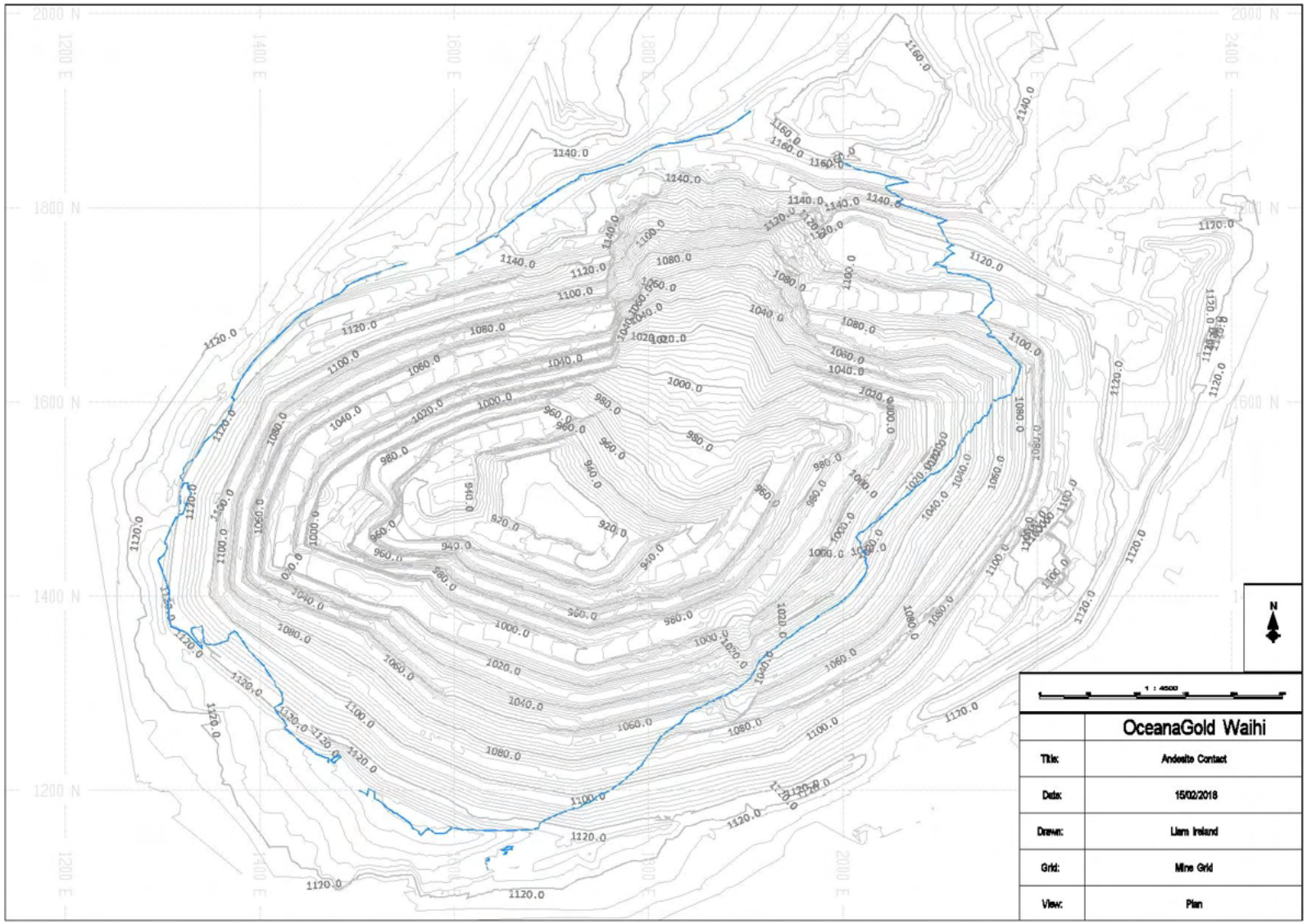


Figure 13: Andesite Younger Volcanic Materials Contact in Martha Pit

5.3.4 Andesite

Andesite rock forms the local basement rock body for the area and hosts the mineralisation which was being mined at Martha Pit and is mined in the Underground.

Figure 14 shows the scope of the dewatering effects in the andesite rock body as a result of dewatering. Data from the Waihi East vibrating wire piezometer units have been included. Figure 15 provides the water level trends in the andesite rock body. While groundwater level data is available for the vein systems and the shallower andesite rock, no monitoring data is available for intermediate depths within the andesite rockmass outside of development areas. Hence, groundwater levels between the vein and the shallow rockmass have been interpolated.

Groundwater levels in the andesite vein systems have responded rapidly and substantially to mine dewatering along the strike of the Martha vein system, along the strike of the Trio vein system beneath Union Hill, and also along the strike of the Favona/Moonlight vein systems (Figure 14). An area of dewatering, indicated between Martha Mine and Trio/Correnso vein systems, suggests a relatively close linkage. Outside of these structures, the dewatering effect in the andesite rock is attenuated or absent. This is illustrated by the different responses shown on Figure 15.

The Martha Mine dewatering effect continues to be abruptly attenuated to the north of the mine and also to the west of the mine. This is considered to be the result of faulting which truncates the veining. A lobe of dewatering extends to the southwest of Martha Mine and this is considered to be due to the drainage effect along the N-S Edward lode structure. Dewatering is shown to reduce eastwards along the Martha system but may extend further at depth as the host rocks are more deeply buried in that direction and no deep monitoring wells are available for confirmation.

Figure 14 also indicates the dewatering centralised on the Favona system with the restriction of connection between Favona and the Union systems. The geological model in Section 3 indicates an up-thrown block (Union Horst, Figure 14) between the Union and Favona systems. This structural hiatus is likely to account for the restricted groundwater interconnection between the Martha-Union and Favona systems.

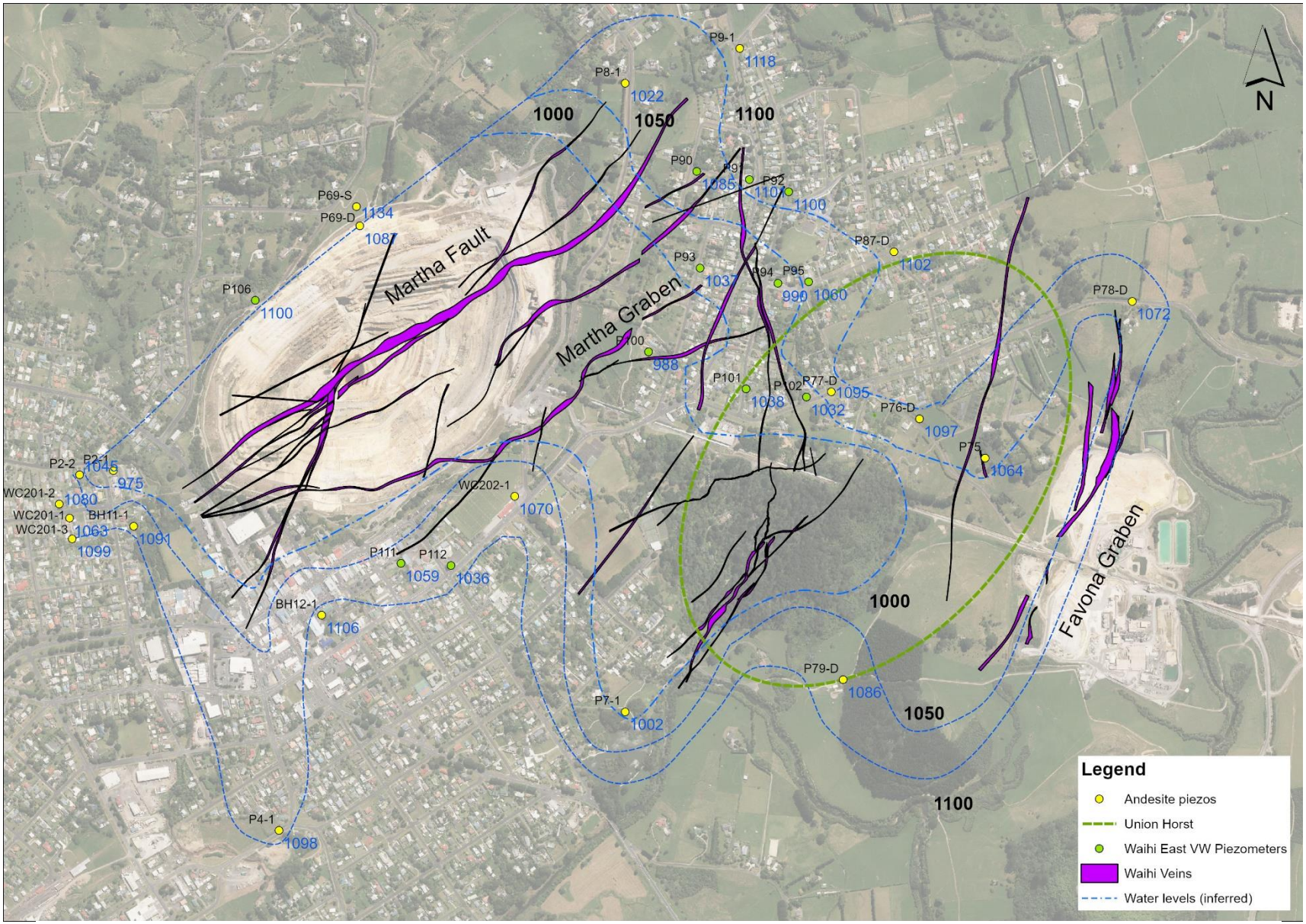


Figure 14: Andesite water level contours

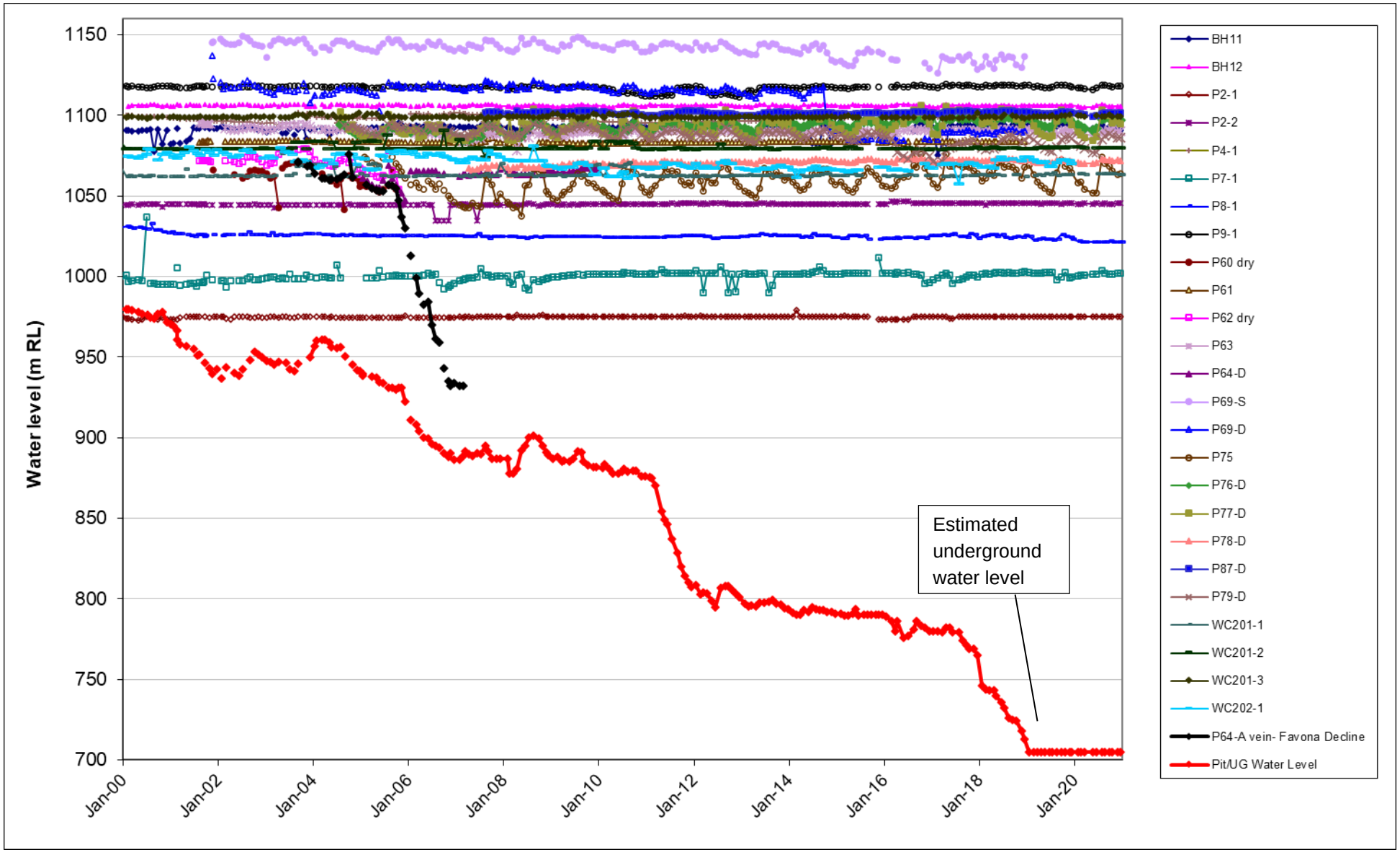


Figure 15: Groundwater Level Trends – Andesite

5.3.5 Martha groundwater assessment

P69D & P69S were installed in 2001 and are located close to the rim of the North Wall of Martha Pit. They were considered control bores and previously uninfluenced by dewatering. Geotechnical stability work in the North Wall was undertaken in October 2014, partly due to excessive water. Drainage holes were drilled into the lower wall. Localised drainage of the wall resulted, and the water levels in P69D and P69S declined. By March 2015 the piezometers had stabilized with P69D and P69S declining by 32m and 12m respectively (Figure 16). With the large North Wall slip in April 2016, access to the piezometers was briefly restricted. Real time loggers were installed in mid-2017 and are currently programmed to record hourly. Water levels have remained stable in both the shallow and the deep hole since that time.

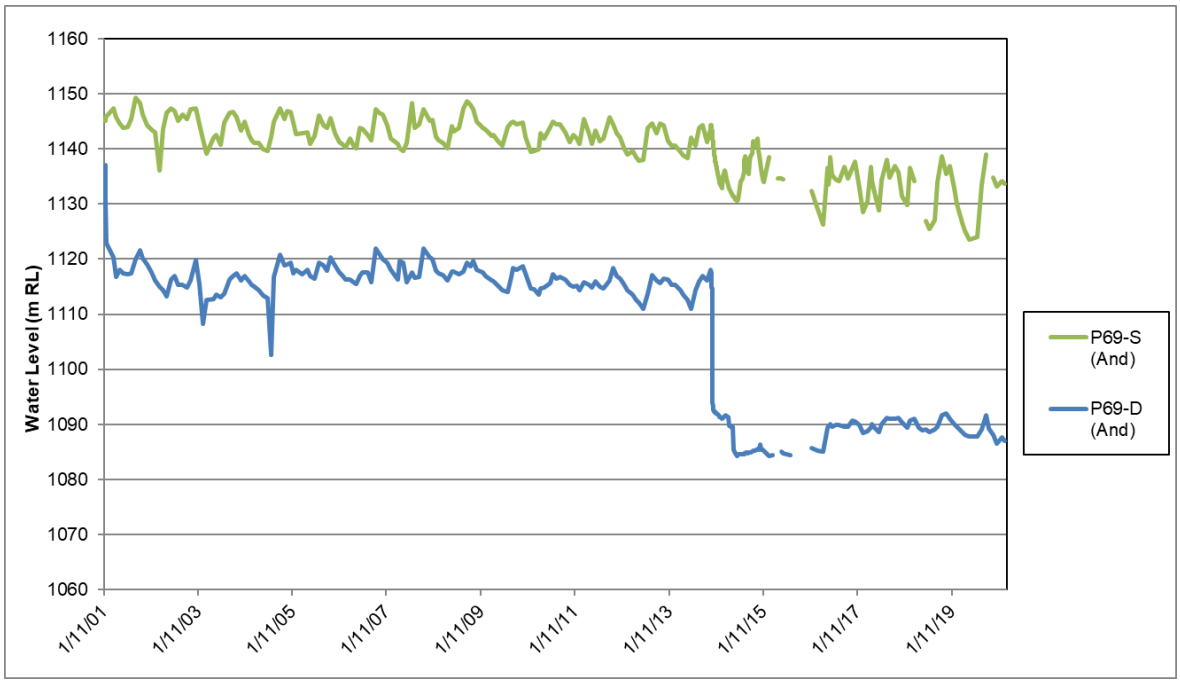


Figure 16: Water Levels P69 Pit North Wall

In September 2017, a piezometer hole (well P106) was drilled on the north-west side of Martha pit (Figure 8). Four piezometers were installed to depths between 37 and 163m. The piezometers tips are in dewatered andesite and results indicate the majority of the rockmass is dry with little or no water pressure.

In mid-2018, five real time loggers recording hourly were installed in new wells (wells P117 – P121) to investigate the source of an area of seepage on the north wall of the pit (Figure 17). Water levels in wells P119, P120 and P121 appear to fluctuate with rainfall while in wells P117 and P118, levels follow long term trends within the andesite. Fluctuations in water level in P117 were observed for the first few months following the installation of loggers before a sudden drop in water level. This effect is likely as a result of the piezometer initially recording the shallower level and responding to rainfall before long term drainage to the pit through the screen occurred, causing the drop to approximately 1118 mRL.

N.B Gaps in data are due to logger malfunction or battery failure.

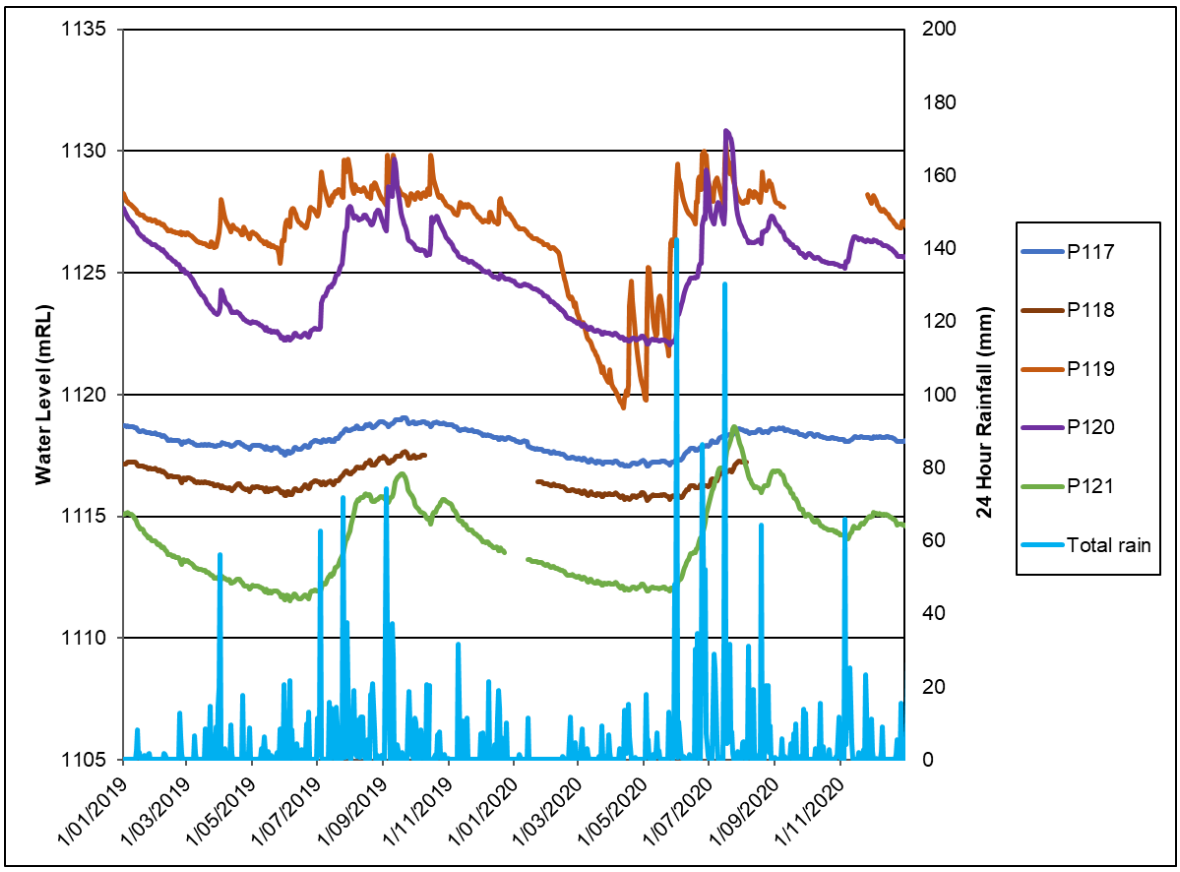


Figure 17: Pit North Wall Piezometer Levels

5.3.6 Private Wells

The private wells show seasonal fluctuations in groundwater levels and these levels can also be influenced by landowners using the bore. The Whangamata Rd and Mataura Rd bores can no longer be accessed due to health and safety concerns. Additional monitoring has been undertaken at an existing well at Black Hill Orchard after a local orchardist requested OGNZL monitor their bore.

Overall, there is no indication of any influence in the bores from mine dewatering (Figure 18Figure).

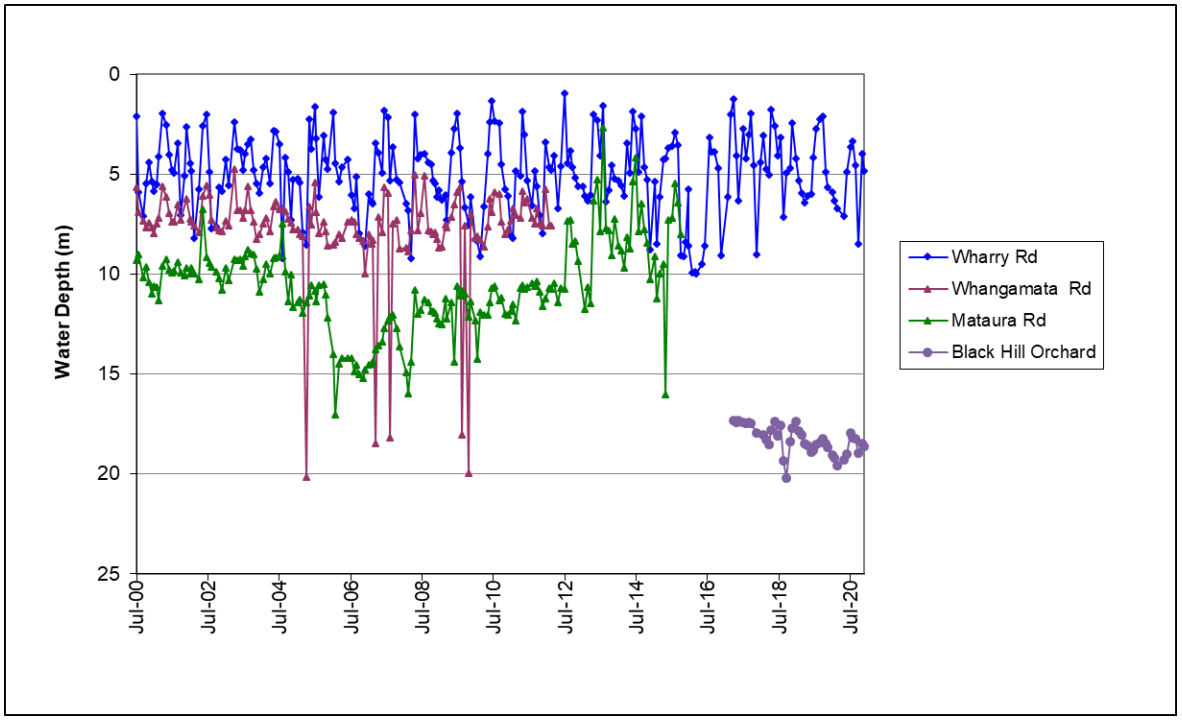


Figure 18: Private Bore Water Levels

5.3.7 Favona Trigger Levels

The Favona dewatering effect is indicated to be limited to the vein system or structures interconnected to the vein system. Apart from P64-A which was directly above Favona workings and ran dry in 2006, the dewatering effect does not extend to wells in andesite rock overlying or adjacent to the vein system (wells P76-D; P77-D and P79-D, Figure 14).

The Dewatering and Settlement Monitoring Plan (2019) sets out trigger levels to alert of rapid depressurisation in the andesite as it could affect the overlying younger volcanic rocks.

The Tier 1 trigger level for groundwater change at Favona is defined as, “a drop in water levels greater than seasonal fluctuation in wells tapping the upper 50m of andesite in response to a water level drop in deeper wells (100m) in andesite rock”. Five wells were selected as suitable for assessment (Figure 19 to 23).

The Tier 1 action involves increasing the monitoring in intermediate wells (i.e. wells tapping the younger volcanic materials) with one option being the installation of pressure transducers. The regulator is to be advised when Tier 1 action is initiated. The trigger level has been calculated as the summer water level less the average seasonal water level change over the record.

Wells P76-D, P77-D, P78-D and P87-D all show a rising trend in water levels; as such, Tier 1 action is not forecast.

Piezometer P79-D reached the trigger limit in 2016 when the piezometer recorded a rapid loss in pressure, most likely due to a reaction to water loss from an underground horizontal drill hole. The drill hole was grouted and no further water loss from the hole occurred. Water levels subsequently recovered to above the trigger level with amplified seasonal variation noted since this time. During May and June 2020, water levels in P79D dropped below the trigger level before recovering in July. This is likely due to the amplified seasonal variation caused by a reduction in rock mass storage following the grouting of the drill hole nearby. Continuous water levels are now being recorded in the P79 well set to monitor the trend (Figure 22). Overall, there appears to be a stabilisation in pressure since 2016. Refer to Appendix G for GWS Limited’s review of the trigger breach.

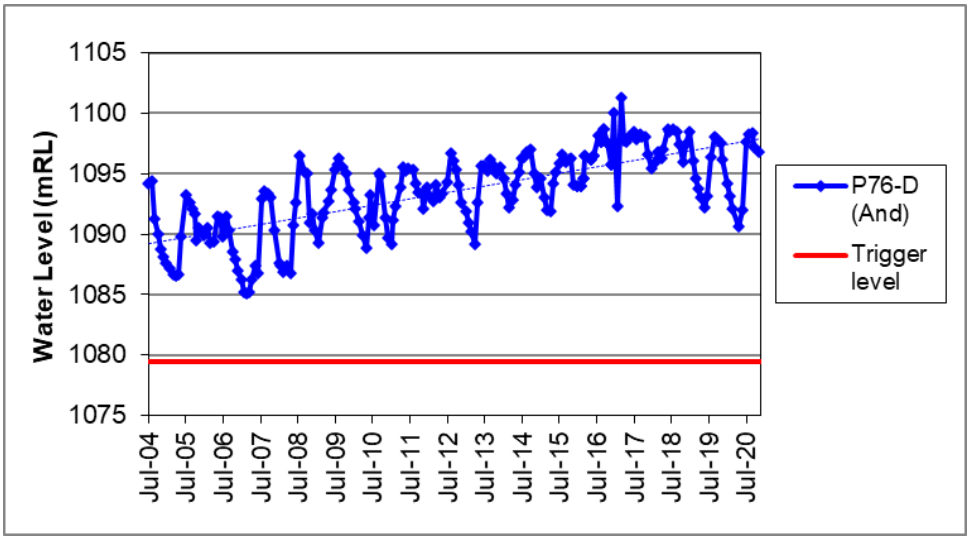


Figure 19: Trigger Level P76-D

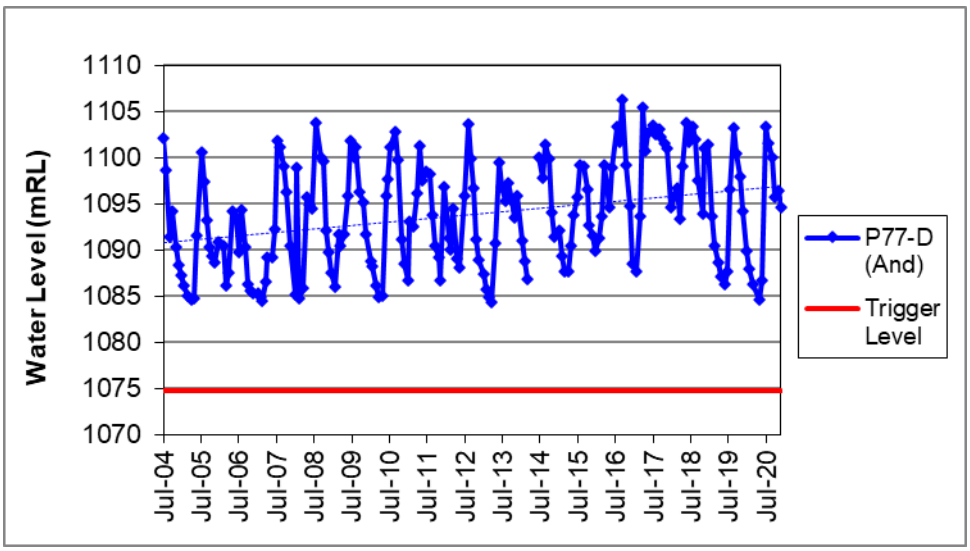


Figure 20: Trigger Level P77-D

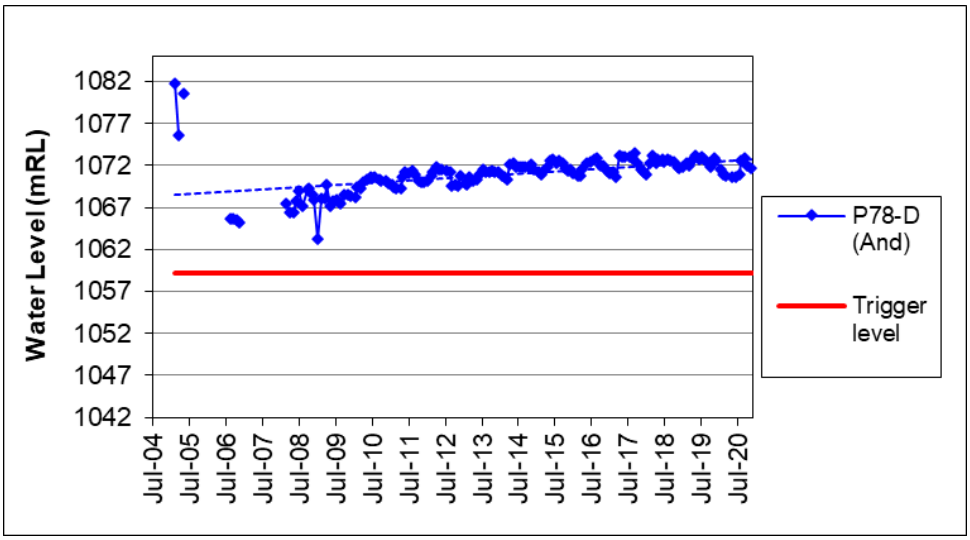


Figure 21: Trigger Level P78-D

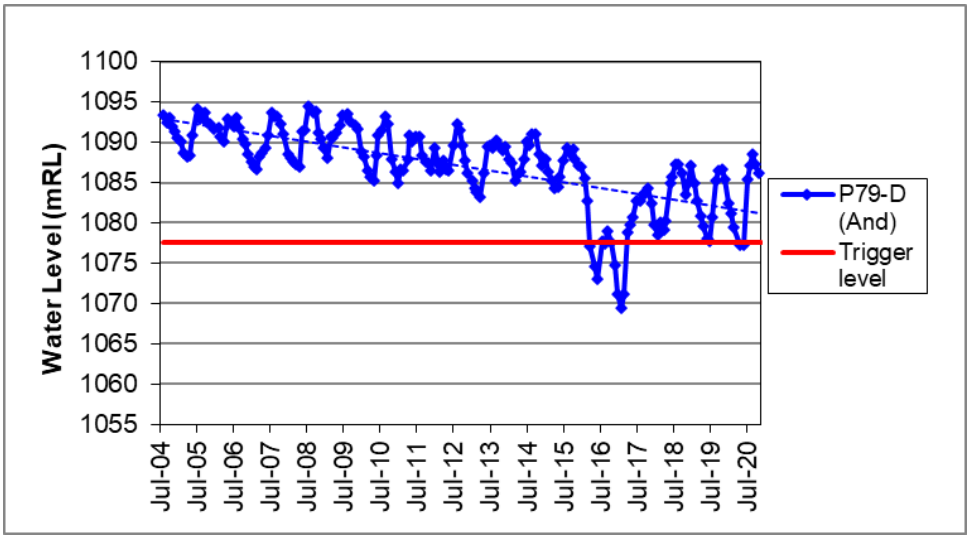


Figure 22: Trigger Level P79-D

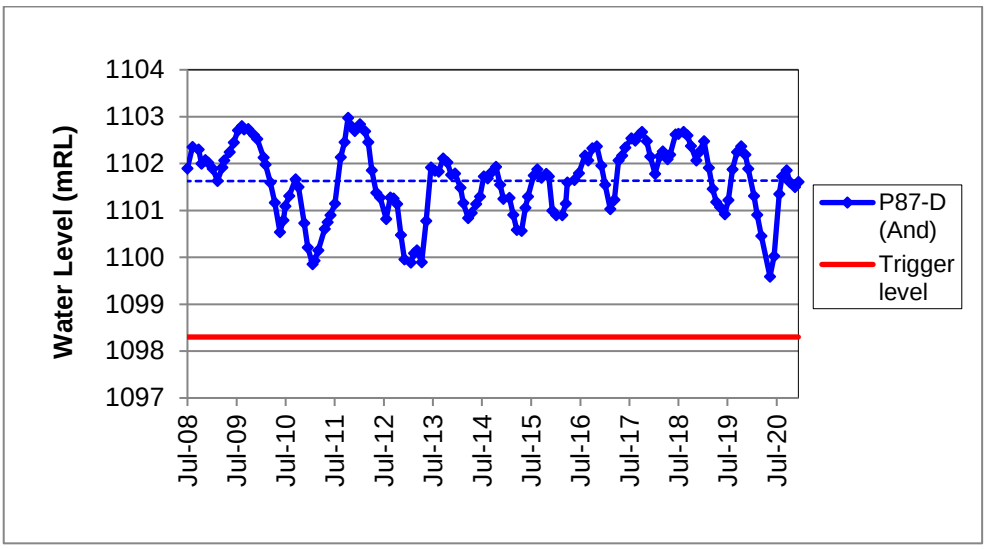


Figure 23: Trigger Level P87-D

Andesite Groundwater Summary

The ongoing evaluation of the groundwater level responses to mining at Martha Mine and at Trio/Favona/Correnso/SUPA Mines has been updated. The data continues to confirm that dewatering effects within the andesite rock are transmitted via interlinked vein systems, faults and historic workings at depth. When the natural conditions are unmodified, these effects are not extending into shallower geological layers or affecting shallower groundwater. Where trigger levels have been set around the Favona Mine, one exceedance of the trigger levels occurred in 2016 and briefly during 2020 (the 2016 trigger was investigated and mitigated; monitoring is ongoing to determine whether further response is warranted for the 2020 trigger). Current trends do not forecast any new exceedances of trigger levels due to mining and dewatering.

5.3.8 Waihi East - CEPA

Six groundwater monitoring boreholes were installed between July – September 2011. They are located east of the Martha pit to provide improved groundwater information in an area with few existing wells and in the vicinity of the Correnso Project. Two additional vibrating wire piezometer boreholes and 39 additional settlement markers were installed in early 2014. One further borehole was installed in 2016 for monitoring related to the Daybreak/SUPA orebody.

The piezometers were located across and perpendicular to the Correnso vein system in three lines (P90, P91 and P92 forming one line, P93, P94 and P95 a second line and P100, P101 and P102 the third). Separation distance between the northern and southern lines is some 500m (Figure 8). The piezometers were constructed to intercept the shallow aquifer, younger volcanics, and andesite rock (Table 4).

Table 4: Geological Units and Depths P90-P95, P100-P102 Piezometers

Bore	Shallow	Younger Volcanics		Andesite	
		Upper	Basal Zone		
P90	-	20	100	137	
P91	9.3	25.5	111.3	151.3	
P92	-	23.3	121.3	156.3	
P93	12.3	26	100	143	
P94	6	25	104	144	
P95	-	35	90	120	
P100	-	50	120	135	160
P101	12.8	32	47	78	
P102	8	38	62	90	

Figures 22 to 30 provide the records from the piezometers expressed as mRL. The charts also display the depth of the piezometer tips. Separation between the shallow and deeper piezometers is evident in the records. The nine groundwater monitoring boreholes have indicated stable water levels in Waihi East. Exceptions are discussed below.

Note: Gaps in the data are due to either brief logger malfunction issues or flat batteries in the unit

