WATER MANAGEMENT PLAN

Martha, Favona, Trio, Correnso and SUPA Mines

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Site:	Waihi

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Document Control

Author	WRC Approver	Change	Date
M Burroughs	S Roa	Annual Review, alignment to OceanaGold Standard 9.5.	November 2018
M Burroughs	S Roa	Includes additional figure of site discharge and sampling points.	October 2017
K Mason	S Roa	Includes plans to upgrade the mine dewatering pumps and reduce the size of the TSF1A supernatant pond due to OGNZL not being a signatory to the cyanide code.	August 2016
K Mason	S Roa	Includes plans to dewater from underground only as a result of a slip on the North Wall of the open pit and to construct a pipeline direct from the underground portal to the WTP	May 2015 – addendum to 2015 Water Management Plan
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URS		Annual Review	2002
K. Mason	D. Crequer	Original Document	Nov 1999

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1. Introduction

1.1 Background

OGNZL holds a suite of resource consents under which it operates the Martha, Favona, Trio, Correnso, SUPA and MDDP Mine Projects at Waihi. A requirement of the silt pond consent (971311) and treated water discharge consents (971318, 971319 and 971320) granted as part of the Martha Mine Extended Project is the preparation of a Water Management Plan ("the Plan"). Consents for the Favona Underground Mine (109742 to 109746), in Schedule 2 – General Conditions, also require the preparation of a Water Management Plan.

While there is no specific requirement for a Water Management Plan for Trio, Correnso, SUPA or MDDP, there are conditions within those consents relating to water management. Additionally, OGNZL environmental compliance standards require a Water Management Plan. The Plan has been prepared to cover all relevant water management consent requirements and other water related matters pertaining to the open pit and underground mines.

The Plan also links in part with the Dewatering and Settlement Monitoring Plan, and in particular the:

- Biannual Ohinemuri River water and sediment quality monitoring programmes; and
- Ongoing reviews of long term predictions of groundwater quality post mining.

There is also a link with the Tailings Storage Facility Monitoring Plan, and in particular the monitoring of underdrain flows and quality with a view to direct discharging clean water when appropriate. These aspects remain in the Dewatering and Settlement Monitoring Plan or in the Tailings Storage Facility Monitoring Plan as required by the consents and are also included within this Water Management Plan where appropriate.

In addition, the Rehabilitation and Closure Plan contains information relating to water management during closure and post closure, including the requirement for water treatment, monitoring and reporting.

1.2 Purpose

The purpose of the Plan is to set out:

- Water management objectives;
- A description of the water management system to be applied across the site to meet the water management objectives;
- Priorities;
- Planned improvements where appropriate;
- Monitoring and reporting requirements; and
- Contingency plans.

The document is reviewed at least annually, and any proposed amendments forwarded to Waikato Regional Council for approval.

1.3 Objectives

The key objective is to manage water in a manner that ensures that site discharges do not have significant adverse effects on the receiving water, users of the resource, or aquatic biota.

To achieve this objective, OGNZL must:

1. Comply with the resource consent conditions as they relate to site water management;
2. Dewater the Martha Open Pit and Underground Mines to the extent that mining progress is not hindered, consent conditions are met and there are no long-term significant adverse effects in terms of groundwater and settlement (refer also to the Martha and Favona Dewatering and Settlement Monitoring Plan);
3. Meet the freeboard requirements for the impoundments of the tailings storage facilities;
4. Prevent unauthorised water discharges through appropriate collection, storage and treatment;
5. Operate a predictive water balance to understand future water management requirements;
6. Reuse and recycle as much water as possible on site and identify opportunities for direct discharge of clean water into the receiving water;
7. Monitor the various waters around site, not only for the purposes of compliance but also to meet internal requirements;
8. Monitor the effects of the site's discharges on the receiving waters;
9. Determine and respond appropriately to trigger limits and targets;
10. Carry out further research and improvements where necessary;
11. Ensure that employees directly involved in site water management are aware of their responsibilities and the necessary procedures for effectively managing water and preventing significant adverse effects on receiving waters.

1.4 Responsibilities

Table 1 summarises the primary responsibilities for water management across the site.

Table 1 - Responsibilities

Role	Responsibilities
Site Services Manager	▪ Maintenance of silt and collection pond storage capacity around the tailings storage facility, conveyor silt ponds and Favona polishing pond collection pond; ▪ Maintenance of drains and diversions around site.
Processing Production Superintendent	▪ Day to day operation and monitoring of the water treatment plant (WTP); ▪ Routine visual checks as they relate to water management i.e. pond and pipeline inspections etc.; ▪ Bunding and contingency measures around the WTP and Processing Plant; ▪ Daily reporting to other relevant staff members, so that water treatment priorities can be discussed, and changes implemented as necessary.
Processing Maintenance Superintendent	▪ Maintenance of water collection, containment and pumping systems around the site; ▪ Maintenance and calibration of collection pond/silt pond continuous monitors, ▪ Maintenance and calibration of collection pond/silt pond flow measuring devices; ▪ Maintenance of contingency ponds around the water treatment plant and mill;

HSE Manager	▪ Monitoring and reviewing data (including water quality, flows, potentially acid forming (PAF) slurry tests and biological monitoring) and reporting both internally and to Waikato Regional Council (WRC) in accordance with consent conditions and the relevant internal procedures; ▪ Maintenance and calibration of river flow gauging facilities and sondes; ▪ Arranging environmental inspections and audits of all areas on a routine basis; ▪ Informing the General Manager Operations of any practice that has, or could potentially result in, a significant adverse effect on the receiving surface waters and/or non-compliance with the conditions of consent.
All Department Heads	▪ Ensuring that relevant contractors are made aware of the Plan and the relevant resource consents
All Applicable Contractors	▪ Complying with the requirements and conditions of the resource consents which apply to the mine. ▪ At the discretion of OGNZL, providing written documentation of how they intend to carry out proposed work in order to ensure that consent conditions are met.
All Applicable Personnel	▪ Being aware of the Plan, and the conditions of the resource consents held for activities at this site. ▪ Meeting the consent conditions and requirements as stated in the Plan and adhering to the relevant site procedures as they relate to water management.