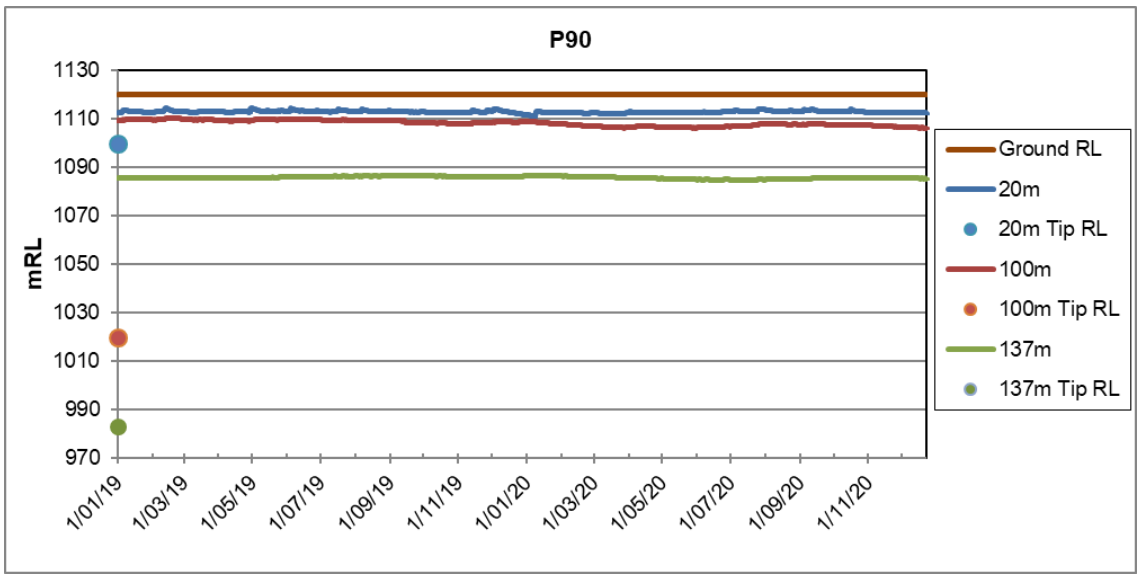


Figure 24: P90 Vibrating Wire Piezometer

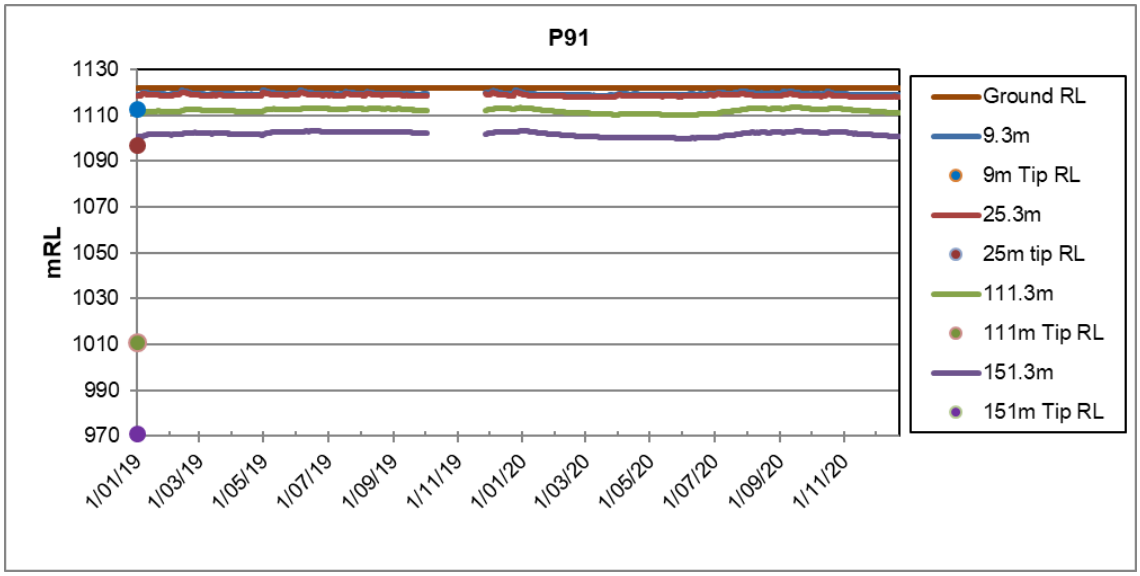


Figure 25: P91 Vibrating Wire Piezometer

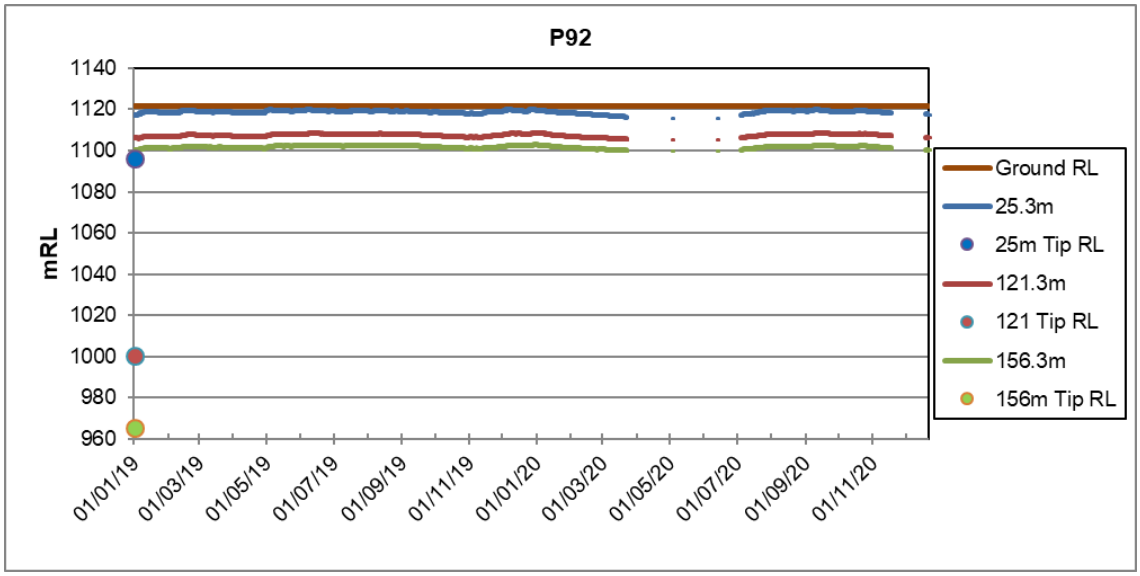


Figure 26: P92 Vibrating Wire Piezometer

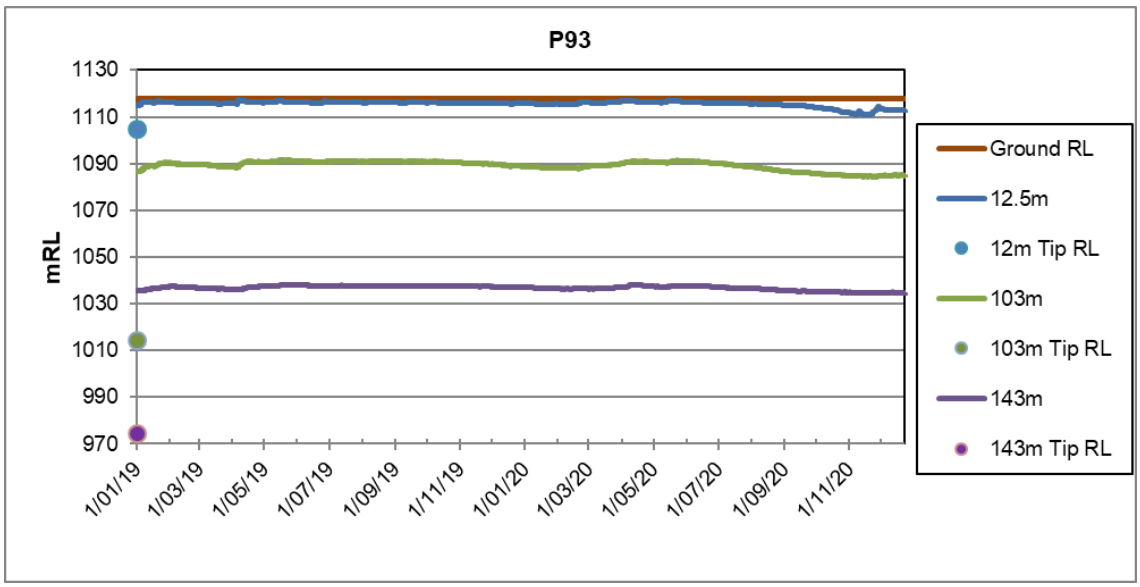


Figure 27: P93 Vibrating Wire Piezometer

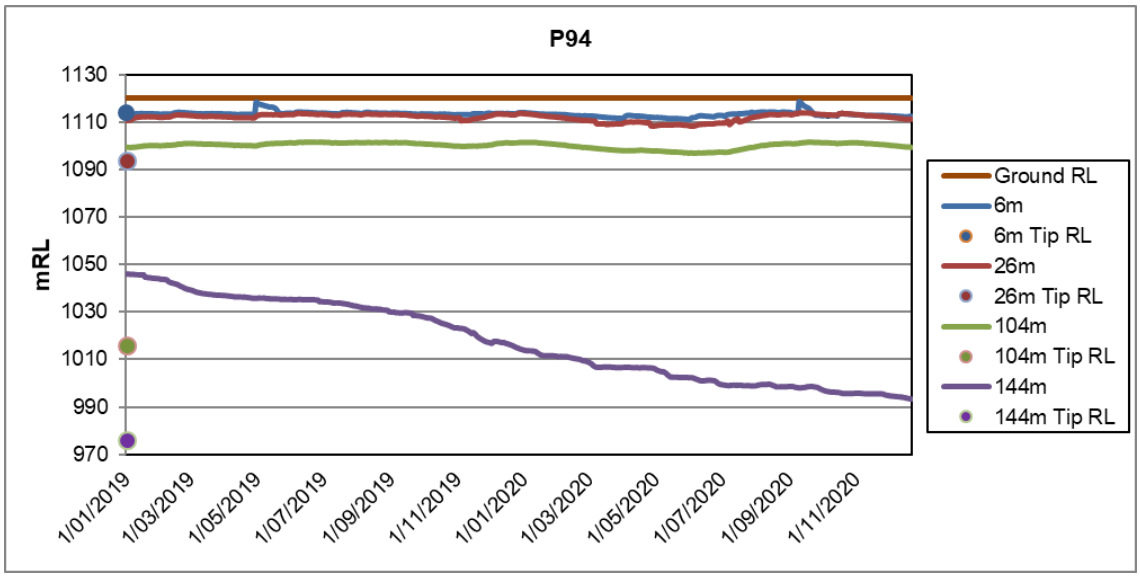


Figure 28: P94 Vibrating Wire Piezometer

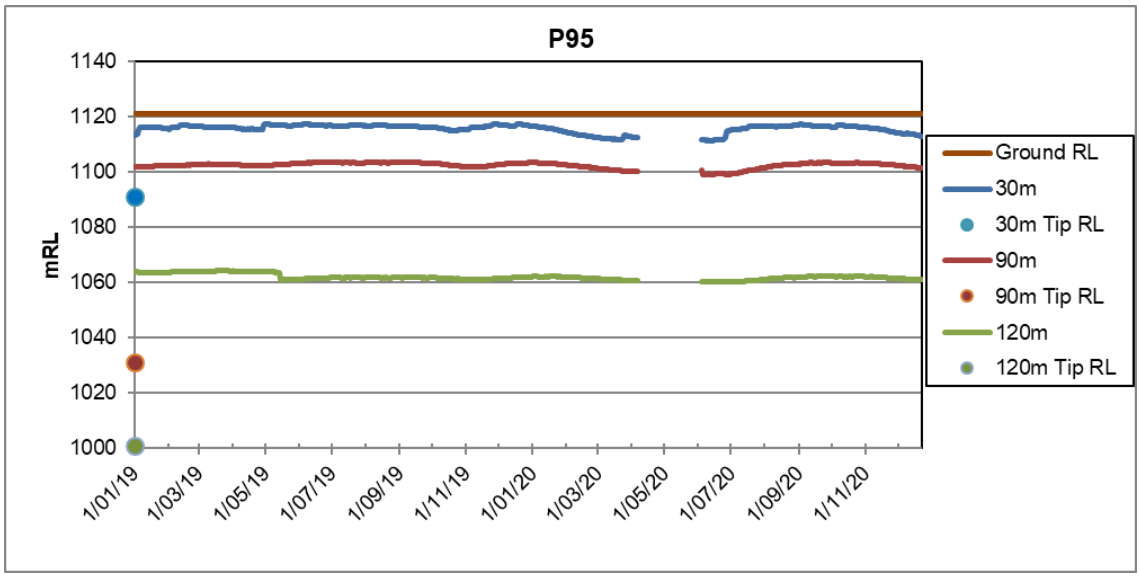


Figure 29: P95 Vibrating Wire Piezometer

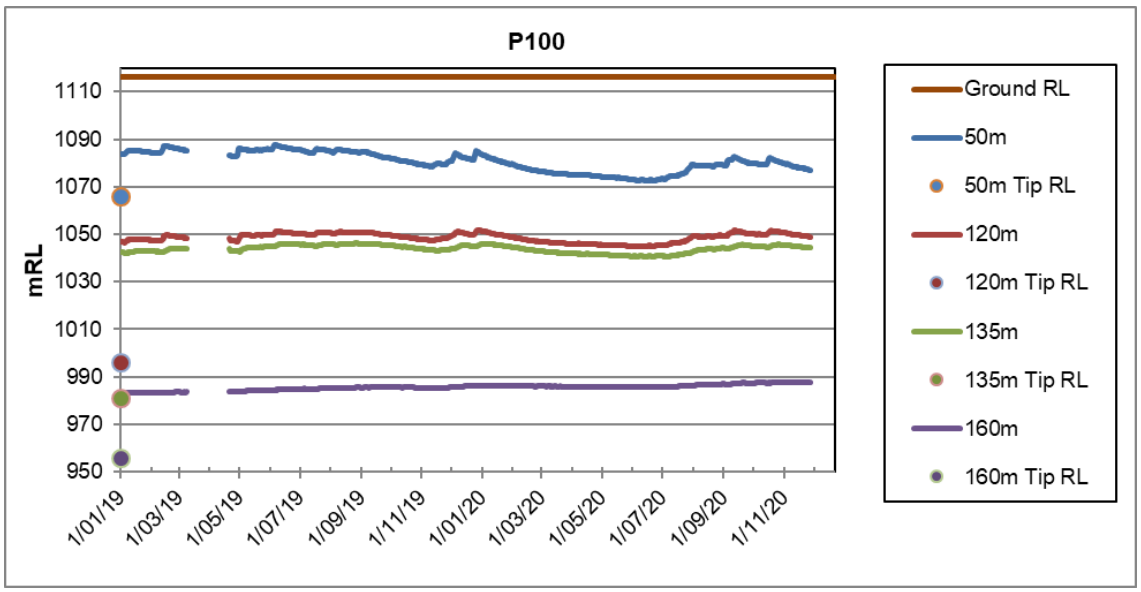


Figure 30: P100 Vibrating Wire Piezometer

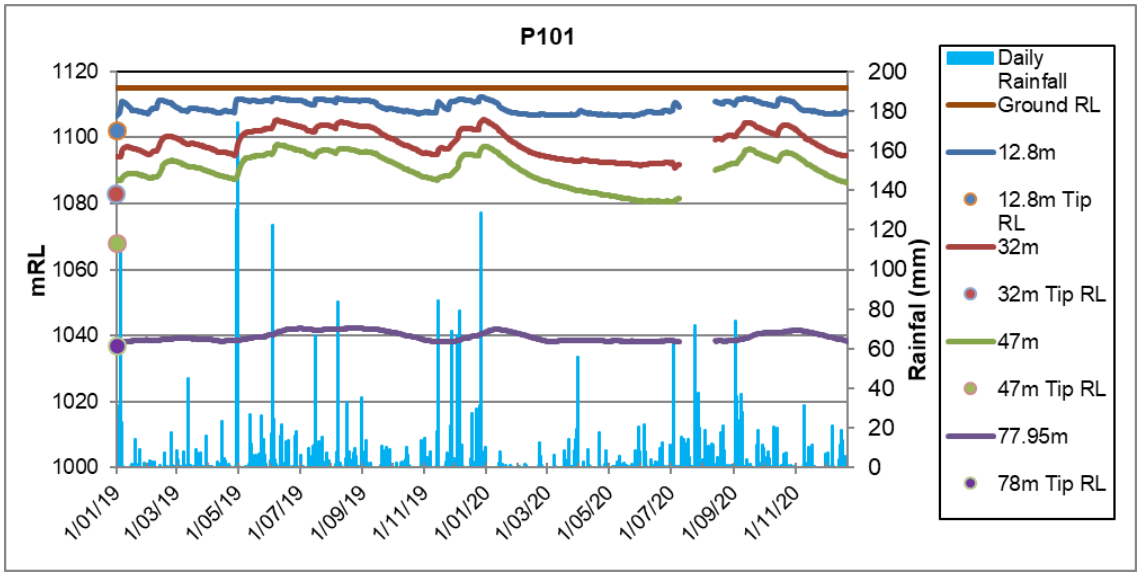


Figure 31: P101 Vibrating Wire Piezometer including daily rainfall

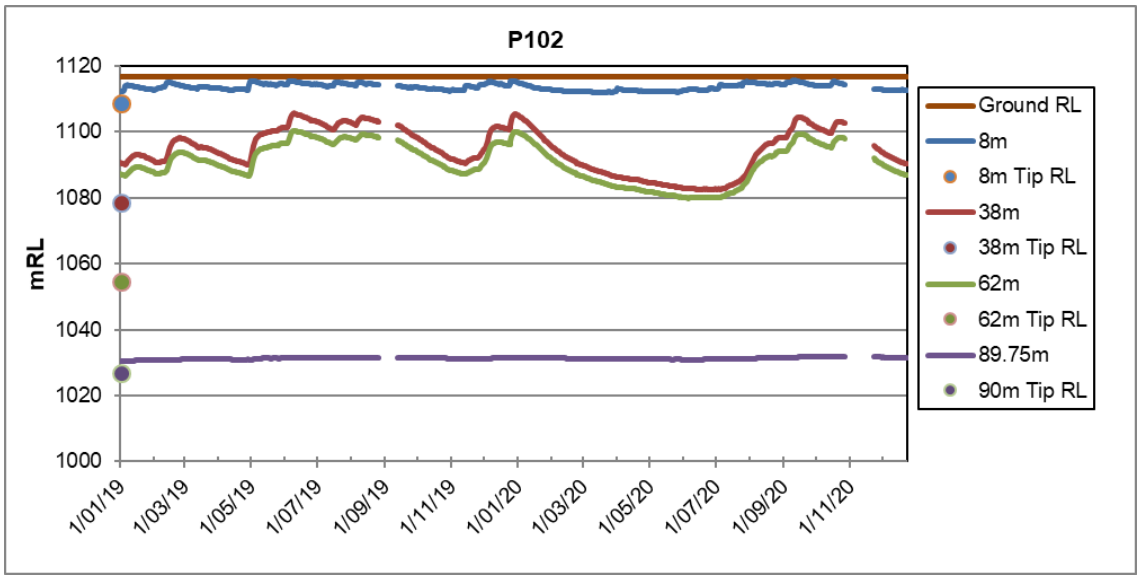


Figure 32: P102 Vibrating Wire Piezometer

Water levels were disrupted during 2012 to 2013 in P90, P91 and P92 by leakage down an incompletely sealed drill hole annulus. Pressures returned to normal after comprehensive effort to seal the leakage pathway.

Piezometric levels in the Younger Volcanics have continued to show some dependence on rainfall. This is particularly evident with P100, P101 and P102. This ongoing fluctuation does not appear to have any significant effect on ground surface settlement.

During 2018 and 2019, the 975 mRL piezometer in well P94 showed a drop in pressure believed to be a result of nearby mining causing relaxation in the country rock host rock surrounding the piezometer tip. The pressure has continued to drop through 2020 but at a slowing rate. The shallower piezometers at this location have not displayed any unusual drop in pressure and there have been no anomalous trends in nearby settlement markers (BM24, MATAURA1, 24F) identified. The effect appears to be stabilising and is expected to reverse once mining has passed the area (Figure 28). Refer to Appendix H for GWS Limited review of the piezometer data.

5.3.9 Waihi South – Project Martha

Following the approval and subsequent development of Project Martha in 2019, 10 new piezometers were installed to monitor the effects of additional dewatering related to the project (Figure 33). Table 5 sets out the piezometer depths of Project Martha piezometers.

Figure 33: Waihi South Piezometers

Table 5: Project Martha piezometer depths

Bore	Young Volcanics		Andesite			
	Depth (m)	Piezo Tip (mRL)	Depth (m)		Piezo Tip (mRL)	
P107	30	1089				
P108	9.8	1116				
P109	22	1091				
P110	16.8	1097				
P111	13	1100	25	58	1088	1055
P112	50	1057	72	110	1035	995
P113	46	1058				
P114	55	1054				
P115	30.8	1103				
P116	53.3	1098				

Project Martha piezometers P107 to P110 and P113 to P116 are standpipes installed at varying ground elevations Figure 34 shows water levels have remained fairly settled. Some initial changes to P109 and P110 are likely due to well flushing after installation. P115 was installed late 2020 and data will be presented in the 2021 report.

Vibrating wire piezometer P111 (Figure 35) was installed with three tips, one in the young volcanics and two in the andesite layer. The younger volcanic piezometer is measuring some water pressure at 1102mRL. The upper andesite piezometer appears to be dry with levels recorded below the tip level (1087mRL cf. 1088mRL), indicating this area may be previously affected by dewatering. The lower andesite piezometer is measuring around 4m of water pressure above the tip, at 1059mRL.

P112 is also a vibrating wire design installed with three tips: one in the young volcanics and two in the andesite layer. Water levels have remained stable in all three piezometers since installation in July 2020 (Figure 36).

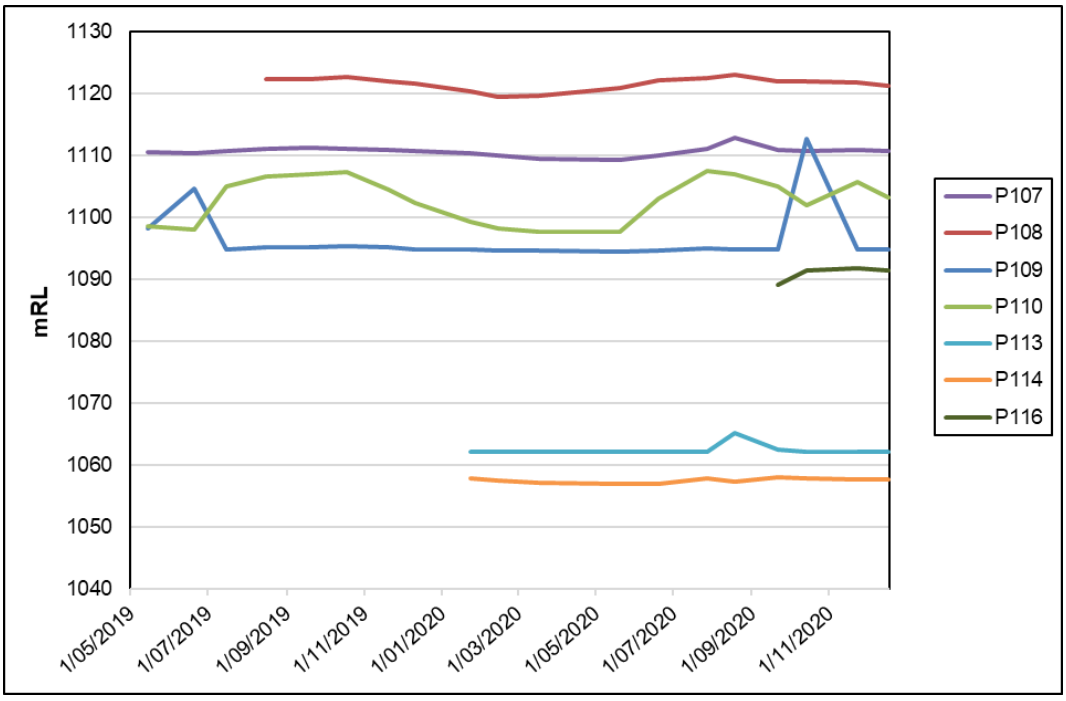


Figure 34: Waihi South Piezometer Levels

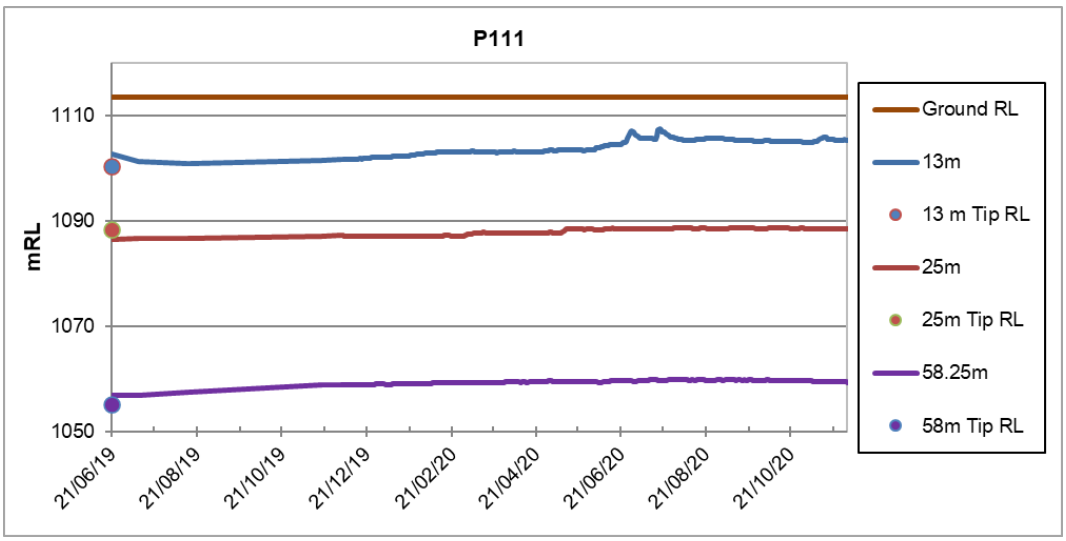


Figure 35: P111 Vibrating Wire Piezometer

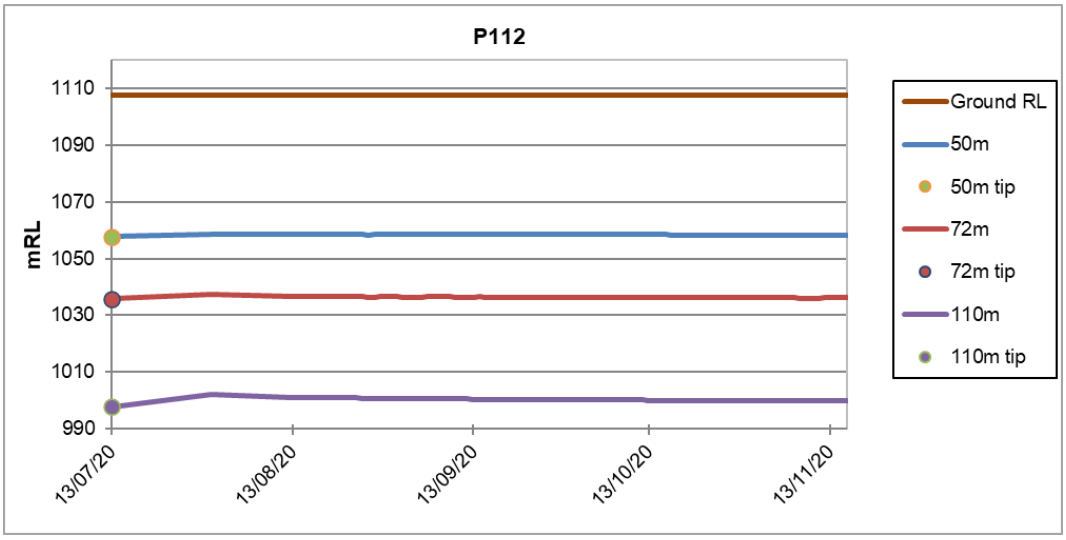


Figure 36: P112 Vibrating Wire Piezometer

6 SETTLEMENT MONITORING

Condition 13b of the Extended Martha Mine consent requires the identification of any environmentally important trends in settlement behaviour. Condition 13d of the same consent requires that a comparison of the settlement survey data with that predicted for the consent.

A reassessment for the settlement prediction was conducted for the Trio Development Project (Engineering Geology, June 2010). This review assessed the effect of pumping from the Martha pit to draw down the groundwater level progressively to 755mRL, which would also dewater the connected Trio system.

Another reassessment was conducted for the Correnso Underground project (Engineering Geology, 2012). The report recommended new trigger levels for settlement based on additional depressurisation of the andesite layer.

Further reassessment was undertaken for Project Martha with dewatering to below 700 mRL authorised. New triggers have been applied during the 2020 reporting period (Table 6).

A review of the settlement marker network was undertaken during 2019 by GWS Ltd (Appendix F). This resulted in the removal of erroneous and high-density settlement markers for 2020 settlement plotting and trigger assessments.

Seven settlements zones were defined around the Martha Mine pit in 1999, extending to the outskirts of Waihi. The zones were established based on the first ten years (pre-extension) of settlement history having regard to the then current knowledge of the thickness and composition of compressible materials (such as ash-soils, alluvium, lake sediments, and unconsolidated younger volcanic deposits) and the expected effect from Martha Mine dewatering. Table 6 provides the most recent update of the Settlement Zone trigger levels, approved in 2019 and applied following the commencement of Project Martha in 2020, to reflect the changed mining and dewatering conditions. Figure 37 shows the predicted settlement zones. These have also been updated with the commencement of Project Martha.

Table 6 - Table of Predicted Settlement with Project Martha Trigger Levels

Zone	New Trigger Levels (mm) Project Martha (2020)
Settlement Zone 1	55
Settlement Zone 2	65
Settlement Zone 3	95
Settlement Zone 4	160
Settlement Zone 5	260
Settlement Zone 6	340
Settlement Zone 7	540

The settlement measured is an accumulation of all causes of settlement. Generally, this is considered to be the result of mine dewatering, but close to the mines and (in the case of Favona) overlying the mine areas, additional settlement may be the result of primary consolidation settlement (as opposed to reconsolidation settlement which is the process in the Martha groundwater system where historic dewatering resulted in groundwater levels dropping to lower elevations for a longer time period than is proposed for current mining activity). Nevertheless, it is the total settlement that is discussed in this report as settlement due to dewatering alone cannot be separated from other causes.

Comment is provided in relation to the predicted settlements given in Table 6 and these comments are expanded on where monitoring data show exceedance of the trigger values.

6.1 Method

The initial settlement survey network was established in 1980 during the exploration phase of the project and has been regularly monitored since December 1987. Over the course of the project, settlement survey marks have been added, removed or replaced, as required, to extend the network or to compensate for damaged sites.

Figure 38 shows the location of settlement marks monitored by OGNZL up to the end of 2020. Also, included on Figure 38 are the defined subsidence hazard zones related to historical underground mine stopes and shafts (IGNS, 2002). Figure 39 provides the settlement monitoring marks across the Favona Mine and shows the locations of the Favona Mine workings in relation to the marks. Figure 40 provides the marks identified as triggered during the November 2020 survey.

Settlement monitoring was undertaken in May/June and November/December 2020 across the settlement network surrounding Waihi Township (refer Appendix C) and also along the Favona network which is an extension of the Martha mine survey network (Figure 39). Appendix B presents the two summary settlement monitoring reports. For simplicity this report refers to surveys as May and November 2020.

The raw data provided by the surveyors has been graphed and where changes in the record are apparent as a result of mark relocation or replacement, corrections have been applied using graphical projection so that total settlement over the life of mining can be determined for each location. The correction process applied was as follows:

- Updating the time-history graph for all data from settlement markers with data up to 1/11/2020.
- Where changes in the time-history graph identified a datum change, a correction was arrived at by projecting the initial data visually on the graph to the time of the new datum and a correction calculated. A smooth settlement curve resulting after the correction was applied and similarity of curve shape to those of adjacent marks was taken as indicating an acceptable correction.
- Where marks were installed in May 1999, the previously determined settlement for that location from 1988 to 1999 was applied as a correction.
- Where marks were installed or changed other than in May 1999, the previously assessed settlement at the location as of May 1999 was used with “Goal Seek” on the (Excel) spreadsheet to correct the values to be consistent with the May 1999 value.
- For Favona marks, settlement values as at 1/12/2005 were assessed for each location and used to correct the new marks to account for settlement from 1988 to 2005.
- The corrected data has then been used to generate:
  - Settlement-time trend graphs for each zone.
  - Plans of total settlement.
  - Contours of total settlement.
  - Calculation of tilt.
  - Settlement-time trend graphs of specific areas.
- Where Favona development has affected settlement, a projection of the pre-Favona mine settlement trend has been made as a means to estimate the current Martha Mine settlement and this settlement value has been subtracted from the total measured settlement to provide an estimate of the settlement due to the Favona Mine development.

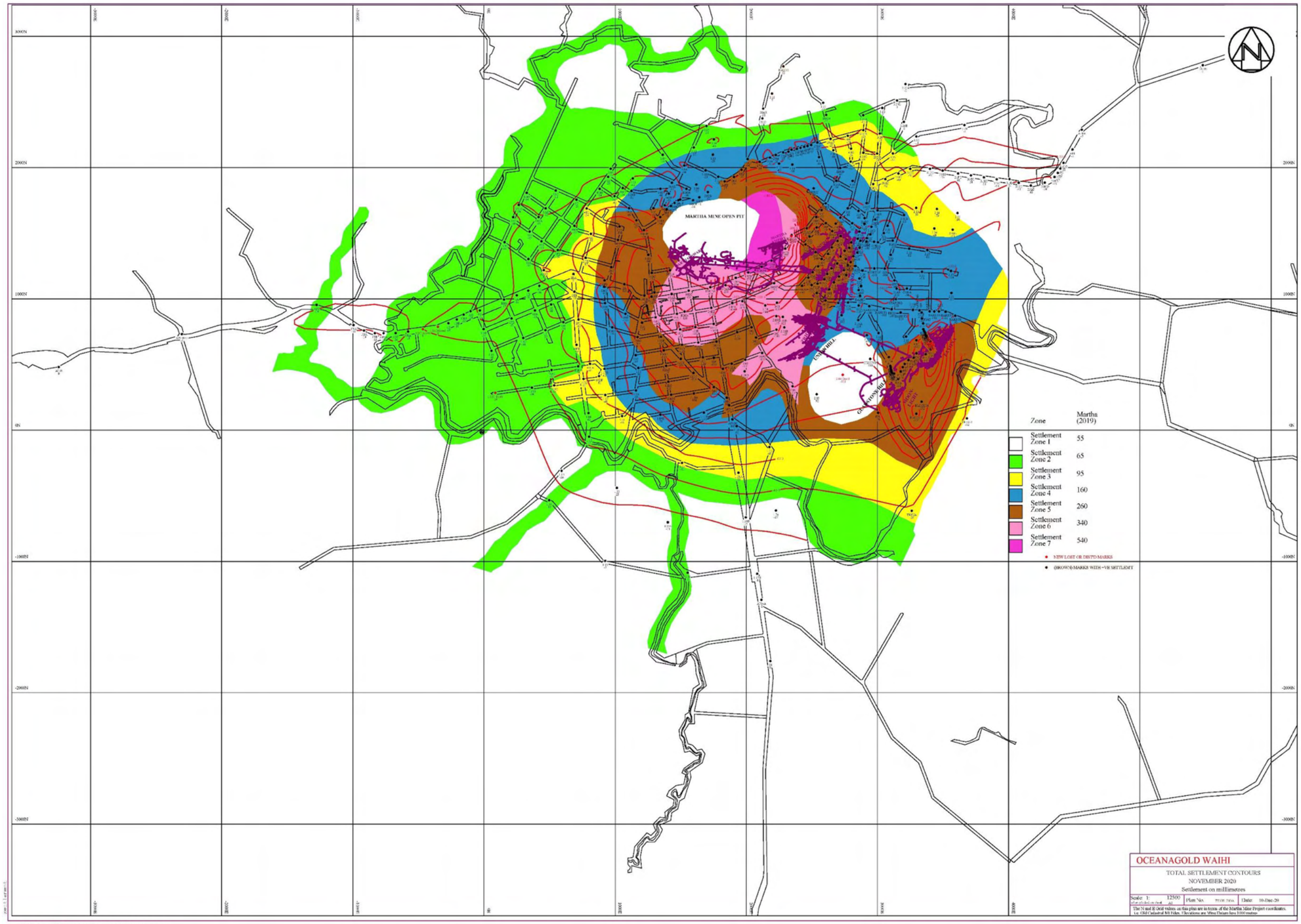


Figure 37: Project Martha Settlement Zones, Trigger Levels and Total Settlement November 2020 Survey

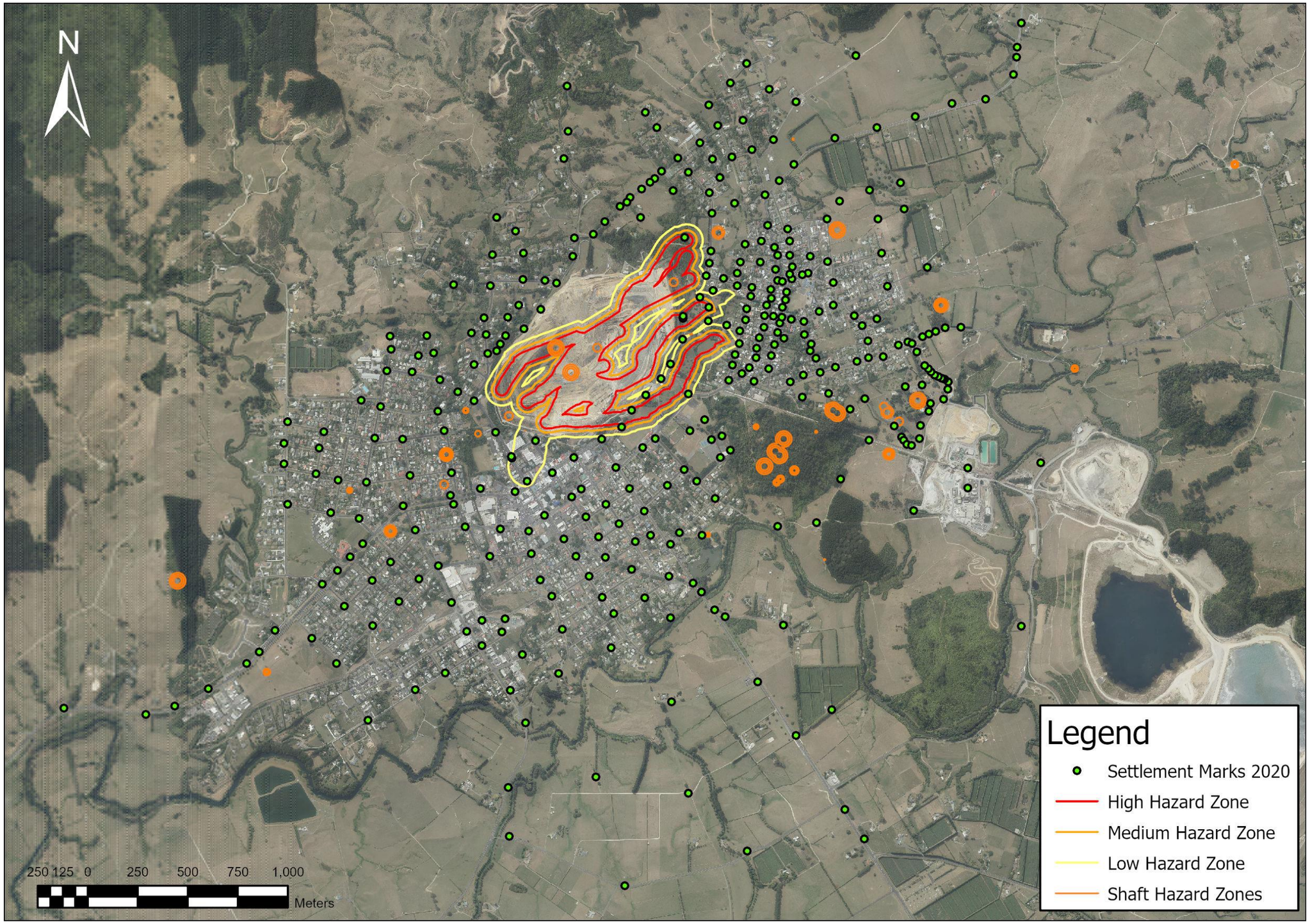


Figure 38: Settlement Marker Location Plan & Hazard Zones

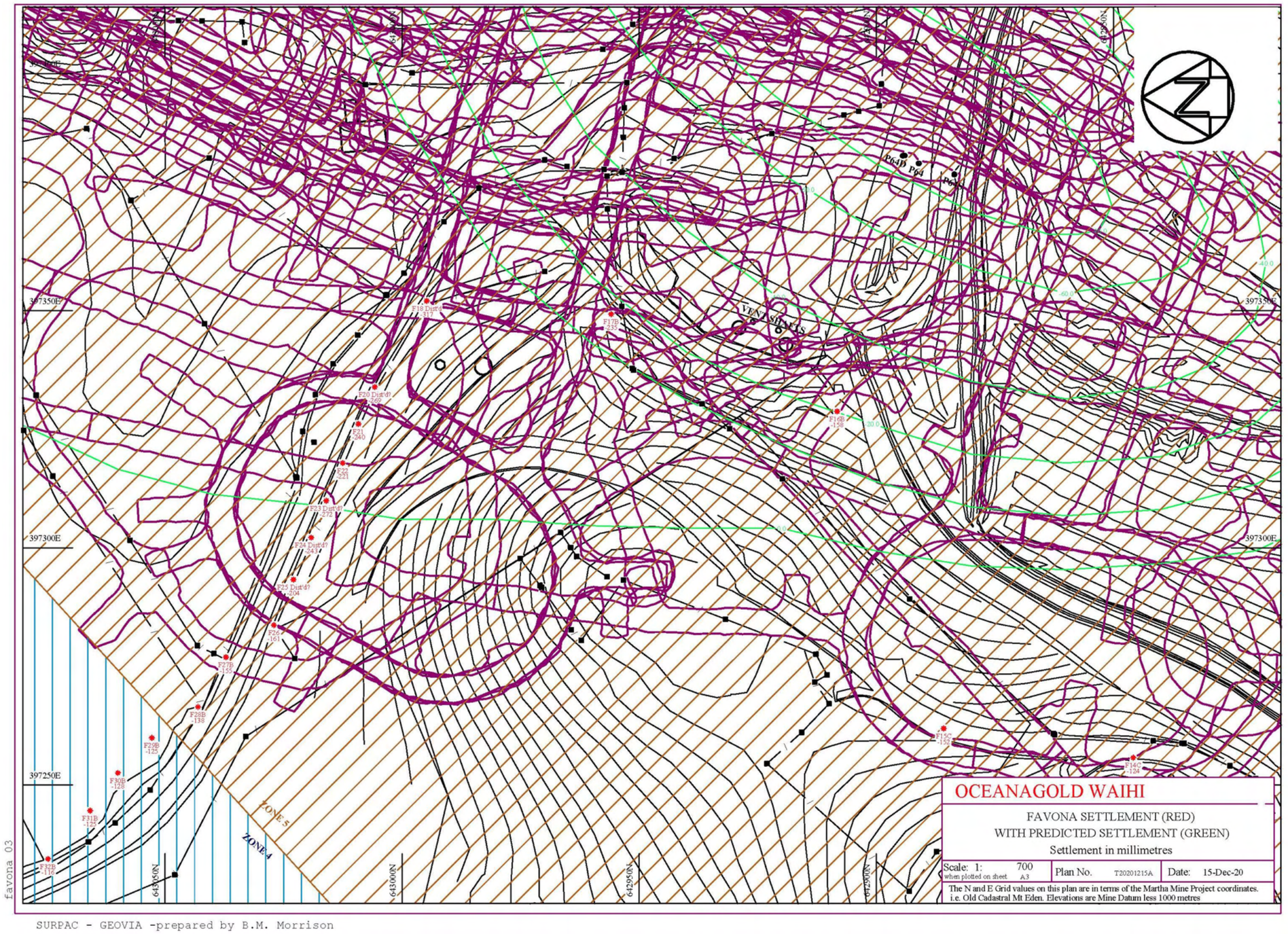


Figure 39: Favona Settlement November 2020 Survey

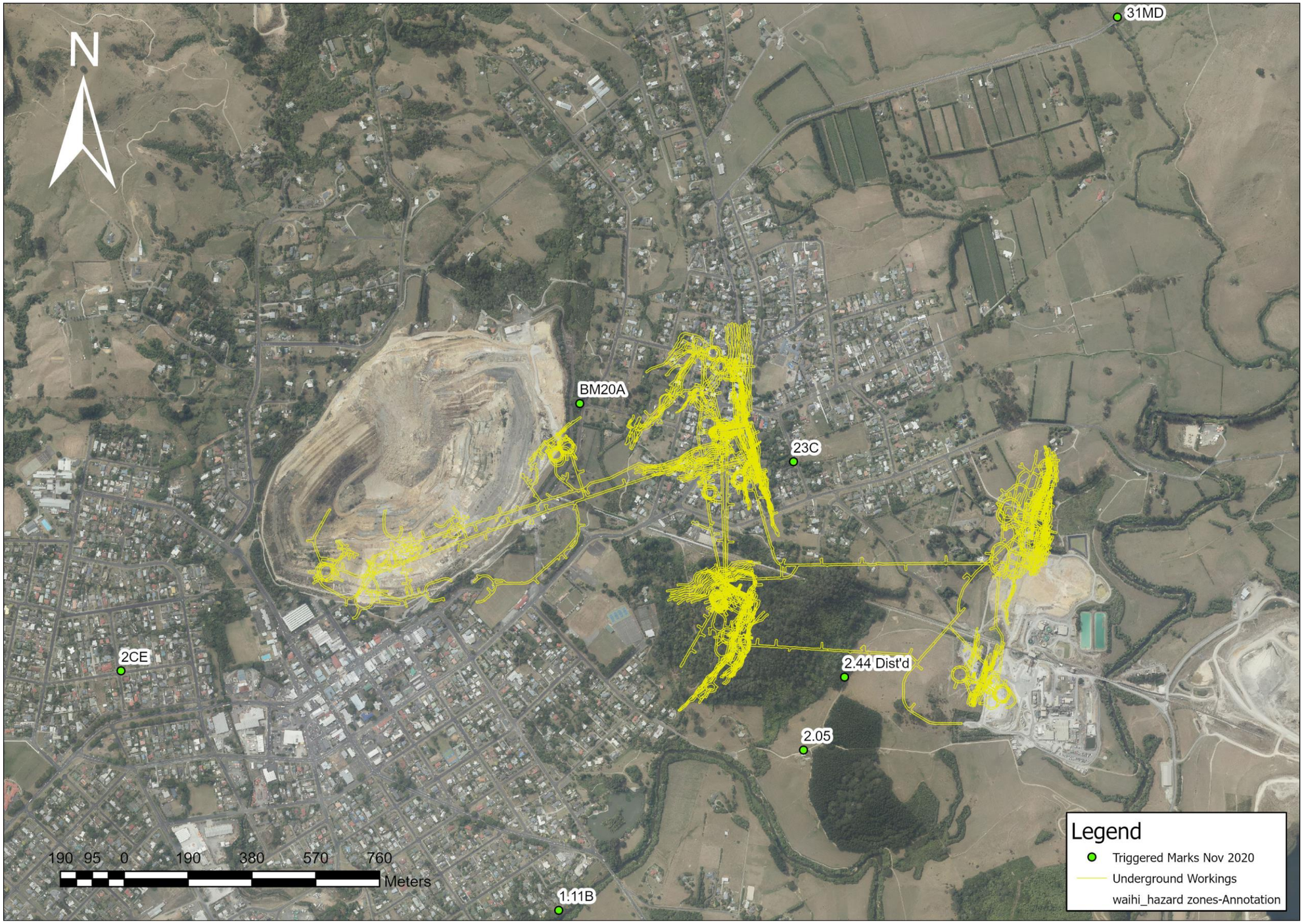


Figure 40: Settlement Marks Triggered During November 2020 Survey

NB: Favona Marks excluded from Figure 40

6.2 Results

Appendix C presents plans showing settlement marks, settlement values and settlement contours.

Time-history plots of settlement survey data for each zone are presented in Appendix D. The plots also depict the zone settlement predictions (for the Martha Extended Project, Trio Development, Correnso Project and Project Martha) shown as horizontal lines on each set of graphs.

The projected trends and the maximum settlements are provided on the graphs in Appendix D. Key trends are described below.

97% (359/370) of the marks did not exceed the settlement trigger levels; 11 marks were triggered. This number is significantly lower than the number triggered in 2019 due to the application of new Project Martha settlement triggers and zones during 2020 (Table 6). Figure 40 displays the seven settlement marks from the November 2020 survey outside the influence of the Favona Underground that exceeded the trigger limits. The other four marks that exceeded the trigger limits are located above the Favona Underground.

The differences between the May and November 2019 surveys showed an increase in settlement at most locations across the settlement network. In May 2020 there was a rebound and then in November 2020 an increase in settlement. The total settlement in November 2020 was similar to that in November 2019.

6.2.1 ZONE 1 – Trigger 55mm

The Zone 1 time-history plot (Appendix D) shows three groupings, one showing a steady increase in settlement after about 1999 of between 10 to 30 mm (Figures 41 and 42), another with little settlement until November 2015 and then increasing (Figure 43) and another group with no trends evident. To further assess these observations the marks for Zone 1 were re-plotted as groups namely:

- Zone 1 along Waihi Whangamata Road (see Figure 41)
- Zone 1 south of Waihi (see Figure 42)
- Zone 1 west of Waihi (see Figure 43)
- Zone 1 north of Waihi (no trends evident)

This grouping shows that the marks with a slow downward trend are located along Waihi Whangamata Road to the east of Waihi and to the south of Waihi. A steady increase in settlement from about 1999 can also be observed in most marks in Zones 2 to 6, suggesting that there is a small and widespread effect occurring. Two settlement marks to the west show little settlement until 2015 and then a steady on-going, but small increase in settlement (Figure 43).

These observations suggest the following:

- The widespread 10 to 40 mm settlement observed from about 1999 at many Zone 1 marks and also the increasing settlement in Zones 2 to 6 marks is a response to the ongoing dewatering of the deeper structures in the andesite rock body (fracture depressurisation) as a result of mine dewatering. This is a broad effect and has negligible influence on differential tilt between marks.

The settlement evident at marks in the vicinity of the Favona Mine is in response to the dewatering of the deeper structures linked to that system and to rockmass relaxation into mining voids.

The stable water levels in the wells monitoring the deeper younger volcanic materials and the upper andesite layers show that the observed settlement behaviour is not related to on-going consolidation of these materials at these locations as no on-going dewatering is evident at these locations.

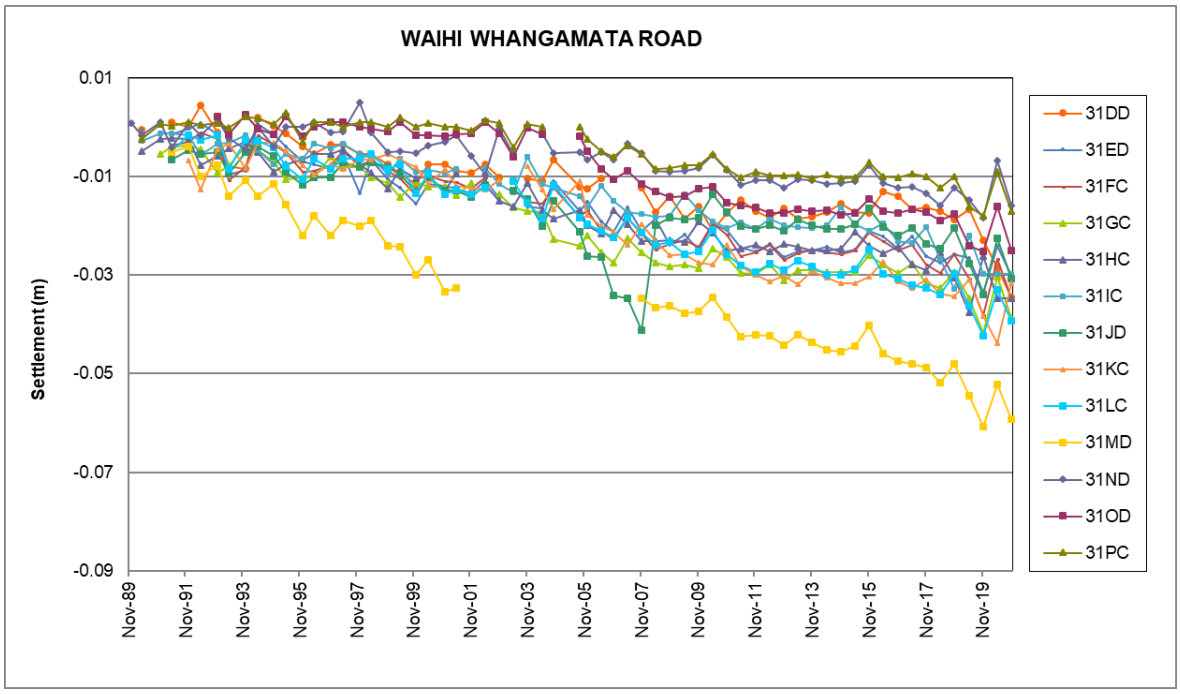


Figure 41: Zone 1 Waihi Whangamata Road

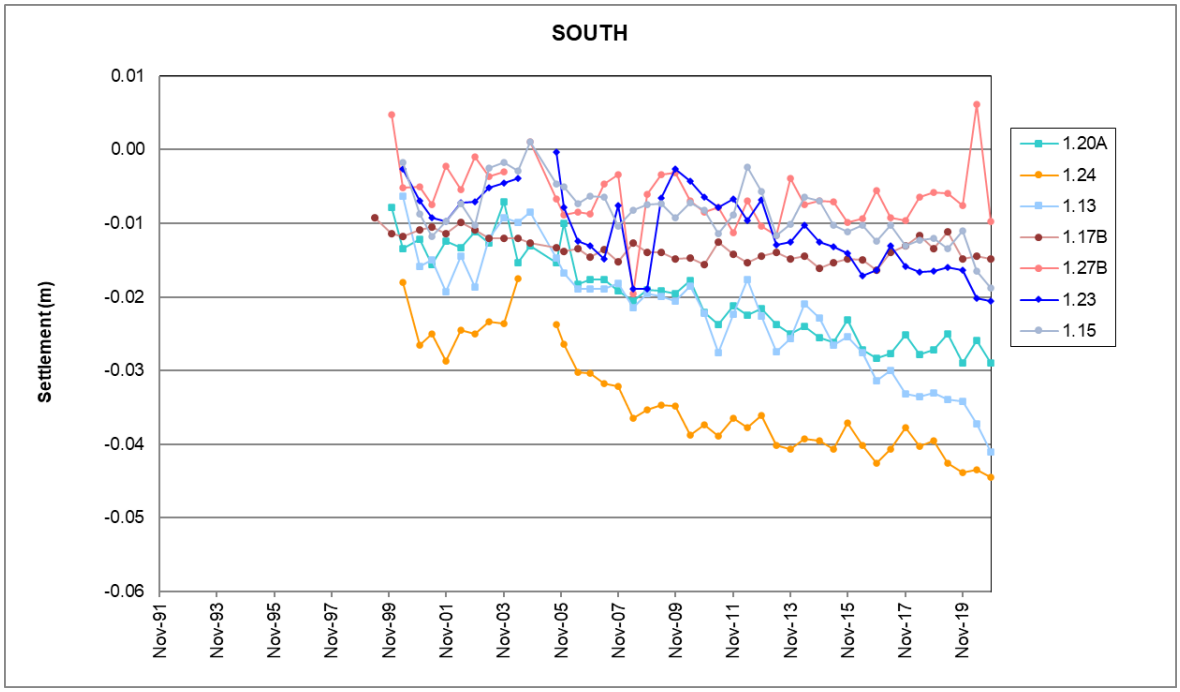


Figure 42: Zone 1 Waihi South

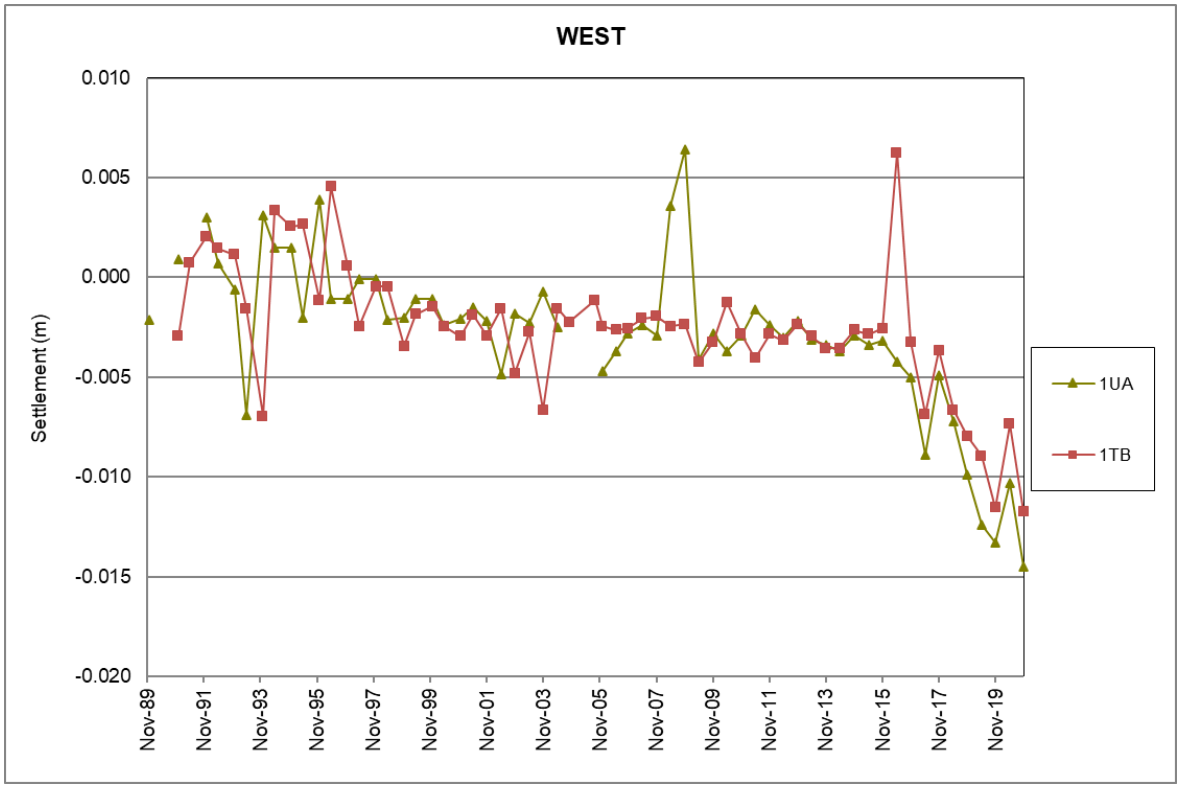


Figure 43: Zone 1 West of Waihi

The absence of widespread effect from Favona dewatering supports the current geological and hydrogeological models.