1.5 Water Sources

There are several different sources of water generated on site that require management; primarily from dewatering the mines, rainfall runoff from disturbed areas of the site, and surplus process water (tailings liquor). **Figure 1** shows the location of potential water discharge points and regular water sampling points. Figure 2 shows the location of surface water containments (ponds), their contributing catchments and water type characteristic that are key features of the site water management system. Clean water diversion drains discharge directly to streams. In addition to the features shown each tailings storage facility has a comprehensive underdrainage system which is described in the Tailings Storage Facility Monitoring Plan.

A schematic diagram of the current site water management system is shown on Figure 3. Changes have been made to the figure to reflect changes to the mine dewatering/service water due to the slip on the North Wall of the open pit and the collection pond direct discharge.

1.6 Regional Water Allocation

Regional water allocation is managed by WRC via their Regional Plan - Variation 6 policy on water. The purpose of the variation is: *"… to ensure there is enough water in waterways to provide for such things as a healthy environment, that towns and businesses are catered for, electricity is generated efficiently and that farmers can work their land successfully*."

Water takes are managed through the resource consent application process.

1.7 Recent and Proposed Consent Condition Changes

In 2012, a number of changes were made to various consent conditions, some of which were water related. The changes made were described in detail in the 2013 Water Management Plan.

Changes were made to the Collection Pond Discharges Consent 971312 and the Silt Pond Discharges Consent 971311 to allow the pond status to be switched between "collection pond" and "silt pond" status depending on water quality.

In 2014, a number of other changes were made to:

- Condition 7 of the silt pond discharges consent 971311, relating to the 2-year design storm,
- Condition 9 of the Tailings and Waste Rock Disposal consents 971303 to 971306 to clarify the intent of the TSF freeboard condition,
- Conditions 6, 7 and 8 of Correnso consent 124861 to clarify the wording relating to the waste rock and ore monitoring programme,
- Schedule 1 to the Golden Link Project consents 124859 to 124864 to tidy up minor typographical errors.

In 2015, a number of changes were made to the treated water discharge consents as follows:

- to increase the fish flesh selenium concentration from 7.9 mg/kg dry weight to 8.1 mg/kg dry weight,
- to reduce the requirement of selenium monitoring to ensure it remains cost effective and relevant,
- to align the wording of the treated water discharge consents as they relate to Regime D,
- to make minor changes for administrative purposes.