Anomalous results shown on the Zone 1 time – history plot are discussed below.

Three marks in Zone 1 showed settlement greater than the expected maximum: 31MD, 2.05 and 2.44

Mark 31MD is located along the Waihi Whangamata Road and showed a period of greater settlement than nearby marks during the early 1990s. Recent recorded settlement is similar to nearby marks. This mark may be influenced by its proximity to the banks of the Ohinemuri River (Figure 40, Figure 41).

Mark 2.44 has been investigated in the past and the cause has been attributed to some localised surface movement. This mark is listed as disturbed by the surveyor.

Mark 2.05 is near Winner Hill and like other marks to the south of Waihi indicates an acceleration of settlement after 2003 or possibly 2004. Local slope movement is also indicated to be affecting this site.

6.2.2 ZONE 2 – Trigger 65mm

This zone encompasses the western outskirts of Waihi township and some marks to the north and south of Waihi. The time-history plot for Zone 2 (Appendix D) shows all but one of the Zone 2 marks to be tracking less than the predicted maximum settlement rate. As with Zone 1 most of the marks have small settlements. Total settlements to date are generally between 10 to 60 mm with settlements of between 10 to 40 mm since 1999. Anomalous movements are discussed below.

Mark 1.11B is the single mark in Zone 2 to have exceeded the predicted maximum settlement in the November 2020 survey. The mark is located to the south of Waihi township near the Ohinemuri River (Figure 40). This mark has shown an increased rate of settlement compared to nearby marks since the early 2000s. Its location near the bank of a watercourse and downslope soil creep may have contributed to the recorded settlement.

Groundwater records in these areas show no ongoing dewatering and only minor water level changes in the deeper younger volcanic materials or the upper andesite rock mass. However, there is a possibility of underdrainage of the andesite rock at depths associated with the Correnso project that is occurring below the depths of the installed piezometers. However, this is unlikely to be the main cause of the settlement at mark 1.11B, it is more likely to be associated with soil creep. The measured settlements are still small, and tilts are well within acceptable limits.

6.2.3 ZONE 3 – Trigger 95mm

This zone is includes small areas to the east and west of Waihi town, with a part extending to the east of the Favona Mine.

Inspection of the time-history plot for Zone 3 shows, as with Zones 1 and 2, most marks display ongoing steady settlement. The measured total settlements are small and generally between 20 to 80 mm with settlements since 1999 of between about 10 to 50 mm. Tilts between adjacent marks are well within acceptable limits.

One mark (2CE) has moved more than the predicted maximum settlement for the zone. Mark 2CE is located to the west of Waihi township and has showed an increased rate of settlement compared to nearby marks between 1991 and 1995. Thereafter, it settled at a similar rate to nearby marks.

6.2.4 ZONE 4 – Trigger 160mm

Zone 4 time-history plots (Appendix D) show a small but steady increase in settlement in the zone since 1995. The measured total settlements are small and generally between 20 to 120 mm. Settlements since 1999 are generally between 10 to 80 mm. Tilts between adjacent marks are well within acceptable limits.

One mark, 23C, exceeded the predicted maximum settlement for this zone in 2020. This mark showed a sharp increase in settlement in the May 2020 survey. The settlement in the subsequent November 2020 survey was similar to nearby marks. This mark is located near a drain and may have been affected by the dry summer and autumn during 2019/2020 or been influenced by recent drainage works nearby. No effects on surrounding land are visible, and nearby piezometers have not shown any unusual changes.

6.2.5 ZONE 5 – Trigger 260mm

The data for the Zone 5 marks are provided in the time-history plot in Appendix D. Marks show a steady increase in settlement with time and total settlements are generally between 30 and 150 mm. Settlements since 1999 are generally between 15 to 85 mm. No marks in this zone exceeded the predicted maximum settlement for the zone.

6.2.6 ZONE 6 – Trigger 340mm

The settlement in this zone is shown on the Zone 6 time-history plot in Appendix D. This zone extends through the centre of the Waihi commercial area. Marks show a steady increase in settlement with time and total settlements are generally between 70 to 250 mm. Settlements since 1999 are generally between 50 to 190 mm. One mark in this zone exceeded the maximum predicted settlement for the zone. This mark (mark BM20) has been noted as disturbed by the surveyor (Appendix B).

6.2.7 ZONE 7 – Trigger 540mm

Zone 7 settlements are all within the predicted maximum settlement (Zone 7 time-history plot, Appendix D). Total settlements are about 290 mm. Settlements since 1999 are about 160 mm. No new trends are indicated.

6.3 Favona Settlement

Settlement in the vicinity of the Favona Mine has a component of settlement due to Martha Mine dewatering as well as settlement related to Favona Mine dewatering.

A separation of total settlement into Martha and Favona settlement components has been undertaken by projecting the settlement evident before the commencement of the Favona Mine and accepting these projected settlements as Martha settlements. The difference between the projected (Martha) settlement and total measured settlement has been taken as the Favona component of settlement. Table 7 sets out the total settlement, the settlement attributed to Martha dewatering and the settlement attributed to Favona Mine dewatering as assessed for the Favona Mine settlement markers.

Table 7 - Separation of Settlement – Favona Marks (Nov 2020)

Mark	Total Settlement (mm)	Martha Settlement (mm)	Favona Settlement (mm)
F02	98	50	48
F03	98	46	52
F04	103	44	59
F05	105	46	59
F06	105	40	65
F07*	107	42	65
F08A	116	44	72
F09A	119	38	81
F10B	127	44	83
F11C	130	42	88
F12C	131	39	92
F13C	129	55	74
F14C	129	60	69
F15C	154	55	99
F16B	156	55	101
F17B	273	55	218
F18	347	49	298
F20	296	44	252
F21	269	43	226
F22	250	42	208
F23	229	49	180
F24	215	42	173
F25	210	49	161
F26	189	45	144
F27B	176	50	126
F28B	166	49	117
F29B	154	48	106
F30B	153	52	101
F31B	137	55	82
F32B	123	49	74
F33	109	52	57
F34C	108	58	50
F35B	100	61	39

* Disturbed by 40+mm

The largest settlement at Favona Mine occurs where the markers overlie mine workings (marks F16B to F26). The maximum predicted settlement over the workings from dewatering was assessed as 80 mm for earlier projects, with mine dewatering related settlement not extending into the urbanised area. The actual total settlement and the extent of settlement exceeded the predictions for the dewatering settlement. The difference between the predictions and measured settlement was considered to reflect depressurisation and consolidation of the andesite rock body, which was not considered in the initial predictions. Andesite rock was considered to be a stiff material with negligible consolidation characteristics, but the long-term settlement observed in response to Martha Mine dewatering (in Zones 1 to 6, discussed above) suggests that some minor consolidation of the deeper andesite rock is occurring, possibly as a response to fracture depressurisation. In addition, some further relaxation of the rockmass towards the mine workings may be occurring, and this may be providing further volume reduction of the andesite rockmass in the vicinity of the mine.

Another potential influence is that the Favona andesite has been undergoing primary consolidation, as current water level monitoring data suggests that the Favona system was not dewatered to the same extent as the Martha groundwater system during historical mining in the early 1900's. Consolidation predictions for Favona were made based on Martha's second dewatering consolidation data. The amount of primary consolidation is greater for the first time of dewatering compared to the second or subsequent times of dewatering. This is because the first cycle of dewatering results in preconsolidation and an increase in the stiffness of the ground, and subsequent re-watering does not result in full rebound of levels to their original levels.

Settlement predictions for Project Martha have been updated for the zone encompassing Favona marks to reflect the effects outlined above. Four Favona marks exceeded the maximum predicted settlement in the November 2020 survey: F17B, F18, F20 and F21. All are located above underground workings, on company owned land. Marks F18 and F20 are noted by the surveyor as being disturbed (Figure 40)

6.4 Trio Underground

The only anomalous result in the vicinity of Trio Underground has been apparent settlement at mark 2.44 (located on a farm track between Union and Black Hill) with pronounced acceleration since the May 2010 survey. This was investigated and determined to be related to a shallow pre-existing landslide, not any mine influence. It is now noted by the surveyor as being disturbed. The mark will continue to be monitored on a biennial basis as per other survey marks but will not be included in any settlement profiling.

6.5 Summary

The analysis of the data to the end of 2020 continues to indicate that current slow settlements associated with Martha Mine are likely to be related to dewatering of the deeper structures within the andesite rock mass. Groundwater monitoring data does not show any widespread or significant ongoing dewatering of alluvium, younger volcanic materials or the upper layers of the andesite rock body.

Settlement triggers include modification to Martha Mine Extended pit associated with the cutback projects; the extended duration of dewatering at Martha Mine; assumptions made in the Favona settlement predictions (fracture depressurisation, secondary rather than primary consolidation); and localised natural, induced and historic effects.

The area around Martha Mine of greatest settlement is adjacent to the eastern pit wall where the weaker younger volcanic rocks are thickest and dewatering of this geological unit is greatest. This is also an area that has historic underground workings that have not been backfilled.

The main area of settlement at Favona overlies the workings, is directly under farmland and within the area of Company owned land. Outside the workings area, settlement is lower. The conditions giving rise to settlement at Favona differ from those in the Martha Groundwater System as the latter has been dewatered to a greater extent for a longer time than the current dewatering while the former has not been previously dewatered. While settlement has exceeded initial estimates at Favona, those estimates were based on Martha settlement data which was responding to reconsolidation rather than primary consolidation.

In relation to Trio, Correnso and SUPA mines, these are located in the dewatered Martha Groundwater System and settlement as described in this document has already been developing in those areas in response to Martha Mine dewatering. Also, as these are linked to the Martha system, settlement will be based on additional consolidation.

7 TILT

As noted earlier, a full review of the Waihi settlement marker network and database was undertaken by GWS Limited in 2019. The review resulted in the removal of erroneous and high-density settlement marks and an updated settlement database with revised settlement marker corrections where appropriate. Marks proposed for removal have been included in tilt calculations until their removal is approved by Hauraki District and Waikato Regional Councils. Revised settlement marker corrections have been applied in this reporting period. GWS's technical memorandum outlining the process and results of the review is included as Appendix F.

Assessments have been grouped into five areas: Favona, Martha (incl. North Wall), Correnso, Correnso South and SUPA. There is some crossover of marks between Mining Permit boundaries. The assessment of tilt between adjacent settlement marks is summarised in Table 8.

Table 8: Tilt Calculations November 2020 Survey

Mark	x	y	Distance (m)	November 2020 (m)	Abs	Δh (m)	Tilt (1:X)
Favona							
F01A	3096.19	498.96		Lost			
F02	3097.60	490.00	9.07	-0.0979	0.0979		N/A
F05	3104.66	455.54	35.18	-0.1046	0.1046	0.0067	5250
F08A	3126.97	430.49	33.54	-0.1158	0.1158	0.0112	2995
F09A	3157.20	388.28	51.92	-0.1193	0.1193	0.0035	14826
F10B	3176.88	446.75	61.69	-0.1266	0.1266	0.0073	8454
F11C	3192.52	479.44	36.24	-0.1297	0.1297	0.0031	11767
F12C	3207.32	503.82	28.52	-0.1310	0.1310	0.0013	21580
F13C	3236.43	533.63	41.66	-0.1286	0.1286	0.0024	17358
F14C	3275.29	551.31	42.69	-0.1289	0.1289	0.0003	142125
F15C	3297.17	585.32	40.44	-0.1542	0.1542	0.0253	1598
F16B	3367.38	578.70	70.52	-0.1564	0.1564	0.0022	32081
F17B	3405.48	613.91	51.88	-0.2731	0.2731	0.1167	445
F18	3423.83	648.30	38.98	-0.3467	0.3467	0.0736	530
F21	3405.99	672.00	29.66	-0.2686	0.2686	0.0781	380
F24	3388.13	690.85	25.97	-0.2150	0.2150	0.0536	485
F27B	3372.41	717.52	30.96	-0.1758	0.1758	0.0392	790
F29B	3363.20	738.71	23.11	-0.1539	0.1539	0.0219	1055
F32B	3348.78	769.10	33.64	-0.1231	0.1231	0.0308	1092
F33	3348.56	812.51	43.41	-0.1094	0.1094	0.0137	3164
F34C	3339.49	849.57	38.15	-0.1080	0.1080	0.0014	27649

F35B	3336.68	896.06	46.58	-0.1002	0.1002	0.0078	5993

Martha

20BB	2533.26	1622.29		-0.1168	0.1168		N/A
20AC	2461.04	1536.91	111.83	-0.1205	0.1205	0.0037	30224
BM20A	2345.50	1484.90	126.71	-0.2350	0.2350	0.1145	1107
20D	2482.07	1473.48	137.05	-0.1445	0.1445	0.0905	1514
19CB	2296.71	1381.40	206.97	-0.2767	0.2767	0.1322	1566
19BB	2191.56	1292.02	138.00	-0.2893	0.2893	0.0126	10952
BM19B	2117.17	1244.36	88.35	-0.2888	0.2888	0.0005	192068
17CB	2014.23	1201.01	111.70	-0.2897	0.2897	0.0009	129878
17BB	1919.52	1160.79	102.90	-0.2072	0.2072	0.0825	1247
17AB	1841.32	1104.80	96.18	-0.1785	0.1785	0.0287	3348
BM17A	1724.44	1088.92	117.95	-0.0892	0.0892	0.0893	1321

North Wall

27AB	2009.08	2064.33		-0.0094	0.0094		N/A
26Q	1963.00	1982.71	93.73	-0.0327	0.0327	0.0233	4028
26PB	1834.84	1893.11	156.38	-0.0501	0.0501	0.0174	8987
26OB	1706.93	1812.27	151.31	-0.0051	0.0051	0.0450	3365
26NC	1641.16	1772.40	228.22	-0.0430	0.0430	0.0379	6028
26MB	1593.46	1750.66	122.11	-0.0447	0.0447	0.0147	8307
26JB	1495.71	1756.55	93.74	-0.0392	0.0392	0.0075	12499
BM26	1542.45	1837.81	100.98	-0.0317	0.0317	0.0130	7768
3.09	1618.51	1870.17	217.54	-0.0300	0.0300	0.0249	8750

Correnso

25E	2472.35	1162.01		-0.1513	0.1513		N/A
25B	2497.67	1105.83	61.63	-0.1277	0.1277	0.0236	2611
25I	2537.20	1045.04	72.51	-0.1187	0.1187	0.0090	8057
24CD	2603.21	987.72	87.42	-0.1273	0.1273	0.0086	10165
24H	2630.70	1072.28	88.91	-0.1184	0.1184	0.0089	9990
24B	2667.67	1126.40	65.54	-0.1215	0.1215	0.0031	21143
24G	2705.96	1170.46	58.38	-0.1311	0.1311	0.0096	6081
24L	2761.67	1181.33	56.76	-0.1272	0.1272	0.0039	14553

24AC	2743.58	1218.90	41.70	-0.1325	0.1325	0.0053	7868
24F	2772.80	1257.27	48.23	-0.1259	0.1259	0.0066	7308
BM24	2794.55	1279.36	31.00	-0.1160	0.1160	0.0099	3131
24E	2758.43	1303.23	43.29	-0.1225	0.1225	0.0065	6661
24DC	2718.29	1323.13	44.80	-0.1130	0.1130	0.0095	4716
24I	2692.57	1269.71	59.29	-0.1243	0.1243	0.0113	5247
25H	2648.48	1232.96	57.40	-0.1275	0.1275	0.0032	17937
25CB	2615.91	1190.50	53.51	-0.1274	0.1274	0.0001	535124
25G	2594.60	1149.42	46.28	-0.1288	0.1288	0.0014	33059
25F	2542.53	1116.24	61.74	-0.1311	0.1311	0.0023	26842
25B	2497.67	1105.83	46.06	-0.1277	0.1277	0.0034	13546
BM25	2424.91	1100.25	72.97	-0.1408	0.1408	0.0131	5571
25E	2472.35	1162.01	77.88	-0.1513	0.1513	0.0105	7417
25A	2505.13	1203.77	53.09	-0.1485	0.1485	0.0028	18960
25D	2547.05	1248.02	60.95	-0.1492	0.1492	0.0007	87072
21DC	2573.96	1304.15	62.25	-0.1360	0.1360	0.0132	4716
21N	2623.25	1342.44	62.41	-0.1259	0.1259	0.0101	6179
21C	2651.57	1389.82	55.20	-0.1105	0.1105	0.0154	3585
21M	2694.90	1439.65	66.03	-0.0941	0.0941	0.0164	4026
21BC	2719.27	1477.80	45.27	-0.0854	0.0854	0.0087	5204
21EB	2799.95	1429.09	94.24	-0.0876	0.0876	0.0022	42838
24K	2783.89	1387.72	44.38	-0.1052	0.1052	0.0176	2516
24J	2749.39	1365.76	40.89	-0.1019	0.1019	0.0033	12240
24DC	2718.29	1323.13	52.77	-0.1130	0.1130	0.0111	4754
22F	2815.91	1325.41	97.65	-0.1205	0.1205	0.0075	13072
22C	2846.39	1352.54	40.80	-0.1350	0.1350	0.0145	2808
22GB	2866.82	1385.23	38.55	-0.1098	0.1098	0.0252	1528
22BC	2916.75	1435.77	71.05	-0.0951	0.0951	0.0147	4842
22I	2918.98	1461.37	25.69	-0.0913	0.0913	0.0038	6761
22H	2869.25	1441.80	53.44	-0.0824	0.0824	0.0089	6004
21P	2849.17	1456.90	25.13	-0.0838	0.0838	0.0014	17949
21FB	2861.65	1512.21	56.70	-0.0601	0.0601	0.0237	2392
21Q	2899.60	1571.32	70.24	-0.0613	0.0613	0.0012	58534
21GC	2901.12	1614.05	42.76	-0.0637	0.0637	0.0024	17817
22K	2985.12	1610.91	84.06	-0.0567	0.0567	0.0070	12009

2.29B	2955.27	1547.42	70.16	-0.0848	0.0848	0.0281	2497
22J	2944.47	1489.76	58.66	-0.0743	0.0743	0.0105	5587
22I	2918.98	1461.37	38.16	-0.0913	0.0913	0.0170	2245
22H	2869.25	1441.80	53.44	-0.0824	0.0824	0.0089	6004
21EB	2799.95	1429.09	70.46	-0.0876	0.0876	0.0052	13549
21BC	2719.27	1477.80	94.24	-0.0854	0.0854	0.0022	42838
BM21	2654.80	1515.40	74.63	-0.0938	0.0938	0.0084	8885
20F	2605.79	1575.98	77.92	-0.1024	0.1024	0.0086	9082
20E	2535.65	1542.67	77.65	-0.1575	0.1575	0.0551	1409
21C	2651.57	1389.82	191.84	-0.1105	0.1105	0.0470	4082
21N	2623.25	1342.44	55.20	-0.1259	0.1259	0.0154	3585
21DC	2573.96	1304.15	62.41	-0.1360	0.1360	0.0101	6179
25D	2547.05	1248.02	62.25	-0.1492	0.1492	0.0132	4716
25A	2505.13	1203.77	60.95	-0.1485	0.1485	0.0007	87072

Correnso South

24CD	2603.21	987.72		-0.1355	0.1355		
23F	2700.77	968.79	99.30	-0.1254	0.1254	0.0101	9839
2.13	2725.42	874.95	166.29	-0.1157	0.1157	0.0097	17143
23E	2774.82	972.51	74.14	-0.1228	0.1228	0.0026	27989
2.14A	2853.28	838.67	132.91	-0.1111	0.1111	0.0046	28893
23B	2856.49	949.79	84.77	-0.1224	0.1224	0.0004	241517
BANK1	2866.21	1023.25	74.10	-0.1081	0.1081	0.0143	5182
23C	2856.14	1068.01	45.88	-0.1697	0.1697	0.0616	745
2.25	2874.51	1097.26	34.54	-0.1182	0.1182	0.0515	671
23D	2861.42	1154.89	59.09	-0.1205	0.1205	0.0023	25693
2.24	2885.91	1215.47	65.35	-0.1259	0.1259	0.0054	12101
MATAURA1	2831.84	1250.81	64.60	-0.1136	0.1136	0.0123	5252
BM24	2794.55	1279.36	46.96	-0.1160	0.1160	0.0024	19568

SUPA

Mark	x	y	Distance (m)	November 2020 (m)	Abs	Δh (m)	Tilt (1:X)
BM25	2424.91	1100.25		-0.1408	0.1408		N/A
34H	2233.59	970.56	231.13	-0.1202	0.1202	0.0206	11220

2.10	2143.92	950.39	91.91	-0.1347	0.1347	0.0145	6339
34C	1968.90	982.67	177.97	-0.1080	0.1080	0.0267	6666
34GC	2211.33	1119.52	278.39	-0.1992	0.1992	0.0912	3053
19BB	2191.56	1292.02	173.63	-0.2893	0.2893	0.0901	1927
19CB	2296.71	1381.40	138.00	-0.2767	0.2767	0.0126	10952
21O	2527.37	1356.34	232.01	-0.1432	0.1432	0.1335	1738
20C	2450.61	1413.86	95.92	-0.1670	0.1670	0.0238	4031
20D	2482.07	1473.48	67.41	-0.1445	0.1445	0.0225	2996
BM20A	2345.50	1484.90	137.05	-0.2350	0.2350	0.0905	1514

Above mine workings

Tilt greater than 1:1000

7.1 Favona

Locations surveyed in 2020 with tilt values steeper than the 1:1000 criterion between adjacent marks are listed in Table 8. The locations of the marks in relation to the Favona mine workings are shown in Figure 45.

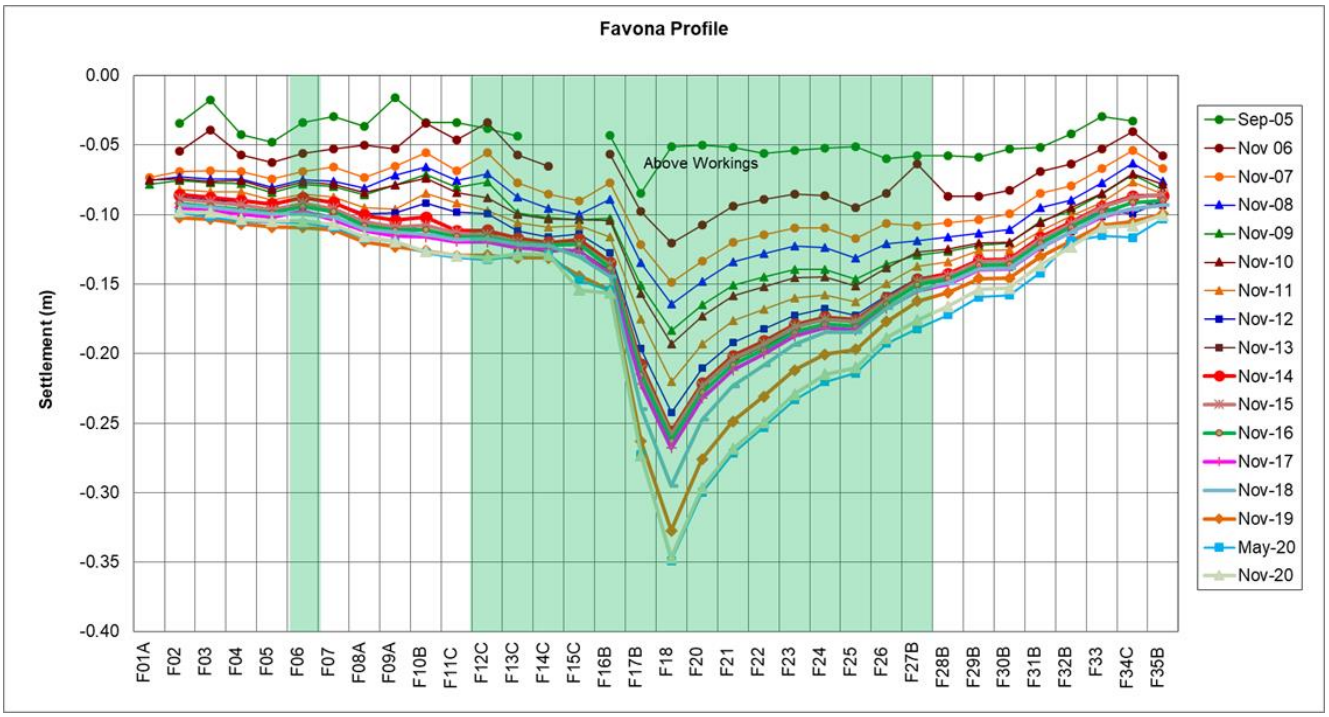


Figure 44: Favona Settlement

Figure 45: Favona Settlement Markers and Underground Workings

Discussion

Favona Tilt

The results for Favona indicate no new trends compared with recent surveys. No new tilt measurements in excess of 1:1000 has been recorded since the May 2020 survey.

Twenty-nine marks showed less settlement than the previous May 2020 survey, while five showed greater settlement. Mark F18 had the greatest settlement recorded (Figure 44). F18 has been listed by the surveyor as possibly disturbed. A substantial change between Nov 2006 and May 2007 occurred which was not recorded at nearby marks. This will contribute to tilt.

Tilt calculations greater than 1:1000 were determined in five locations (F16B/F17B, F17B/F18, F18/F21, F21/F24 and F24/27B). These were all located over or near underground workings. A new tilt measurement in excess of 1:1000 between marks F29B and F32B was identified during the May 2020 survey following the application of revised corrections for these marks. This tilt did not exceed the 1:1000 trigger in the November 2020 survey. Tilt in this area has changed little since mining began, with small increases in tilt as the dewatered underground workings adjust compared to the adjacent land. These locations are on farmland owned by the company; are over 100m south of any non-company residences; and are not considered to be an issue. Monitoring will continue, and this will determine any anomalous results that need to be addressed.

Note 1: Marks F18, F20, F23, F24 & F25 have been identified by the surveyor as possibly disturbed or damaged, which could exacerbate the amount of settlement and tilt recorded.

Note 2: The Favona tilt calculation is calculated from the total settlement at each mark, without separation of any Martha effect. While the calculated tilt may not precisely reflect the tilt due to Favona alone, the discrepancy is considered to be minor.

Note 3: Mark F34C was identified as having been ‘disturbed’, probably by an excavator passing over the mark. Although this resulted in an anomalous settlement for the mark, the tilt between adjacent marks did not exceed 1:1000.

7.2 Martha/North Wall Tilt

No tilt calculations greater than 1:1000 in the Martha/North Wall area have been identified during the November 2020 survey. Following the recent revision of corrections in the settlement database, the tilt between 20C/20D recorded in previous reporting periods is no longer greater than 1:1000.

As the Slevin Park area is swampy, historically infilled with poor material and with previous slumping/subsidence, close monitoring of this area will continue. We understand that HDC is also undertaking regular monitoring of this area.

7.3 Correnso

Two new tilt calculations greater than 1:1000 in the Correnso South area were identified during the May 2020 survey and remain in the November 2020 survey (between marks 23C/2.25 and 23C/BANK1). Both tilts in this area are as a result of increased settlement of mark 23C (Figure 46). This mark showed a sharp increase in settlement in the May 2020 survey, however the rate of settlement in the November 2020 survey was similar to nearby marks. The mark is noted by the surveyor as being near a watercourse. It may have been influenced by the dry summer over 2019/2020 and the subsequent dry autumn during 2020. It may also have been disturbed or influenced by improved drainage nearby.

Figure 46: Correnso Tilts and Underground Workings

7.4 SUPA

No tilts in the SUPA area have been identified.

8 COMPLAINTS

The company maintains a complaints database in accordance with consent condition 13f. There were no complaints received during 2020 in relation to dewatering or settlement.

A number of other property damage complaints or enquiries were made during the year, generally in relation to impacts of blast vibration. As a result, some of the properties were inspected to determine likely sources. No evidence was found of land deformation as a consequence of mining activities.

9 CONTINGENCY ACTIONS AND FUTURE IMPACTS

No consent or management plan settlement trigger has been activated.

10 UNDERGROUND WATER QUALITY

Underground dewatering water is sampled at the Water Treatment Plant. This is a combination of underground water from Favona, Trio, Correnso, SUPA, Martha mines and treated service water, but gives a general indication of underground water quality.

During the reporting period, results from the dewatering line sample point had stable pH and EC values averaging 7.3 units and 258 mS/m respectively. Sulphate values averaged 1536 g/m^3. Fe and Mn were elevated. Other metal concentrations were low (Figure 47-51; Appendix E).

The only mine backfilled and considered near its final closure state is the Favona underground mine. As Favona dewatering water is not segregated from active mine dewatering water, separate sampling of Correnso and Favona underground water from sumps at the lowest accessible points in each mine began during 2018. The Favona sump was dry on one sampling occasion during 2020, so only one sample was collected throughout the year. It should be noted that in Correnso, dewatering water is a composite of treated service water and groundwater, however, this is currently the best proxy for back-filled water quality for Correnso available.

One sample from the new underground dewatering system was also collected during 2020. Sampling from underground dewatering bores will continue during 2021.

Figure 47 to 48 show Piper Diagrams for the various types of underground water. Correnso and Favona underground waters have a similar make up of cation and anions, all being calcium sulphate type waters.

During the period, the pH averaged 7.1 in Correnso and the pH of the single sample from the Favona sump was 7.3. EC averaged 269 mS/m in Correnso and was 184.2 mS/m in Favona. Average sulphate levels were 1730 g/m^3 and 1010 g/m^3 in Correnso and Favona, respectively (Figure 51).

While elevated levels of some metals are noted, all underground water is currently pumped to the Water Treatment Plant.

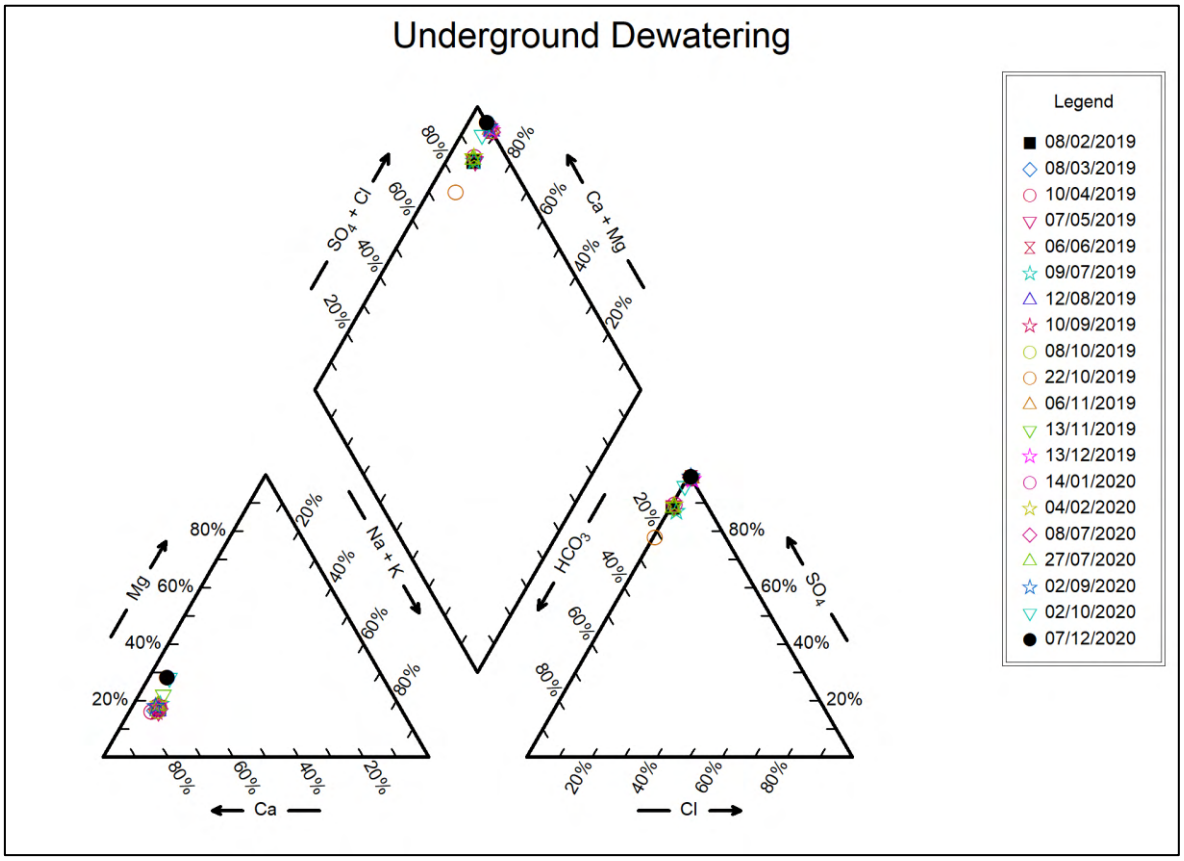


Figure 47: Underground Dewatering Piper Diagram

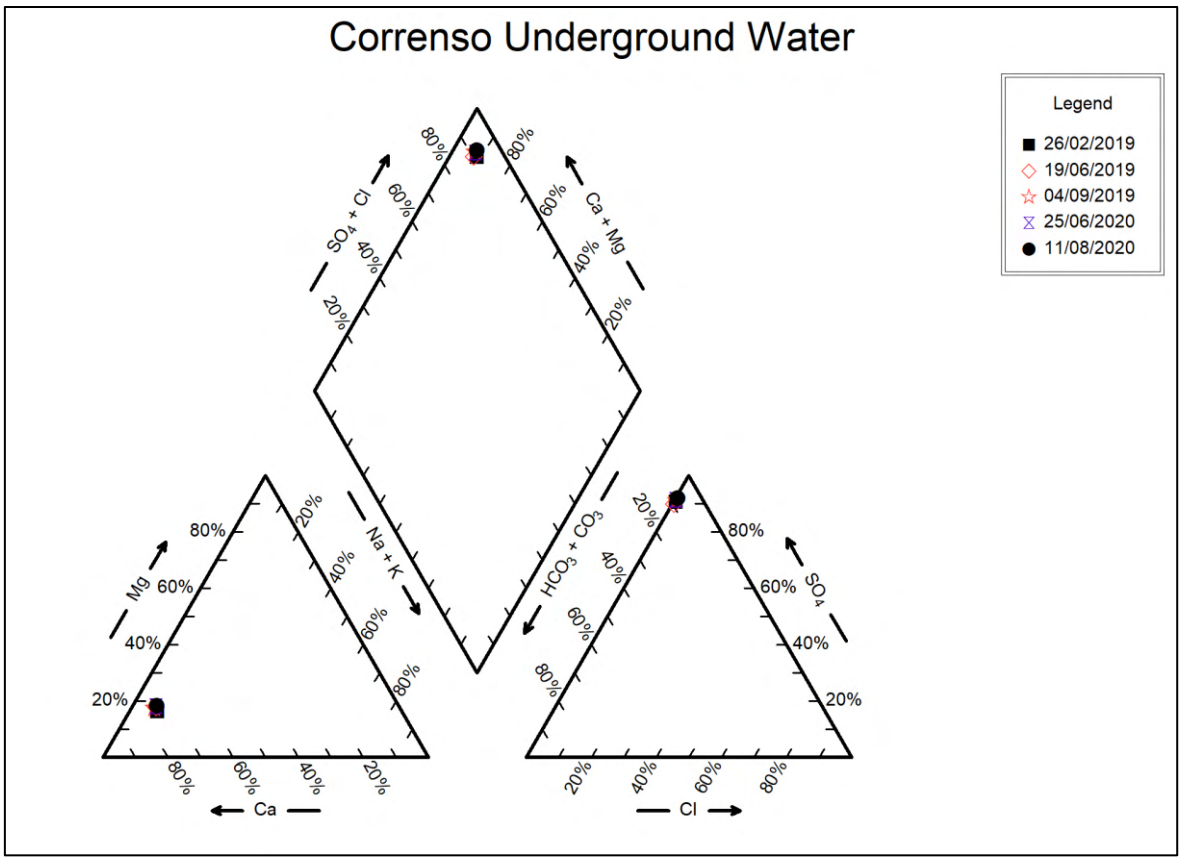


Figure 48: Correnso Underground Water Piper Diagram

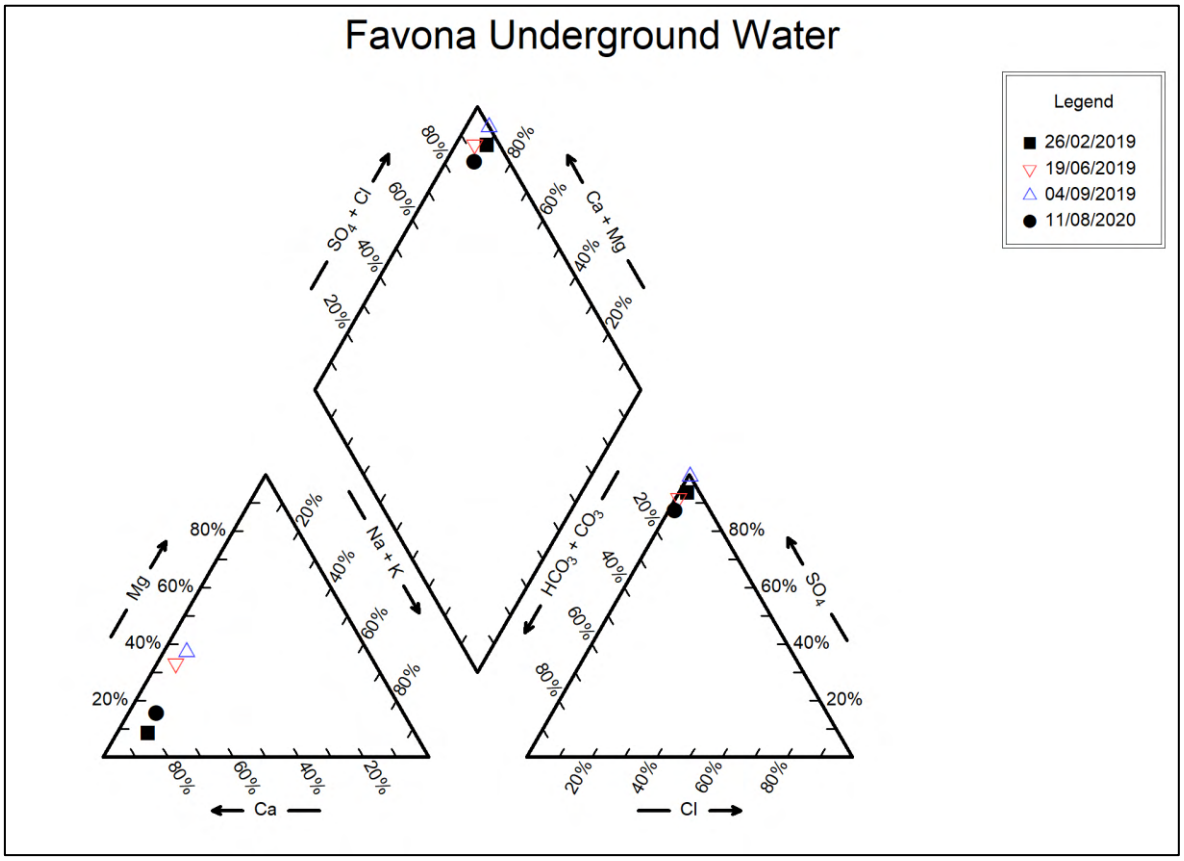


Figure 49: Favona Underground Water Piper Diagram

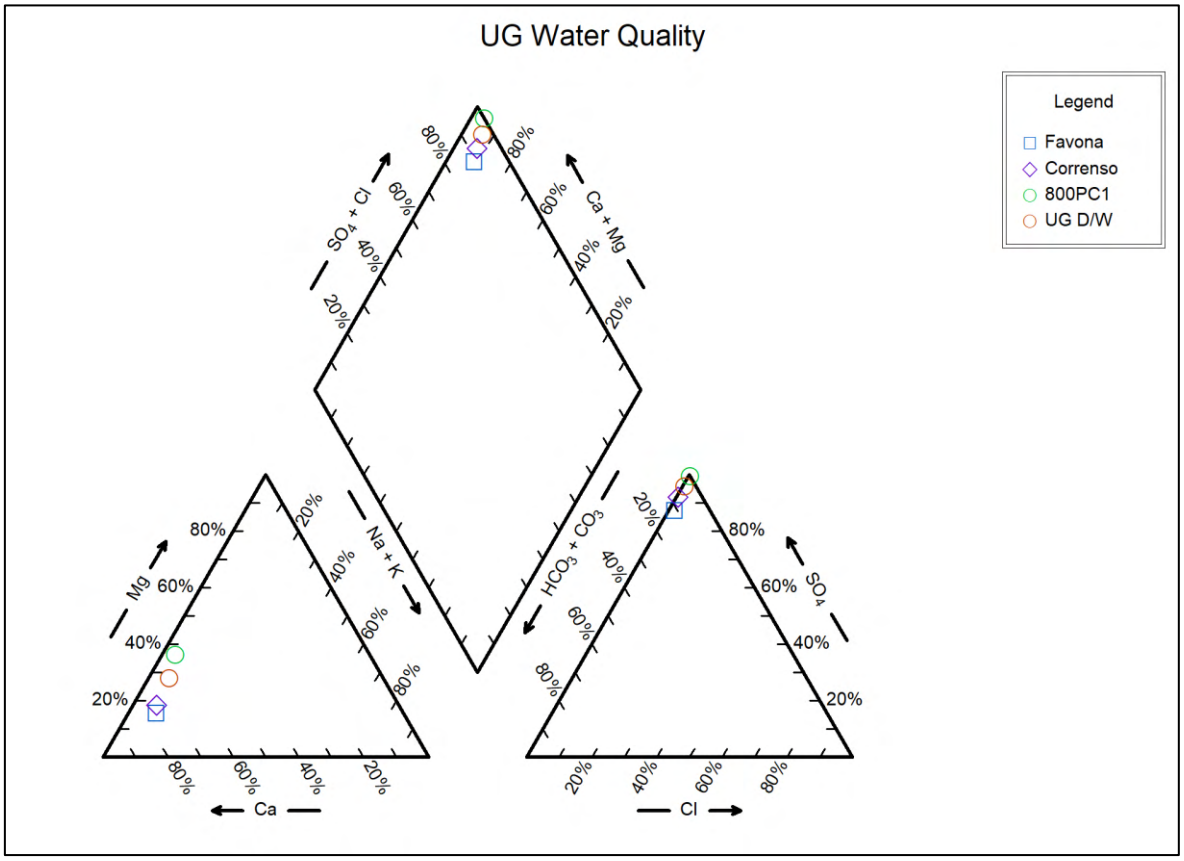


Figure 50: Underground Water Piper Diagram

Figure 51: Underground Water EC and pH

11 IMPROVEMENT ACTIVITIES

Works that have been undertaken to improve environmental performance during 2020 include:

- Installation of the final three piezometers to monitor Project Martha dewatering
- Monitoring of underground water levels from Project Martha dewatering bores
- Commencement of dewatering water quality sampling from the Project Martha underground dewatering bores
- Review of settlement marker network; removal of erroneous and high-density markers
- Application of Project Martha settlement triggers and zones.

Proposed improvement activities to be undertaken in 2021:

- Review of the Project Martha piezometer network to assess effectiveness.

12 RESOURCE CONSENT EVALUATION

Comments on compliance with all conditions of the Martha, Favona, Trio, Correnso and Project Marha consents including any reasons for non-compliance or difficulties in achieving conformance with the consent conditions are summarised in Table 9. The Correnso/Golden Link take 124860 has been superseded by Project Martha Water Permit 139551.

Table 9 – Favona, Trio, Correnso, SUPA, Project Martha Consent Condition Compliance Assessment

Description	Consent (Condition)	Compliance	Comment
Favona Dewatering and Settlement Plan	**109742 - 109746**		
Favona groundwater take	109742 (3)	Full	Favona discharge plumbed into main dewatering line, new meter installed on Favona line.
Divert and discharge ground and surface water (farm run-off and intercepted groundwater) from around the (Favona) project area.	109743	Full	Non-mine run-off has been diverted to natural drainage.
Discharge waste rock and ore onto land in temporary surface stockpiles and to discharge seepage from the temporary stockpiles into ground.	109744	Full	Stockpile area design & construction. Water quality monitoring in manholes and shallow bores (the subject of a separate report – *Favona Water Quality Monitoring Annual Report.*
Discharge waste rock into land underground in the project area as backfill and to allow degraded quality groundwater to discharge from the flooded workings in the project area into the surrounding ground post closure.	109745	Full	Favona back-filling completed. Dewatering being maintained
Discharge treated mine water from the Martha Mine Water Treatment Plant to ground in association with flooding the underground mine on completion of the project.	109746	Full	Favona Water Quality Monitoring Annual Report
	109742 – 109746 Schedule 2		
Water Management Plan	(1)		Under separate negotiation
Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Settlement, Dewatering and Water Quality Monitoring Plan	(2)	Full	Dewatering and Settlement Monitoring Plan, April 2019
The monitoring regime shall be designed to assess the effects of: a) mine dewatering on the regional groundwater system,		Full	Defined in this document

b) mine dewatering on settlement; c) leachate from stockpiles containing potentially acid forming material on shallow groundwater quality, and d) the discharge of degraded-quality water from the backfilled and flooded workings on groundwater quality.			c) Reported annually in Favona Water Quality Monitoring Report. d) Combined dewatering sample taken monthly
Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.		Full	Section 5 Stockpile water quality bores agreed in Nov 2006
The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed, and updated as necessary, by the consent holder at least once every two years. Any updated Plan shall be promptly forwarded to the Council for approval and following approval the updated Plan shall be implemented in place of the previous version.		Full	Consent activated following approval of Plan. Combined plan, approved by WRC, April 2019
In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Settlement, Dewatering and Water Quality Monitoring Plan, then the conditions of this consent shall prevail.		Full	No inconsistency identified
In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Council in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:	(3)	Full	Section 7 Correspondence in Jun 2019 and January 2020 (Tilt Reports)
a) explain the cause of the non-conformance,			Section 7
b) agree with the Council on the appropriate settlement contingency measures to be implemented as described,			Propose ongoing monitoring
c) implement settlement contingency measures as appropriate,			Not considered necessary as on company owned farmland
d) advise the Council on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.			Propose ongoing monitoring
The report shall include at least the following information:	(4)		
a) volume of groundwater abstracted		Full	Section 4
b) data from monitoring undertaken during the previous year including groundwater contour plans		Full	Section 5
c) an interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.		Full	Section 5 & 9

This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information.		Full	GWS Ltd & OGNZL staff
d) any contingency actions that may have been taken during the year.		Full	Section 9
e) comment on compliance with all conditions of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of this consent.		Full	This section
Trio Dewatering and Settlement Plan - General conditions	**121416 - 121418, 121446 & 121447**		
Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Settlement, Dewatering and Water Quality Monitoring Plan	Schedule 1 (5)	Full	Combined plan Approved by WRC April 2019
The monitoring regime shall be designed to assess the effects of: i) dewatering on the regional groundwater system, ii) dewatering on settlement; iii) the discharge of degraded-quality water from the backfilled and flooded workings on groundwater quality.		Full	Defined in plan iii) No significant flooded workings as yet.
Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.		Full	Defined in approved Plan
The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed, and updated as necessary, by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.		Full	Consent activated following approval of Plan Jul 2014
In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Settlement, Dewatering and Water Quality Monitoring Plan, then the conditions of this consent shall prevail.		Full	No inconsistency identified
Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:	Schedule 1 (6)		
i) volume of groundwater abstracted		Full	Section 4
ii) data from monitoring undertaken during the previous year including groundwater contour plans		Full	Section 5
iii) an interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what		Full	Section 5 & 9

contingency actions, if any, the consent holder proposes to take in response to those predictions.			
This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information.		Full	GWS Ltd & OGNZL staff
iv) any contingency actions that may have been taken during the year.		Full	Section 9
v) comment on compliance with all conditions of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of this consent.		Full	This section
Monitoring - Tilt:	Schedule 1 (7)		
In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, installed in accordance with the Settlement, Dewatering and Water Quality Monitoring Plan required pursuant to condition 2 above, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Council in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:		Full	Section 7 Correspondence in Jun 2019 & Jan 2020
i) explain the cause of the non-conformance,			Section 9
ii) agree with the Councils on the appropriate settlement contingency measures to be implemented,			Propose ongoing monitoring
iii) implement settlement contingency measures as appropriate,			Not considered necessary
iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.			Propose ongoing monitoring
The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:			
a) The volume of groundwater abstracted;		Full	Section 4
b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;		Full	Section 5
c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately		Full	Annual Report reviewed by GWS Ltd and Engineering Geology

	experienced and qualified to assess the information;		
d)	Any contingency actions that may have been taken during the year; and	Full	Section 9
e)	Comment on compliance with Conditions 27 to 34 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.	Full	This section.
The report shall be forwarded in a form acceptable to the Council.			
Advice note:			
The Dewatering and Settlement Monitoring Report shall be consistent with the Dewatering and Settlement Monitoring Report prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council.			
Golden Link Project Area Groundwater Take – General conditions	**124860**		
Monitoring - Abstraction Volume		Full	Section 4
4.The consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council on a quarterly basis.			
Dewatering and Settlement Monitoring Plan 5. Prior to the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.		Full	Latest plan April 2019
The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:			
(i)	dewatering on the regional groundwater system; and	Full	Defined in plan
(ii)	dewatering on settlement; and		
(iii)	the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.		iii) No significant flooded workings as yet.
Monitoring locations are to provide appropriate resolution of surface tilt relative to the scale of surface infrastructure and final details are to be agreed with the Councils. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.		Full	Defined in plan

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Such updated Plans shall relate to the Correnso Mine or to any new mine within Area L. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.	Full	Plan April 19
In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.		
Dewatering and Settlement Monitoring Report		
6.The consent holder shall provide to the Councils an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:	Full	Section 4
	Full	Section 5
(i) The volume of groundwater abstracted;		
(ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;	Full	Section 5 & 9
(iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;	Full	Section 9
	Full	Section 12
(iv) Any contingency actions that may have been taken during the year; and		
(v) Comment on compliance with condition 5 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.		
The report shall be forwarded in a form acceptable to the Councils.		
Monitoring - Tilt		
7. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to condition 5 of this consent, and such tilt is caused by the de-watering and/or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then engage in a process with the Councils:	Full	Section 7 Correspondence in Jun 2019 & Jan 2020
(i) explain the cause of the non-conformance,		Section 9

(ii) Propose appropriate settlement contingency measures for discussion with Councils and agree with the Councils on the appropriate settlement contingency measures and the timing for their implementation as described,		Propose ongoing monitoring
(iii) implement agreed settlement contingency measures as appropriate within the agreed time limit,		Not considered necessary
(iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.		Propose ongoing monitoring
Monitoring – Water Quality		
8.The consent holder shall monitor throughout the period of operation, the chemistry of the groundwater, pit run-off and pit discharge water abstracted from the open pit. The monitoring data is to be used to correlate these inflows with pit lake water quality predictions, and to provide a database for input into the closure plans. The sampling parameters and frequencies shall be described in the Martha Extended Project dewatering consent (unless agreed otherwise with the Waikato Regional Council) with the results forwarded to the Waikato Regional Council on an annual basis.	Partial	Pit sampling limited, dewatering sampled monthly. Favona and Correnso Underground WQ measured separately. Underground dewatering from Project Martha bores commenced.
Other Water Users	Full	
9.If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Waikato Regional Council.		
Project Martha – Common Conditions	**202.2018.00000857.001**	
Dewatering and Settlement Monitoring Plan		
14. The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.	Full	Dewatering and Settlement Monitoring Plan approved April 2019 (Conditions 14-18)
15. Two months prior to dewatering below 700 m RL (mine datum), the consent holder shall prepare, and submit to the Councils for their certification, a Dewatering and Settlement Monitoring Plan. The purpose of the Dewatering and Settlement Monitoring Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.		

16 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 14 of this schedule. The monitoring regime shall be designed to assess the effects of: a. Dewatering on the regional groundwater system; and b. Dewatering on settlement.		
17. Monitoring locations are to provide appropriate resolution of mine inflows and pumping, groundwater levels (both for shallow and deep aquifers) and ground surface tilt relative to the scale of surface infrastructure, throughout the area within the maximum extent of the groundwater cone of depression and particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Councils, but are to include additional piezometers and extensometers located along the line of upper level workings in the Rex Orebody. The Dewatering and Settlement Monitoring Plan shall also provide groundwater and settlement trigger limits that will initiate the implementation of contingency mitigation and / or monitoring measures and shall detail any linkages with the operation of the Martha Pit and Martha Underground Mine.		
18. The exercise of this consent shall be in accordance with the Dewatering and Settlement Monitoring Plan as certified by the Councils. The Dewatering and Settlement Monitoring Plan shall be reviewed and updated as necessary by the consent holder. Any updated Dewatering and Settlement Monitoring Plan shall be promptly forwarded to the Councils for certification, and following this process, the updated plan shall be implemented in place of the previous version.		
19. In the event that a tilt greater than 1 in 1,000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 15 of this schedule, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing within 20 working days of receiving the results of the monitoring. The consent holder shall then:	Full	Notification of tilts greater than 1:1000 provided in Tilt Report, January 2021.
a. Explain the cause of the non-conformance;		No non-conformances
b. Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;		
c. Implement settlement contingency measures as appropriate within the agreed time limit; and		
d. Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.		

20. The consent holder shall as a matter of urgency, advise the Councils of any significant anomalies identified by the regular reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Councils within 10 working days of the anomalous results being identified. A "significant anomaly" is defined as a drop in groundwater level greater than the seasonal variation in piezometers within the alluvium and younger volcanic rocks and a drop of 15 m or more in the recordings from piezometers tapping the upper 50 m of Andesite over a one month period.			
Dewatering and Settlement Monitoring Report			
22. The consent holder shall provide to the Councils (within one month of an agreed anniversary date) an annual Dewatering and Settlement Monitoring Report. The report shall, as a minimum, provide the following information:		Full	
a. The volume of groundwater abstracted;		Full	Section 4
b. The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;			
c. An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of the future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions, this analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;		Full	Sections 5, 6 and 9
d. Any contingency actions that may have been taken during the year; and		Full	Section 9
e. Comment on compliance with Conditions 14 to 21 of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.		Full	This section
f. The report shall be forwarded in a form acceptable to the Councils.			
Project Martha Groundwater take permit	**139551**		
Dewatering Level			
1. The exercise of this consent shall not result in groundwater lowering to a level below 500mRL.		Full	Groundwater level not lowered below 700 mRLduring 2020.
MONITORING			
2. Upon commencement of this consent, the consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council.		Full	Abstraction volumes reported to Council via Hyquest,

3.	Upon the first exercise of this consent the consent holder must telemeter – via a telemetry system developed after liaison with the Waikato Regional Council to ensure that the telemetry system is compatible with the Waikato Regional Council telemetry system standards and data protocols – continuous 15 minute values of: gross take volume (in units of cubic metres). The data must be reported once daily to the Waikato Regional Council via the telemetry system. There must be 96 values, respectively, per daily report. When no water is being taken the data must specify the gross take volume and calculated net take volume as zero.	Full	As above.
4.	The consent holder shall monitor the chemistry of the water abstracted under this consent. Prior to the commencement of this consent the sampling parameters and frequencies shall be agreed with the Waikato Regional Council, with the results forwarded to the Waikato Regional Council on an annual basis. The consent holder may change the sampling parameters and frequencies with the agreement of the Waikato Regional Council.	Full	Appendix E
OTHER WATER USERS			
5.	If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects any existing stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Council.	N/A	
MONITORING OF THE SHALLOW AND DEEP AQUIFERS			
6.	The consent holder shall upon commencement of this consent and at five yearly intervals thereafter, provide a report to the Waikato Regional Council commenting on the effect the groundwater take and dewatering activity is having on the deep and shallow aquifers under the Martha Pit and immediate surrounds. The report shall as a minimum, provide the following information: (a) The nature of the geology under the Martha Pit and immediate surrounds; (b) Comment on the existing groundwater chemistry for the deep and shallow aquifers; (c) Comment on the groundwater levels in the deep and shallow aquifers; and (d) Provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows.	Full	Provided to Waikato Regional Council in June 2019

	Taking into account all of this information (and any other relevant data) the consent holder shall provide comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

13 CONCLUSION

Monitoring of dewatering, groundwater, settlement, tilt, and water quality in and around the Martha, Favona, Trio, Correnso, SUPA and Project Martha operations was undertaken during 2020 in accordance with the consent conditions and the approved monitoring plan.

In 2020, water levels underground were held at approximately 705 mRL throughout the year. No significant changes to groundwater contours in the alluvium, younger volcanics and the upper andesite rock occurred relating to the Martha Mine site during 2020.

At Favona, water levels were maintained around 800mRL and dewatering has maintained the steep but localised depression of the groundwater (contour pattern) along the NE-SW trending vein structure. Water levels in the younger volcanic suite and overlying alluvium have not responded to the significant dewatering of the vein-hosted andesite. Minor or no response has been seen in wells monitoring the upper layers of the andesite rock body. Response is only evident in deeper wells constructed in the andesite rockmass that intercept structures connected to the vein systems.

The drop in pressure in the 975 mRL piezometer in well P94 noted in 2018 and 2019 has continued but at a slowing rate. Shallower piezometers at this location have not shown any corresponding drop in pressure. The depressurisation effect at the 975mRL level is expected to reverse once mining has passed the area. Monitoring of all other piezometers in the Waihi East network show levels consistent with baseline data recorded in 2011.

Settlement monitoring, to assess any effects from groundwater changes, was conducted in May/June and November/December 2020. Settlement survey results indicated that 97% (359/370) of marks graphed were within the predicted settlement ranges, based on the newly implemented Project Martha predicted settlement. Of the greater-than-predicted settlements, four were above or near the Favona Underground mining. The other seven exceedances are generally associated with sites that are considered to be affected by unstable ground or soil creep due to proximity to stream banks or drains. At all these locations no visible effects were noted nearby, and shallow piezometers have not shown any abnormal changes.

A general settlement rate across town of 10 to 60 mm over the period from 1999 to present has been identified and is considered to be a response to ongoing dewatering of structures within the deeper andesite within the Martha groundwater system. There are no widespread ongoing dewatering effects observed in the younger volcanic or upper andesite rock that would give rise to such widespread settlement.

Settlement continues to be observed in marks near and overlying the Favona mine, although the total amount is similar to previous years. The deep monitoring wells connected to the Favona vein system are the only wells showing dewatering changes consistent with this settlement, indicating the settlement is likely to be a response to dewatering of the deeper structures of the Favona vein system and/or to changes in the rockmass volume associated with mining at Favona. Tilt is also apparent between marks near and overlying the Favona mine which is occurring on farmland owned by OGNZL and is not expected to be an issue.

Some elevated trace metal results were noted from underground water sampling during the period; however, all underground water is currently collected and treated.

14 REFERENCES

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IGNS, 2002: Waihi Underground mine workings Stage II investigations Volume 2 – Figures. Prepared for Waihi Underground Mine Workings Technical Working Party. Client Report 2002/46, August.

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URS, 2009: Favona Temporary Stockpile – Water Quality Report.

Appendix A Relevant Consent Conditions

Extract from conditions of Waikato Regional Council Resource Consents 109742 to 109746, pertaining to Dewatering and Settlement:

SCHEDULE TWO – GENERAL CONDITIONS

The granting of consents (109742 to 109746 inclusive) is subject to the following conditions, which shall apply to each individual consent.

Water Management Plan

1. Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Water Management Plan describing the water management system to be applied across the project area, with emphasis on management of stormwater including water storage options, decline and mine dewatering, and stockpile runoff.

   The consent holder shall exercise this consent in accordance with the approved Water Management Plan.

Settlement, Dewatering and Water Quality Monitoring Plan

2. Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Settlement, Dewatering & Water Quality Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement, the groundwater hydraulic regime and on water quality, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   a) mine dewatering on the regional groundwater system,
   b) mine dewatering on settlement;
   c) leachate from stockpiles containing potentially acid forming material on shallow groundwater quality, and
   d) the discharge of degraded-quality water from the backfilled and flooded workings on groundwater quality.

   Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The Plan shall be consistent with the recommendations included in the reports to the Council entitled;

   - *"Proposed Favona Underground Mine – Review of Groundwater Assessment" dated October 2003 and prepared by Pattle Delamore Partners; and*
   - *"Technical Review of Water Quality and Geochemistry Issues - Favona Underground Project", dated October 2003 and prepared by GEOKEM.*

   The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed, and updated as necessary, by the consent holder at least once every two years. Any updated Plan shall be promptly forwarded to the Council for approval and following approval the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Settlement, Dewatering & Water Quality Monitoring Plan, then the conditions of this consent shall prevail.

3. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, installed in accordance with the Settlement, Dewatering & Water Quality Monitoring Plan required pursuant to condition 2 above, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Council in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

   a) explain the cause of the non-conformance,
   b) agree with the Council on the appropriate settlement contingency measures to be implemented as described,
   c) implement settlement contingency measures as appropriate,
   d) advise the Council on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Settlement, Dewatering & Water Quality Monitoring Report

4. The consent holder shall provide to the Council (with a copy provided to the Hauraki District Council) an annual Settlement, Dewatering & Water Quality Monitoring Report. The report shall include at least the following information:

   a) the volume of groundwater abstracted,
   b) the data from monitoring undertaken during the previous year including groundwater contour plans (derived from the data) in respect of the piezometer network,
   c) an interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information,
   d) any contingency actions that may have been taken during the year,
   e) comment on compliance with all conditions of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of this consent.

   The report shall be forwarded in a format acceptable to the Council.

Extract from conditions of Hauraki District Council Resource Consent 97/98-105, pertaining to Dewatering and Settlement:

3.30 Settlement

a) The consent holder shall prepare a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of dewatering on land settlement and the effects of the mining activities on the subsurface hydraulic regime. The Dewatering and Settlement Monitoring Plan shall address at least the following:

i) An overall description of the groundwater and settlement monitoring system and the measures to be adopted to meet the objectives of the groundwater and settlement monitoring system.

ii) Details of the piezometer network proposed to monitor the effects of pit dewatering on the aquifers under Waihi township.

Any monitoring bores additional to the existing piezometer network shall be installed and operational prior to the exercising of this consent.

iii) Details of the settlement monitoring network proposed to monitor the extended zone which has been, or is likely to be, affected by settlement caused by mine dewatering.

Any settlement monitoring network locations additional to the existing monitoring locations shall be installed and operational prior to exercising this consent.

iv) Details of the survey of facilities in the Waihi township considered by the consent holder to be potentially "at risk" of damage from ground settlement caused by mine dewatering. The survey to be completed shall include collection of information about the facility's location, the nature of construction materials, the nature of sensitive equipment that might be potentially "at risk", and the sensitivity of this equipment to ground settlement caused by mine dewatering and/or tilt.

This survey shall be completed prior to exercise of the Waikato Regional Council consent number 971286.

v) A settlement contingency plan to include mitigation measures to be implemented in the event that ground settlement caused by mine dewatering induces a tilt that exceeds 1 in 1000 between any two network monitoring locations spaced no less than 25 metres apart. The settlement contingency plan shall particularly address those facilities identified by the consent holder as being potentially "at risk" of damage from ground settlement caused by mine dewatering.

vi) A dewatering contingency plan that describes the steps the consent holder shall implement in the event that dewatering results in adverse impacts on affected aquifer systems and associated groundwater supplies used for domestic, stock or other purposes.

In detailing the monitoring programmes the consent holder shall provide information on the monitoring methods proposed, the parameters to be monitored, and the calibration and maintenance of monitoring equipment.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of Waikato Regional Council consent number 971286 shall prevail.

b) The Dewatering and Settlement Monitoring Plan shall be submitted to Hauraki District Council for approval at least one month prior to the exercise of this consent. The Hauraki District Council shall consult with the Waikato Regional Council prior to approving the Dewatering and Settlement Monitoring Plan. The consent holder shall review and update (as necessary) the Plan and shall provide promptly such updated Plan to the Hauraki District Council annually for approval.

c) If in the opinion of Hauraki District Council the dewatering adversely affects land or facilities, then the consent holder shall at its own cost be responsible for reinstating the facilities to an equivalent standard to the reasonable satisfaction of Council.

d) The consent holder shall measure and record the daily volume of water abstracted from the pit.

e) The consent holder shall undertake monthly water level monitoring of the piezometer network in accordance with the Dewatering and Settlement Monitoring Plan.

f) The consent holder shall monitor ground settlement at a minimum of six monthly intervals in accordance with the Dewatering and Settlement Monitoring Plan.

g) In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations spaced no less than 25 metres apart, and such tilt is caused by mine dewatering, or there is a significant variance from the predicted settlement rates described in the evidence of Dr Semple (Table 5, Figure 8 dated 13 November 1997 as presented to the Joint Hearing Committee – attached hereto as Appendix C), the consent holder shall notify the Hauraki District Council and the Waikato Regional Council, in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

- explain the cause of the non-conformance,
- agree with the Hauraki District Council and Waikato Regional Council on the appropriate settlement contingency measures to be implemented as described,
- implement settlement contingency measures as appropriate,
- advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

h) The consent holder shall provide to the Hauraki District Council and the Waikato Regional Council an annual dewatering and settlement monitoring report. The report shall include at least the following information:

- The data from monitoring undertaken during the previous year including ground water contour plans (derived from the data) in respect of the piezometer network.
- Identification of any environmentally important trends in settlement and dewatering behaviour.
- Interpretation and analysis of any change in ground water profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.
- A comparison of the settlement survey data with that predicted in Table 5 and Figure 8 (dated 13 November 1997) by Dr Semple of Woodward Clyde (NZ) Ltd as provided in evidence to the Joint Hearing Committee.
- Comment on compliance with this condition.
- A summary and analysis of complaints relevant to this condition.
- Any reasons for non-compliance or difficulties in achieving conformance with this condition.
- Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by this condition.

The report shall be forwarded in a format acceptable to the Hauraki District Council.

(Note: This condition is complementary to Waikato Regional Council consent number 971286).

Extract from conditions of Hauraki District Council Resource Consent RC-15735, as pertaining to Dewatering and Settlement:

Dewatering and Settlement Monitoring Plan

14. Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

    The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

    (i) dewatering on the regional groundwater system; and
    (ii) dewatering on settlement.

    Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

    The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

    In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

15. The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:
    (i) The volume of groundwater abstracted;
    (ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
    (iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;
    (iv) Any contingency actions that may have been taken during the year; and
    (v) Comment on compliance with condition 14 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Monitoring – Tilt

16. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the De-watering and Settlement Monitoring Plan required pursuant to condition 14 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

(i) Explain the cause of the non-conformance,
(ii) Agree with the Councils on the appropriate settlement contingency measures to be implemented as described,
(iii) Implement settlement contingency measures as appropriate,
(iv) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Extract from conditions of Waikato Regional Council Resource Consents 121416, 121417, 121418, 121446, and 121447, pertaining to Dewatering and Settlement:

SCHEDULE ONE – GENERAL CONDITIONS

Resource Consents **121416, 121417, 121418, 121446, and 121447** are subject to the following general conditions, which are applicable to all consents.

Dewatering and Settlement Monitoring Plan

5 Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

(i) dewatering on the regional groundwater system; and
(ii) dewatering on settlement, and
(iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

6. The consent holder shall provide to the Councils an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

(i) The volume of groundwater abstracted;
(ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
(iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis

shall be undertaken by a party appropriately experienced and qualified to assess the information;

(iv) Any contingency actions that may have been taken during the year; and

(v) Comment on compliance with condition 5 of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Monitoring – Tilt

7. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the De-watering and Settlement Monitoring Plan required pursuant to condition 5 of this schedule, and such tilt is caused by the de-watering and/or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then engage in a process with the Councils:

(i) explain the cause of the non-conformance,

(ii) agree with the Councils on the appropriate settlement contingency measures to be implemented as described,

(iii) implement settlement contingency measures as appropriate,

(iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Extract from conditions of Mining Licence 32 2388, pertaining to Dewatering and Settlement:

Dewatering

11. (a) The licensee shall prepare a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of dewatering associated with the extended project on land settlement and the effects of the mining activities on the subsurface hydraulic regime. The Dewatering and Settlement Monitoring Plan shall address at least the following:

(i) An overall description of the groundwater and settlement monitoring system and the measures to be adopted to meet the objectives of the groundwater and settlement monitoring system.

(ii) Details of the piezometer network proposed to monitor the effects of pit dewatering on the aquifers under Waihi township.

Any monitoring bores additional to the existing piezometer network shall be installed and operational prior to the commencement of the extended project.

(iii) Details of the settlement monitoring network proposed to monitor the extended zone which has been, or is likely to be, affected by settlement caused by mine dewatering.

Any settlement monitoring network locations additional to the existing monitoring locations shall be installed and operational prior to the commencement of the extended project.

(iv) Details of the survey of facilities in the Waihi township considered by the licensee to be potentially "at risk" of damage from ground settlement caused by mine dewatering. The survey to be completed shall include collection of information about the facility's location, the nature of construction materials, the nature of sensitive equipment that might be potentially "at risk", and the sensitivity of this equipment to ground settlement caused by mine dewatering and/or tilt.

This survey shall be completed prior to the commencement of the extended project.

(v) A settlement contingency plan to include mitigation measures to be implemented in the event that ground settlement caused by mine dewatering induces a tilt that exceeds 1 in 1000 between any two network monitoring locations spaced no less than 25 metres apart. The settlement contingency plan shall particularly address those facilities identified by the licensee as being potentially "at risk" of damage from ground settlement caused by mine dewatering.

(vi) A dewatering contingency plan that describes the steps the licensee shall implement in the event that dewatering results in adverse impacts on affected aquifer systems and associated groundwater supplies used for domestic, stock or other purposes.

In detailing the monitoring programmes the licensee shall provide information on the monitoring methods proposed, the parameters to be monitored, and the calibration and maintenance of monitoring equipment.

In the event of any conflict or inconsistency between these conditions and the provisions of the Dewatering and Settlement Monitoring Plan, these conditions shall prevail.

(b) The Dewatering and Settlement Monitoring Plan shall be submitted to the Minister for approval at least one month prior to the commencement of the extended project. The licensee shall review and update (as necessary) the Plan and shall provide promptly such updated Plan to the Minister annually for approval.

(c) If in the opinion of the Minister the dewatering adversely affects land or facilities, then the licensee shall at its own cost be responsible for reinstating the facilities to an equivalent standard to the reasonable satisfaction of the Minister.

(d) The licensee shall measure and record the daily volume of water abstracted from the pit.

(e) The licensee shall undertake monthly water level monitoring of the piezometer network in accordance with the Dewatering and Settlement Monitoring Plan.

(f) The licensee shall monitor ground settlement at a minimum of six monthly intervals in accordance with the Dewatering and Settlement Monitoring Plan.

(g) In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations spaced no less than 25 metres apart, and such tilt is caused by mine dewatering, or there is a significant variance from the predicted settlement rates described in the evidence of Dr Semple (Table 5, Figure 8 dated 13 November) the licensee shall notify the Minister, in writing, within 20 working days of receiving the results of the monitoring. The licensee shall then:

- Explain the cause of the non-conformance;
- Agree with the Minister on the appropriate settlement contingency measures to be implemented as described;
- Implement settlement contingency measures as appropriate;
- Advise the Minister on the steps the licensee proposes to take in order to prevent any further occurrence of the situation.

(h) The licensee shall provide to the Minister an annual dewatering and settlement monitoring report. The report shall include at least the following information:

- The data from monitoring undertaken during the previous year including ground water contour plans (derived from the data) in respect of the piezometer network;
- Identification of any environmentally important trends in settlement and dewatering behaviour;
- Interpretation and analysis of any change in groundwater profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what contingency actions, if any, the licensee proposes to take in response to those predictions;
- A comparison of the settlement survey data with that predicted in Table 5 and Figure 8 (dated 13 November 1997 by Dr Semple of Woodward Clyde (NZ) Ltd);
- Comment on compliance with this condition;
- A summary and analysis of complaints relevant to this condition;

- Any reasons for non-compliance or difficulties in achieving conformance with this condition;
- Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by this condition;
- The report shall be forwarded in a format acceptable to the Minister.

Extract from conditions of Hauraki District Council Resource Consent 202.2012 (Correnso), as pertaining to Dewatering and Settlement:

Dewatering and Settlement Monitoring Plan

27 The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

28 Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

29 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 27. The monitoring regime shall be designed to assess the effects of:

a) Dewatering on the regional groundwater system; and

b) Dewatering on settlement.

30 Monitoring locations are to provide appropriate resolution of groundwater levels and surface tilt relative to the scale of surface infrastructure, particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Council. The Plan shall also provide settlement trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

31 The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

32 In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 28 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) Explain the cause of the non-conformance;

b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

c) Implement settlement contingency measures as appropriate within the agreed time limit;

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

33 The consent holder shall as a matter of urgency, advise the Council of any significant anomalies identified by the regular (monthly) reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Council within 10 working days of the anomalous results being identified.

A “significant anomaly” is defined as 15m or more offset occurring in piezometer recordings over a 1 month period.

34 In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice notes:

1. The Dewatering and Settlement Monitoring Plan shall be consistent with the Dewatering and Settlement Monitoring Plan prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council.
2. The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and the filling of the Martha Pit.

Dewatering and Settlement Monitoring Report

35 The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

a) The volume of groundwater abstracted;

b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

d) Any contingency actions that may have been taken during the year; and

e) Comment on compliance with Conditions 27 to 34 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Advice note:

The Dewatering and Settlement Monitoring Report shall be consistent with the Dewatering and Settlement Monitoring Report prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council.

Extract from conditions of Waikato Regional Council Resource Consent 124860, pertaining to Dewatering and Settlement:

Monitoring - Abstraction Volume

4. The consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council on a quarterly basis.

Dewatering and Settlement Monitoring Plan

5. Prior to the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   (i) dewatering on the regional groundwater system; and
   (ii) dewatering on settlement; and
   (iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

   Monitoring locations are to provide appropriate resolution of surface tilt relative to the scale of surface infrastructure and final details are to be agreed with the Councils. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Such updated Plans shall relate to the Correnso Mine or to any new mine within Area L. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

   In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

6. The consent holder shall provide to the Councils an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:
   (i) The volume of groundwater abstracted;
   (ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
   (iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;
   (iv) Any contingency actions that may have been taken during the year; and
   (v) Comment on compliance with condition 5 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

   The report shall be forwarded in a form acceptable to the Councils.

Monitoring - Tilt

7. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to condition 5 of this consent, and such tilt is caused by the de-watering and/or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then engage in a process with the Councils:
   (i) explain the cause of the non-conformance,
   (ii) Propose appropriate settlement contingency measures for discussion with Councils and agree with the Councils on the appropriate settlement contingency measures and the timing for their implementation as described,
   (iii) implement agreed settlement contingency measures as appropriate within the agreed time limit,
   (iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Monitoring – Water Quality

8. The consent holder shall monitor throughout the period of operation, the chemistry of the groundwater, pit run-off and pit discharge water abstracted from the open pit. The monitoring data is to be used to correlate these inflows with pit lake water quality predictions, and to provide a database for input into the closure plans. The sampling parameters and frequencies shall be described in the Martha Extended Project dewatering consent (unless agreed otherwise with the Waikato Regional Council) with the results forwarded to the Waikato Regional Council on an annual basis.

Other Water Users

9. If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Waikato Regional Council.

Extract from conditions of Waikato Regional Council Resource Consent 124861, pertaining to Dewatering and Settlement:

Groundwater Monitoring

5. Piezometers shall be installed at sites to be approved by the Waikato Regional Council for the purpose of monitoring changes in groundwater arising from the exercise of this consent. The groundwater monitoring system shall be detailed in the dewatering and Settlement Monitoring Plan, prepared pursuant to condition 5 of consent number 124860.

Extract from common conditions of Hauraki District Council and Waikato Regional Council Resource Consent for Project Martha (202.2018), as pertaining to Dewatering and Settlement:

Dewatering and Settlement Monitoring Plan

11 The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

12 Two months prior to dewatering below 700 m RL (mine datum), the consent holder shall prepare, and submit to the Councils for their certification, a Dewatering and Settlement Monitoring Plan. The purpose of the Dewatering and Settlement Monitoring Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

13 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 14 of this schedule. The monitoring regime shall be designed to assess the effects of:

a. Dewatering on the regional groundwater system; and

b. Dewatering on settlement.

14 Monitoring locations are to provide appropriate resolution of mine inflows and pumping, groundwater levels (both for shallow and deep aquifers) and ground surface tilt relative to the scale of surface infrastructure, throughout the area within the maximum extent of the groundwater cone of depression and particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Councils, but are to include additional piezometers and extensometers located along the line of upper level workings in the Rex Orebody. The Dewatering and Settlement Monitoring Plan shall also provide groundwater and settlement trigger limits that will initiate the implementation of contingency mitigation and / or monitoring measures and shall detail any linkages with the operation of the Martha Pit and Martha Underground Mine.

15 The exercise of this consent shall be in accordance with the Dewatering and Settlement Monitoring Plan as certified by the Councils. The Dewatering and Settlement Monitoring Plan shall be reviewed and updated as necessary by the consent holder. Any updated Dewatering and Settlement Monitoring Plan shall be promptly forwarded to the Councils for certification, and following this process, the updated plan shall be implemented in place of the previous version.

16 In the event that a tilt greater than 1 in 1,000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 15 of this schedule, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a. Explain the cause of the non-conformance;

14.1.1

b. Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

14.1.2

c. Implement settlement contingency measures as appropriate within the agreed time limit; and

14.1.3

d. Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

17 The consent holder shall as a matter of urgency, advise the Councils of any significant anomalies identified by the regular reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Councils within 10 working days of the anomalous results being identified.

A “significant anomaly” is defined as a drop in groundwater level greater than the seasonal variation in piezometers within the alluvium and younger volcanic rocks and a drop of 15 m or more in the recordings from piezometers tapping the upper 50 m of Andesite over a one month period.

18 In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice Note:
The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and filling of the Martha Pit.

Dewatering and Settlement Monitoring Report

19 The consent holder shall provide to the Councils (within one month of an agreed anniversary date) an annual Dewatering and Settlement Monitoring Report. The report shall, as a minimum, provide the following information:

g) The volume of groundwater abstracted;

14.1.4

h) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

14.1.5

i) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of the future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions, this analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

14.1.6

j) Any contingency actions that may have been taken during the year; and

14.1.7

k) Comment on compliance with Conditions 14 to 21 of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

14.1.8

l) The report shall be forwarded in a form acceptable to the Councils.

Appendix B Surveyor Reports

MEMORANDUM

TO: **MARK BURROUGHS, KATHY MASON**

FROM: **BRUCE MORRISON**

DATE: **14TH JULY 2020**

SUBJECT: **GROUND SETTLEMENT MONITORING –MAY 2020**

Introduction

This report outlines the results from the May 2020 Ground Settlement Monitoring Survey.

Field Method

The settlement monitoring marks were levelled during late May and June 2020 for OceanaGold by myself utilising an experienced *Kauri Gold* assistant under my supervision.

Equipment used was a LEICA DNA03 electronic digital level paired with a 3 section 4 metre fibreglass bar coded staff. To minimise 'windage', the staff was used in 2 section 'mode'. The level was serviced and check calibrated by the supplier in March 2020. A field calibration check was carried out by myself before commencing this event and the check result was satisfactory.

Benchmarks AP19 to BUH5 were treated as fixed and the -5.5 mm level misclose distributed. A level run was then taken off this base line from 34BE south to C1 and this -1.7 mm misclose distributed. Control mark C1 was established and levelled during the November 2019 levelling event. The remaining monitoring marks were levelled from these baselines and adjusted using LEICA LEVELPAK-PRO software.

A summary of the above framework 'misclosures' for the last twenty-seven events is tabulated below.

Event	West –East misclose (mm)	North –South misclose (mm)
	AP2 > 34BE > AP1	34BE > AP6
May 2007	+2.4	+6.4
Nov 2007	+2.7	+3.1
May 2008	+13.2	+4.0
Nov 2008	-8.1	+7.3
May2009	+8.8	+3.7
Nov 2009	-5.8	+2.0
May 2010	-8.1	+4.3
Nov 2010	-0.6	+6.4
May 2011	+2.0	+2.7
Nov 2011	+6.9	+6.5
May 2012	+4.1	+6.7

Nov 2012	+23.3	+5.3
May 2013	+2.7	+9.5
Nov 2013	-0.9	+4.5
May 2014	-1.1	+11.5
Nov 2014	-2.6	+7.0
May 2015	+1.6	+6.3
Nov 2015	-8.0	+10.3
May 2016	+9.2	+12.2
	AP20 No 2 >AP2 > 34BE > AP1	34BE > AP6
Nov 2016	+14.2	+3.6
	AP19 >AP2 > 34BE > AP1	34BE > AP6
May 2017	+1.0	+0.4
Nov 2017	-10.2	-0.5
May 2018	+6.4	+4.0
Nov 2018	-11.1	+3.6
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP6
May 2019	See page 2	See page 2
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP6
May 2019	-7.9	-6.9
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP24A> 34BE
Nov 2019	+0.3	-1.3
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP24A> C1
May 2020	-5.5	-1.7

Extending Levelling

This levelling event included LINZ benchmarks AP2, AP20 No 2, AP19, (to the west of Waihi), AP1 and BUH5 (to the east of Waihi). AP24 a.k.a control mark AP6 (south of Waihi) has been lost to road works. AP24A and C1 have been established as a replacement for the lost AP6 control mark in this vicinity. AP2 and AP20 No 2 have now been 'unfixed' and AP19 is the fixed benchmark west of Waihi. The 'fixed' elevation value for AP19 was deduced from LINZ data comparing the relative levels of AP19, AP2, AP20 No2, and AP24 dating back to the year 1990. East of Waihi, AP1 is now 'unfixed. The R.L. for the 'new' fixed eastern control mark (BUH5) was the mean value from two close values (relative to AP1) levelled in May 2018 and Nov 2018.

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Photographs

The order of levelling of the monitoring points has now been fixed. This has been achieved by photographing all of the settlement points and placing them in 22 albums –generally in the order the points are to be levelled. This will achieve repeatable error distribution and should therefore give better results. I believe **all** the marks now have accurate GPS fixes. In the future, this should make the task of locating these marks easier if the marks are covered over by re-seal etc, or quickly confirm if the marks have definitely been 'lost' to street maintenance etc. Mark 22G in Gladstone Rd has been lost to reseal construction. New mark 22GB has been established clear of the carriageway in the western kerb. This new mark was levelled and GPS coordinates were used to reference the 'new' location and a new photograph taken.

I recommend continuing these 'maintenance' details before or during the next levelling event.

Adjustments

Disturbed marks BM20 and 2.44 are excluded from the settlement contouring- as are marks F18, F20, F23, F24, and F25. Marks 22KB, 1.20B, AP24A, 2.08B, and 2.11B have a 'previous history' deduced for this levelling event after careful consideration of the previous settlement for adjacent marks. Mark 1PA was 'missed' owing to a large stockpile of road gravel over it and this mark is excluded from the settlement contouring.

Results

One A1 plan is attached -colour coded by seven zones as identified in the 'Settlement and Groundwater Monitoring Plan.' Relative to previous plans, the Zone boundaries and 'trigger' settlement values have been modified to match *Engineering Geology Ltd* Drawing No. 8332-Fig 16.

This plan "Total Settlement Contours" (T20200715A) identifies all marks (in black and brown) that have been used to produce the contours for the plan. The plan shows total movement (in millimetres) at the monitoring mark itself. Missed, 'lost', or disturbed marks are shown in red and these marks are not used for contouring. New marks are also shown in red and generally not used for settlement contouring until the next levelling event.

This plan also displays settlement contours in 20mm intervals. The Settlement and Groundwater Monitoring Plan identifies gradients steeper than 1:1000 to be cause for concern. BM20 has been a large mover in the past and has been identified in past surveys as being placed on shrinking material. There are no buildings in this area anymore. I understand (from Mark Halloran) BM20A was placed near BM20 with a 'foot' bedded in firm ground. Significant differential settlement (1:126) is now occurring between BM20A and BM20 –sufficient to decide to omit BM20 from the settlement 'contour' calculation.

These contours represent the total negative (–ve) movement (or settlement) around Waihi since monitoring began. Positive contours are not shown. Small consistent ground 'rises' are associated with the sector north of the pit -with the mark with the highest elevation (BM28/2) showing the most (+56.6 millimetre) rise.

The closest contours (omitting disturbed marks) are between marks 20AC and BM20A. The distance between these marks using GPS measurements, calculates at 126.706 metres, and show 0.1770 metres of relative vertical movement to give a gradient of 1:715. The distance between marks BM20A and 20D using GPS measurements, calculates at 137.047 metres, and shows 0.1481 metres of relative vertical movement to give a gradient of 1:925. The distance between marks 20C and BM20A, when checked by GPS measurements, calculates at 126.865 metres, and show 0.1190 metres of relative vertical movement to give a gradient of 1:1066.

Some cracks are visible in the sealed pavements in this area of closest contours.

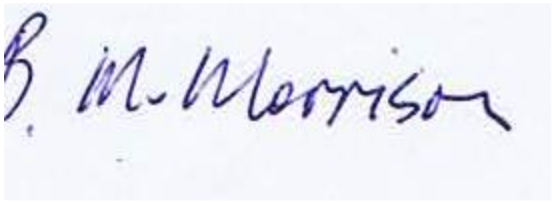
Table 1 (pages 3-12) lists all the marks used for this settlement levelling event with the marks sorted first by Zone and then by settlement value. Marks that record ‘exceedences’ in terms of zone predictions (for Martha (2019) are highlighted with colour and have comments attached. All marks that ‘exceeded’ in Table 1 were analysed further and field inspections were conducted where required.

The comments included below attempt to explain the probable reason for ‘excess’ movement. The comments are *Dist’d* for BM20 in Zone 6. In Zone 4, the comment is ‘*Nr watercourse’* for 23C. The swampy(?) ground may have de-watered during the autumn drought. For Zone 1, 2.44 is *Dist’d,* 2.05 is near Zone 5, 2.35 is near Zone 3, and 31LC,31MD, and 31NE are near(?) Zone 3 and near the Ohinemuri River.

The ‘Favona’ marks were installed for monitoring the effects of dewatering in the underground mine area. The underlying original ‘Martha’ zone is Zone 3 but the Favona marks have not been given zone exceedence parameters in terms of the original Martha zones. The Favona marks all report significant settlement. Note marks F18, F20, F23, F24, F25 are tentatively labelled as ‘Dist’d’ and not used for contouring the settlement.

The five extra ‘Favona’ settlement marks are again shown on the plan. These are FP1, BLOCK-S, BLOCK-N, TRIG 22, and TRIG 24. The settlements for these marks have generally been deduced relative to original reduced levels measured around the year 1987 –although FP1 (at the Favona portal) was established about the year 2000. Favona mark F07 is disturbed but has been relabelled as F09A. A ‘previous history’ has been calculated for F09A so this mark can be used for settlement contouring. The underlying zone for the Favona marks is now Zone 5 Martha(2019).