Figure 1 - Water discharge and sampling point locations

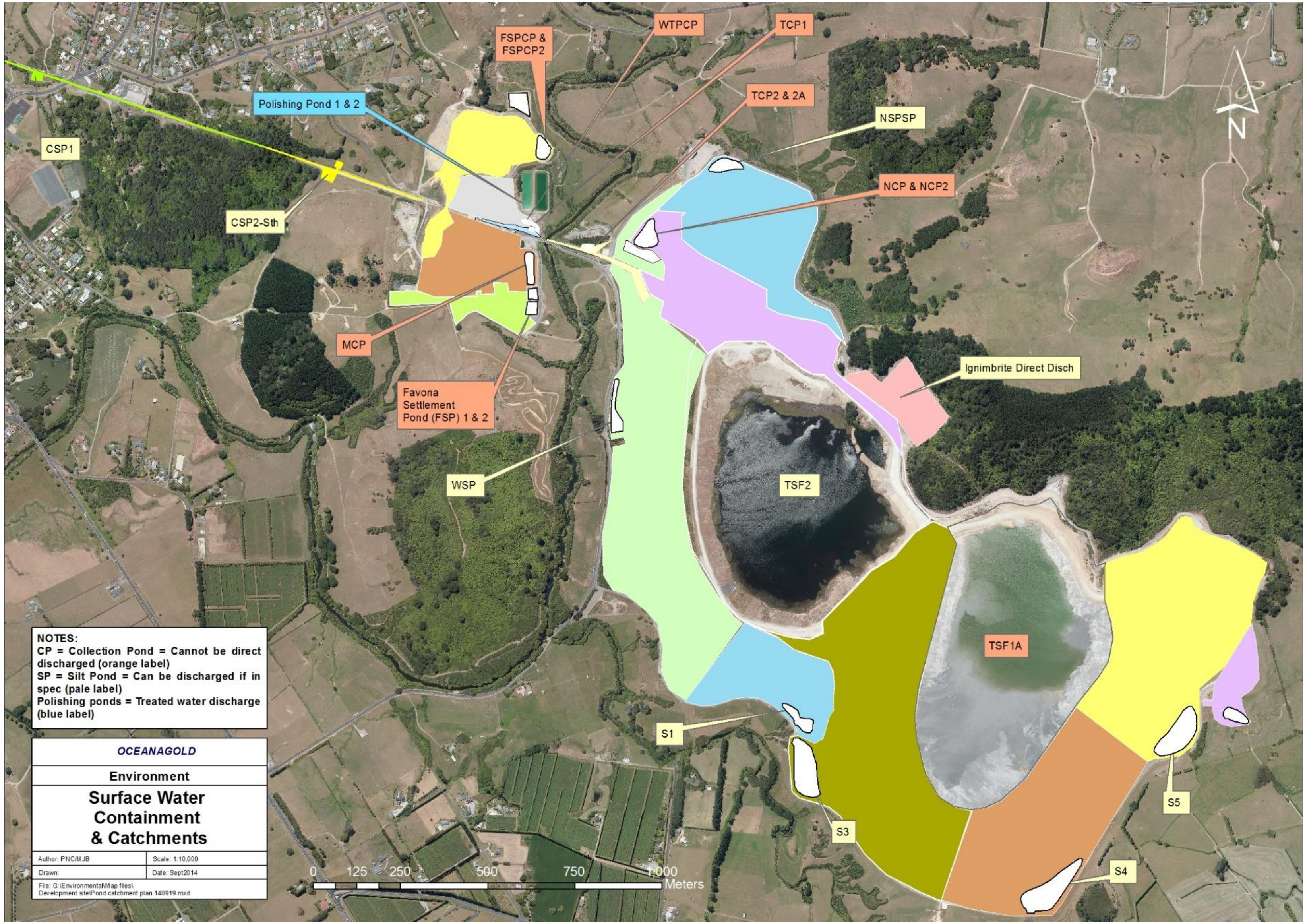

Figure 2 - Pond catchment plan and characterisation of runoff

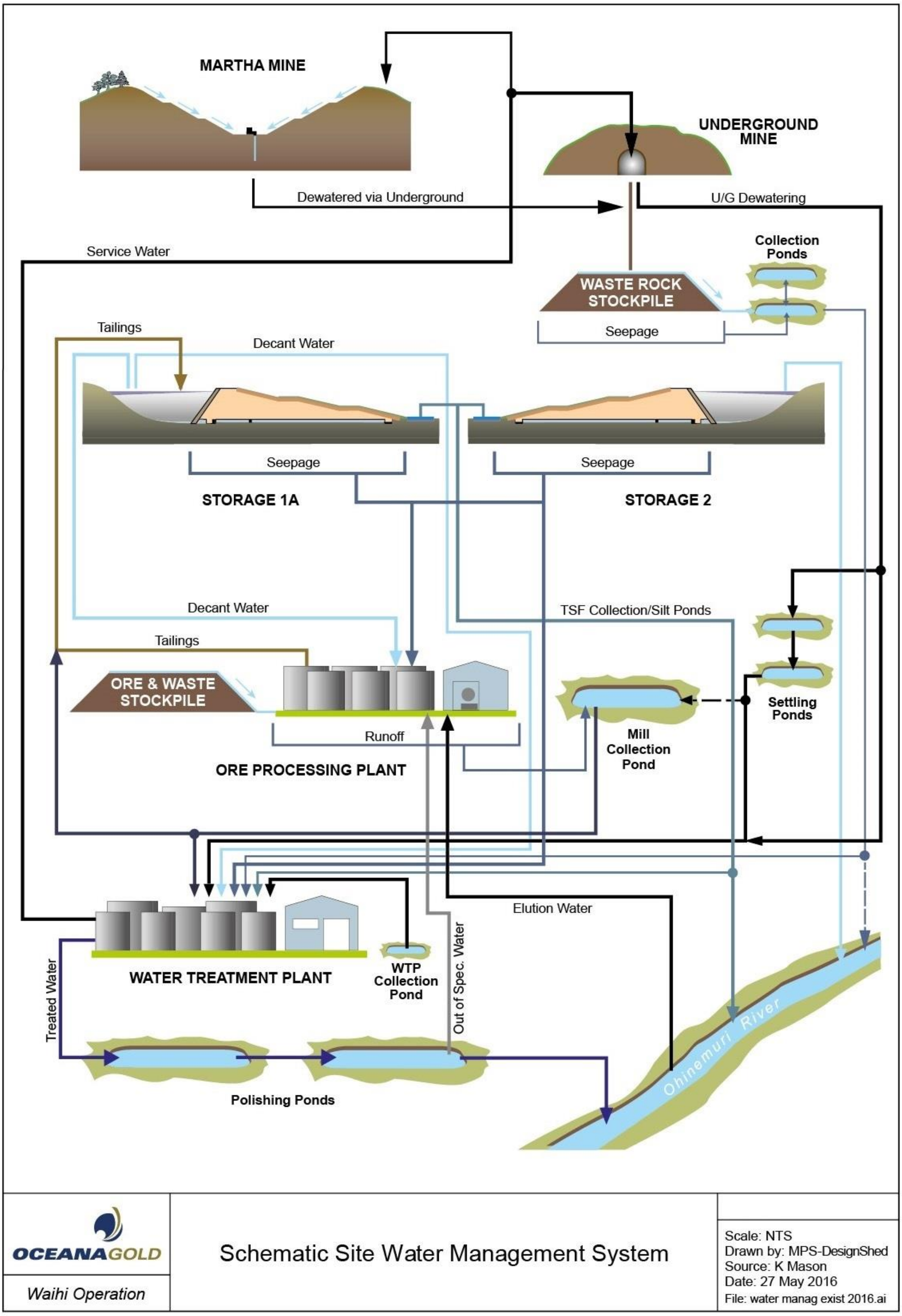

Figure 3 - Site Water Management Schematic

Mining Licence 32-2388 and a number of consents expired in July 2017. These are summarised in Table 2.

Table 2 – Licences/Consents Expired 2017

Type	Reference	Summary	Consent Authority	Expiry Date
Mining Licence	32 2388	Original Mining Licence granted in 1987 and variations thereto	Minister of Energy	16/07/2017
Land Use (Vegetation Removal) consent	971282	To remove up to 20 hectares of vegetation from Areas A and B	WRC	15/07/2017
Land use (earthworks)	971283	To carry out earthworks and contouring of land of up to 82 hectares for mining, mining operations and rehabilitation in Areas A and B	WRC	15/07/2017
Discharge permit (to land)	971284	To place ore, waste rock, topsoil and tramp material in stockpiles in Area B and noise bunds created in Areas A and B	WRC	15/07/2017
Water take (ground)	971286	To dewater the pit (Areas A and B) and surrounding areas at a rate of 15,000 m^3 of surface water and groundwater per day, at or about NZMS260 T13:620 202		15/07/2017
Water permit (diversion)	118633	To divert stormwater in the Surface Facilities Area	WRC	16/07/2017
Discharge permit (air)	971281	Air permit to discharge contaminants to air for all of the site	WRC	15/07/2017
Discharge permit (to water)	W1742	To discharge clean stormwater from conveyor trench (Barry Rd silt pond)	WRC	24/07/2017
Discharge permit (to water)	W1743	To discharge clean stormwater from conveyor trench (Union Hill)	WRC	24/07/2017
Water permit (surface water take)	114554	To take up to 430 m^3/day of water for elution	WRC	15/07/2017

The new variation of the Extended Martha Mine Project was issued on 22/06/2018. Any activity conducted in accordance with the relevant terms and conditions of, and within the area covered by Mining Licence 97/98 - 105 are now permitted activities in the Hauraki District Plan.

Similarly, replacement consents have been granted to replace dewatering consent 971286 and air discharge permit 971281. The dewatering consent for Correnso (124860) and the Correnso Discharge to air consent (124859) were activated on 16 July 2017.

The Company has applied for replacement consents for consents 971282, 971283, 971284, 118633, W1742, W1743 and 114554 six months before expiry. At the time of writing not all consents have yet to be reissued and

the company is operating under the expired consents. Renewal applications were submitted six months before expiry, as described under Section 124 of the RMA, which allows continued operation as per the existing consent until a council decision is made.

1.8 Water Management Imperatives

The Water Treatment Plant (WTP) is an integral part of the water management system for the site. The WTP treats a number of water sources prior to discharge to the Ohinemuri River. The system relies on effective monitoring, planning and response both on a day to day basis and into the future to ensure that the water treatment priorities are well understood and targets are met.

On a day to day basis, and more frequently if necessary, an assessment is made of the water treatment priorities for the following day. This information is communicated to the Water Treatment Plant Operators as they start their shifts. For longer term planning, a site water balance (Goldsim) is used to evaluate any potential water management issues based on future mine plans to ensure that all water sources will be appropriately managed. Goldsim is also used for predicting closure water treatment costs.

There are a number of site water management imperatives that must always be considered, planned for, and managed as follows:

1. Effective WTP operation and consistently compliant treated water quality (i.e. limited downtime for the WTP)
2. Maintenance of the quality of the TSF2 decant pond to allow the continuation of direct discharge
3. Collection, reuse and/or treatment of seepage
4. Treatment or pumping to WTP/TSF1A of Favona Stockpile Collection Pond water
5. Addition of limestone to potentially acid forming waste rock as necessary, i.e. waste rock used to construct the TSF1A embankment, stockpile areas and channels as required e.g. the Favona stockpile area (otherwise known as the Polishing Pond Stockpile).
6. Progressive rehabilitation where possible
7. Direct discharge and/or treatment as necessary of Collection Pond water
8. Direct discharge and/or treatment as necessary of West and S1 Silt Pond water
9. Treatment of Mill Contingency Pond water
10. Treatment of Water Treatment Plant Contingency Pond water
11. Treatment of Tailings Contingency Pond water
12. Mine dewatering
13. Maintenance of the required TSF freeboards and management of water levels in the TSF1A tailings impoundment to optimize tailings consolidation
14. Maintenance of diversion channels
15. Maintenance of silt control

At all times, the water treatment decisions that are made take into account the requirements of the consent conditions while seeking to ensure that no unauthorised discharges occur. There are no discharge permits for the Mill Contingency Pond and Tailings Contingency Ponds, and no permitted activity rules in the Regional Plan

that authorise their discharge. For this reason, the Mill Contingency Pond and Tailings Contingency Ponds are managed to avoid discharges into the receiving waters.

1.9 Plan Structure

Following an overview of the project status and the implications on water management, the Plan outlines the key elements of the water management system and for each element provides:

1. A brief description of where and how the element fits into the water management system.
2. The specific objectives for that element of the water management system.
3. An explanation of its priority in the management hierarchy.
4. The key areas on which to focus the management of that component.
5. A brief description of the consent requirements (performance criteria), monitoring and reporting requirements and the available contingencies.