I understand that Time-History plots for all survey marks grouped by zone will be produced by other persons in accordance with the “Settlement and Groundwater Monitoring Plan 31 July 2005”



Bruce Morrison

Registered Professional Surveyor

Table 1. Total Movement

Zone	station i.d.	SURVEY DATE	X	Y	TOTAL Z	SETTLEMENT May-20	Comments
Zone7	BM19B	1/05/2020	2117.17	1244.355	35.576	-0.29	
Zone7	19BB	1/05/2020	2191.56	1292.02	35.5711	-0.2867	
Zone7	17CB	1/05/2020	2014.23	1201.01	35.5082	-0.2654	
Zone6	BM20	1/05/2020	2342.50	1476.25	35.6236	-0.3572	Dist'd
Zone6	BM20A	1/05/2020	2345.50	1484.901	35.7924	-0.2848	
Zone6	19CB	1/05/2020	2296.71	1381.40	34.9613	-0.2686	
Zone6	17BB	1/05/2020	1919.52	1160.787	37.4047	-0.2263	
Zone6	17AB	1/05/2020	1841.32	1104.802	36.9232	-0.1921	
Zone6	34GC	1/05/2020	2211.33	1119.52	32.1669	-0.1849	
Zone6	2.04B	1/05/2020	1893.21	968.34	29.1244	-0.1664	
Zone6	18EE	1/05/2020	1750.73	809.33	23.4608	-0.1606	
Zone6	34H	1/05/2020	2233.59	970.561	32.1867	-0.1604	
Zone6	18C	1/05/2020	1494.95	767.193	27.499	-0.1559	
Zone6	18IB	1/05/2020	1611.19	784.79	25.8602	-0.1552	
Zone6	2.10	1/05/2020	2143.92	950.39	30.3153	-0.1536	
Zone6	34AD	1/05/2020	1470.88	886.92	29.7954	-0.1514	
Zone6	34BE	1/05/2020	1732.56	931.603	28.3659	-0.1408	
Zone6	34C	1/05/2020	1968.90	982.67	30.1377	-0.1322	
Zone6	BM34	1/05/2020	1528.38	903.297	30.3522	-0.1309	
Zone6	11AC	1/05/2020	1308.26	859.51	29.3705	-0.1264	
Zone6	2.08B	1/05/2020	2289.75	782.64	24.5639	-0.1225	
Zone6	2.11B	1/05/2020	2278.86	862.45	26.5886	-0.1222	
Zone6	18AB	1/05/2020	1632.39	667.733	22.1697	-0.1217	
Zone6	10BC	1/05/2020	1560.13	1062.92	38.1459	-0.1217	
Zone6	1.28B	1/05/2020	1987.03	447.706	12.1243	-0.1206	
Zone6	10AB	1/05/2020	1430.61	1036.998	35.0355	-0.1175	
Zone6	34FC	1/05/2020	2120.79	587.931	19.0902	-0.1158	
Zone6	2.09C	1/05/2020	2228.35	868.63	28.6734	-0.1105	
Zone6	BM17A	1/05/2020	1724.44	1088.92	40.0805	-0.1077	
Zone6	34I	1/05/2020	2229.55	765.534	28.4946	-0.1036	
Zone6	2.06	1/05/2020	2351.95	334.473	11.3004	-0.1013	
Zone5	20C	1/05/2020	2450.61	1413.86	36.3416	-0.1658	

Zone5	21DC	1/05/2020	2573.96	1304.15	37.7929	-0.1468
Zone5	20E	1/05/2020	2535.65	1542.672	37.1144	-0.1464
Zone5	A10B	1/05/2020	1298.62	1049.61	30.7221	-0.1447
Zone5	21O	1/05/2020	2527.37	1356.342	36.0323	-0.1435
Zone5	25D	1/11/2019	2547.05	1248.02	36.8984	-0.1424
Zone5	16BC	1/05/2020	1252.81	1336.473	39.4882	-0.1393
Zone5	25A	1/05/2020	2505.13	1203.77	35.9716	-0.1382
Zone5	A11D	1/05/2020	1277.04	1017.33	30.8855	-0.1379
Zone5	25E	1/11/2019	2472.35	1162.013	34.8061	-0.1374
Zone5	BM25	1/05/2020	2424.91	1100.253	33.511	-0.1371
Zone5	20D	1/05/2020	2482.07	1473.478	36.5807	-0.1367
Zone5	21N	1/05/2020	2623.25	1342.435	38.3176	-0.1314
Zone5	10DC	1/05/2020	1279.04	1198.326	35.3354	-0.1297
Zone5	2.41	1/05/2020	3296.32	685.398	46.2903	-0.1261
Zone5	2.02	1/05/2020	1992.61	536.10	15.2958	-0.1258
Zone5	34EB	1/05/2020	2073.93	705.952	24.6632	-0.1244
Zone5	18F	1/05/2020	1752.28	551.03	17.3568	-0.1243
Zone5	12CE	1/05/2020	1499.92	543.077	21.0124	-0.1230
Zone5	24L	1/05/2020	2761.67	1181.326	39.3557	-0.1225
Zone5	25B	1/05/2020	2497.67	1105.83	34.8546	-0.1224
Zone5	2.03	1/05/2020	1930.08	745.943	22.6211	-0.1223
Zone5	25H	1/05/2020	2648.48	1232.956	38.9535	-0.1222
Zone5	25G	1/05/2020	2594.60	1149.415	37.6225	-0.122
Zone5	25F	1/05/2020	2542.53	1116.24	36.0313	-0.1216
Zone5	24I	1/05/2020	2692.57	1269.713	39.3162	-0.1213
Zone5	25CB	1/05/2020	2615.91	1190.496	38.3301	-0.1212
Zone5	10CB	1/05/2020	1222.46	1025.86	29.8112	-0.1209
Zone5	1.28A	1/05/2020	1888.26	505.89	13.2355	-0.1200
Zone5	18G	1/05/2020	1669.05	554.60	18.5043	-0.1185
Zone5	24CD	1/05/2020	2603.21	987.72	34.8509	-0.1181
Zone5	13AC	1/05/2020	1751.98	327.38	18.6285	-0.1164
Zone5	BM12	1/05/2020	1370.27	607.735	23.9912	-0.1155
Zone5	24K	1/05/2020	2783.89	1387.719	40.6424	-0.1155
Zone5	34D	1/05/2020	2038.90	783.431	25.371	-0.1151

Zone5	18B	1/05/2020	1510.36	650.578	23.5919	-0.1151
Zone5	24AC	1/05/2020	2743.58	1218.9	40.1209	-0.1145
Zone5	25I	1/05/2020	2537.20	1045.036	34.7182	-0.1145
Zone5	BM18	1/05/2020	1771.96	674.528	19.4573	-0.1131
Zone5	24DC	1/05/2020	2718.29	1323.13	39.6678	-0.1130
Zone5	13BC	1/05/2020	1850.36	246.587	13.748	-0.113
Zone5	22F	1/05/2020	2815.91	1325.407	40.2649	-0.1126
Zone5	18HC	1/05/2020	1821.52	466.47	14.9164	-0.1115
Zone5	24E	1/05/2020	2758.43	1303.234	40.3971	-0.111
Zone5	21C	1/05/2020	2651.57	1389.82	38.5013	-0.1109
Zone5	24F	1/05/2020	2772.80	1257.274	40.1633	-0.1104
Zone5	2A	1/05/2020	1069.03	1111.858	23.8328	-0.11
Zone5	21EB	1/05/2020	2799.95	1429.09	41.6636	-0.1100
Zone5	24G	1/05/2020	2705.96	1170.464	39.8336	-0.1092
Zone5	BM24	1/05/2020	2794.55	1279.361	40.4342	-0.1089
Zone5	24B	1/05/2020	2667.67	1126.399	39.4131	-0.1082
Zone5	12DC	1/05/2020	1596.95	435.49	19.9973	-0.1082
Zone5	24H	1/05/2020	2630.70	1072.279	36.1858	-0.108
Zone5	BM16	1/05/2020	1418.09	1218.03	46.4864	-0.1080
Zone5	20AC	1/05/2020	2461.04	1536.905	37.0513	-0.1078
Zone5	12AC	1/05/2020	1388.32	488.89	19.0781	-0.1070
Zone5	AP22A	1/05/2020	1868.44	188.57	12.4333	-0.1057
Zone5	24J	1/05/2020	2749.39	1365.756	40.2663	-0.1048
Zone5	15A	1/05/2020	1204.79	818.863	28.8072	-0.1015
Zone5	1.10A	1/05/2020	1599.70	278.938	16.6632	-0.1003
Zone5	20BB	1/05/2020	2533.26	1622.29	37.912	-0.0991
Zone5	12BC	1/05/2020	1405.27	368.295	14.949	-0.0987
Zone5	BM13	1/05/2020	1426.61	269.34	13.607	-0.0981
Zone5	15BC	1/05/2020	1169.90	708.86	26.3672	-0.0977
Zone5	21M	1/05/2020	2694.90	1439.648	39.2199	-0.0956
Zone5	11BB	1/05/2020	1348.57	710.573	26.9644	-0.0945
Zone5	20F	1/05/2020	2605.79	1575.98	37.6085	-0.0931
Zone5	2.17A	1/05/2020	3085.76	555.866	36.9373	-0.0922
Zone5	4DB	1/05/2020	1033.26	1550.66	32.2858	-0.092

Zone5	BM21	1/05/2020	2654.80	1515.397	39.4638	-0.0896	
Zone5	21BC	1/05/2020	2719.27	1477.799	41.3081	-0.0868	
Zone5	21K	1/05/2020	2681.11	1572.207	40.0389	-0.0864	
Zone5	4B	1/05/2020	1021.54	1448.63	31.2881	-0.0863	
Zone5	2BC	1/05/2020	970.20	1241.90	30.4204	-0.0856	
Zone5	30C	1/05/2020	2573.54	1675.395	38.48	-0.0739	
Zone5	BM9B	1/05/2020	1220.25	1523.29	34.7881	-0.0693	
Zone5	AP3	1/05/2020	918.94	1140.585	26.1014	-0.0689	
Zone5	7CB	1/05/2020	1161.74	1597.63	30.6473	-0.0685	
Zone5	26EE	1/05/2020	1343.86	1621.82	44.3319	-0.0500	
Zone5	26F	1/05/2020	1392.77	1680.261	43.8979	-0.042	
Zone5	26Q	1/05/2020	1963.00	1982.71	73.7173	-0.0338	
Zone5	26PB	1/05/2020	1834.84	1893.11	67.9931	-0.0295	
Zone5	26R	1/05/2020	1905.59	1927.165	71.4072	-0.028	
Zone4	23C	1/05/2020	2856.14	1068.014	37.5857	-0.1804	Nr watercourse
Zone4	23AB	1/05/2020	3145.42	1078.73	37.2135	-0.1583	
Zone4	22C	1/05/2020	2846.39	1352.544	40.3498	-0.1295	
Zone4	2.24	1/05/2020	2885.91	1215.469	41.3177	-0.1293	
Zone4	23F	1/05/2020	2700.77	968.793	36.6704	-0.1272	
Zone4	BARRY1	1/05/2020	3047.74	926.576	38.1381	-0.1267	
Zone4	23D	1/05/2020	2861.42	1154.885	38.8903	-0.1266	
Zone4	BANK1	1/05/2020	2866.21	1023.248	37.8282	-0.1261	
Zone4	2.25	1/05/2020	2874.51	1097.261	38.0112	-0.124	
Zone4	23E	1/05/2020	2774.82	972.514	37.7385	-0.123	
Zone4	2.19B	1/05/2020	3270.21	916.063	38.5884	-0.1205	
Zone4	21P	1/05/2020	2849.17	1456.9	41.8634	-0.1199	
Zone4	2.23	1/05/2020	3560.02	1212.795	36.6528	-0.1197	
Zone4	23B	1/05/2020	2856.49	949.79	38.7811	-0.1190	
Zone4	2.14A	1/05/2020	2853.28	838.669	41.3492	-0.1184	
Zone4	BARRY3	1/05/2020	3176.85	895.991	37.7129	-0.1177	
Zone4	MATAURA1	1/05/2020	2831.84	1250.806	41.1046	-0.1152	
Zone4	STAFORD	1/05/2020	3139.86	998.179	37.339	-0.1152	
Zone4	2.16	1/05/2020	3007.62	739.64	33.6147	-0.1131	
Zone4	2.13	1/05/2020	2725.42	874.951	47.2436	-0.1123	

Zone4	BARRY4B	1/05/2020	3320.16	912.693	38.9201	-0.1105
Zone4	1.11B	1/05/2020	1675.83	133.622	9.0525	-0.1105
Zone4	2.18	1/05/2020	3218.04	712.76	44.5768	-0.1099
Zone4	BARRY2	1/05/2020	2936.96	944.224	38.3863	-0.1093
Zone4	MORTON	1/05/2020	2975.42	1231.913	40.7507	-0.109
Zone4	BM23	1/05/2020	3107.42	921.05	38.1192	-0.1079
Zone4	2.15	1/05/2020	2918.94	723.52	38.3933	-0.1036
Zone4	BARRY5	1/05/2020	3397.59	904.647	41.0295	-0.1029
Zone4	2.21	1/05/2020	3563.09	1045.181	34.0575	-0.1021
Zone4	2HB	1/05/2020	1078.24	886.849	24.4236	-0.1017
Zone4	22E	1/05/2020	3055.20	1231.504	40.8218	-0.1017
Zone4	BARRY6	1/05/2020	3432.52	904.356	42.5158	-0.1015
Zone4	22BC	1/05/2020	2916.75	1435.773	42.1414	-0.1004
Zone4	22I	1/05/2020	2918.98	1461.367	41.9488	-0.1004
Zone4	AP100	1/05/2020	1893.80	81.273	11.8082	-0.0996
Zone4	BARRY8	1/05/2020	3592.28	871.451	37.9625	-0.0992
Zone4	CUBA	1/05/2020	3224.32	1079.177	35.8551	-0.0981
Zone4	22H	1/05/2020	2869.25	1441.796	41.6591	-0.0977
Zone4	2.20	1/05/2020	3467.69	904.56	43.8254	-0.0957
Zone4	22M	1/05/2020	2973.44	1434.656	41.7104	-0.0956
Zone4	2.22	1/05/2020	3339.13	1206.603	40.3826	-0.0952
Zone4	GW	1/05/2020	3128.83	1140.936	38.5763	-0.0931
Zone4	BARRY7	1/05/2020	3518.87	901.897	43.6485	-0.0928
Zone4	22L	1/05/2020	3047.70	1499.876	41.0313	-0.0904
Zone4	22A	1/05/2020	3003.28	1429.771	41.6833	-0.0894
Zone4	1.05	1/05/2020	1176.96	473.454	21.8503	-0.0891
Zone4	2.28	1/05/2020	3076.72	1555.994	42.9829	-0.0876
Zone4	22D	1/05/2020	3100.02	1335.441	41.4887	-0.0874
Zone4	BM2	1/05/2020	915.74	1091.80	24.8634	-0.0871
Zone4	22J	1/05/2020	2944.47	1489.763	42.464	-0.0857
Zone4	1.26	1/05/2020	1926.81	30.053	15.1212	-0.0856
Zone4	21FB	1/05/2020	2861.65	1512.211	42.6898	-0.0805
Zone4	2.29B	1/05/2020	2953.39	1548.172	42.6275	-0.0793

Zone4	21AC	1/05/2020	2716.64	1617.767	39.7299	-0.0791
Zone4	2.27	1/05/2020	3379.40	1371.481	37.7918	-0.0788
Zone4	1.06	1/05/2020	1159.34	302.26	17.2526	-0.0785
Zone4	2.26	1/05/2020	3241.22	1380.889	39.2553	-0.0779
Zone4	15C	1/05/2020	1156.82	571.08	24.2439	-0.0777
Zone4	BM22	1/05/2020	3115.79	1442.95	40.6571	-0.0771
Zone4	2GB	1/05/2020	922.38	967.661	22.7089	-0.0766
Zone4	21L	1/05/2020	2806.79	1575.074	43.1277	-0.0761
Zone4	26BE	1/05/2020	1408.78	1800.55	38.851	-0.0751
Zone4	1.09B	1/05/2020	1344.14	117.48	9.9538	-0.0713
Zone4	21Q	1/05/2020	2899.60	1571.317	43.1686	-0.0686
Zone4	26CE	1/05/2020	1377.77	1711.89	40.6357	-0.0679
Zone4	22KB	1/05/2020	2981.80	1603.49	42.8893	-0.0674
Zone4	BM15	1/05/2020	976.94	783.00	20.5497	-0.0668
Zone4	30BB	1/05/2020	2604.86	1726.50	41.5885	-0.0664
Zone4	21J	1/05/2020	2773.44	1688.923	40.0023	-0.0644
Zone4	27KB	1/05/2020	2320.23	2120.206	63.382	-0.0636
Zone4	21I	1/05/2020	2854.70	1668.793	41.6866	-0.0632
Zone4	2.31B	1/05/2020	3201.23	1637.289	42.131	-0.0623
Zone4	26AE	1/05/2020	1432.47	1883.479	37.5708	-0.062
Zone4	SM822	1/05/2020	2512.91	1841.132	41.4973	-0.0608
Zone4	21GC	1/05/2020	2901.12	1614.054	43.4862	-0.0606
Zone4	2.30B	1/05/2020	3000.35	1672.94	43.2121	-0.0555
Zone4	21HC	1/05/2020	2916.84	1728.842	42.9239	-0.0521
Zone4	7BB	1/05/2020	1105.69	1689.90	35.9764	-0.0509
Zone4	27E	1/05/2020	2494.09	2171.622	50.3884	-0.0498
Zone4	3.02	1/05/2020	1344.87	1837.735	34.9695	-0.0477
Zone4	3.09	1/05/2020	1618.51	1870.17	51.9454	-0.0466
Zone4	27N	1/05/2020	2179.57	2075.99	71.9644	-0.0462
Zone4	4.08	1/05/2020	2350.64	2022.324	73.262	-0.0451
Zone4	3.01	1/05/2020	1291.95	1690.334	37.3348	-0.0447
Zone4	3.04B	1/05/2020	1123.76	1821.50	39.3222	-0.0427
Zone4	4.05	1/05/2020	2809.68	1897.682	40.6587	-0.0427
Zone4	4.07	1/05/2020	2554.47	2079.24	45.0917	-0.0414

Zone4	27G	1/05/2020	2440.97	2157.30	54.6045	-0.0406	
Zone4	27H	1/05/2020	2413.27	2149.757	57.071	-0.0395	
Zone4	BM26	1/11/2019	1542.45	1837.81	45.447	-0.0391	
Zone4	4.09	1/05/2020	2249.27	2029.94	78.9714	-0.0373	
Zone4	26H	1/05/2020	1452.90	1729.59	50.0015	-0.0373	
Zone4	26JB	1/05/2020	1495.71	1756.55	53.7664	-0.0360	
Zone4	BM30	1/05/2020	2715.36	1996.21	44.1276	-0.0360	
Zone4	26G	1/05/2020	1425.06	1706.748	47.0395	-0.0353	
Zone4	27J	1/05/2020	2344.14	2136.14	62.1807	-0.0352	
Zone4	26I	1/05/2020	1481.67	1750.49	52.767	-0.0337	
Zone4	26NC	1/11/2019	1641.16	1772.40	60.4364	-0.0335	
Zone4	27I	1/05/2020	2385.10	2141.94	59.5758	-0.0316	
Zone4	27F	1/05/2020	2466.48	2164.026	52.3637	-0.0312	
Zone4	30AB	1/05/2020	2685.64	1898.44	46.2784	-0.0302	
Zone4	26MB	1/05/2020	1593.46	1750.66	59.0132	-0.0299	
Zone4	3.11A	1/05/2020	1786.17	1929.216	62.1924	-0.0297	
Zone4	3.10A	1/05/2020	1689.03	1978.29	53.4764	-0.028	
Zone4	27DC	1/05/2020	2541.24	2190.709	48.2345	-0.025	
Zone4	27M	1/05/2020	2224.38	2095.264	69.204	-0.0231	
Zone4	27L	1/05/2020	2280.24	2115.41	65.886	-0.0219	
Zone4	3.13	1/05/2020	1744.89	2097.49	53.8041	-0.0205	
Zone4	27AB	1/05/2020	2009.08	2064.33	73.5333	-0.0173	
Zone4	27O	1/05/2020	2101.57	2042.82	75.0752	-0.0153	
Zone4	3.6A	1/05/2020	1526.28	2015.739	38.9565	-0.0091	
Zone4	26OB	1/11/2019	1706.93	1812.27	67.2298	-0.0050	
Zone4	22GB	1/05/2020	2862.88	1387.968	40.8772	new mark	New mark
Zone3	2CE	1/05/2020	774.75	1313.19	34.6482	-0.0777	
Zone3	14DB	1/05/2020	876.99	411.22	15.1785	-0.0753	
Zone3	2.34	1/05/2020	3452.45	1683.502	37.7438	-0.0695	
Zone3	1.25	1/05/2020	2175.94	-129.105	20.0835	-0.0625	
Zone3	1.07	1/05/2020	924.43	267.49	12.5218	-0.0618	
Zone3	2.36	1/05/2020	3433.14	1534.879	35.9556	-0.0596	
Zone3	2.40B	1/05/2020	3572.85	1526.452	33.1806	-0.0595	
Zone3	15DB	1/05/2020	917.56	466.15	15.6235	-0.0565	

Zone3	2.33	1/05/2020	3294.51	1691.952	40.3379	-0.055
Zone3	A33C	1/05/2020	456.03	1219.226	35.8859	-0.054
Zone3	2DA	1/05/2020	682.15	1189.58	35.8355	-0.0531
Zone3	14EA	1/05/2020	808.56	504.723	17.1158	-0.053
Zone3	2FC	1/05/2020	720.33	843.06	23.9538	-0.0527
Zone3	14CB	1/05/2020	759.10	389.766	18.8433	-0.0525
Zone3	1.08	1/05/2020	1052.91	107.17	16.5486	-0.0502
Zone3	1.21A	1/05/2020	1939.94	-325.50	19.6804	-0.0493
Zone3	4.02	1/05/2020	2797.90	2143.571	45.8011	-0.048
Zone3	14BC	1/05/2020	535.45	340.67	20.9377	-0.0478
Zone3	1.22	1/05/2020	1510.00	-249.925	15.8869	-0.0459
Zone3	4A	1/05/2020	815.01	1494.15	40.7267	-0.0457
Zone3	4EC	1/05/2020	782.01	1687.78	41.1644	-0.0453
Zone3	4.03B	1/05/2020	2794.90	2044.783	43.8369	-0.0440
Zone3	BM31	1/05/2020	2967.04	1873.475	43.3218	-0.0437
Zone3	31BC	1/05/2020	3159.33	1954.86	45.5393	-0.0432
Zone3	14FB	1/05/2020	705.60	649.144	20.1774	-0.042
Zone3	2EB	1/05/2020	689.02	1054.621	29.2903	-0.0417
Zone3	4.01C	1/05/2020	2891.78	2113.15	47.3366	-0.0415
Zone3	4.04	1/05/2020	2662.60	2131.77	45.9569	-0.0383
Zone3	31AC	1/05/2020	3059.04	1910.629	44.1063	-0.0362
Zone3	29DB	1/05/2020	2996.63	2106.664	47.8449	-0.034
Zone3	31CC	1/05/2020	3248.97	1989.89	47.0726	-0.0273
Zone3	3.25	1/05/2020	3116.90	2107.056	49.8514	-0.0257
Zone3	29AC	1/05/2020	2641.62	2218.071	48.5584	-0.0175
Zone3	29CE	1/05/2020	2891.84	2285.59	51.6137	-0.0159
Zone3	3.24	1/05/2020	3017.29	2258.712	51.9745	-0.0117
Zone3	29B	1/05/2020	2772.84	2242.217	50.0434	-0.0033
Zone2	1K	1/05/2020	511.74	957.174	29.6274	-0.0416
Zone2	1.12	1/05/2020	800.71	-50.23	10.8071	-0.0396
Zone2	1.04	1/05/2020	795.98	129.36	12.8218	-0.0371
Zone2	3.07	1/05/2020	1362.08	2096.818	48.0631	-0.0361
Zone2	33F	1/05/2020	347.95	1511.68	42.0733	-0.0352
Zone2	3.03	1/05/2020	1134.46	1917.24	39.3803	-0.0346
Zone2	3.14	1/05/2020	1752.75	2214.32	48.7928	-0.0338

Zone2	7AC	1/05/2020	994.54	1781.823	43.5589	-0.033
Zone2	1JB	1/05/2020	604.79	822.76	26.4377	-0.0325
Zone2	1SC	1/05/2020	-674.31	739.27	14.4611	-0.0317
Zone2	1C	1/05/2020	421.48	1098.886	34.8179	-0.0307
Zone2	1B	1/05/2020	337.50	1062.94	34.0274	-0.0298
Zone2	3.12	1/05/2020	1599.68	2152.411	40.2984	-0.0294
Zone2	BM14	1/05/2020	718.16	485.955	19.8591	-0.0285
Zone2	4FB	1/05/2020	562.51	1370.97	39.4047	-0.0284
Zone2	1I	1/05/2020	468.34	761.228	27.3009	-0.0281
Zone2	BM4	1/05/2020	689.21	1555.547	42.3131	-0.0276
Zone2	BM7	1/05/2020	1057.32	1843.069	44.1501	-0.0263
Zone2	33A	1/05/2020	338.15	1303.893	36.7538	-0.0248
Zone2	1O	1/05/2020	-271.35	814.183	22.7331	-0.0246
Zone2	1NB	1/05/2020	-206.98	842.12	24.8303	-0.0230
Zone2	33E	1/05/2020	437.71	1437.52	41.0233	-0.0230
Zone2	14AC	1/05/2020	515.17	457.622	24.0509	-0.0222
Zone2	1HC	1/05/2020	299.70	702.8	27.0695	-0.0214
Zone2	1FB	1/05/2020	210.46	850.779	29.8565	-0.021
Zone2	6A	1/05/2020	946.43	1928.115	47.548	-0.02
Zone2	1LD	1/05/2020	-102.13	906.05	28.3801	-0.0199
Zone2	1EB	1/05/2020	388.60	912.09	30.4602	-0.0187
Zone2	1GB	1/05/2020	-2.87	769.74	29.3168	-0.0179
Zone2	1ME	1/05/2020	-155.40	879.89	26.1255	-0.0177
Zone2	33DB	1/05/2020	265.40	1714.719	46.4021	-0.0163
Zone2	1.03B	1/05/2020	365.55	323.37	19.4091	-0.0161
Zone2	1A	1/05/2020	249.92	1026.38	33.3598	-0.0159
Zone2	AP2	1/05/2020	-1276.40	954.13	5.7808	-0.0152
Zone2	BM6	1/05/2020	881.86	1837.08	46.2686	-0.0150
Zone2	1.01	1/05/2020	56.47	604.08	25.472	-0.0149
Zone2	1RA	1/05/2020	-579.06	750.356	16.7532	-0.0146
Zone2	BM1	1/05/2020	152.75	994.87	32.8015	-0.0131
Zone2	5BC	1/05/2020	547.16	1824.599	49.166	-0.0128
Zone2	1.14	1/05/2020	496.74	-535.10	8.4569	-0.0127
Zone2	5C	1/05/2020	705.43	1754.71	45.2046	-0.0124
Zone2	3.15	1/05/2020	1696.24	2315.82	39.1361	-0.0119
Zone2	33GA	1/05/2020	415.95	1621.64	45.3889	-0.0116

Zone2	1QC	1/05/2020	-466.05	769.147	18.1694	-0.0104	
Zone2	1.02C	1/05/2020	86.31	283.86	18.661	-0.0099	
Zone2	33B	1/05/2020	156.88	1430.804	34.447	-0.0060	
Zone2	BM5	1/05/2020	325.93	1806.47	47.8398	-0.0056	
Zone2	1D	1/05/2020	-32.05	911.592	30.0682	-0.0046	
Zone2	BM29	1/05/2020	2608.80	2400.76	56.0046	-0.0038	
Zone2	3.05	1/05/2020	966.29	1990.771	47.2293	-0.0031	
Zone2	3.22A	1/05/2020	2891.15	2398.65	56.7022	-0.0025	
Zone2	5AC	1/05/2020	470.30	1688.45	47.0753	-0.0025	
Zone2	33C	1/05/2020	222.53	1621.24	44.4476	-0.0005	
Zone2	1.16	1/05/2020	1552.97	-1086.27	18.3779	-0.0001	
Zone2	1PA	1/05/2020	-351.51	787.24	20.0808	MISSED	Gravel heap
Zone1	2.44	1/05/2020	2734.64	421.03	27.2656	-0.5631	Dist'd
Zone1	2.05	1/05/2020	2535.68	272.682	20.7866	-0.0935	Nr edge Zone 5
Zone1	31MD	1/05/2020	4275.09	1884.55	30.7379	-0.0721	Nr edge Zone 3?
Zone1	31NE	1/05/2020	4349.43	1927.421	33.3649	-0.0637	Nr edge Zone 3?
Zone1	31LC	1/05/2020	4168.53	1862.11	32.1059	-0.0617	Nr edge Zone 3?
Zone1	2.35	1/05/2020	3609.80	1652.681	34.1243	-0.0614	Nr edge Zone 3
Zone1	31FC	1/05/2020	3614.22	1954.15	43.4501	-0.0520	
Zone1	31KC	1/05/2020	4076.39	1883.199	34.5023	-0.052	
Zone1	31JD	1/05/2020	4005.65	1911.42	35.5746	-0.0459	
Zone1	31IC	1/05/2020	3909.03	1909.895	37.8654	-0.045	
Zone1	31HC	1/05/2020	3810.83	1924.65	40.351	-0.0445	
Zone1	31GC	1/05/2020	3711.83	1939.28	42.2011	-0.0422	
Zone1	31DD	1/05/2020	3400.43	1989.83	46.7179	-0.0420	
Zone1	31QC	1/05/2020	4417.71	2035.37	39.6384	-0.0373	
Zone1	31PC	1/05/2020	4393.52	1991.662	37.7478	-0.0349	
Zone1	31ED	1/05/2020	3496.21	1975.77	45.9457	-0.0325	
Zone1	1VA	1/05/2020	-994.62	800.62	6.4367	-0.0303	
Zone1	1.24	1/05/2020	2225.16	-613.23	16.7077	-0.0259	
Zone1	1.23	1/05/2020	1013.01	-440.77	13.2842	-0.0244	
Zone1	1.13	1/05/2020	591.36	-310.797	7.0709	-0.0216	
Zone1	1.20B	1/05/2020	1995.49	-664.093	22.051	-0.0215	
Zone1	AP2A	1/05/2020	-766.18	738.51	12.3291	-0.0206	
Zone1	31OD	1/05/2020	4374.76	1958.38	36.0822	-0.0165	
Zone1	1UA	1/05/2020	-914.75	759.05	8.7398	-0.0148	

Zone1	28AE	1/05/2020	2128.26	2448.76	85.9636	-0.0127		
Zone1	1.27B	1/05/2020	1401.56	-701.57	15.3505	-0.0106		
Zone1	3.30	1/05/2020	3296.29	2235.94	50.4132	-0.0095		
Zone1	1TB	1/05/2020	-832.77	738.922	11.2461	-0.0084		
Zone1	27CD	1/05/2020	2122.89	2374.362	85.099	-0.0068		
Zone1	3.21	1/05/2020	2585.77	2493.38	64.9698	-0.0064		
Zone1	AP1A	1/05/2020	4557.10	2288.33	42.494	-0.006		
Zone1	AP1	1/05/2020	4486.29	2137.008	41.3871	-0.0054		
Zone1	3.29	1/05/2020	3662.64	2323.53	44.9456	-0.0049		
Zone1	1.15	1/05/2020	923.35	-995.413	14.3676	-0.0044		
Zone1	AP20No2	1/05/2020	-2303.63	731.69	20.2014	-0.0038		
Zone1	1.17B	1/05/2020	2082.20	-1093.92	25.6002	-0.0034		
Zone1	3.26B	1/05/2020	3200.09	2347.92	55.4515	-0.0030		
Zone 1	AP24A	1/05/2020	2114.57	-1292.93	28.0745	-0.0007		
Zone1	AP19	1/05/2020	-3242.58	480.68	-6.5213	0.0000	control	
Zone1	BUH5	1/05/2020	5480.15	2780.649	52.7423	0	control	
Zone1	C1	1/05/2020	2183.23	-1759.33	32.8425	0.0000	control	
Zone1	3.28A	1/05/2020	3212.99	2635.997	53.8716	0.0019		
Zone1	3.23	1/05/2020	3035.80	2453.651	59.6615	0.0039		
Zone1	3.27B	1/05/2020	3148.37	2510.53	60.3188	0.0072		
Zone1	3.16	1/05/2020	2195.60	2563.077	95.6621	0.0156		
Zone1	BM28/2	1/05/2020	2282.46	2770.68	101.9423	0.0566		
Favona	F18	1/05/2020	3423.83	648.3	40.0124	-0.319		Dist'd?
Favona	F23	1/05/2020	3393.93	684.82	40.6248	-0.2758		Dist'd?
Favona	F20	1/05/2020	3411.70	665.72	40.9323	-0.2718		Dist'd?
Favona	F24	1/05/2020	3388.13	690.85	40.6392	-0.2487		Dist'd?
Favona	F21	1/05/2020	3405.99	672.00	40.7705	-0.2428		
Favona	F17B	1/05/2020	3405.48	613.912	44.0045	-0.2350		
Favona	F22	1/05/2020	3399.79	678.39	40.7119	-0.2245		
Favona	F25	1/05/2020	3381.55	697.882	40.613	-0.2085		Dist'd?
Favona	BLOCK-S	1/05/2020	3295.82	124.32	24.8407	-0.1713		
Favona	F26	1/05/2020	3374.47	705.54	40.6006	-0.1653		
Favona	F27B	1/05/2020	3372.41	717.52	40.5114	-0.1618		
Favona	F16B	1/05/2020	3367.38	578.70	46.4093	-0.1567		
Favona	F11C	1/05/2020	3192.52	479.444	51.4554	-0.1549		

Favona	BLOCK-N	1/05/2020	3336.45	215.694	24.3114	-0.1516
Favona	F34C	1/05/2020	3339.49	849.57	40.1897	-0.1508
Favona	F15C	1/05/2020	3297.17	585.32	57.3718	-0.1447
Favona	F28B	1/05/2020	3365.21	727.17	40.5154	-0.1443
Favona	F10B	1/05/2020	3176.88	446.75	49.2886	-0.1395
Favona	F12C	1/05/2020	3207.32	503.824	53.5145	-0.1383
Favona	F30B	1/05/2020	3359.36	748.26	40.7046	-0.1329
Favona	F09A	1/05/2020	3157.20	388.283	45.173	-0.132
Favona	F29B	1/05/2020	3363.20	738.71	40.5012	-0.1308
Favona	F31B	1/05/2020	3354.47	756.84	41.25	-0.1304
Favona	F13C	1/05/2020	3236.43	533.631	57.9307	-0.1248
Favona	F33	1/05/2020	3348.56	812.51	40.6401	-0.1236
Favona	F14C	1/05/2020	3275.29	551.31	60.6843	-0.1235
Favona	F08A	1/05/2020	3126.97	430.49	42.7598	-0.1177
Favona	F35B	1/05/2020	3336.68	896.06	39.7847	-0.1125
Favona	F32B	1/05/2020	3348.78	769.103	40.8805	-0.1115
Favona	F07A	1/05/2020	3110.57	437.24	41.373	-0.1095
Favona	ITXCIVB	1/05/2020	2943.85	542.17	32.6182	-0.1045
Favona	F06	1/05/2020	3107.08	445.21	40.5144	-0.1034
Favona	F04	1/05/2020	3100.96	470.88	38.7338	-0.1011
Favona	F03	1/05/2020	3099.03	480.33	38.409	-0.0987
Favona	F02	1/05/2020	3097.60	490	38.2123	-0.0984
Favona	F05	1/05/2020	3104.66	455.54	39.4729	-0.0962
Favona	FP1	1/05/2020	3004.15	131.25	45.4304	-0.0786
Favona	TRIG 24	1/05/2020	3260.76	-615.68	25.6895	-0.0405
Favona	TRIG 22	1/05/2020	3681.97	89.36	26.1595	-0.0305

MEMORANDUM

TO: **MARK BURROUGHS, KATHY MASON**

FROM: **BRUCE MORRISON**

DATE: **9TH DECEMBER 2020**

SUBJECT: **GROUND SETTLEMENT MONITORING –NOVEMBER 2020**

Introduction

This report outlines the results from the November 2020 Ground Settlement Monitoring Survey.

Field Method

The settlement monitoring marks were levelled during November and December 2020 for OceanaGold by myself utilising an experienced *Kauri Gold* assistant under my supervision.

Equipment used was a LEICA DNA03 electronic digital level paired with a 3 section 4 metre fibreglass bar coded staff. To minimise 'windage', the staff was used in 2 section 'mode'. The level was serviced and check calibrated by the supplier in March 2020. A field calibration check was carried out by myself before commencing this event and the check result was satisfactory.

Benchmarks AP19 to BUH5 were treated as fixed and the -3.2 mm level misclose distributed. A level run was then taken off this base line from 34BE south to C1 and this -2.5 mm misclose distributed. Control mark C1 was established and levelled during the November 2019 levelling event. The remaining monitoring marks were levelled from these baselines and adjusted using LEICA LEVELPAK-PRO software.

A summary of the above framework 'misclosures' for the last twenty-eight events is tabulated below.

Event	West –East misclose (mm)	North –South misclose (mm)
	AP2 > 34BE > AP1	34BE > AP6
May 2007	+2.4	+6.4
Nov 2007	+2.7	+3.1
May 2008	+13.2	+4.0
Nov 2008	-8.1	+7.3
May2009	+8.8	+3.7
Nov 2009	-5.8	+2.0
May 2010	-8.1	+4.3
Nov 2010	-0.6	+6.4
May 2011	+2.0	+2.7
Nov 2011	+6.9	+6.5

May 2012	+4.1	+6.7
Nov 2012	+23.3	+5.3
May 2013	+2.7	+9.5
Nov 2013	-0.9	+4.5
May 2014	-1.1	+11.5
Nov 2014	-2.6	+7.0
May 2015	+1.6	+6.3
Nov 2015	-8.0	+10.3
May 2016	+9.2	+12.2
	AP20 No 2 >AP2 > 34BE > AP1	34BE > AP6
Nov 2016	+14.2	+3.6
	AP19 >AP2 > 34BE > AP1	34BE > AP6
May 2017	+1.0	+0.4
Nov 2017	-10.2	-0.5
May 2018	+6.4	+4.0
Nov 2018	-11.1	+3.6
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP6
May 2019	See page 2	See page 2
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP6
May 2019	-7.9	-6.9
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP24A> 34BE
Nov 2019	+0.3	-1.3
	AP19 >AP2 > 34BE > AP1>BUH5	34BE > AP24A> C1
May 2020	-5.5	-1.7
Nov 2020	-3.2	-2.5

Extending Levelling

This levelling event included LINZ benchmarks AP2, AP20 No 2, AP19, (to the west of Waihi), AP1 and BUH5 (to the east of Waihi). AP24 a.k.a control mark AP6 (south of Waihi) has been lost to road works. AP24A and C1 have been established as a replacement for the lost AP6 control mark in this vicinity. AP2 and AP20 No 2 have now been 'unfixed' and AP19 is the fixed benchmark west of Waihi. The 'fixed' elevation value for AP19 was deduced from LINZ data comparing the relative levels of AP19, AP2, AP20 No2, and AP24 dating back to the year 1990. East of Waihi, AP1 is now 'unfixed. The R.L. for the 'new' fixed eastern control mark (BUH5) was the mean value from two close values (relative to AP1) levelled in May 2018 and Nov 2018.

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Photographs

The order of levelling of the monitoring points has now been fixed. This has been achieved by photographing all of the settlement points and placing them in 22 albums –generally in the order the points are to be levelled. This will achieve repeatable error distribution and should therefore give better results. I believe **all** the marks now have accurate GPS fixes. In the future, this should make the task of locating these marks easier if the marks are covered over by re-seal etc, or quickly confirm if the marks have definitely been 'lost' to street maintenance etc.

I recommend continuing these 'maintenance' details before or during the next levelling event.

Adjustments

Disturbed marks BM20 and 2.44 are excluded from the settlement contouring- as are marks F18, F20, F23, F24, and F25. Mark 22GB has a 'previous history' deduced for this levelling event after careful consideration of the previous settlement for adjacent marks. Marks 1PA and 1QC were 'missed' owing to a large stockpiles of road gravel over them and these marks are excluded from the settlement contouring. Mark 1.02C In a concrete footpath appears to be slightly damaged owing to street works. It is labelled as 'disturbed and excluded from the settlement contouring.

Results

One A1 plan is attached -colour coded by seven zones as identified in the 'Settlement and Groundwater Monitoring Plan.' Relative to previous plans, the Zone boundaries and 'trigger' settlement values have been modified to match *Engineering Geology Ltd* Drawing No. 8332-Fig 16.

This plan "Total Settlement Contours" (T2020-----) identifies all marks (in black and brown) that have been used to produce the contours for the plan. The plan shows total movement (in millimetres) at the monitoring mark itself. Missed, 'lost', or disturbed marks are shown in red and these marks are not used for contouring. New marks are also shown in red and generally not used for settlement contouring until the next levelling event.

This plan also displays settlement contours in 20mm intervals. The Settlement and Groundwater Monitoring Plan identifies gradients steeper than 1:1000 to be cause for concern. BM20 has been a large mover in the past and has been identified in past surveys as being placed on shrinking material. There are no buildings in this area anymore. I understand (from Mark Halloran) BM20A was placed near BM20 with a 'foot' bedded in firm ground. Significant differential settlement (1:125) is now occurring between BM20A and BM20 –sufficient to decide to omit BM20 from the settlement 'contour' calculation.

These contours represent the total negative (–ve) movement (or settlement) around Waihi since monitoring began. Positive contours are not shown. Small consistent ground 'rises' are associated with the sector north of the pit -with the mark with the highest elevation (BM28/2) showing the most (+50.0 millimetre) rise.

The closest contours (omitting disturbed marks) are between marks 20AC and BM20A. The distance between these marks using GPS measurements, calculates at 126.706 metres, and show 0.1805 metres of relative vertical movement to give a gradient of 1:702. The distance between marks BM20A and 20D using GPS measurements, calculates at 137.047 metres, and shows 0.1589 metres of relative vertical movement to give a gradient of 1:862. The distance between marks 20C and BM20A, when checked by GPS measurements, calculates at 126.865 metres, and show 0.1265 metres of relative vertical movement to give a gradient of 1:1003.

Some cracks are visible in the sealed pavements in this area of closest contours.

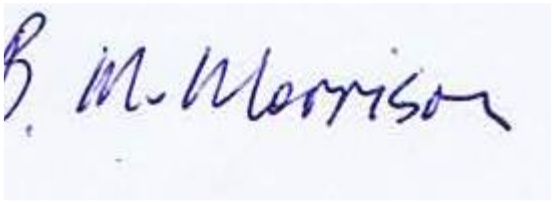
Table 1 (pages 3-12) lists all the marks used for this settlement levelling event with the marks sorted first by Zone and then by settlement value. Marks that record 'exceedences' in terms of zone predictions (for Martha (2019) are highlighted with colour and have comments attached. All marks that 'exceeded' in Table 1 were analysed further and field inspections were conducted where required.

The comments included below attempt to explain the probable reason for 'excess' movement. The comments are *Dist'd* for BM20 in Zone 6. In Zone 4, the comment is '*Nr watercourse'* for 23C. The swampy(?) ground may have de-watered during the autumn drought. For Zone 1, 2.44 is *Dist'd,* 2.05 is near Zone 5, 2.35 and 31FC.are near Zone 3, and 31KC, 31LC, 31MD, and 31NE are near the Ohinemuri River bridge.

The 'Favona' marks were installed for monitoring the effects of dewatering in the underground mine area. The underlying original 'Martha' zone is Zone 3 but the Favona marks have not been given zone exceedence parameters in terms of the original Martha zones. The Favona marks all report significant settlement. Note marks F18, F20, F23, F24, F25 are tentatively labelled as 'Dist'd' and not used for contouring the settlement.

The five extra 'Favona' settlement marks are again shown on the plan. These are FP1, BLOCK-S, BLOCK-N, TRIG 22, and TRIG 24. The settlements for these marks have generally been deduced relative to original reduced levels measured around the year 1987 –although FP1 (at the Favona portal) was established about the year 2000. Favona mark F07 is disturbed but has been relabelled as F07A. A 'previous history' has been calculated for F07A so this mark can be used for settlement contouring. The underlying zone for the Favona marks is now Zone 5 Martha (2019).