In the past, it has been difficult at times to treat all of the water sources due to the need to treat large quantities of collection pond water. For that reason, priorities were set to ensure that collection ponds with the lowest quality, and those that were about to overflow, were treated first.

Now that the direct discharge of collection pond water occurs, there is additional capacity at the Water Treatment Plant and less pressure during times of high rainfall, provided that the collection pond water meets the conditions relating to pH and turbidity that allow it to be direct discharged. By allowing collection pond water of a suitable quality to direct discharge, the Water Treatment Plant Operators are better able to focus on those sources of water that warrant management and treatment priority.

2. Overview

2.1 Project Status

As at July 2018, the following is relevant with respect to water management across the site:

- Mining of the Correnso deposit continues,
- Development and mining within SUPA continues,
- MDDP development continues, and
- Mine dewatering from the underground continues.

Within the coming year, OGNZL intends to trial a monitoring programme for total suspended sediment (TSS) discharges from the silt and collection ponds. The issue is that improvements are needed for OGNZL to be able to clearly demonstrate TSS compliance in instances where the ponds overflow in events that are greater than the design storm[1]. In order to assess the effects of the pond discharges both separately and in combination, OGNZL proposes the following monitoring locations (Table 3).

[1] Refer to condition 8 and Table 1 of consent 971311 (silt ponds) and condition 16 and Table 2 of consent 971312 (collection ponds).

Table 3 – Pond discharges and monitoring

Pond Discharge	Receiving Water Sites to be Monitored in Conjunction with Pond Discharges
S3, S4 and S5	RU10 (U/S) and RU1 (D/S). See Note 1.
NSPSP	TB1b (U/S) and TB1a (D/S)
West Silt Pond	OH3 (U/S) and OH5 (D/S)
CSP1	ES04 Weir (U/S) and ES04 South (D/S)
CSP2	TB5a (U/S) and TB5 (D/S). See Note 2.
All discharges in combination	OC2 (U/S) and OH6 (D/S)

Notes:

1. As a number of small tributaries flow into the Ruahorehore Stream between the upstream site RU10 and the downstream site RU1, any of which can carry elevated TSS concentrations, it is proposed to monitor the two largest Ruahorehore Stream tributaries upstream of the pond discharges at sites RU4 and RU7. This will improve determining any pond discharge effect. It will also provide an opportunity to collect further data for those tributaries.

2. OGNZL has recently applied for a replacement consent for W1742 and W1743 and it is proposed that the conditions be aligned with those of silt pond consent 971311. However, in hindsight we see practical difficulties in demonstrating compliance with the conditions due to the lack of an appropriate upstream TSS monitoring site for CSP2. Monitoring at the upstream site will continue until this matter is resolved through the granting of a new consent with appropriate conditions.

The proposal is to continue to monitor silt pond overflows for rainfall events greater than the 2-year return period duration using hand held instrumentation as opposed to sampling and sending samples away for laboratory testing. Monitoring of pH and turbidity using hand held instrumentation during overflow events offers a number of advantages as follows:

- Allows compliance to be assessed immediately (no laboratory turnaround time),
- Immediately triggers the need to investigate any exceedences,
- Provides the opportunity to report the results far more quickly, and
- Is cost effective (laboratory analyses not required).

OGNZL's does have a portable meter to measure turbidity, however appropriate methodology requires investigation prior to measurement. In the interim, the local SGS laboratory can test for turbidity with a turnaround time of around two hours.

Condition 12 of the collection pond consent 971312 requires collection pond overflows to be monitored for a suite of parameters. S3, S4 and S5 can be either silt ponds or collection ponds depending on their water quality. If the ponds are deemed to be collection ponds (based on continuous monitors), overflows will be monitored in accordance with condition 12, and upstream and downstream samples will be taken and sent to the laboratory to demonstrate compliance with the receiving water standards (condition 16 and Table 2).

It is noted that monthly monitoring for a range of parameters including metals is currently undertaken in the Ohinemuri River (4 sites) and the Ruahorehore Stream (4 sites). In addition, weekly monitoring for a range of parameters including two metals is currently carried out at three Ohinemuri River sites (refer condition 15 of the treated water discharge consent).

2.2 Water Management Implications

2.2.1 Mine Dewatering and Re-watering

The underground mine dewatering pumps have now been upgraded. OGNZL is currently operating under the dewatering consent for the Correnso Project, which allows dewatering to 700mRL. Current flow rates are around 150 l/s. OGNZL intends to dewater to the 712mRL level within the next twelve months.

Dewatering will need to continue until:

- open pit and underground mining are complete,
- OGNZL is satisfied that there will be no continuation of mining,
- a decision has been made that lake filling can commence.

In recent years, significant efforts were made refining the pit wall runoff sampling, analysis and mapping the geology of the wall to provide a refined alteration map. This information was used to remodel the lake water quality predictions. As part of the Martha Project consenting in 2018, AECOM remodelled the lake water quality.

2.2.2 Favona / Trio

The following consents exist for dewatering of the current underground mining operations:

- 109742 – To take groundwater and mine water for dewatering the Favona Underground Mine,
- 121446 – Dewatering of the underground workings associated with the Trio Project,
- 124860 - Undertake dewatering of underground workings (including groundwater and mine water) within the Golden Link Project Area, including the Correnso Underground Mine.