I understand that Time-History plots for all survey marks grouped by zone will be produced by other persons in accordance with the "Settlement and Groundwater Monitoring Plan 31 July 2005"



Bruce Morrison

Registered Professional Surveyor

Table 1. Total Movement

Zone	station i.d.	SURVEY DATE	X	Y	TOTAL Z	SETTLEMENT Nov-20	Comments
Zone7	BM19B	1/11/2020	2117.17	1244.36	35.5666	-0.2994	
Zone7	19BB	1/11/2020	2191.56	1292.022	35.5618	-0.296	
Zone7	17CB	1/11/2020	2014.23	1201.01	35.4992	-0.2744	
Zone6	BM20	1/11/2020	2342.50	1476.25	35.6149	-0.3659	Dist'd
Zone6	BM20A	1/11/2020	2345.50	1484.90	35.7843	-0.2929	
Zone6	19CB	1/11/2020	2296.71	1381.4	34.9525	-0.2774	
Zone6	17BB	1/11/2020	1919.52	1160.79	37.3951	-0.2359	
Zone6	17AB	1/11/2020	1841.32	1104.80	36.9147	-0.2006	
Zone6	34GC	1/11/2020	2211.33	1119.517	32.1597	-0.1921	
Zone6	2.04B	1/11/2020	1893.21	968.34	29.117	-0.1738	
Zone6	18EE	1/11/2020	1750.73	809.328	23.4553	-0.1661	
Zone6	34H	1/11/2020	2233.59	970.56	32.1813	-0.1658	
Zone6	18C	1/11/2020	1494.95	767.193	27.4924	-0.1625	
Zone6	18IB	1/11/2020	1611.19	784.79	25.8537	-0.1617	
Zone6	2.10	1/05/2020	2143.92	950.39	30.3094	-0.1595	
Zone6	34AD	1/11/2020	1470.88	886.92	29.7881	-0.1587	
Zone6	34BE	1/11/2020	1732.56	931.60	28.3589	-0.1478	
Zone6	34C	1/11/2020	1968.90	982.673	30.1312	-0.1387	
Zone6	BM34	1/11/2020	1528.38	903.297	30.3446	-0.1385	
Zone6	11AC	1/11/2020	1308.26	859.51	29.3626	-0.1343	
Zone6	10BC	1/11/2020	1560.13	1062.92	38.1378	-0.1298	
Zone6	18AB	1/11/2020	1632.39	667.73	22.1621	-0.1293	
Zone6	1.28B	1/11/2020	1987.03	447.706	12.118	-0.1269	
Zone6	10AB	1/11/2020	1430.61	1037.00	35.0271	-0.1259	
Zone6	2.08B	1/05/2020	2289.75	782.64	24.5614	-0.125	
Zone6	2.11B	1/05/2020	2278.86	862.45	26.5875	-0.1233	
Zone6	34FC	1/11/2020	2120.79	587.931	19.0849	-0.1211	
Zone6	BM17A	1/11/2020	1724.44	1088.919	40.0726	-0.1156	
Zone6	2.09C	1/05/2020	2228.35	868.63	28.6693	-0.1146	
Zone6	34I	1/11/2020	2229.55	765.53	28.4905	-0.1077	
Zone6	2.06	1/11/2020	2351.95	334.47	11.3004	-0.1013	
Zone5	20C	1/11/2020	2450.61	1413.86	36.341	-0.1664	

Zone5	A10B	1/11/2020	1298.62	1049.61	30.712	-0.1548
Zone5	20E	1/11/2020	2535.65	1542.672	37.111	-0.1498
Zone5	21DC	1/11/2020	2573.96	1304.152	37.7907	-0.149
Zone5	25D	1/11/2020	2547.05	1248.02	36.8922	-0.1486
Zone5	A11D	1/11/2020	1277.04	1017.33	30.8763	-0.1471
Zone5	25A	1/11/2020	2505.13	1203.77	35.965	-0.1448
Zone5	25E	1/11/2020	2472.35	1162.013	34.7992	-0.1443
Zone5	21O	1/11/2020	2527.37	1356.342	36.0315	-0.1443
Zone5	BM25	1/11/2020	2424.91	1100.253	33.5047	-0.1434
Zone5	16BC	1/11/2020	1252.81	1336.473	39.4851	-0.1424
Zone5	10DC	1/11/2020	1279.04	1198.326	35.3294	-0.1357
Zone5	20D	1/11/2020	2482.07	1473.478	36.5834	-0.134
Zone5	21N	1/11/2020	2623.25	1342.435	38.3167	-0.1323
Zone5	18F	1/11/2020	1752.28	551.027	17.3501	-0.131
Zone5	2.02	1/11/2020	1992.61	536.097	15.2909	-0.1307
Zone5	10CB	1/11/2020	1222.46	1025.86	29.8017	-0.1304
Zone5	12CE	1/11/2020	1499.92	543.077	21.006	-0.1294
Zone5	2.03	1/11/2020	1930.08	745.94	22.614	-0.1294
Zone5	25G	1/11/2020	2594.60	1149.415	37.6154	-0.1291
Zone5	25F	1/11/2020	2542.53	1116.24	36.0246	-0.1283
Zone5	25CB	1/11/2020	2615.91	1190.50	38.3237	-0.1276
Zone5	25H	1/11/2020	2648.48	1232.956	38.9484	-0.1273
Zone5	25B	1/11/2020	2497.67	1105.828	34.8498	-0.1272
Zone5	34EB	1/11/2020	2073.93	705.952	24.6615	-0.1261
Zone5	1.28A	1/11/2020	1888.26	505.887	13.2295	-0.126
Zone5	18G	1/11/2020	1669.05	554.602	18.497	-0.1258
Zone5	24L	1/11/2020	2761.67	1181.326	39.353	-0.1252
Zone5	24I	1/11/2020	2692.57	1269.713	39.3124	-0.1251
Zone5	2.41	1/11/2020	3296.32	685.398	46.2919	-0.1245
Zone5	BM12	1/11/2020	1370.27	607.74	23.984	-0.1227
Zone5	18B	1/11/2020	1510.36	650.58	23.5844	-0.1226
Zone5	13AC	1/11/2020	1751.98	327.376	18.6227	-0.1222
Zone5	25I	1/05/2020	2537.20	1045.036	34.7124	-0.1203
Zone5	24AC	1/11/2020	2743.58	1218.9	40.1155	-0.1199

Zone5	BM18	1/11/2020	1771.96	674.53	19.4506	-0.1198
Zone5	34D	1/11/2020	2038.90	783.431	25.3664	-0.1197
Zone5	2A	1/11/2020	1069.03	1111.86	23.8231	-0.1197
Zone5	13BC	1/11/2020	1850.36	246.59	13.7422	-0.1188
Zone5	24CD	1/11/2020	2603.21	987.721	34.8508	-0.1182
Zone5	24E	1/11/2020	2758.43	1303.234	40.39	-0.1181
Zone5	22F	1/11/2020	2815.91	1325.407	40.2595	-0.118
Zone5	18HC	1/11/2020	1821.52	466.47	14.9102	-0.1177
Zone5	24F	1/11/2020	2772.80	1257.274	40.1561	-0.1176
Zone5	BM16	1/11/2020	1418.09	1218.03	46.4772	-0.1172
Zone5	24G	1/11/2020	2705.96	1170.464	39.8264	-0.1164
Zone5	BM24	1/11/2020	2794.55	1279.361	40.427	-0.1161
Zone5	24DC	1/11/2020	2718.29	1323.127	39.6648	-0.116
Zone5	24B	1/11/2020	2667.67	1126.399	39.4058	-0.1155
Zone5	12DC	1/11/2020	1596.95	435.491	19.9905	-0.115
Zone5	21C	1/11/2020	2651.57	1389.816	38.4975	-0.1147
Zone5	24H	1/11/2020	2630.70	1072.279	36.1792	-0.1146
Zone5	12AC	1/11/2020	1388.32	488.888	19.0709	-0.1142
Zone5	20AC	1/11/2020	2461.04	1536.905	37.0467	-0.1124
Zone5	24K	1/11/2020	2783.89	1387.719	40.6458	-0.1121
Zone5	15A	1/11/2020	1204.79	818.863	28.7988	-0.1099
Zone5	21EB	1/11/2020	2799.95	1429.087	41.6653	-0.1083
Zone5	24J	1/11/2020	2749.39	1365.756	40.2629	-0.1082
Zone5	AP22A	1/11/2020	1868.44	188.57	12.4315	-0.1075
Zone5	15BC	1/11/2020	1169.90	708.855	26.3588	-0.1061
Zone5	12BC	1/11/2020	1405.27	368.295	14.9421	-0.1056
Zone5	BM13	1/11/2020	1426.61	269.34	13.5995	-0.1056
Zone5	1.10A	1/11/2020	1599.70	278.938	16.658	-0.1055
Zone5	20BB	1/11/2020	2533.26	1622.291	37.906	-0.1051
Zone5	11BB	1/11/2020	1348.57	710.57	26.9571	-0.1018
Zone5	4DB	1/11/2020	1033.26	1550.66	32.2774	-0.1004
Zone5	21M	1/11/2020	2694.90	1439.648	39.2154	-0.1001
Zone5	20F	1/11/2020	2605.79	1575.98	37.6037	-0.0979
Zone5	4B	1/11/2020	1021.54	1448.63	31.2796	-0.0948

Zone5	BM21	1/11/2020	2654.80	1515.40	39.459	-0.0944	
Zone5	2BC	1/11/2020	970.20	1241.90	30.412	-0.0940	
Zone5	21BC	1/11/2020	2719.27	1477.799	41.3033	-0.0916	
Zone5	2.17A	1/11/2020	3085.76	555.866	36.9389	-0.0906	
Zone5	21K	1/11/2020	2681.11	1572.207	40.0347	-0.0906	
Zone5	30C	1/11/2020	2573.54	1675.395	38.4733	-0.0806	
Zone5	AP3	1/11/2020	918.94	1140.59	26.092	-0.0783	
Zone5	7CB	1/11/2020	1161.74	1597.63	30.6389	-0.0769	
Zone5	BM9B	1/11/2020	1220.25	1523.285	34.7814	-0.076	
Zone5	26EE	1/11/2020	1343.86	1621.82	44.3261	-0.0558	
Zone5	26F	1/11/2020	1392.77	1680.26	43.8917	-0.0482	
Zone5	26PB	1/11/2020	1834.84	1893.106	67.9859	-0.0367	
Zone5	26R	1/11/2020	1905.59	1927.165	71.4001	-0.0351	
Zone5	26Q	1/11/2020	1963.00	1982.711	73.7178	-0.0333	
Zone4	23C	1/11/2020	2856.14	1068.014	37.5799	-0.1862	Nr watercourse
Zone4	23AB	1/11/2020	3145.42	1078.732	37.2213	-0.1505	
Zone4	2.24	1/11/2020	2885.91	1215.47	41.3108	-0.1362	
Zone4	22C	1/11/2020	2846.39	1352.544	40.3437	-0.1356	
Zone4	BANK1	1/11/2020	2866.21	1023.248	37.822	-0.1323	
Zone4	23D	1/11/2020	2861.42	1154.885	38.8855	-0.1314	
Zone4	2.25	1/11/2020	2874.51	1097.261	38.0051	-0.1301	
Zone4	23B	1/11/2020	2856.49	949.794	38.7734	-0.1267	
Zone4	23E	1/11/2020	2774.82	972.514	37.736	-0.1255	
Zone4	MATAURA1	1/11/2020	2831.84	1250.806	41.0969	-0.1229	
Zone4	23F	1/11/2020	2700.77	968.793	36.6752	-0.1224	
Zone4	22GB	1/11/2020	2862.88	1387.968	40.8725	-0.1217	
Zone4	1.11B	1/11/2020	1675.83	133.622	9.0448	-0.1182	
Zone4	2.19B	1/11/2020	3270.21	916.063	38.5922	-0.1167	
Zone4	BARRY1	1/11/2020	3047.74	926.576	38.1487	-0.1161	
Zone4	2.14A	1/05/2020	2853.28	838.669	41.3533	-0.1143	
Zone4	BARRY3	1/11/2020	3176.85	895.991	37.7171	-0.1135	
Zone4	2.13	1/05/2020	2725.42	874.95	47.2425	-0.1134	
Zone4	MORTON	1/11/2020	2975.42	1231.913	40.7468	-0.1129	
Zone4	2HB	1/11/2020	1078.24	886.849	24.4154	-0.1099	

Zone4	BARRY4B	1/11/2020	3320.16	912.693	38.9225	-0.1081
Zone4	STAFORD	1/11/2020	3139.86	998.179	37.3464	-0.1078
Zone4	2.18	1/11/2020	3218.04	712.756	44.5796	-0.1071
Zone4	22BC	1/11/2020	2916.75	1435.773	42.1362	-0.1056
Zone4	AP100	1/11/2020	1893.80	81.273	11.8029	-0.1049
Zone4	BM23	1/11/2020	3107.42	921.05	38.1225	-0.1046
Zone4	2.23	1/11/2020	3560.02	1212.795	36.6683	-0.1042
Zone4	BARRY5	1/11/2020	3397.59	904.647	41.0285	-0.1039
Zone4	22E	1/11/2020	3055.20	1231.50	40.8196	-0.1039
Zone4	22H	1/11/2020	2869.25	1441.796	41.6531	-0.1037
Zone4	BARRY2	1/11/2020	2936.96	944.224	38.392	-0.1036
Zone4	BARRY6	1/11/2020	3432.52	904.356	42.5149	-0.1024
Zone4	21P	1/11/2020	2849.17	1456.9	41.8813	-0.102
Zone4	2.16	1/11/2020	3007.62	739.64	33.6259	-0.1019
Zone4	22M	1/11/2020	2973.44	1434.656	41.705	-0.101
Zone4	22I	1/11/2020	2918.98	1461.367	41.9485	-0.1007
Zone4	2.20	1/11/2020	3467.69	904.56	43.8233	-0.0978
Zone4	2.21	1/11/2020	3563.09	1045.181	34.0623	-0.0973
Zone4	BM2	1/11/2020	915.74	1091.80	24.854	-0.0965
Zone4	2.15	1/05/2020	2918.94	723.52	38.4004	-0.0965
Zone4	1.05	1/11/2020	1176.96	473.454	21.8434	-0.096
Zone4	22A	1/11/2020	3003.28	1429.771	41.6776	-0.0951
Zone4	22L	1/11/2020	3047.70	1499.876	41.0277	-0.094
Zone4	CUBA	1/11/2020	3224.32	1079.177	35.8596	-0.0936
Zone4	GW	1/11/2020	3128.83	1140.936	38.5759	-0.0935
Zone4	BARRY8	1/11/2020	3592.28	871.451	37.9683	-0.0934
Zone4	2.22	1/11/2020	3339.13	1206.603	40.3848	-0.093
Zone4	2.28	1/11/2020	3076.72	1555.994	42.9785	-0.092
Zone4	22J	1/11/2020	2944.47	1489.763	42.4582	-0.0915
Zone4	BARRY7	1/11/2020	3518.87	901.897	43.6499	-0.0914
Zone4	1.26	1/11/2020	1926.81	30.05	15.1155	-0.0913
Zone4	22D	1/11/2020	3100.02	1335.441	41.4865	-0.0896
Zone4	2GB	1/11/2020	922.38	967.661	22.7001	-0.0854
Zone4	1.06	1/11/2020	1159.34	302.26	17.2465	-0.0846

Zone4	15C	1/11/2020	1156.82	571.077	24.2372	-0.0844
Zone4	21FB	1/11/2020	2861.65	1512.211	42.6861	-0.0842
Zone4	2.29B	1/11/2020	2953.39	1548.172	42.6234	-0.0834
Zone4	21AC	1/11/2020	2716.64	1617.767	39.7257	-0.0833
Zone4	26BE	1/11/2020	1408.78	1800.553	38.8442	-0.0819
Zone4	2.27	1/11/2020	3379.40	1371.481	37.7889	-0.0817
Zone4	2.26	1/11/2020	3241.22	1380.889	39.2517	-0.0815
Zone4	BM22	1/11/2020	3115.79	1442.95	40.6532	-0.0810
Zone4	21L	1/11/2020	2806.79	1575.074	43.1234	-0.0804
Zone4	1.09B	1/11/2020	1344.14	117.48	9.9473	-0.0778
Zone4	BM15	1/11/2020	976.94	783.004	20.5416	-0.0749
Zone4	30BB	1/11/2020	2604.86	1726.496	41.5812	-0.0737
Zone4	26CE	1/11/2020	1377.77	1711.891	40.6305	-0.0731
Zone4	22KB	1/11/2020	2981.80	1603.49	42.8837	-0.073
Zone4	21Q	1/11/2020	2899.60	1571.317	43.1646	-0.0726
Zone4	27KB	1/11/2020	2320.23	2120.21	63.3751	-0.0705
Zone4	21I	1/11/2020	2854.70	1668.793	41.6814	-0.0684
Zone4	21J	1/11/2020	2773.44	1688.923	39.9989	-0.0678
Zone4	SM822	1/11/2020	2512.91	1841.132	41.4905	-0.0676
Zone4	21GC	1/11/2020	2901.12	1614.054	43.4815	-0.0653
Zone4	2.31B	1/11/2020	3201.23	1637.289	42.128	-0.0653
Zone4	2.30B	1/11/2020	3000.35	1672.941	43.207	-0.0606
Zone4	7BB	1/11/2020	1105.69	1689.90	35.9678	-0.0595
Zone4	21HC	1/11/2020	2916.84	1728.842	42.9187	-0.0573
Zone4	27E	1/11/2020	2494.09	2171.622	50.3815	-0.0567
Zone4	26AE	1/11/2020	1432.47	1883.48	37.5803	-0.0525
Zone4	3.01	1/11/2020	1291.95	1690.334	37.3274	-0.0521
Zone4	27N	1/11/2020	2179.57	2075.99	71.9594	-0.0512
Zone4	3.04B	1/11/2020	1123.76	1821.50	39.3138	-0.0511
Zone4	4.08	1/11/2020	2350.64	2022.32	73.2576	-0.0495
Zone4	4.07	1/11/2020	2554.47	2079.237	45.0843	-0.0488
Zone4	4.05	1/11/2020	2809.68	1897.68	40.6529	-0.0485
Zone4	27G	1/11/2020	2440.97	2157.30	54.599	-0.0461
Zone4	27H	1/11/2020	2413.27	2149.76	57.0646	-0.0459

Zone4	3.02	1/11/2020	1344.87	1837.735	34.9714	-0.0458
Zone4	BM30	1/11/2020	2715.36	1996.21	44.1199	-0.0437
Zone4	27J	1/11/2020	2344.14	2136.138	62.173	-0.0429
Zone4	26H	1/11/2020	1452.90	1729.59	49.9959	-0.0429
Zone4	4.09	1/11/2020	2249.27	2029.94	78.967	-0.0417
Zone4	26G	1/11/2020	1425.06	1706.748	47.0336	-0.0412
Zone4	26NC	1/11/2020	1641.16	1772.4	60.4299	-0.04
Zone4	27I	1/11/2020	2385.10	2141.936	59.5681	-0.0393
Zone4	26JB	1/11/2020	1495.71	1756.55	53.7633	-0.0391
Zone4	26I	1/11/2020	1481.67	1750.49	52.7617	-0.039
Zone4	27F	1/11/2020	2466.48	2164.026	52.3566	-0.0383
Zone4	30AB	1/11/2020	2685.64	1898.44	46.2709	-0.0377
Zone4	3.09	1/11/2020	1618.51	1870.17	51.9547	-0.0373
Zone4	26MB	1/11/2020	1593.46	1750.66	59.0073	-0.0358
Zone4	3.11A	1/11/2020	1786.17	1929.22	62.1868	-0.0353
Zone4	27DC	1/11/2020	2541.24	2190.71	48.2266	-0.0329
Zone4	3.10A	1/11/2020	1689.03	1978.29	53.4716	-0.0328
Zone4	BM26	1/11/2019	1542.45	1837.81	45.4558	-0.0303
Zone4	3.13	1/11/2020	1744.89	2097.492	53.7953	-0.0293
Zone4	27M	1/11/2020	2224.38	2095.26	69.1989	-0.0282
Zone4	27L	1/11/2020	2280.24	2115.405	65.881	-0.0269
Zone4	27AB	1/11/2020	2009.08	2064.33	73.5268	-0.0238
Zone4	27O	1/11/2020	2101.57	2042.821	75.0722	-0.0183
Zone4	3.6A	1/11/2020	1526.28	2015.739	38.9493	-0.0163
Zone4	26OB	1/11/2020	1706.93	1812.27	67.2228	-0.012
Zone3	2CE	1/11/2020	774.75	1313.19	34.6386	-0.0873
Zone3	14DB	1/11/2020	876.99	411.215	15.171	-0.0828
Zone3	2.34	1/11/2020	3452.45	1683.50	37.7401	-0.0732
Zone3	1.25	1/11/2020	2175.94	-129.105	20.0773	-0.0687
Zone3	1.07	1/11/2020	924.43	267.487	12.5157	-0.0679
Zone3	2.36	1/11/2020	3433.14	1534.879	35.9516	-0.0636
Zone3	15DB	1/11/2020	917.56	466.148	15.6167	-0.0633
Zone3	A33C	1/11/2020	456.03	1219.23	35.8768	-0.0631
Zone3	2.40B	1/11/2020	3572.85	1526.452	33.1772	-0.0629
Zone3	2FC	1/11/2020	720.33	843.06	23.9454	-0.0611

Zone3	14EA	1/11/2020	808.56	504.72	17.1081	-0.0607
Zone3	14CB	1/11/2020	759.10	389.766	18.8359	-0.0599
Zone3	2.33	1/11/2020	3294.51	1691.952	40.3351	-0.0578
Zone3	1.08	1/11/2020	1052.91	107.17	16.5435	-0.0553
Zone3	1.21A	1/11/2020	1939.94	-325.504	19.6745	-0.0552
Zone3	14BC	1/11/2020	535.45	340.67	20.9304	-0.0551
Zone3	4A	1/11/2020	815.01	1494.154	40.7175	-0.0549
Zone3	2DA	1/11/2020	682.15	1189.579	35.8344	-0.0542
Zone3	4.02	1/11/2020	2797.90	2143.571	45.7951	-0.054
Zone3	4EC	1/11/2020	782.01	1687.78	41.1557	-0.0540
Zone3	1.22	1/11/2020	1510.00	-249.925	15.8818	-0.051
Zone3	4.03B	1/11/2020	2794.90	2044.783	43.8309	-0.05
Zone3	BM31	1/11/2020	2967.04	1873.48	43.3156	-0.0499
Zone3	31BC	1/11/2020	3159.33	1954.857	45.5332	-0.0493
Zone3	14FB	1/11/2020	705.60	649.144	20.1703	-0.0491
Zone3	2EB	1/11/2020	689.02	1054.62	29.2832	-0.0488
Zone3	4.04	1/11/2020	2662.60	2131.765	45.9497	-0.0455
Zone3	4.01C	1/11/2020	2891.78	2113.146	47.3343	-0.0438
Zone3	31AC	1/11/2020	3059.04	1910.63	44.1001	-0.0424
Zone3	29DB	1/11/2020	2996.63	2106.66	47.8396	-0.0393
Zone3	31CC	1/11/2020	3248.97	1989.886	47.0677	-0.0322
Zone3	3.25	1/11/2020	3116.90	2107.06	49.8476	-0.0295
Zone3	29AC	1/11/2020	2641.62	2218.07	48.5513	-0.0246
Zone3	29CE	1/11/2020	2891.84	2285.59	51.6063	-0.0233
Zone3	3.24	1/11/2020	3017.29	2258.712	51.9679	-0.0183
Zone3	29B	1/11/2020	2772.84	2242.22	50.0374	-0.0093
Zone2	1K	1/11/2020	511.74	957.174	29.6206	-0.0484
Zone2	1.12	1/11/2020	800.71	-50.23	10.8027	-0.0440
Zone2	3.14	1/11/2020	1752.75	2214.323	48.7834	-0.0432
Zone2	1.04	1/11/2020	795.98	129.359	12.8164	-0.0425
Zone2	3.03	1/11/2020	1134.46	1917.24	39.3729	-0.0420
Zone2	7AC	1/11/2020	994.54	1781.82	43.5501	-0.0418
Zone2	1JB	1/11/2020	604.79	822.76	26.4318	-0.0384
Zone2	4FB	1/11/2020	562.51	1370.97	39.3956	-0.0375
Zone2	33F	1/11/2020	347.95	1511.678	42.0711	-0.0374
Zone2	3.12	1/11/2020	1599.68	2152.41	40.2905	-0.0373

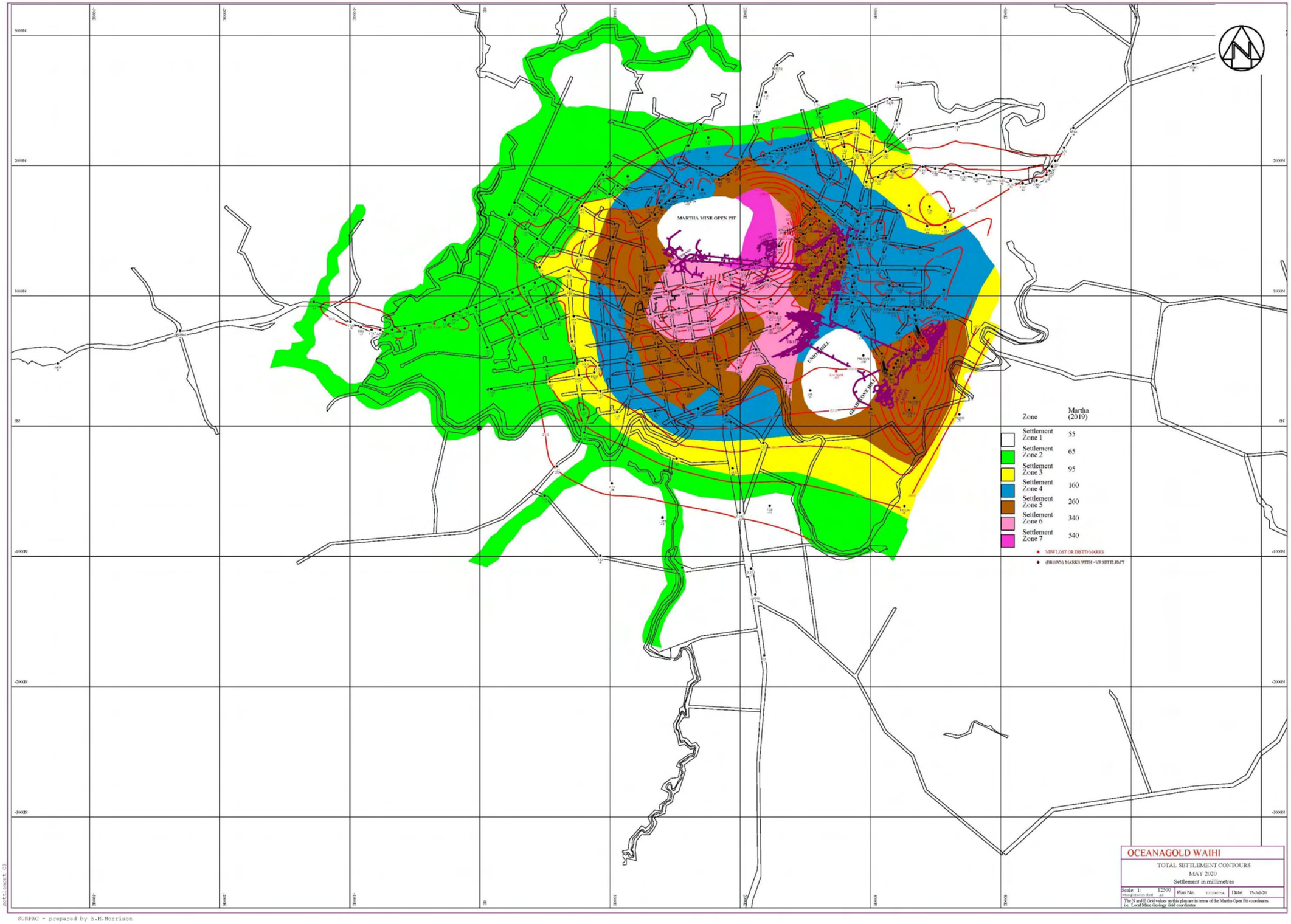
Zone2	BM4	1/11/2020	689.21	1555.547	42.3042	-0.0365	
Zone2	1SC	1/11/2020	-674.31	739.267	14.4566	-0.0362	
Zone2	1C	1/11/2020	421.48	1098.89	34.8128	-0.0358	
Zone2	BM14	1/11/2020	718.16	485.96	19.8522	-0.0354	
Zone2	33A	1/11/2020	338.15	1303.89	36.7441	-0.0345	
Zone2	BM7	1/11/2020	1057.32	1843.069	44.1421	-0.0343	
Zone2	1I	1/11/2020	468.34	761.228	27.2959	-0.0331	
Zone2	33E	1/11/2020	437.71	1437.52	41.0136	-0.0327	
Zone2	1B	1/11/2020	337.50	1062.935	34.0262	-0.031	
Zone2	1HC	1/11/2020	299.70	702.80	27.0613	-0.0296	
Zone2	14AC	1/11/2020	515.17	457.622	24.0438	-0.0293	
Zone2	6A	1/11/2020	946.43	1928.12	47.5395	-0.0285	
Zone2	1O	1/11/2020	-271.35	814.183	22.7293	-0.0284	
Zone2	3.07	1/11/2020	1362.08	2096.818	48.0713	-0.0279	
Zone2	1NB	1/11/2020	-206.98	842.119	24.8269	-0.0264	
Zone2	33DB	1/11/2020	265.40	1714.72	46.3928	-0.0256	
Zone2	1FB	1/11/2020	210.46	850.779	29.8524	-0.0251	
Zone2	BM6	1/11/2020	881.86	1837.08	46.2598	-0.0238	
Zone2	1.03B	1/11/2020	365.55	323.37	19.4015	-0.0237	
Zone2	1LD	1/11/2020	-102.13	906.05	28.3765	-0.0235	
Zone2	1.02C	1/11/2020	86.31	283.86	18.6474	-0.0235	Dist'd?
Zone2	1EB	1/11/2020	388.60	912.09	30.4564	-0.0225	
Zone2	3.15	1/11/2020	1696.24	2315.82	39.1257	-0.0223	
Zone2	1GB	1/11/2020	-2.87	769.742	29.3127	-0.022	
Zone2	1ME	1/11/2020	-155.40	879.887	26.1214	-0.0218	
Zone2	5C	1/11/2020	705.43	1754.71	45.1959	-0.0211	
Zone2	1A	1/11/2020	249.92	1026.38	33.3547	-0.021	
Zone2	33GA	1/11/2020	415.95	1621.64	45.3796	-0.0209	
Zone2	1RA	1/11/2020	-579.06	750.356	16.7486	-0.0192	
Zone2	AP2	1/11/2020	-1276.40	954.13	5.7771	-0.0189	
Zone2	1.01	1/11/2020	56.47	604.075	25.4688	-0.0181	
Zone2	BM1	1/11/2020	152.75	994.869	32.7972	-0.0174	
Zone2	33B	1/11/2020	156.88	1430.80	34.437	-0.0160	
Zone2	1.14	1/11/2020	496.74	-535.095	8.454	-0.0156	
Zone2	BM5	1/11/2020	325.93	1806.47	47.8314	-0.014	
Zone2	5BC	1/11/2020	547.16	1824.60	49.1662	-0.0126	

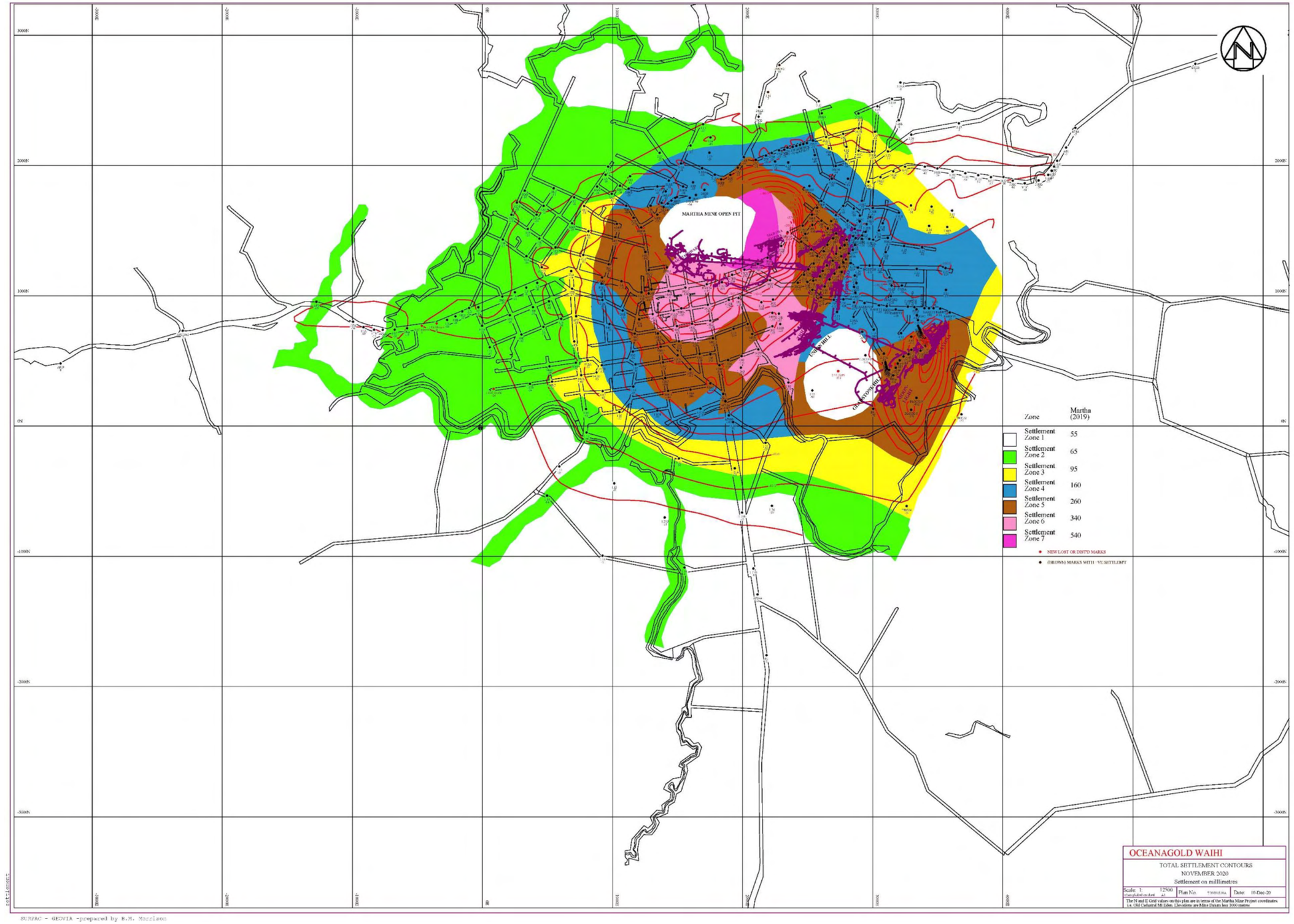
Zone2	5AC	1/11/2020	470.30	1688.454	47.0654	-0.0124	
Zone2	3.05	1/11/2020	966.29	1990.77	47.2211	-0.0113	
Zone2	BM29	1/05/2020	2608.80	2400.76	55.9976	-0.0108	
Zone2	33C	1/11/2020	222.53	1621.24	44.438	-0.0101	
Zone2	3.22A	1/11/2020	2891.15	2398.65	56.6947	-0.0100	
Zone2	1D	1/11/2020	-32.05	911.592	30.0644	-0.0084	
Zone2	1.16	1/11/2020	1552.97	-1086.27	18.3767	-0.0013	
Zone2	1PA	1/11/2020	-351.51	787.24	MISSED	MISSED	Gravel heap
Zone2	1QC	1/11/2020	-466.05	769.147	MISSED	MISSED	Gravel heap
Zone1	2.44	1/11/2020	2734.64	421.025	27.2761	-0.5526	Dist'd
Zone1	2.05	1/11/2020	2535.68	272.682	20.7881	-0.092	Nr edge Zone 5
Zone1	31MD	1/11/2020	4275.09	1884.554	30.7309	-0.0791	Nr river bridge
Zone1	31NE	1/11/2020	4349.43	1927.421	33.3558	-0.0728	Nr river bridge
Zone1	31LC	1/11/2020	4168.53	1862.106	32.0996	-0.0680	Nr river bridge
Zone1	2.35	1/11/2020	3609.80	1652.681	34.1216	-0.0641	Nr edge Zone 3
Zone1	31KC	1/11/2020	4076.39	1883.199	34.4926	-0.0617	Nr river bridge
Zone1	31FC	1/11/2020	3614.22	1954.15	43.442	-0.0601	Nr edge Zone 3
Zone1	31JD	1/11/2020	4005.65	1911.423	35.5663	-0.0542	
Zone1	31HC	1/11/2020	3810.83	1924.654	40.3425	-0.0530	
Zone1	31IC	1/11/2020	3909.03	1909.895	37.8576	-0.0528	
Zone1	31GC	1/11/2020	3711.83	1939.28	42.1928	-0.0505	
Zone1	31DD	1/11/2020	3400.43	1989.83	46.7132	-0.0467	
Zone1	31PC	1/11/2020	4393.52	1991.66	37.7397	-0.0430	
Zone1	31ED	1/11/2020	3496.21	1975.774	45.9396	-0.0386	
Zone1	31QC	1/11/2020	4417.71	2035.374	39.6375	-0.0382	
Zone1	1VA	1/11/2020	-994.62	800.624	6.4315	-0.0355	
Zone1	1.24	1/11/2020	2225.16	-613.228	16.7066	-0.0270	
Zone1	AP2A	1/11/2020	-766.18	738.506	12.3238	-0.0259	
Zone1	1.13	1/11/2020	591.36	-310.797	7.067	-0.0255	
Zone1	31OD	1/11/2020	4374.76	1958.38	36.0733	-0.0254	
Zone1	1.23	1/11/2020	1013.01	-440.769	13.2839	-0.0247	
Zone1	1.20B	1/11/2020	1995.49	-664.093	22.048	-0.0245	
Zone1	28AE	1/11/2020	2128.26	2448.76	85.9561	-0.0202	
Zone1	1UA	1/11/2020	-914.75	759.054	8.7356	-0.019	
Zone1	27CD	1/11/2020	2122.89	2374.362	85.0923	-0.0135	
Zone1	3.30	1/11/2020	3296.29	2235.94	50.4093	-0.0134	

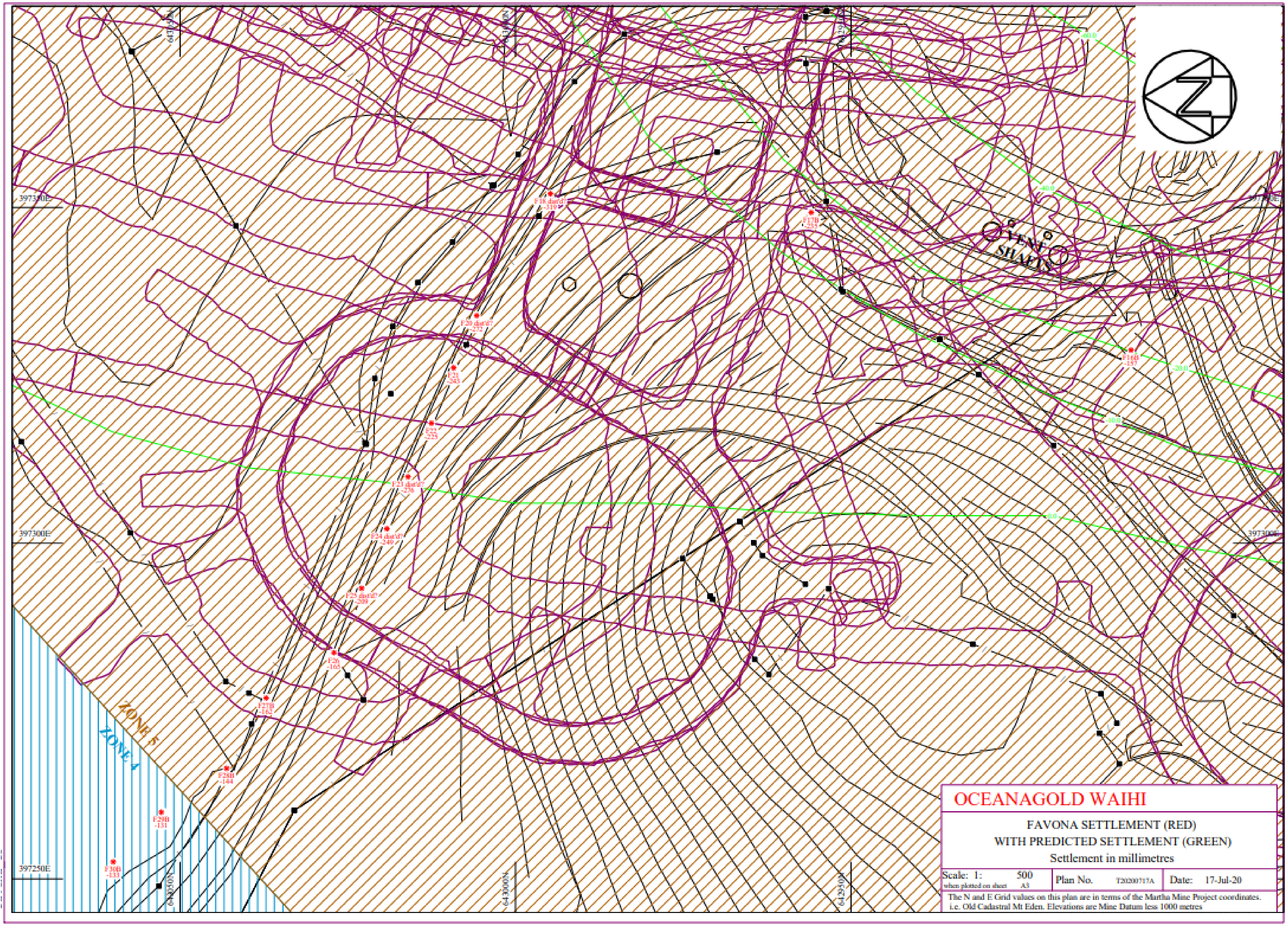
Zone1	1TB	1/11/2020	-832.77	738.922	11.2417	-0.0128		
Zone1	1.27B	1/11/2020	1401.56	-701.57	15.3484	-0.0127		
Zone1	3.21	1/11/2020	2585.77	2493.375	64.9655	-0.0107		
Zone1	3.29	1/11/2020	3662.64	2323.53	44.9419	-0.0086		
Zone1	3.26B	1/11/2020	3200.09	2347.92	55.4466	-0.0079		
Zone1	3.28A	1/11/2020	3212.99	2635.997	53.862	-0.0077		
Zone1	1.15	1/11/2020	923.35	-995.41	14.3653	-0.0067		
Zone1	AP1A	1/11/2020	4557.10	2288.33	42.4934	-0.0066		
Zone1	AP20No2	1/11/2020	-2303.63	731.69	20.2006	-0.0046		
Zone1	AP1	1/11/2020	4486.29	2137.008	41.3879	-0.0046		
Zone1	1.17B	1/11/2020	2082.20	-1093.92	25.5998	-0.0038		
Zone1	3.23	1/11/2020	3035.80	2453.651	59.6545	-0.0031		
Zone 1	AP24A	1/11/2020	2114.57	-1292.93	28.0737	-0.0015		
Zone1	3.27B	1/11/2020	3148.37	2510.53	60.3115	-0.0001		
Zone1	AP19	1/11/2020	-3242.58	480.68	-6.5213	0.0000	control	
Zone1	BUH5	1/11/2020	5480.15	2780.65	52.7423	0.0000	control	
Zone1	C1	1/11/2020	2183.23	-1759.33	32.8425	0.0000	control	
Zone1	3.16	1/11/2020	2195.60	2563.077	95.6539	0.0074		
Zone1	BM28/2	1/11/2020	2282.46	2770.68	101.9357	0.0500		
Favona	F18	1/11/2020	3423.83	648.3	40.0146	-0.3168		Dist'd?
Favona	F23	1/11/2020	3393.93	684.82	40.6287	-0.2719		Dist'd?
Favona	F20	1/11/2020	3411.70	665.72	40.9356	-0.2685		Dist'd?
Favona	F24	1/11/2020	3388.13	690.846	40.6445	-0.2434		Dist'd?
Favona	F21	1/11/2020	3405.99	671.998	40.7736	-0.2397		
Favona	F17B	1/11/2020	3405.48	613.91	44.0043	-0.2352		
Favona	F22	1/11/2020	3399.79	678.39	40.7154	-0.2210		
Favona	F25	1/11/2020	3381.55	697.88	40.6171	-0.2044		Dist'd?
Favona	BLOCK-S	1/11/2020	3295.82	124.324	24.8412	-0.1708		
Favona	F26	1/11/2020	3374.47	705.54	40.6048	-0.1611		
Favona	F16B	1/11/2020	3367.38	578.696	46.4077	-0.1583		
Favona	F27B	1/11/2020	3372.41	717.518	40.5178	-0.1554		
Favona	F11C	1/11/2020	3192.52	479.444	51.4566	-0.1537		
Favona	F15C	1/11/2020	3297.17	585.32	57.3648	-0.1517		
Favona	BLOCK-N	1/11/2020	3336.45	215.69	24.3114	-0.1516		
Favona	F34C	1/11/2020	3339.49	849.57	40.1982	-0.1423		
Favona	F10B	1/11/2020	3176.88	446.75	49.2896	-0.1385		

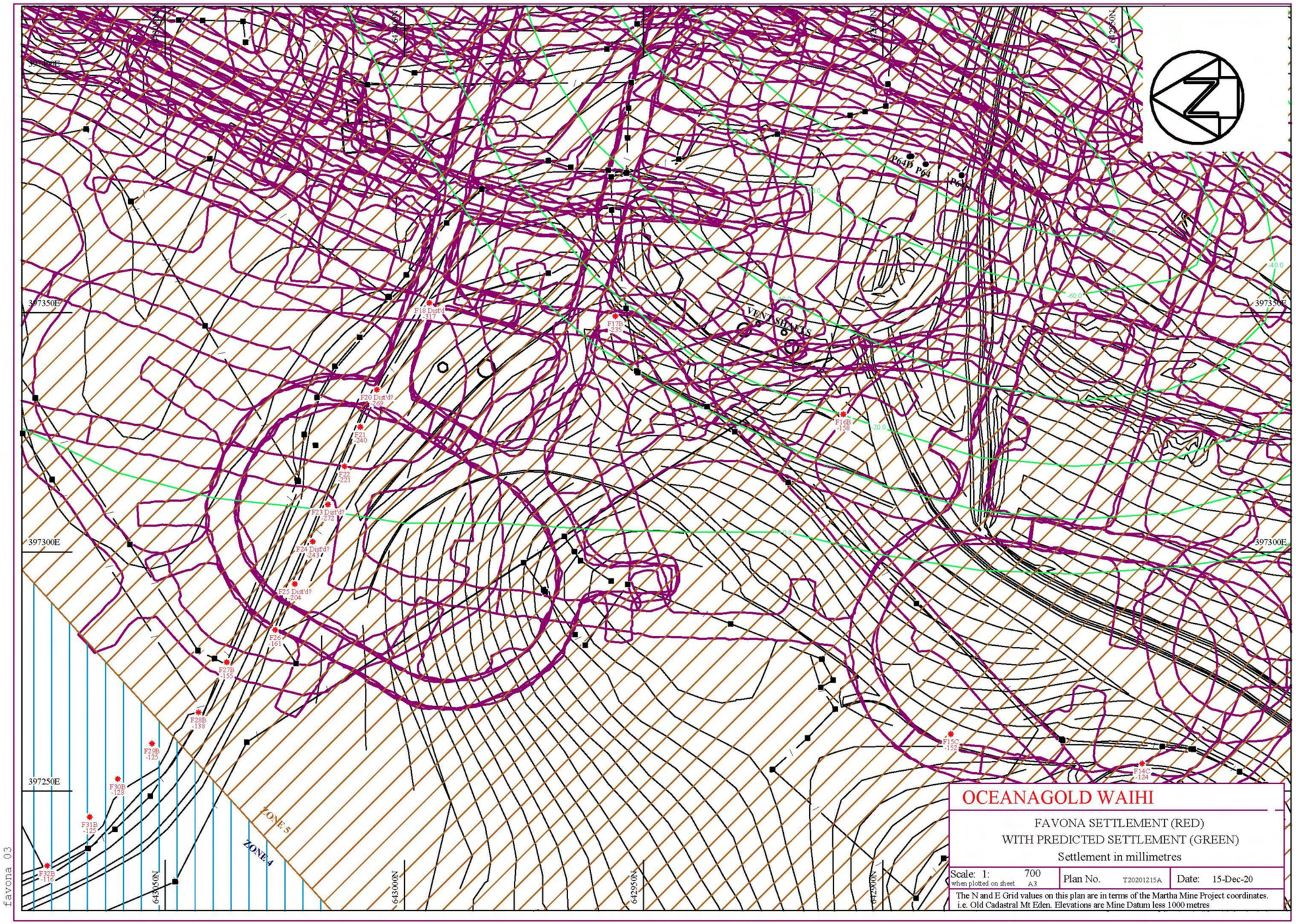
Favona	F28B	1/11/2020	3365.21	727.17	40.5218	-0.1379
Favona	F12C	1/11/2020	3207.32	503.82	53.516	-0.1368
Favona	F09A	1/11/2020	3157.20	388.28	45.1735	-0.1315
Favona	F30B	1/11/2020	3359.36	748.26	40.7098	-0.1277
Favona	F29B	1/11/2020	3363.20	738.71	40.5067	-0.1253
Favona	F31B	1/11/2020	3354.47	756.84	41.2552	-0.1252
Favona	F14C	1/11/2020	3275.29	551.312	60.6838	-0.124
Favona	F13C	1/11/2020	3236.43	533.63	57.9316	-0.1239
Favona	F33	1/11/2020	3348.56	812.51	40.6459	-0.1178
Favona	F08A	1/11/2020	3126.97	430.49	42.7612	-0.1163
Favona	F32B	1/11/2020	3348.78	769.10	40.8763	-0.1157
Favona	F35B	1/11/2020	3336.68	896.063	39.7875	-0.1097
Favona	F07A	1/11/2020	3110.57	437.24	41.375	-0.1075
Favona	F06	1/11/2020	3107.08	445.21	40.5161	-0.1017
Favona	ITXCIVB	1/11/2020	2943.85	542.17	32.6214	-0.1013
Favona	F04	1/11/2020	3100.96	470.88	38.7355	-0.0994
Favona	F02	1/11/2020	3097.60	490	38.2135	-0.0972
Favona	F03	1/11/2020	3099.03	480.33	38.4123	-0.0954
Favona	F05	1/11/2020	3104.66	455.54	39.4739	-0.0952
Favona	FP1	1/11/2020	3004.15	131.25	45.4329	-0.0761
Favona	TRIG 24	1/11/2020	3260.76	-615.678	25.6907	-0.0393
Favona	TRIG 22	1/11/2020	3681.97	89.36	26.1576	-0.0324