OGNZL is currently exercising consents 109742, 121446 and 124860. The consent for dewatering of the Trio Project was sought and granted only for those parts of the project that were not consented as part of the Favona Underground Project.

Rehabilitation of the Favona (polishing pond) stockpile area and the Favona portal area will not advance until backfilling of the underground is complete, by which time any remaining ore and waste rock stockpiles will be depleted.

2.2.3 Waste Rock Embankments

No construction or rehabilitation work is planned this coming reporting period. Some Northern Stockpile NAF material may be transported to the portal stockpile to be utilized as backfill in the Underground.

2.2.4 Tailings Impoundments

Discharge of Storage 2 impoundment water directly to the Ohinemuri River will continue subject to appropriate ongoing monitoring. The capping of TSF2 tailings, and the construction of an outlet/spillway from the TSF2 pond to the adjacent tributary will not be completed until OGNZL is sure that it will not be needed to store additional tailings.

As described previously, OGNZL is now focussing on drawing down the water level in TSF1A while ensuring that birdlife is monitored and protected through a rationalised and more targeting monitoring programme. Improvements in the Storage 1A impoundment water quality cannot be expected to start until after the end of ore processing. Storage 1A impoundment water quality is expected to take two or so years, once tailings deposition has stopped, to improve to the point where it could be discharged directly to the receiving environment. As a

result, the WTP will be required to operate over that period, although Reverse Osmosis (RO) is not expected to be required throughout the period.

Partial capping of Storage 1A and construction of a spillway to Storage 2 would occur during the post-mining period.

2.2.5 Seepage

The collection and treatment of seepage is expected to continue for some time, although OGNZL expects to separate out the clean seepage flows from those that have yet to achieve acceptable quality, thus significantly reducing the volumes of seepage requiring treatment before discharge.

OGNZL intends to commence an individual assessment of seepage drain quantity and quality which, when complete, will determine whether approval should be sought to direct discharge any seepage flows. In some cases, generally around TSF2, some of the pipework discharges to manholes at elevations that are too low to gravity feed them into adjacent surface water collection systems. OGNZL is keen to apply some thinking to this as part of its planning for closure.

2.2.6 Summary

In the coming year, stormwater and treated water practices will continue largely unchanged from that of recent years.

3. Water Management Program

3.1 Introduction

The Waihi area is characterised by high rainfall and the site operates with a net excess of water. Effective management of all of the water sources is important to maintaining production while ensuring compliance with the conditions of consent. To ensure that the quality and timing of any site discharges do not adversely affect the ecology of the receiving water, the following are key elements of the water management system:

- Natural water is diverted away from areas disturbed by mining activities wherever practicable in order to reduce the volumes of water affected by the activities.
- All water from areas disturbed by mining activities is directed to appropriate collection and treatment facilities prior to discharge off-site.
- Where practicable, OGNZL will endeavour to reduce the volumes of water requiring treatment.
- Disturbed areas will be progressively rehabilitated at the earliest practicable time to minimise silt losses and improve runoff water quality.

For those sources of water that are affected by mining activities, OGNZL has limited ability to control the quantities of water requiring treatment prior to discharge from the site. The underground mines need to be constantly dewatered for safety and operational reasons, the volumes of mine water being determined by the nature of the host rocks and groundwater systems within them. All other volumes are related to rainfall. The tools and on-site practices at OGNZL's disposal to manage the volumes are limited to:

- Optimising the capacity of the WTP.
- Regularly updating the water balance model to predict future site water management requirements and implementing actions necessary to effectively manage the predicted volumes of water.
- Maintaining effective buffer storage, so that water can be stored on site as necessary e.g. during wet months and/or years.
- Ensuring, through PAF slurry testing, that adequate limestone is added to the waste rock to ensure that the collection pond water pH remains above 6.5 thus providing an opportunity for direct discharge,

- Prioritising daily waters to be treated.

The remainder of this section provides a detailed description of the various sources of water around the site and the related control/management systems.

3.2 Water Treatment

3.2.1 Description

The original WTP has been in operation since 1988. It was upgraded in 2011 to add a fourth metals treatment stream and a reverse osmosis (RO) plant stream to allow for treatment of increased volumes of groundwater from the Martha open pit. This was necessary to enable continued dewatering of the Martha pit and Favona and the increased dewatering of the deep andesite aquifer in order to develop the Trio Underground Project beneath Union Hill.

The WTP comprises four parallel streams. Three of the streams (streams 1, 2 and 4) are designed and operated to precipitate and remove soluble metals, while stream 3 comprises two phases of treatment; oxidation of cyanide to destroy the cyanide complexes followed by metals precipitation and removal. The metals-removal streams are dedicated to treating non-cyanided mine water and pond water. Stream 3 is used primarily to treat tailings decant liquors, cyanided seepage and water from the Mill Contingency Pond (MCP) but is used for metals-only removal during periods of high rainfall when excess surface water volumes accumulate on-site.

Inclusion of the RO plant and the fourth stream within the treatment system allows water treatment in four different operating modes set out in discharge permit 97318:

- Regime A – allows for a 15% increase in flow (the less of 20,000m3/d or 15% of river flow) and quality compliance limits set for Regime A.
- Regime B – allows for a 20% increase in flow (the lesser of 26,000m3/d or 20% of river flow) with a commensurate improvement in treated water quality (reduction of constituents)
- Regime C – provides for treatment and discharge from the RO plant only (the lesser of 5,200 m3/d or 10% of river flow).
- Regime D – allows for a 40% increase in flow (the lesser of 26,000m3/d or 40% of river flow) with a commensurate improvement in treated water quality (reduction of constituents).