Appendix C Plans of Settlement Marks & Contours

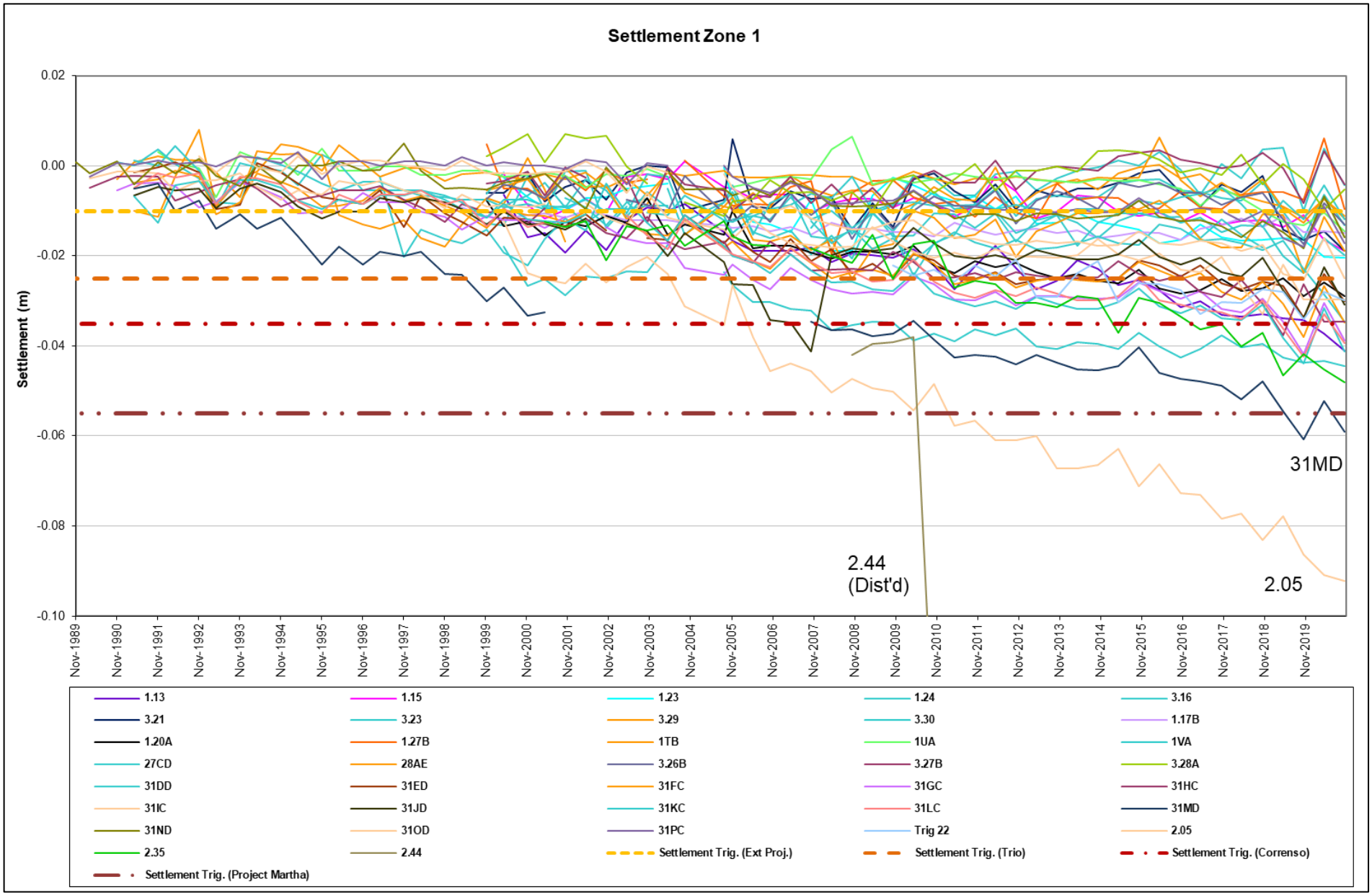

MARTHA MINE OPEN PIT
TWIN KNOB
GRAPESTONE HILL
Zone
Martha (2019)
Settlement Zone 1 55
Settlement Zone 2 65
Settlement Zone 3 95
Settlement Zone 4 160
Settlement Zone 5 260
Settlement Zone 6 340
Settlement Zone 7 540
NEW LOST OR DISTD MARKS
(BROWN) MARKS WITH +VE SETTLMNT
OCEANAGOLD WAIHI
TOTAL SETTLEMENT CONTOURS
MAY 2020
Settlement in millimetres
Scale: 1: 12500
Plan No. Y22200/5A
Date: 15-Jul-20
The N and E Grid values on this plan are in terms of the Martha Open Pit coordinates.
i.e. Local Mine Geology Grid coordinates
SURPAC - prepared by S.M.Morrison

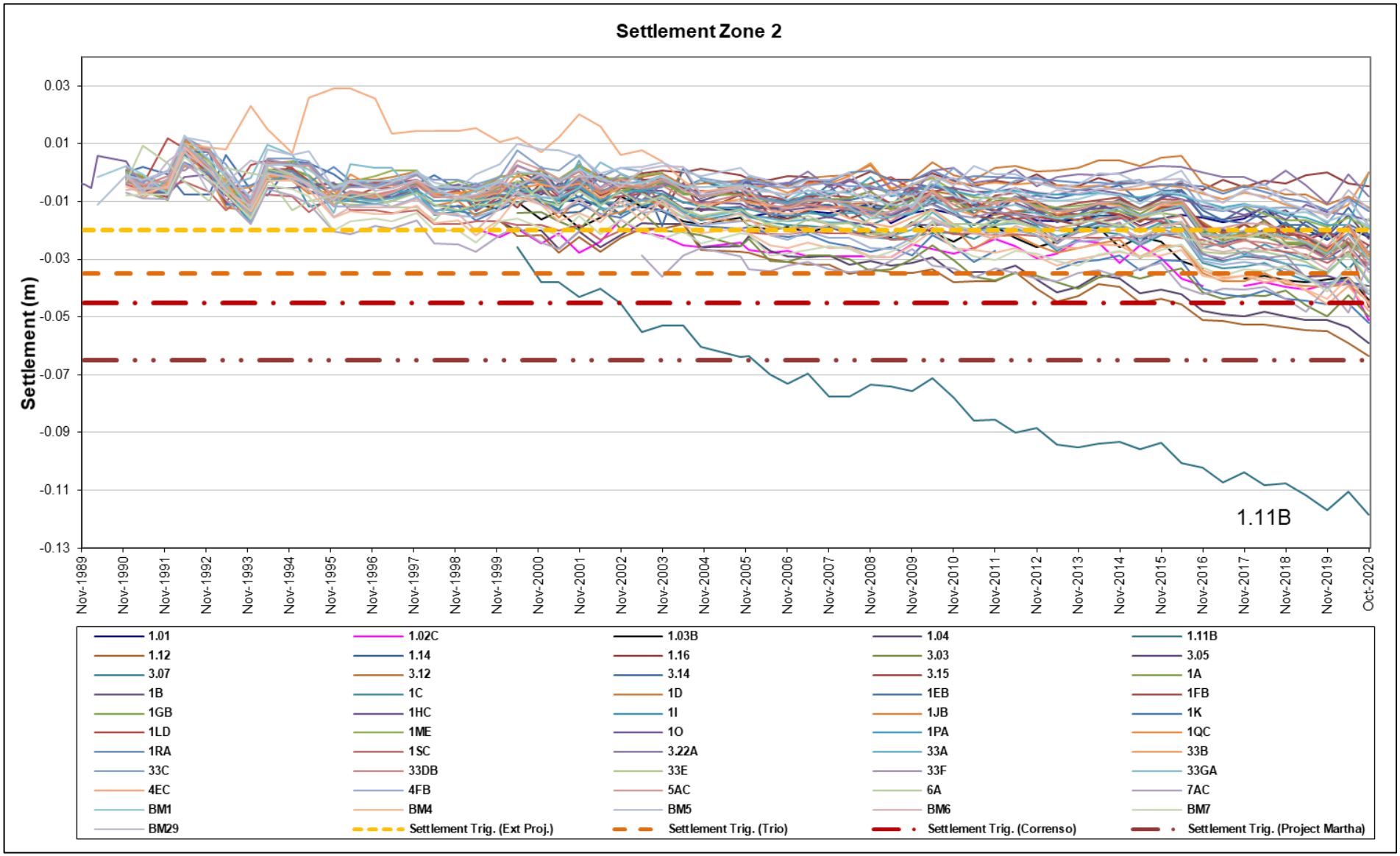

MARTHA MINE OPEN PIT
Zone
Martha (2019)
Settlement Zone 1 55
Settlement Zone 2 65
Settlement Zone 3 95
Settlement Zone 4 160
Settlement Zone 5 260
Settlement Zone 6 340
Settlement Zone 7 540
NEW LOST OR DISTD MARKS
(BROWN) MARKS WITH -VE SETTLEMNT
OCEANAGOLD WAIHI
TOTAL SETTLEMENT CONTOURS
NOVEMBER 2020
Settlement on millimetres
Scale 1: 12500
Plan No.
Date: 10-Dec-20
The N and E Grid values on this plan are in terms of the Martha Mine Project coordinates, i.e. Old Cadastral Mt Eden. Elevations are Mine Datum less 1000 metres
SURPAC - GEOVIA -prepared by R.M. Morrison

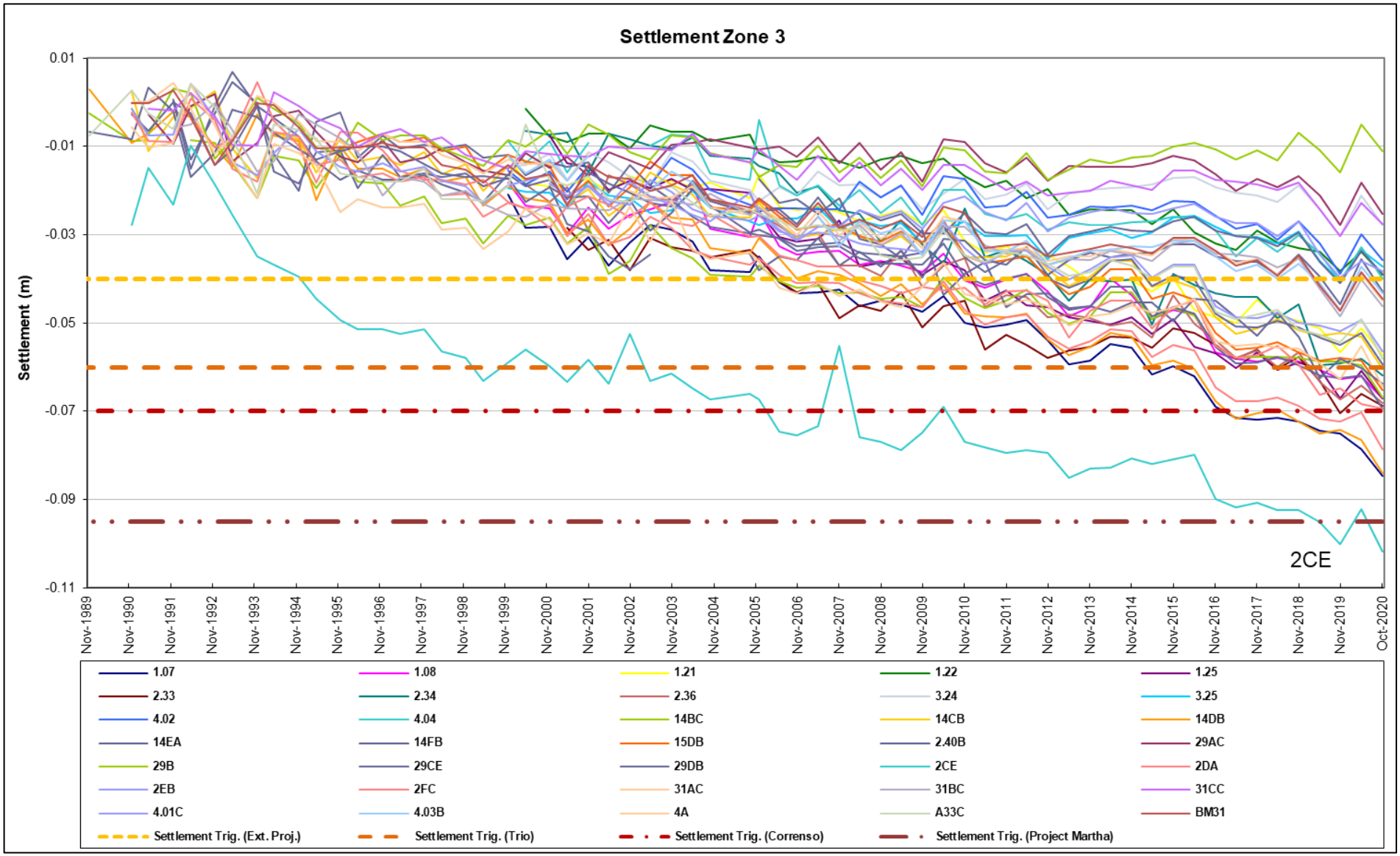

OCEANAGOLD WAIHI
FAVONA SETTLEMENT (RED)
WITH PREDICTED SETTLEMENT (GREEN)
Settlement in millimetres
Scale: 1: 500
when plotted on sheet A3
Plan No. T20200717A
Date: 17-Jul-20
The N and E Grid values on this plan are in terms of the Martha Mine Project coordinates.
i.e. Old Cadastral Mt Eden. Elevations are Mine Datum less 1000 metres
397350E
397300E
397250E
ZONE 5
ZONE 4
VENT SHAFTS

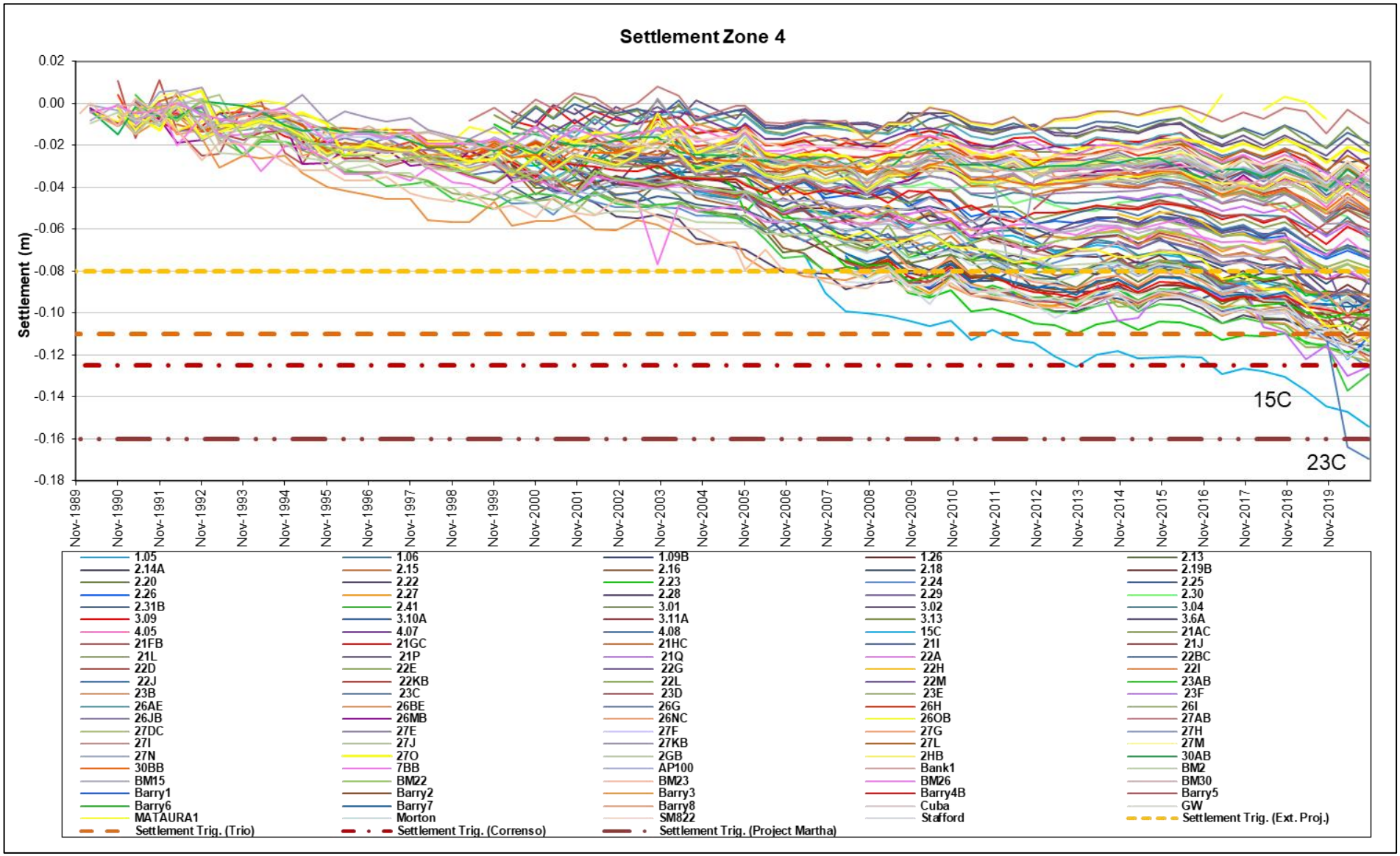

397350E
397300E
397250E
643050N
643000N
642950N
642900N
F18 Dist'd -317
F17B -235
F20 Dist'd -269
F21 -240
F22 -221
F23 Dist'd -272
F24 Dist'd -243
F25 Dist'd -204
F26 -161
F27B -155
F28B -138
F29B -125
F30B -128
F31B -125
F32B -116
F16B -158
F15C -152
F14C -124
P64B
P64
P64A
VENT SHAFTS
ZONE 5
ZONE 4
OCEANAGOLD WAIHI
FAVONA SETTLEMENT (RED)
WITH PREDICTED SETTLEMENT (GREEN)
Settlement in millimetres
Scale: 1: 700 when plotted on sheet A3
Plan No. T20201215A
Date: 15-Dec-20
The N and E Grid values on this plan are in terms of the Martha Mine Project coordinates. i.e. Old Cadastral Mt Eden. Elevations are Mine Datum less 1000 metres
favona 03

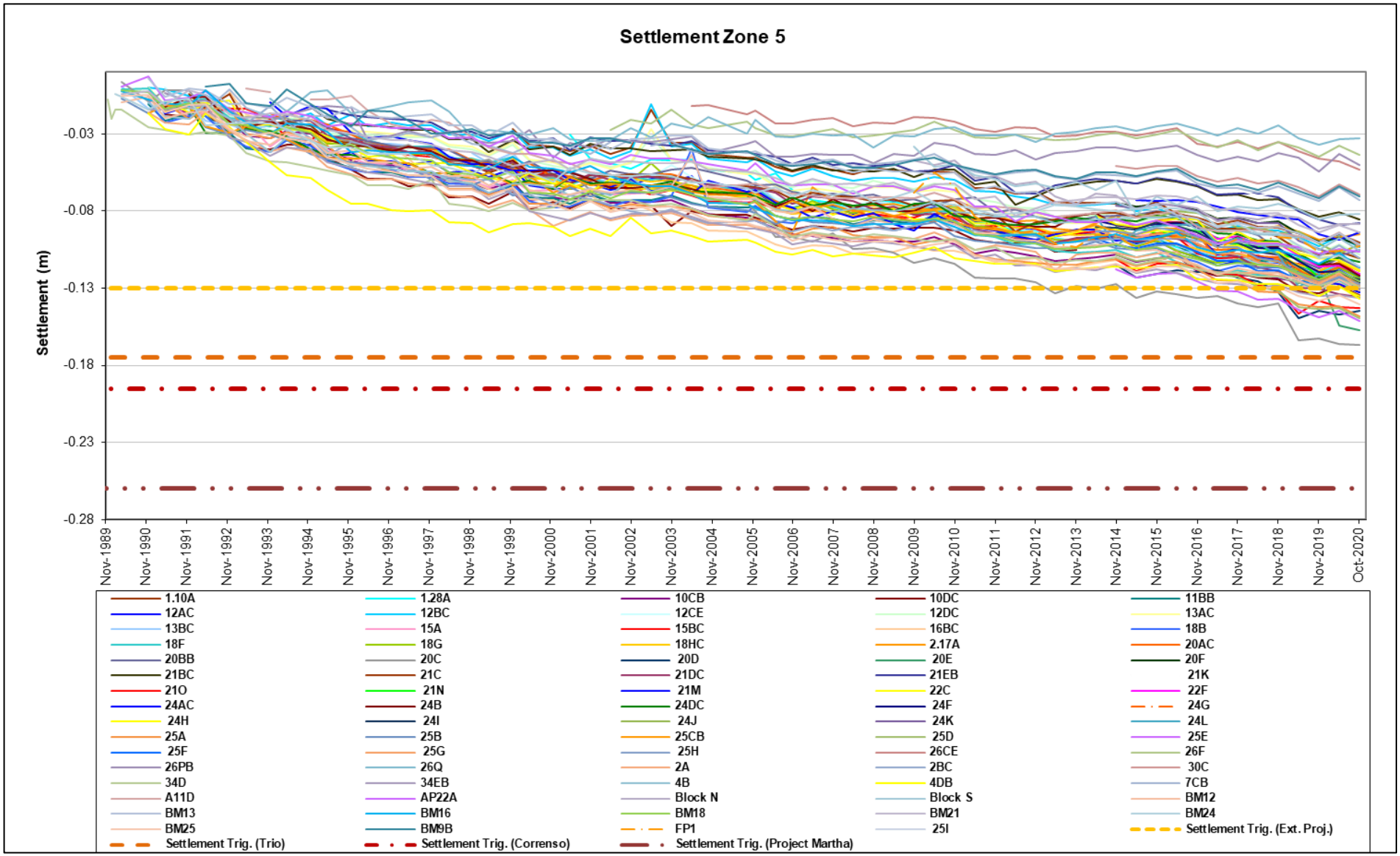
Appendix D Trend Plots of Settlement Zones


Settlement Zone 1
Settlement (m)
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
Nov-1989
Nov-1990
Nov-1991
Nov-1992
Nov-1993
Nov-1994
Nov-1995
Nov-1996
Nov-1997
Nov-1998
Nov-1999
Nov-2000
Nov-2001
Nov-2002
Nov-2003
Nov-2004
Nov-2005
Nov-2006
Nov-2007
Nov-2008
Nov-2009
Nov-2010
Nov-2011
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Nov-2016
Nov-2017
Nov-2018
Nov-2019
31MD
2.44
(Dist'd)
2.05
1.13
1.15
1.23
1.24
3.16
3.21
3.23
3.29
3.30
1.17B
1.20A
1.27B
1TB
1UA
1VA
27CD
28AE
3.26B
3.27B
3.28A
31DD
31ED
31FC
31GC
31HC
31IC
31JD
31KC
31LC
31MD
31ND
31OD
31PC
Trig 22
2.05
2.35
2.44
Settlement Trig. (Ext Proj.)
Settlement Trig. (Trio)
Settlement Trig. (Correnso)
Settlement Trig. (Project Martha)


Settlement Zone 2
Settlement (m)
0.03
0.01
-0.01
-0.03
-0.05
-0.07
-0.09
-0.11
-0.13
1.11B
Nov-1989
Nov-1990
Nov-1991
Nov-1992
Nov-1993
Nov-1994
Nov-1995
Nov-1996
Nov-1997
Nov-1998
Nov-1999
Nov-2000
Nov-2001
Nov-2002
Nov-2003
Nov-2004
Nov-2005
Nov-2006
Nov-2007
Nov-2008
Nov-2009
Nov-2010
Nov-2011
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Nov-2016
Nov-2017
Nov-2018
Nov-2019
Oct-2020
1.01
1.02C
1.03B
1.04
1.11B
1.12
1.14
1.16
3.03
3.05
3.07
3.12
3.14
3.15
1A
1B
1C
1D
1EB
1FB
1GB
1HC
1I
1JB
1K
1LD
1ME
1O
1PA
1QC
1RA
1SC
3.22A
33A
33B
33C
33DB
33E
33F
33GA
4EC
4FB
5AC
6A
7AC
BM1
BM4
BM5
BM6
BM7
BM29
Settlement Trig. (Ext Proj.)
Settlement Trig. (Trio)
Settlement Trig. (Correnso)
Settlement Trig. (Project Martha)


Settlement Zone 3
Settlement (m)
0.01
-0.01
-0.03
-0.05
-0.07
-0.09
-0.11
2CE
Nov-1989
Nov-1990
Nov-1991
Nov-1992
Nov-1993
Nov-1994
Nov-1995
Nov-1996
Nov-1997
Nov-1998
Nov-1999
Nov-2000
Nov-2001
Nov-2002
Nov-2003
Nov-2004
Nov-2005
Nov-2006
Nov-2007
Nov-2008
Nov-2009
Nov-2010
Nov-2011
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Nov-2016
Nov-2017
Nov-2018
Nov-2019
Oct-2020
1.07
1.08
1.21
1.22
1.25
2.33
2.34
2.36
3.24
3.25
4.02
4.04
14BC
14CB
14DB
14EA
14FB
15DB
2.40B
29AC
29B
29CE
29DB
2CE
2DA
2EB
2FC
31AC
31BC
31CC
4.01C
4.03B
4A
A33C
BM31
Settlement Trig. (Ext. Proj.)
Settlement Trig. (Trio)
Settlement Trig. (Correnso)
Settlement Trig. (Project Martha)


Settlement Zone 4
Settlement (m)
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
-0.16
-0.18
15C
23C
Nov-1989
Nov-1990
Nov-1991
Nov-1992
Nov-1993
Nov-1994
Nov-1995
Nov-1996
Nov-1997
Nov-1998
Nov-1999
Nov-2000
Nov-2001
Nov-2002
Nov-2003
Nov-2004
Nov-2005
Nov-2006
Nov-2007
Nov-2008
Nov-2009
Nov-2010
Nov-2011
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Nov-2016
Nov-2017
Nov-2018
Nov-2019
1.05
1.06
1.09B
1.26
2.13
2.14A
2.15
2.16
2.18
2.19B
2.20
2.22
2.23
2.24
2.25
2.26
2.27
2.28
2.29
2.30
2.31B
2.41
3.01
3.02
3.04
3.09
3.10A
3.11A
3.13
3.6A
4.05
4.07
4.08
15C
21AC
21FB
21GC
21HC
21I
21J
21L
21P
21Q
22A
22BC
22D
22E
22G
22H
22I
22J
22KB
22L
22M
23AB
23B
23C
23D
23E
23F
26AE
26BE
26G
26H
26I
26JB
26MB
26NC
26OB
27AB
27DC
27E
27F
27G
27H
27I
27J
27KB
27L
27M
27N
27O
2GB
2HB
30AB
30BB
7BB
AP100
Bank1
BM2
BM15
BM22
BM23
BM26
BM30
Barry1
Barry2
Barry3
Barry4B
Barry5
Barry6
Barry7
Barry8
Cuba
GW
MATAURA1
Morton
SM822
Stafford
Settlement Trig. (Ext. Proj.)
Settlement Trig. (Trio)
Settlement Trig. (Correnso)
Settlement Trig. (Project Martha)


Settlement Zone 5
Settlement (m)
-0.03
-0.08
-0.13
-0.18
-0.23
-0.28
Nov-1989
Nov-1990
Nov-1991
Nov-1992
Nov-1993
Nov-1994
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Settlement Trig. (Corrensо)
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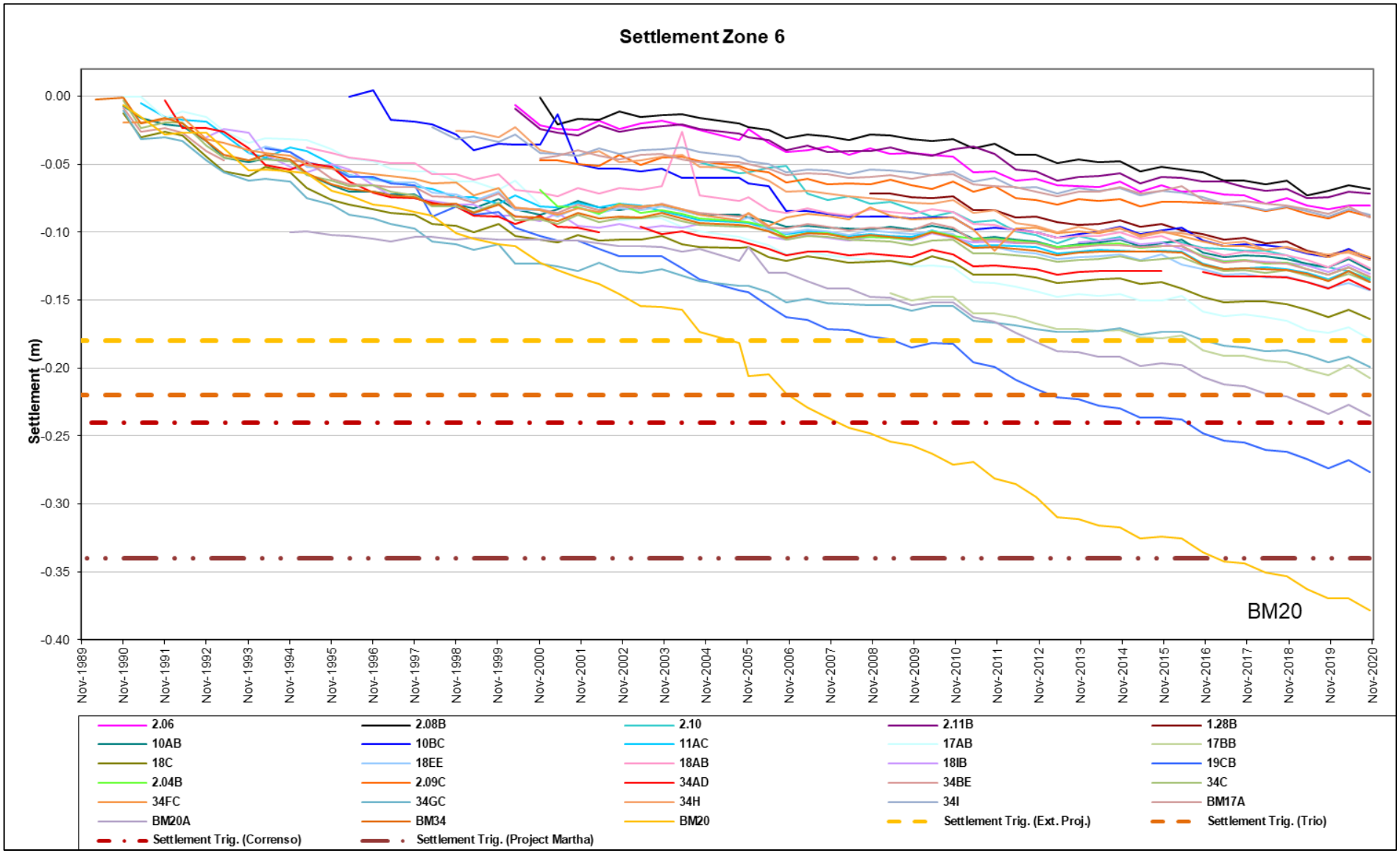
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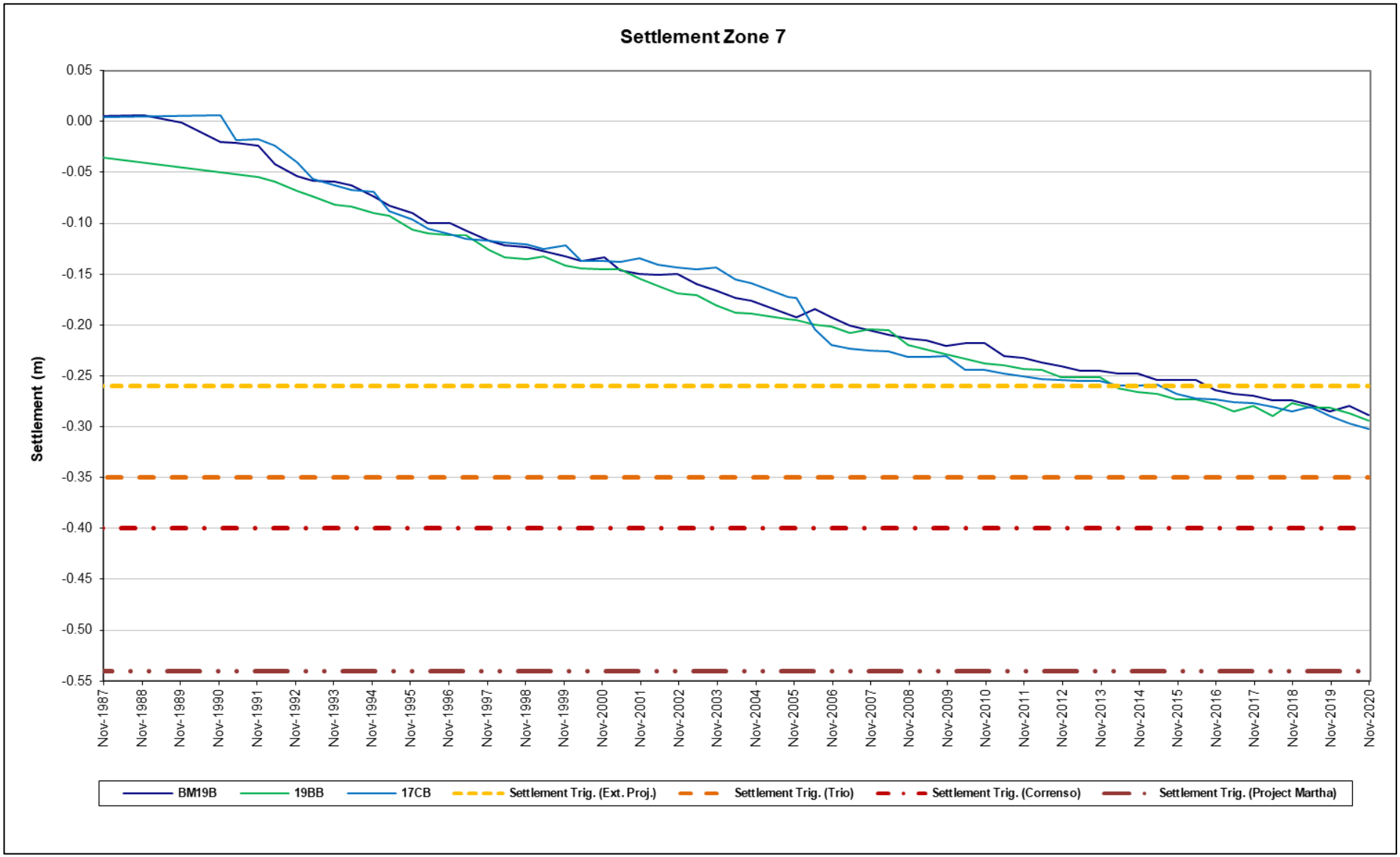
Settlement Trig. (Project Martha)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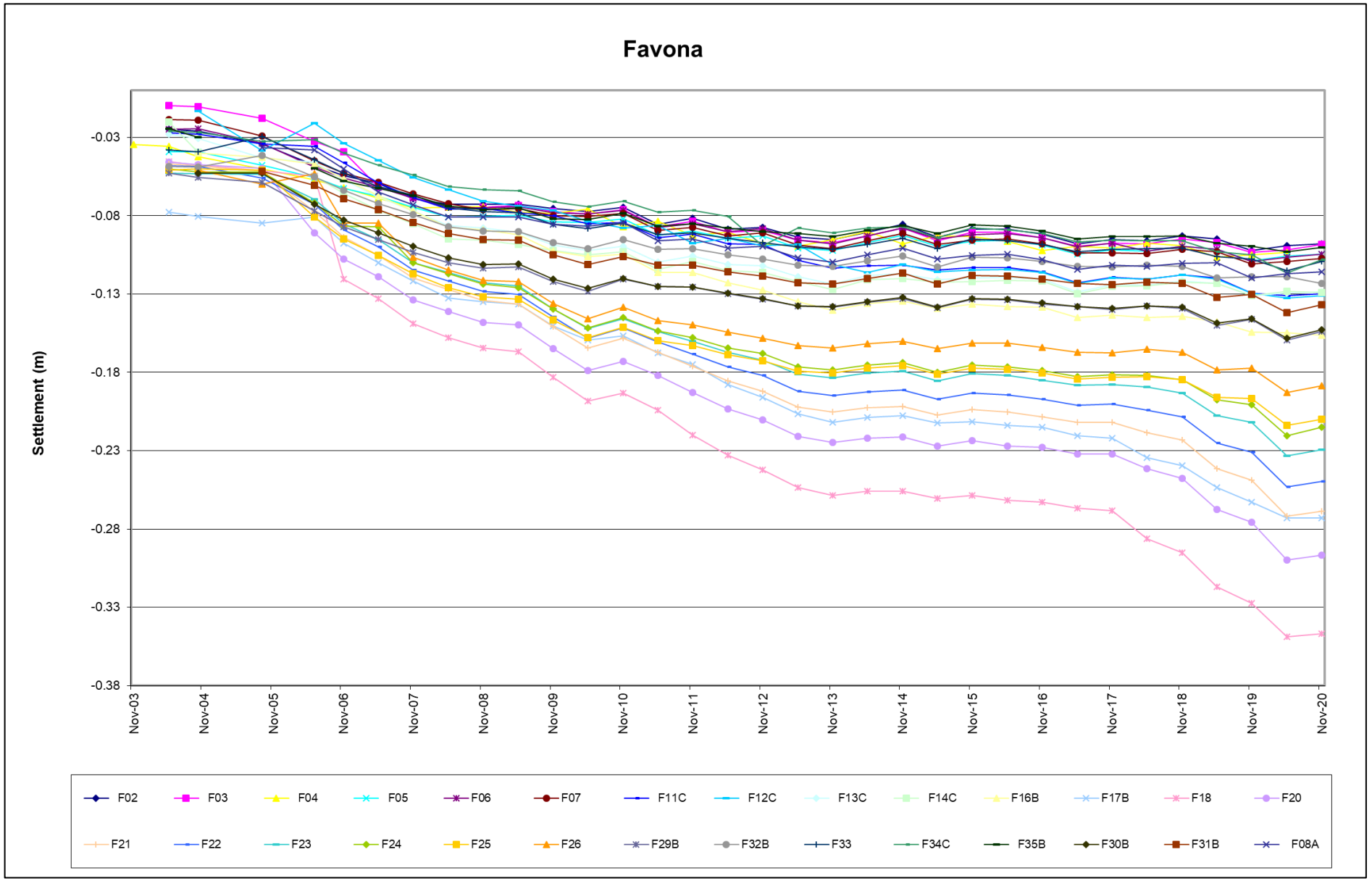
Settlement Trig. (Trio)
Settlement Trig. (Correnso)
Settlement Trig. (Project Martha)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Appendix E Pit/Underground & Pit Wall Runoff – Water Quality 2020

Pit / Underground Dewatering Water Quality

Date	Data Point	FLS pH	FLS EC (mS/m)	FLS Temp	Acidity (ph 8.3)(g/m3 as CaCO3)	Acidity (pH 3.7)	Alk-Bicarb	Alk-T	Alk	AlS	SbS	AsS	Bicarb	CdS	CaSO	COD	Cl	CrS	Cr6col	CoS	CuS	CNTOT	EC (mS/m)	NH3	AuS	Hard	FeA
6/01/2020	Underground Dewatering				1				686						527		14.9						268			1600	17
14/01/2020	Underground Dewatering	280	7.25	29		1	169	169		0.041	0.0071	0.011	210	0.00043	520	13	11	0.001	0.01	0.0102	0.001	0.02	251	0.00027	0.0006	1610	3.8
4/02/2020	Underground Dewatering	256.6	7.34	28.4		1	192	192		0.04	0.0078	0.006	230	0.00058	530	24	13	0.001	0.01	0.0118	0.001	0.02	259	0.00064	0.0006	1650	10
3/03/2020	Underground Dewatering	255	7.14	28.6	1				184						498		12.3						278			1500	5
29/04/2020	Underground Dewatering	271	7.46	27.3	1				203						493		16.8						263			1500	5.8
13/05/2020	Underground Dewatering	194	7.58	18.5	1				192						509		13.5						256			1600	4.9
7/06/2020	Underground Dewatering	190	7.14	15.2	1				166						467		13.5						252			1500	0.071
8/07/2020	Underground Dewatering	222.8	8.95	13.9	1				706						442.7515		14.9						231.6			1400	5.9825
27/07/2020	Underground Dewatering	221.6	7.15	26.1		1	179	179		0.031	0.0062	0.01	220	0.00043	490	6	12.7	0.001	0.01	0.006	0.001	0.02	244	0.00042	0.0006	1540	2.1
2/09/2020	Underground Dewatering	249.2	6.69	25.2	1				168						502		10.9						251			1600	3.49
2/10/2020	Underground Dewatering	268.1	5.87	22.7		1	68	68		0.062	0.0026	0.004	83	0.0071	460	11	11	0.001	0.01	0.095	0.041	0.02	265	7.60E-05	0.0006	1640	2.4
11/11/2020	Underground Dewatering	250	6.12	23.3	1				62.4						454		12.2						265			1600	3.9
7/12/2020	Underground Dewatering	285.1	7.52	26.2	1				85.1						501		12.5						281			1800	3.5

Date	Data Point	FeT	PbS	MgS	MnA	MnS	HgA	HgT	NiS	NO3-N	NOxN	NO2-N	NH4N	pH	PTO	KSO	DRP	SeS	SeT	SI	AgS	NaSO	SO4	Sum Anion	Sum Cation	TKN	SeT	TSS	CNWAD	ZnS
6/01/2020	Underground Dewatering			69	11									7.2		11		0.0094				56	1400				0.0099	10400		
14/01/2020	Underground Dewatering	18	0.0002	77		8.7	8.00E-05	9.00E-05	0.0183	0.73	0.76	0.1	0.093	7.1	0.1	7.9	0.004	0.002	0.0021	42	0.0002	60	1500	35	35	0.2		83	0.02	0.28
4/02/2020	Underground Dewatering	42	0.0003	82		8.9	8.00E-05	0.00022	0.0196	1.13	1.16	0.1	0.199	7.2	0.116	8.7	0.006	0.002	0.0021	41	0.0002	60	1610	38	36	0.43		630	0.02	0.33
3/03/2020	Underground Dewatering			70	8.9									7.2		8.1		0.0094				58	1500				0.0094	690		
29/04/2020	Underground Dewatering			70	8.2									7.3		9.5		0.0094				61	1530				0.0094	1400		
13/05/2020	Underground Dewatering			75	8.2									7.5		7.5		0.0094				57	1470				0.0094	1200		
7/06/2020	Underground Dewatering			73	7									7.2		7.3		0.0094				52	1410				0.0094	64		
8/07/2020	Underground Dewatering			61.5347	4.648									9.8		9.5777		0.0094				56.6075	1400				0.0094	1500		
27/07/2020	Underground Dewatering	10.8	0.0002	74		8	8.00E-05	8.00E-05	0.0128	1.28	1.32	0.1	0.098	7.3	0.139	7.8	0.004	0.002	0.0021	40	0.0002	56	1430	34	34	0.29		530	0.02	0.25
2/09/2020	Underground Dewatering			72.3	7.33									7.1		7.68		0.0094				51.87	1470				0.0094	560		
2/10/2020	Underground Dewatering	9.1	0.038	119		18.5	8.00E-05	8.00E-05	0.21	0.47	0.48	0.1	0.093	6.6	0.097	9.3	0.04	0.002	0.0021	46	0.0002	47	1750	38	36	0.22		340	0.02	3.5
11/11/2020	Underground Dewatering			107	15									6.6		7.7		0.0094				39	1640				0.0094	420		
7/12/2020	Underground Dewatering			129	20									6.6		9.7		0.0094				43	1870				0.0094	300		

Date	Data Point	Acidity (pH 3.7)	Alk-Bicarb	Alk-T	AlA	AlS	SbA	SbS	AsA	AsS	Bicarb	CdA	CdS	CaSO	Cl	CrA	CrS	Cr6col	CoA	CoS	CuA	CuS	CNTOT	EC (mS/m)	F	NH3	Hard	FeA	FeS	PbA	PbS	MgS	MnA
25/06/2020	705 Gladstone sump	1	184	184	0.016	0.006	0.0047	0.0037	0.057	0.03	220	0.00028	0.00022	550	5	0.001	0.001	0.001	0.0041	0.0044	0.001	0.001	0.02	258	0.18	7.00E-05	1690	1.01	0.04	0.0016	0.0002	81	9.3
11/08/2020	705 Gladstone sump	1	175	175	0.111	0.012	0.0073	0.0079	0.027	0.012	210	0.00074	0.00072	540	8	0.001	0.001	0.001	0.0063	0.0058	0.0026	0.001	0.02	254	0.21	1.30E-05	1680	0.69	0.11	0.0077	0.0002	81	8.9
22/09/2020	800 PC1	1	1	1	14	13.5	0.0004	0.0004	0.002	0.002	1	0.0195	0.02	440	9	0.003	0.003	0.001	0.24	0.27	0.25	0.27	0.02	287	0.74	1.00E-05	1760	0.93	0.89	0.63	0.63	162	33
25/06/2020	Correnso vein water	1	195	195	0.006	0.006	0.0034	0.0028	0.089	0.076	240	0.0001	0.0001	590	5	0.001	0.001	0.001	0.0038	0.004	0.001	0.001	0.02	277	0.16	7.00E-05	1830	1.57	1.33	0.0015	0.0002	86	10.2

Date	Data Point	MnS	HgS	HgT	NiA	NiS	NO3-N	NOxN	NO2-N	NH4N	pH	PTO	KSO	SeA	SeS	SI	AgA	AgS	NaSO	SO4	Sum Anion	Sum Cation	TlA	TlS	TKN	TSS	UA	US	CNWAD	ZnA	ZnS
25/06/2020	705 Gladstone sump	9.4	8.00E-05	8.00E-05	0.0088	0.0089	0.25	0.25	0.1	0.031	7	0.012	7.6	0.002	0.002	43	0.0002	0.0002	57	1590	37	37	0.00047	0.00045	0.1	6	4.00E-05	4.00E-05	0.02	0.159	0.161
11/08/2020	705 Gladstone sump	9.5	8.00E-05	8.00E-05	0.0165	0.0153	1.06	1.1	0.1	0.01	6.8	0.004	7.7	0.002	0.002	44	0.0002	0.0002	57	1560	36	37	0.00077	0.00082	0.1	8	4.00E-05	4.00E-05	0.02	0.37	0.37
22/09/2020	800 PC1	35	8.00E-05	8.00E-05	0.51	0.59	0.18	0.19	0.1	0.145	3.8	0.004	10	0.002	0.003	57	0.0002	0.0002	30	1980	42	40	0.00184	0.00183	0.17	3	0.00105	0.00106	0.02	9.6	9.4
25/06/2020	Correnso vein water	10.6	8.00E-05	8.00E-05	0.0076	0.0081	0.1	0.1	0.1	0.036	7	0.019	7.8	0.002	0.002	44	0.0002	0.0002	57	1790	41	40	0.00032	0.00031	0.2	3	4.00E-05	4.00E-05	0.02	0.062	0.063

Date	Data Point	FLS Comments	Acidity (pH 3.7)	Alk-Bicarb	Alk-T	AlA	AlS	SbA	SbS	AsA	AsS	Bicarb	CdA	CdS	CaSO	Cl	CrA	CrS	Cr6col	CoA	CoS	CuA	CuS	CNTOT	EC (mS/m)	F	NH3	Hard	FeA	FeS	PbA
25/06/2020	Favona 800 sump	Dry -just mud																													
11/08/2020	Favona 800 sump		1	144	144	0.79	0.016	0.0089	0.0104	0.0112	0.0064	175	0.00012	9.00E-05	370	16	0.0029	0.0005	0.001	0.0039	0.0024	0.0038	0.0006	0.02	184.2	0.21	0.0028	1130	1.26	0.02	0.026

Date	Data Point	PbS	MgS	MnA	MnS	HgS	HgT	NiA	NiS	NO3-N	NOxN	NO2-N	NH4N	pH	PTO	KSO	SeA	SeS	SI	AgA	AgS	NaSO	SO4	Sum Anion	Sum Cation	TlA	TlS	TKN	TSS	UA	US	CNWAD	ZnA	ZnS
25/06/2020	Favona 800 sump																																	
11/08/2020	Favona 800 sump	0.0002	46	2.2	2.1	8.00E-05	8.00E-05	0.0082	0.0061	6.9	7.6	0.74	0.63	7.3	0.54	11.5	0.001	0.001	33	0.0001	0.0001	42	1010	25	25	0.00033	0.00031	0.84	1840	0.00016	0.00014	0.02	0.059	0.0183

Pit Wall Runoff Water Quality

No pit wall sampling was undertaken in 2020.