3.2.2 Objectives

- To prevent any discharge of treated water from the site that could adversely affect the water quality of the Ohinemuri River and/or its biota.
- To avoid any operational constraints due to the accumulation of excess water on-site by optimising the volumes of excess water treated and discharged from the site.

3.2.3 Priority

The discharge of treated water is the primary discharge from the site, and it remains the ultimate contingency if ponds require treatment. For these reasons it is imperative that the WTP remains operational with limited downtime, and that it continues to consistently achieve compliance with the discharge permit quality limits.

While the risk of a non-compliant discharge is considered low due to the inherent safeguards designed into the process, a non-compliant discharge has the potential to cause significant, and possibly long-term, environmental impairment to the Ohinemuri River, thus breaching the first objective of the Plan, and needs to be guarded against at all costs.

Additionally, it can be very important that the WTP availability and the rate of discharge be maximised for operational reasons. For this reason, continual close attention to treatment plant process is required on the part of the operators to avoid down-time, and to river flow, which dictates the allowable discharge rates.

The site operates under a delicate water balance, which means that the discharge capacity is slightly in excess of combined inflow volumes. The site could easily shift from a negative water balance (discharge capacity in excess of inflows) to a positive water balance if process upsets were experienced in the WTP. The direct discharge of the collection pond water in accordance with the silt pond discharges consent is providing significant relief in that regard.

During WTP outages, water must be stored on-site until treated water compliance is again achieved and discharge can restart. There is limited on-site storage, the greatest capacity being the Storage 1A impoundment, and the accumulation of water can have longer-term implications on water management in terms of both the increased pressure on the site water management systems as well as on other processes, e.g. excess water on the impoundment reduces tailings density and hence tailings storage capacity. Ultimately, an accumulation of excess water on-site could lead to a mandatory shut-down of the entire operation.

In summary, the WTP is a very important component of the site's water management system. The greater the WTP availability, the easier the overall site water management becomes, with a greater level of environmental protection and a lower operational risk.

3.2.4 Management Focus

The operation of the WTP is managed through a suite of Standard Operating Procedures (SOPs). This Plan does not usurp those detailed processes, but in applying them, the WTP operators need to apply the following management focus to the operation;

1. Maximising WTP utilisation by avoiding discharge downtime due to process upsets (i.e. WTP on recycle) as far as practicable.
2. Maintaining as necessary WTP throughput as close as safely practicable to the allowable discharge rates set by the discharge permit.
3. Optimising the treatment rate for TSF1A decant.
4. Optimising treatment of seepage.
5. Optimising the treatment rate for collection pond/silt pond water whenever necessary.
6. Optimising treatment of mine dewatering water.
7. Ensuring no unauthorised pond overflows.

To maintain the treatment system in good working order to meet the above management priorities, an annual maintenance shut-down is expected to occur during the summer low-flow period when the allowable rate of treated water discharge prevents or severely constrains WTP operation. Routine maintenance tasks during this shut-down include de-scaling of the treated water discharge pipes and diffusers to minimise the build-up and discharge of scale (gypsum) which has been shown to carry elevated trace element concentrations.

3.2.5 Performance Criteria

The maximum combined daily discharge from both the upstream (E1 or Frendrups) and downstream (E2 or Domain Rd) discharge points under the available regimes are as follows:

- Regime A – Limits the rate of discharge to no more than 15% of the instantaneous river flow, up to a maximum of 235l/s (846m^3/hr). The maximum daily discharge is limited to 20,000m^3/d, or a daily average discharge of 833m3/hr.

- Regime B – Limits the rate of discharge to no more than 20% of the instantaneous river flow, up to a maximum of 26,000m^3/d (1083m^3/hr).
- Regime C – Limits the rate of discharge to no more than 10% of the instantaneous river flow, up to a maximum of 5,200m^3/d (216m^3/hr).
- Regime D - Limits the rate of discharge to no more than 40% of the instantaneous river flow, up to a maximum of 26,000m^3/d (1083m^3/hr).

The treated water quality under each of the regimes is set out overleaf in Table 4.

3.2.6 Monitoring and Reporting

An extensive monitoring and reporting program is undertaken by OGNZL in relation to water management. Several of the monitoring and/or reporting requirements are stipulated in various consents, while others are implemented based on internal standards or requirements, best practice environmental management or other external guidelines (such as AS/NZ Standards).

Monitoring, calibration and reporting requirements are captured in an extensive suite of documentation and procedures across multiple departments on site. These documents are reviewed and updated as necessary, and copies of specific documentation will be made available to WRC on request.

3.2.7 Contingency

In the event of treated water being out of specification with the discharge permit limits, discharge from the polishing ponds (alternatively know as compliance ponds) must cease and the treatment plant operated in recycle mode until the pond water is suitable for discharge.