Appendix F GWS Settlement Marker Review Memo

TECHNICAL MEMO

GWS Limited

3rd December 2019

To: Mark Burroughs

From: Chris Simpson

Subject: Settlement Mark Review

1. Background

OceanaGold (New Zealand) Limited (OGL) have requested that GWS LIMITED (GWS) undertake a review of the of the Waihi Township settlement marker network data base. This review has included cleansing, verification and, where appropriate, removal of erroneous and high density settlement markers. The objective has been be to provide OGL with a clean database spreadsheet with marker corrections identified.

2. Issues

The Settlement Data Corrections spreadsheet has suffered from a number of different operators over the years. This has resulted in errors in the spreadsheet which have included:

- Repeated cells in calculations not fixed.
- Corrections not properly applied.
- Corrections not applied.
- Data in columns displaced by 1 to 3 rows.
- An unstable file which continued to crash and had had to be re-built.

As a result, each marker data set has had to be checked for correctness (some 18,000 lines of data). There are also a number of survey values where adjustment of a marker data set has been undertaken. These have include:

- Correcting values for survey marks which had been replaced or moved to a new position.
- Removal of step changes in a marker settlement record and which were not shown by adjacent marks.
- Modifying marker corrections where values resulted in contour plotting anomalies.

Extraneous matter, (data and colours in cells) has been removed in order to tidy up the spreadsheet. Corrections have been identified by date and the marker data set calculations modified to show where corrections have been applied and to enable future changes to be readily inserted.

As mining and the settlement marker network expanded, marker records were initiated at different times. These records have been zeroed to 1/12/1989, the date of the network survey closely following initiation of Martha Pit dewatering.

Data fluctuations in some marker data sets were substantial, particularly at the beginning of a record. These fluctuations are considered to be the result of:

- Survey methodology.
- Soil shrink-swell.

3. Methodology

The full correction data set was first checked for obvious errors and step changes. Corrections were determined by calculating changes over the time period of the error by considering the rate of change prior to and following the correction interval, and correcting the record in an additional column. This was repeated for all indicated errors the graph updated for that marker.

During this initial process multiple crashes of the spreadsheet occurred. This problem was resolved by transferring each marker data set to a new spreadsheet and redrawing all the graphs.

Dewatering of the Martha Pit began in October 1989. A survey round of the marker network at the time was undertaken 1/12/1989 and this date was adopted as the zero point for the settlement calculations. The monitoring network was progressively increase as mine developments at Waihi expanded. The start of these curves has been set to zero at 1/12/1989. Where records commenced after that date a false zero at 1/12/1989 was inserted into each of those data sets.

Because of the data fluctuations, measured values do not reflect actual settlement. Actual settlement is considered to be best identified as the average of the fluctuations. In order to provide a more likely estimate of settlement over time, trend curves were applied to each of the marker data sets.

Most marker data sets were able to be fitted with a polynomial trend curve of varying order (3 being the most common order), these curves being either concave (increasing settlement over time) or convex (reducing settlement over time or a mixture of the two curve types. Some data sets could be described by linear trend lines while a small number of curves were manually sketched with settlement assessed on screen with a digital planimeter.

The procedure for determining corrections for data sets was as follows:

- Visually determine which trend line best fitted the data, particularly the latest data.
- Copy the trend line equation to the cell below the 1/12/1989 date and complete the equation for that date
- Copy the completed equation to cells below selected dates 1/12/1999, 1/05/2004, 1/5/2008, 1/11/2014 and 1/11/2018, dates at which numbers of new marks were established.
- Copy the calculated settlement data for these dates to a plotting file.
- Starting with the 1989 data set, use SURFER to plot the contours for 1990, correct that series and add the 1990 data points to the 1989 data set.
- With the updated data set plot contours for 1999 a using Surfer and provide corrections for the 98 markers which were started in 1999 and once corrected add to the combined data set.
- Repeat the process with the larger groups including the 2004 markers (Favona); 2008 markers (Barry Road); and the 2014 markers (Waihi East).
- Plot the data for 1/11/2018.

However, this methodology resulted in a number of, apparently, anomalous marker values. In order to check and adjust these marker data sets, and to pick up marks installed or replaced but not in a large group, each mark of the full data base was individually checked. Further plotting and further checks of remaining anomalies were undertaken to arrive at smoother settlement curves.

For these anomalous values the process of correction was as follows.

- From the graph, determine what settlement value should apply at the mark location.
- Adjust the marker graph by modifying the earliest dated correction.
- Visually determine which trend line best fitted the revised data, particularly the latest data.
- Copy the revised trend line equation to the cell below the 1/12/1989 date and complete the equation for that date.
- Copy the completed equation to cells below selected dates 1/12/1999, 1/05/2004, 1/5/2008, 1/11/2014 and 1/11/2018, dates at which numbers of new marks were established.
- Copy the revised calculated settlement data for these dates to a plotting file.
- Once current corrections completed, rerun the plot.
- Review result and repeat when further anomalies identified.

4. Data file Updating

The new data file does not have the linkages present in the original file. We have assumed that OGL has personnel sufficiently expert in EXCEL who can regenerate the linkages which allow the marker data sets to be updated and plotting files to be prepared.

Given the problems we identified with the original file, we recommend that an in-house procedure be developed to ensure the data file remains in good working order. The procedures should ensure personnel working on the data file have sufficient expertise to do so.

5. Plotting File

A separate plotting file has been prepared and manually updated during this exercise. This plotting file was used to generate the surfer plots. Coordinates as well as settlement in metres and mm are included for the following initiating date of additional markers:

- 1/12/1999 Extension
- 1/5/2004 Favona
- 1/5/2008 Barry
- 1/11/2014 Waihi East
- 1/11/2018

The current plots are for 1/11/2018'

6. Proposed Marks to be Removed

This file provides those marks recommended for removal. Proposed deletions have included:

- Marks with poor or incomplete records.
- Marks where corrections could not be sensible made.
- Marks where the plotted graph showed clear errors.
- Marks in close proximity to other marks with similar values.

The following Figures 1 to 3 provide the final updated interpolated contour plan with the settlement markers corrected.

Figure 4 and 5 show the interpolated contour plan before and after the marks have been removed. In summary, the contour plot is smoothed by removing the erroneous marks.

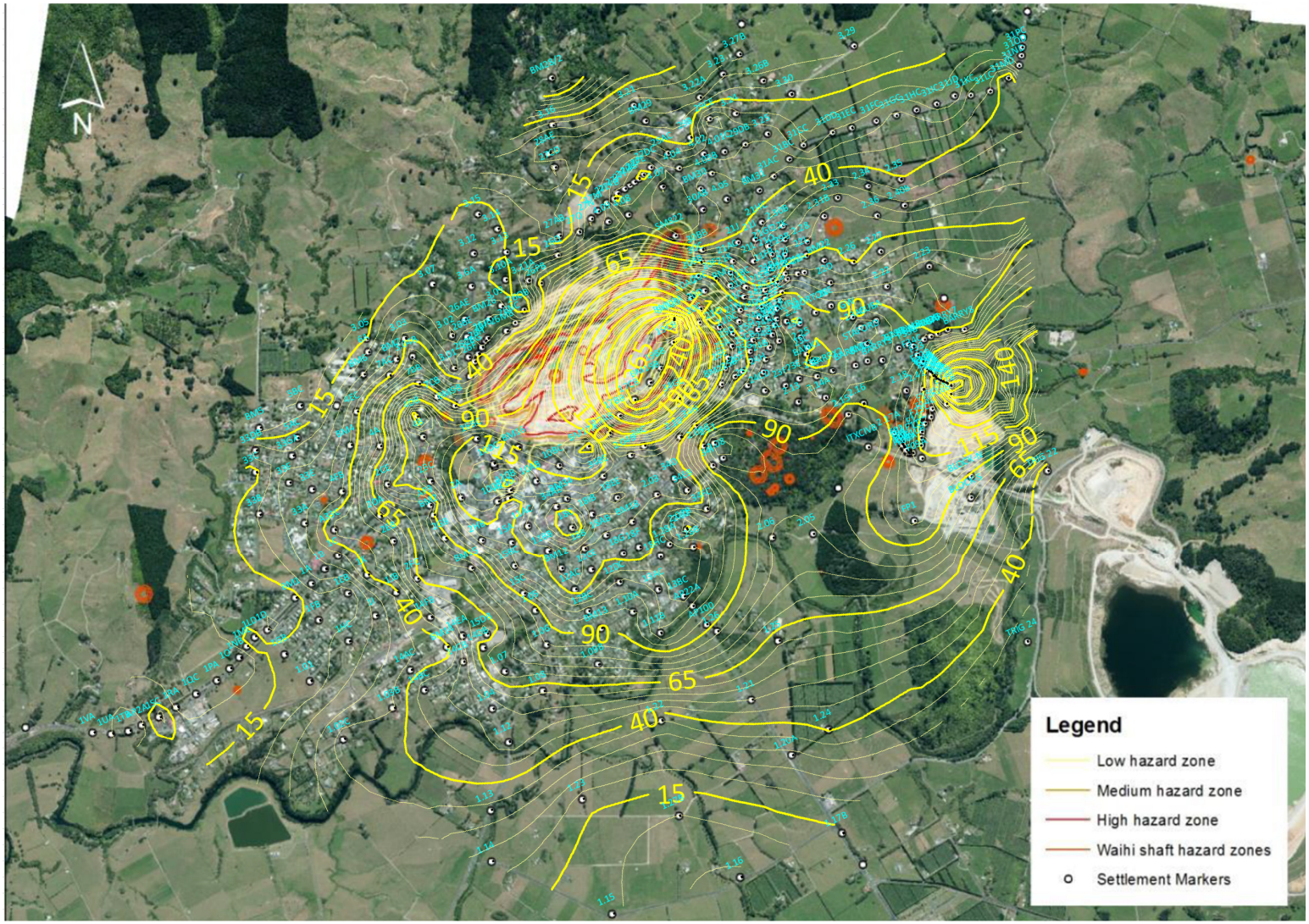


Figure 1 Settlement Contours and Marks

Level 1/320 Ti Rakau Dr
East Tamaki
Auckland 2013

Phone: 09 576 0093
Email: GWS@xtra.co.nz
Web Page: www.gwsconsulting.co.nz

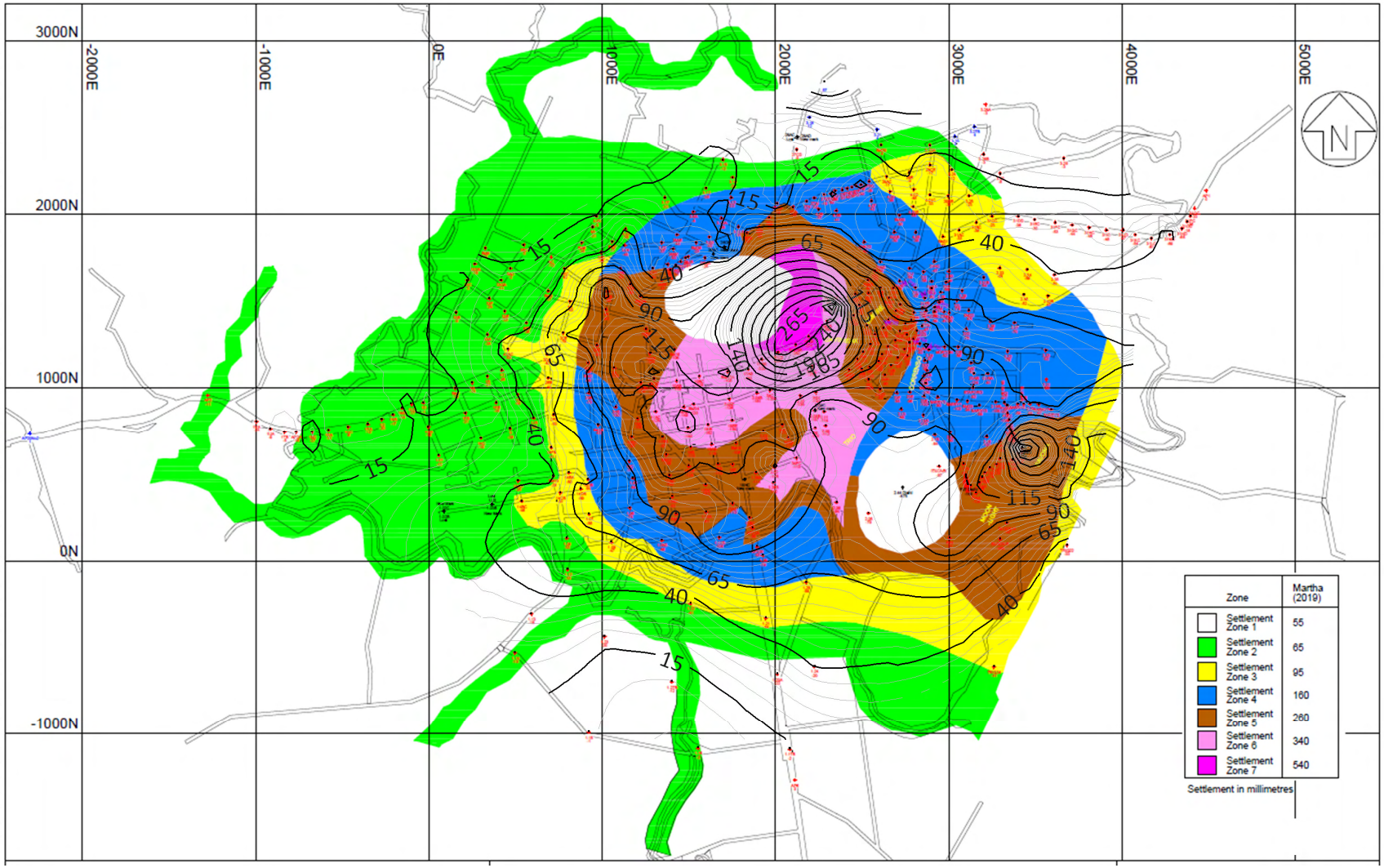


Figure 2 Settlement Contours and Settlement Zones

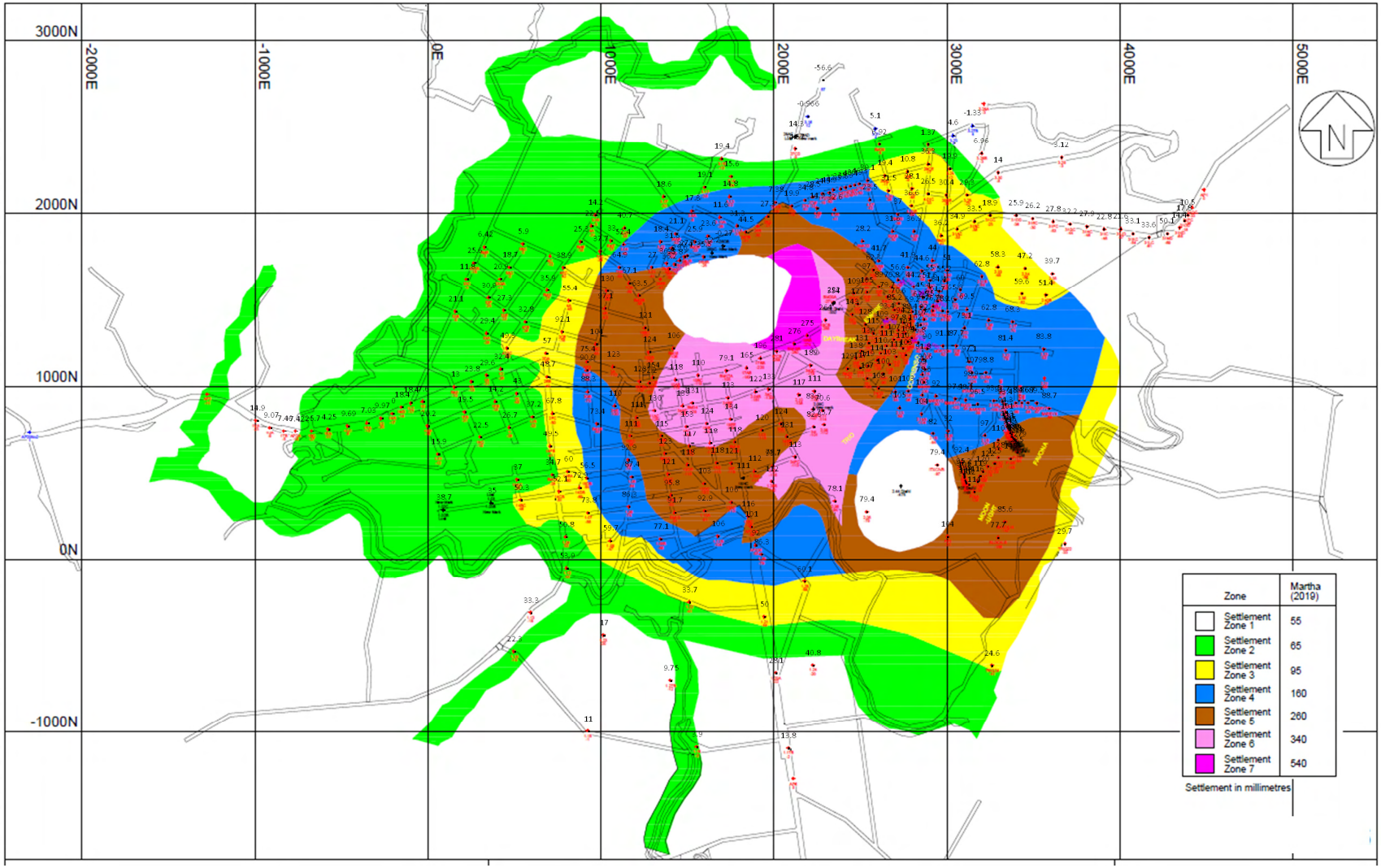


Figure 3 Settlement Values and Settlement Zones

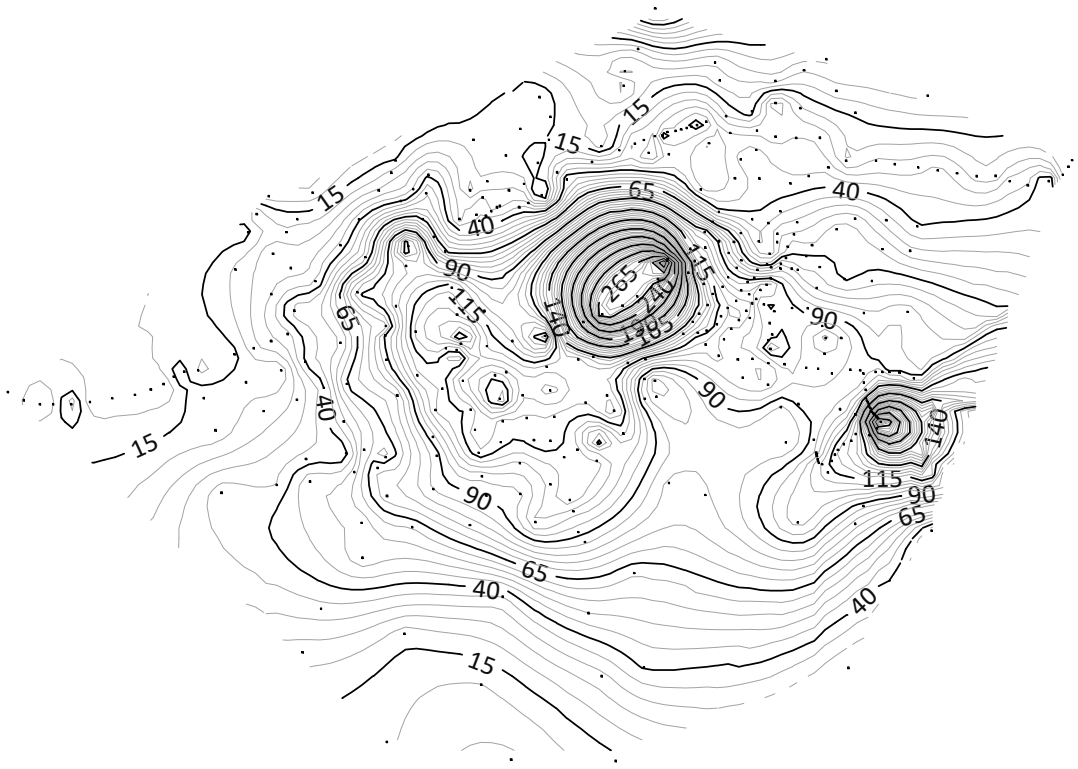


Figure 4 Contours from All Marks

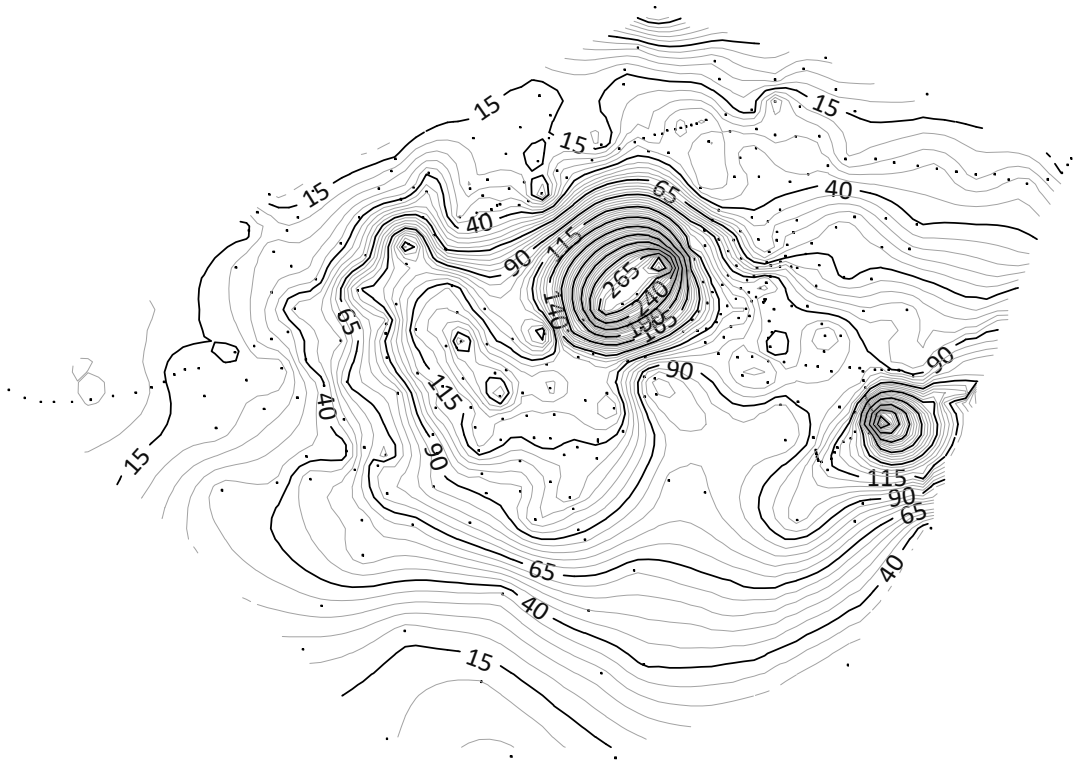


Figure 5 Contours with Marks Removed

Appendix G GWS P79D Memorandum

TECHNICAL MEMO

GWS Limited

17th February 2021

To: Cassie Craig

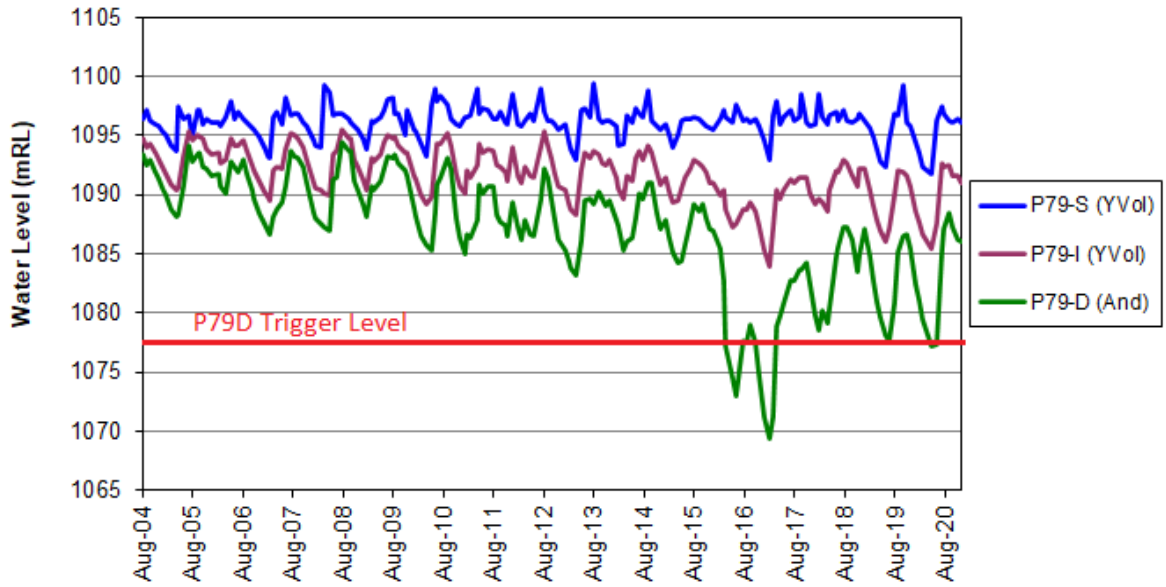
From: Chris Simpson

Subject: Favona Underground Mine - P79D Trigger Level Breach 2020

This memo captures the occurrence of a breach of the trigger level for groundwater elevation in the deep piezometer P79D constructed in Andesite near the Favona underground mine that occurred in the months of May and June 2020.

In accordance with the consent, the Tier 1 response from the Management Plan requires Oceania Gold Limited (OGL) to notify the regulator in the event of a trigger level breach and "increase monitoring in intermediate depth wells i.e. the wells tapping the younger volcanics. This may be assisted by installing Level Trolls in the wells to provide 'continuous' water level records."

The groundwater elevation records for the multi-level piezometers installed within P79 is shown below.



The main observations from these data are that the trigger level was initially breached in May 2016. Investigation of that exceedance showed that the vein water level was a long way below the piezometer so the effect on P79D must have been due to a localised change in pressure. It was concluded that a horizontal drill hole was advanced near to P79D that could explain the observed pressure change. Sealing the hole appeared to arrested the pressure drop, but some relaxation around the drill hole may account for the 10 m change observed. Since that time the data indicates a slight long-term increase in pressure and seasonal fluctuations have re-developed at the deeper elevation.

Given that P79I and P79S did not respond in the same manner as P79D, it does not appear that the pressure response observed in P79D migrated to the shallower levels. Maintaining monitoring was considered the appropriate response given the above.

Level 1/320 Ti Rakau Dr
East Tamaki
Auckland 2013

Phone: 09 576 0093
Email: GWS@xtra.co.nz
Web Page: www.gwsconsulting.co.nz

The breach of the P79D trigger level noted in May and June 2020 is a continuation of this trend. While there is an average long-term trend of the water pressure recovering, seasonal changes in elevation have caused the level to once more fall below the trigger level briefly. Reviewing the data from May 2016 shows a possible increase in the amplitude of the seasonal variation is occurring. This could be explained by a reduction in rock mass storage (void space) due to grouting of the horizontal drill hole resulting in greater seasonal changes than that noted prior to 2016.

Continuous water level measurements are being recorded in all of the piezometers in P79 to continue to observe any changes that may be occurring, and this is proposed to continue. Once further data has been collected that demonstrates there has been a stabilization in average pressure and in magnitude of seasonal variation, it may be appropriate to recalculate the P79D trigger level. This would need to be agreed to by the Regional Council.

Appendix H GWS P94 Memorandum

MEMO

GWS LTD

19th March 2018

To: Mark Burroughs

From: Wayne Russell

Subject: P94 Pressure Response.

Mark,

Thanks for bringing the P94 pressure response to our attention. The response is as we have predicted as workings approach piezometers.

Figure 1 provides the current pressures for the piezometers at site P94. While remaining stable for much of the record, pressure in the deep piezometer positioned within the andesite rock at 144 m depth (976 mRL) began to reduce from the beginning of October 2017. Figure 2 provides a detailed view of the pressure change with time. The pressure has dropped some 11.46 m between 1 October 2017 and 8 March 2018. The small, rapid pressure jumps may be responses to blasting. The sudden pressure drops may indicate rock relaxation following blasting.

P94 piezometers are located just to the east of the Correnso North drives (Figures 3 and 4). We understand that stoping occurred in the Correnso mine between 900 mRL and 915 mRL from October 2017 into early March 2018 with the section closest to P94 being mined during December 2017 to January 2018. Figure 2 shows a steepening of the pressure change during and following this period. It is also understood that a small amount of stoping is left at this level and so additional pressure change may be expected.

Figure 5 provides the pressure heads in the piezometers at P94 plotted between October 2017 and March 2018. The pressures in the piezometers in the younger volcanics are shown to be relatively stable. The pressure in the deep piezometer (976 mRL) is shown to be lower than the piezometer at 1116 mRL and that the pressure is falling. It is clear from Figure 5 that the pressure change in the deeper andesite rock has not migrated up into the base of overlying younger volcanic rocks.

Figure 6 is a plot of the pressure heads against elevation. The data points in the younger volcanics are relatively tightly grouped showing only small scatter. The pressures in the andesite rock show a clear pressure drop from 8/10/2017 to 8/3/2018. A single line has been used to represent the hydraulic gradient through the younger volcanics. This line is continued with a negative gradient (decreasing pressure with depth) through the data point at 976 mRL for the 8 March 2018 and terminates at the zero pressure boundary at approximately 920 m RL. This indicates the location of the boundary between saturated and dewatered rock as at the 8 March 2018. The black line through the data point at 976 for the 8 Oct 2017 intercepts

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 268 8312
Email: chris@gws.co.nz
Web: www.gwsconsulting.co.nz

the zero axis at approximately 867 mRL. Hence, the dewatered zone at this location has expanded from 867 mRL to 920 mRL between 18 Oct 2017 and 8 Mar 2018.

Table 1 compares the saturated thickness of P94 with the thinnest saturated zones at the top of the andesite rockmass identified by piezometers.

Table 1 Saturated Thicknesses

	Low k Contact (mRL)	Zero Pressure (mRL)	Saturated Thickness (m)
P100	976	944	32
P101	1058	1034	24
P102	1053	1026	27
P94	1005	920	85

While pressures at the base of the younger volcanic rocks in piezometers P100 to P102 are indicated to have reduced, this has not transferred to shallower levels within those materials. Rainfall recharge has sustained shallow water levels such that the water table remains at a constant elevation. As a result the reduced pressures at the base of these materials have caused the hydrostatic lines to steepen. This pressure relationship appears to have occurred by the early 1990's and no apparent change in the pressures in the younger volcanics has been recorded at these sites as a result of changes within the upper layers of the andesite rockmass. It is expected that pressure responses at P94 will behave similarly to those at P100 to P102. Pressures in the upper layers of the andesite rock are expected to continue to drop for a period before stabilising. Pressures at the base of the younger volcanics are not likely to be affected.

However, it would be appropriate to maintain close observation of the pressure changes in the P94 piezometers. Settlement markers above this part of the Correnso mine should also be reviewed.

Wayne
For and on behalf of GWS Limited

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 268 8312
Email: chris@gws.co.nz
Web: www.gwsconsulting.co.nz

MEMO

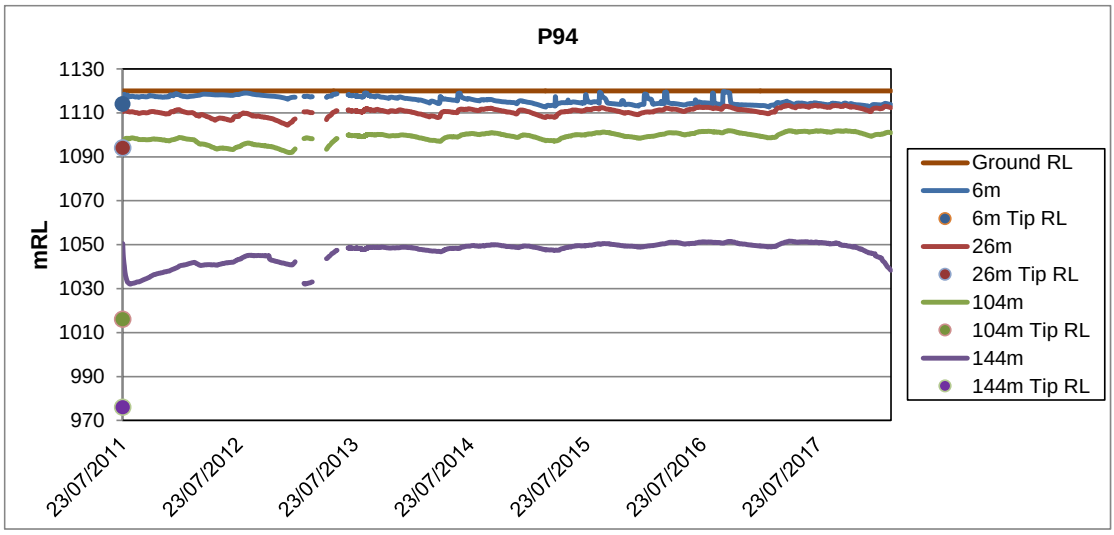


Figure 1 P94 Piezometer Pressure Responses

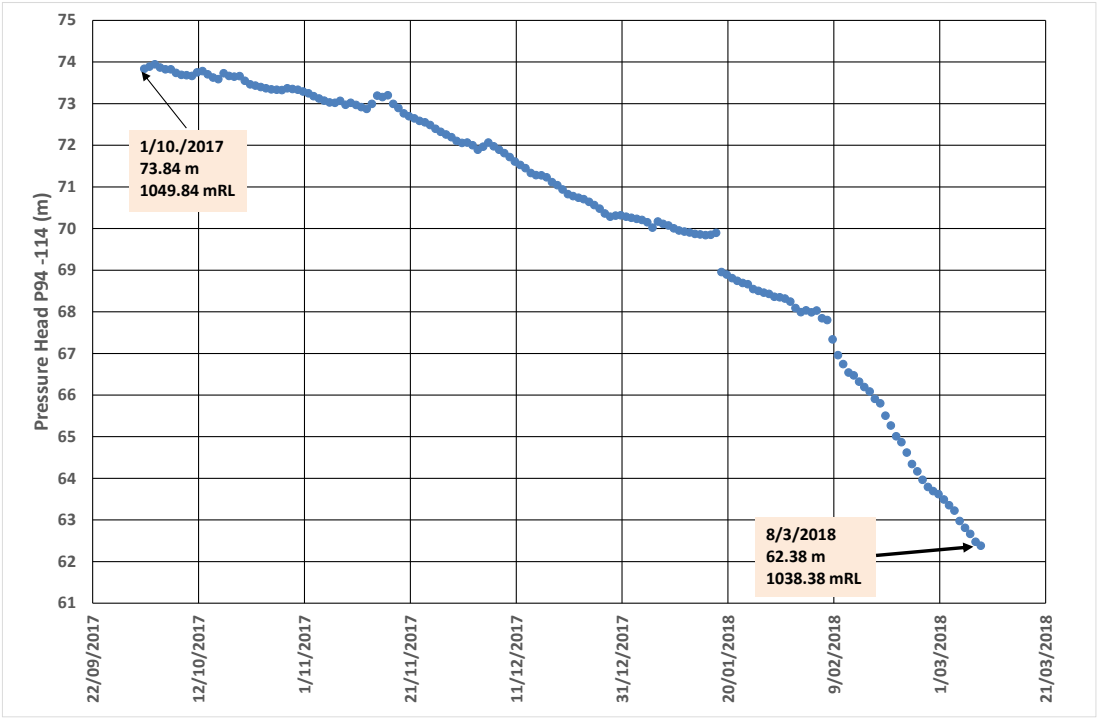


Figure 2 Expanded View of Pressure Change October 2017 to March 2018

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 268 8312
Email: chris@gws.co.nz
Web: www.gwsconsulting.co.nz

Figure 3 Location Plan of P94 with Respect to Correnso

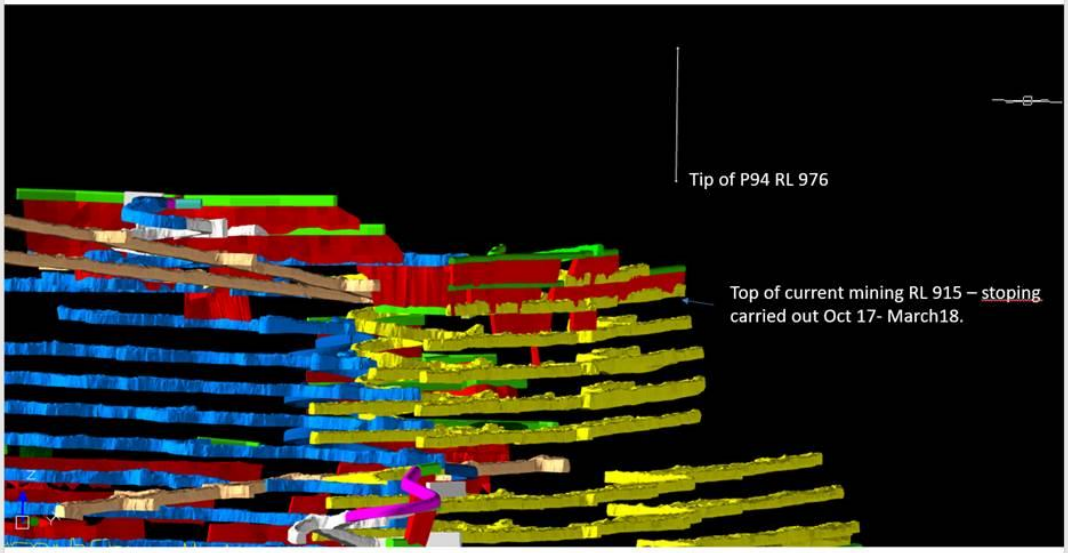


Figure 4 Section Location of P94

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 268 8312
Email: chris@gws.co.nz
Web: www.gwsconsulting.co.nz

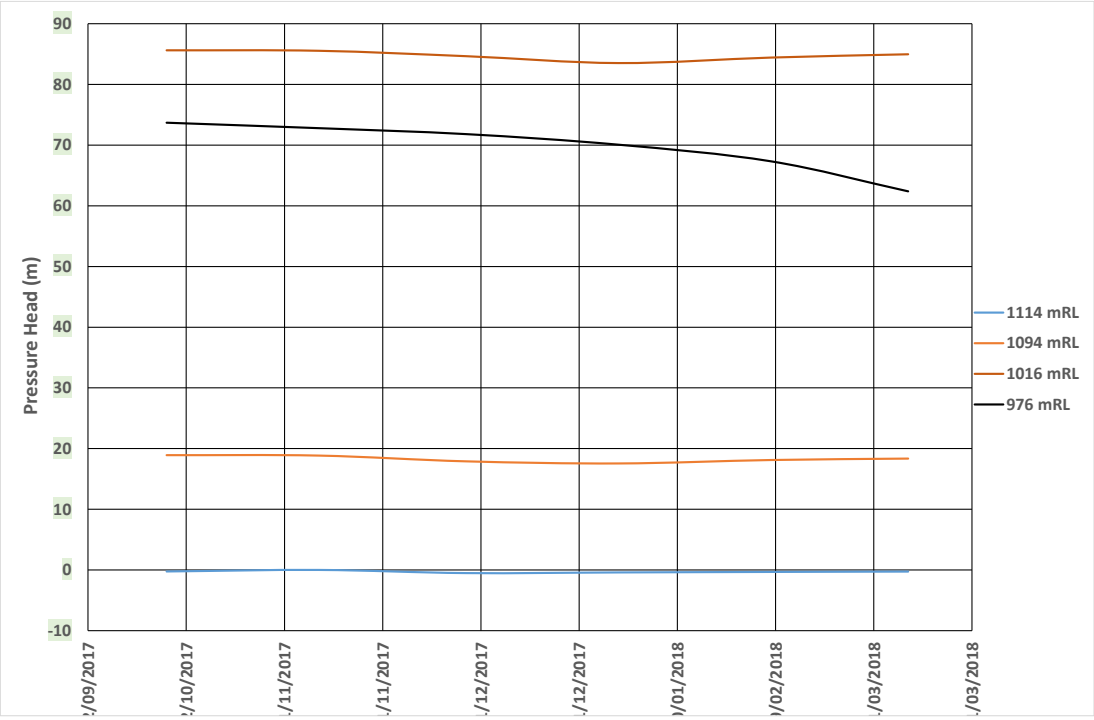


Figure 5 Pressure Heads P94 – October 2017 to March 2018

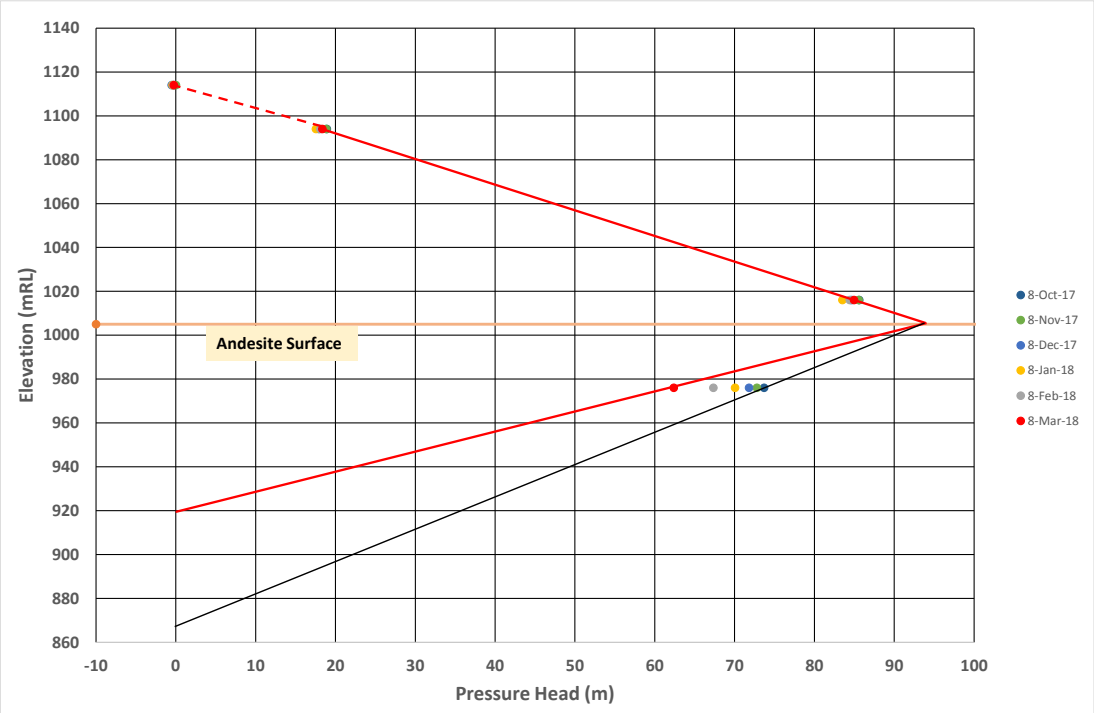


Figure 6 Pressure Heads versus Elevation – P94

4 Katote Close, The Gardens
Manurewa
Auckland 2105

Phone: 09 268 8312
Email: chris@gws.co.nz
Web: www.gwsconsulting.co.nz