Table 4 - Water Treatment Plant Discharge Limits

Parameter	Treated Water Concentration - (g/m^3 unless otherwise stated)							
	Operating Regime A		Operating Regime B		Operating Regime C		Operating Regime D	
	Normal Compliance(1)	Maximum (1)	Normal Compliance(1)	Maximum(1)	Normal Compliance(1)	Maximum(1)	Normal Compliance(1)	Maximum(1)
pH	6.5-9.5		6.5-9.5		6.5-9.5		6.5-9.5	
Temperature	<3°C rise	<3°C rise	<3°C rise	<3°C rise	<3°C rise	<3°C rise	<3° C Rise	<3° C Rise
Total Suspended Solids	10	50	8	40	5	10	8	40
Cyanide (WAD)	0.25	0.71	0.2	0.56	0.36	1.02	0.11	0.32
Iron	1.0	6.7	0.8	5.0	0.1	0.3	0.5	3.1
Manganese	1.0	1.3	0.8	1.0	0.1	0.4	0.5	0.6
Copper	0.07(2)	0.13(2)	0.055(3)	0.10(3)	0.031(4)	0.054(4)	0.033(4a)	0.06(4a)
Nickel		1.2(2)		0.94(3)		0.64(4)		
Zinc		0.8(2)		0.61(3)		0.38(4)		
Ammonia	Refer Table 3		Refer Table 3		Refer Table 3		Refer Table 3	
Silver	0.02(2)	0.03(2)	0.017(3)	0.024(3)	0.005(4)	0.005(4)	0.01(4a)	0.014(4a)
Antimony		0.23	0.1(5)	0.18	0.07(5)	0.33	0.06(5)	0.10
Arsenic		1.45		1.14		0.02		0.66
Selenium	0.15	0.27	0.12(5)	0.2(5)	0.22(5)	0.38(5)	0.07(5)	0.12(5)
Mercury		0.0005(6)		0.0005(6)		0.0005(6)		0.0005(6)
Cadmium		0.008(2)		0.007(3)		0.004(4)		0.004(4a)
Chromium (VI)		0.08		0.06		0.05(6)		0.04
Lead		0.02(2)		0.018(3)		0.006(4)		0.011(4a)
Hardness Assumption	670		530		200(4)		315	

Notes:

1. "Normal Compliance" values to be met 97% of time based on all analyses taken during a quarterly period when the WTP is discharging. "Maximum" values are not to be exceeded in any single analysis.
2. Operating Regime A – For hardness related metals, the compliance values in Table 1 assume a hardness in the WTP discharge of 670 g/m^3 as $CaCO_3$ prior to dilution in the Ohinemuri River. This equates to an in-river hardness of about 100 g/m^3 as $CaCO_3$ following mixing. Refer to Table 2 for compliance levels at differing hardness concentrations.
3. Operating Regime B – For hardness related metals, the compliance values in Table 1 assume a hardness in the RO only discharge of zero and 530 g/m^3 as $CaCO_3$ prior to dilution in the Ohinemuri River. This equates to an in-river hardness of about 100 g/m^3 as $CaCO_3$ following mixing. Refer to Table 2 for compliance levels at differing hardness concentrations.
4. Operating Regime C – Prior to discharge of RO permeate, hardness must be added to achieve a minimum hardness of 200 g/m^3 as $CaCO_3$ to ensure in-river compliance for hardness-related metals. Refer to Table 2 for compliance levels at differing hardness concentrations.
   4a) Operating Regime D – For hardness related metals, the compliance values in Table 1 assume a hardness in the WTP discharge of 315g/m^3 as $CaCO_3$ prior to dilution in the Ohinemuri River This equates to an in-river hardness of about 100 g/m^3 as $CaCO_3$ following mixing. Refer to Table 2 for compliance levels at differing hardness concentrations.
5. Values are trigger limits, not compliance limits. In the event that the trigger limits are exceeded, the consent holder shall inform the Waikato Regional Council as soon as practicable and prepare a report, to the satisfaction of the council, to demonstrate that continued discharges at concentrations exceeding the trigger limits will have no more than minor effects on the Ohinemuri River. This report shall be provided to the Council within two months of the consent holder becoming aware of the trigger exceedence.
6. Current analytical procedures for mercury have a practical quantification limit (PQL) of 0.0005 g/m^3, and for chromium (VI) have a PQL of 0.05 g/m^3. The reporting 'limit' for mercury and chromium concentrations shall be reviewed annually by the consent holder and shall be adjusted in line with improvements in analytical technology.
7. Discharge limits for metals are for 'acid-soluble' concentration, determined on unfiltered samples.

3.3 Storage 2 Tailings Pond

3.3.1 Description

Discharge of tailings to TSF2 (Storage 2) ceased on 15 July 2005. Since that time the water quality of the tailings pond has improved to a level where its constituent concentrations are lower than the receiving water standards defined in various resource consents. Approval was received from WRC on 23 October 2007 allowing OGNZL to discharge Storage 2 water to the Ohinemuri River via an unnamed tributary to the north of the Waste Disposal Area under discharge permit 971323.

Discharge occurs via a pump located in what was the decant pond during the operational life of Storage 2. The pump is turned on manually when rainfall raises the pond water level close to the maximum allowable level and once water quality analyses have confirmed that the water is suitable for discharge. The maximum allowable water level is determined by a minimum freeboard requirement, which is defined as being sufficient to impound the surface run-off arising from the Probable Maximum Precipitation (PMP) event plus 1.0 metre. This was recalculated by Engineering Geology Ltd in 2016. In practice, for Storage 2 the minimum freeboard is 3.12m. Following rainfall or any event that reduces the freeboard below the minimum requirement, the water level will be drawn down as soon as practicable to restore the full freeboard.

In 2016 - 2017 OGNZL raised the crest to 156.4mRL and capped an area of beach that could become exposed in prolonged dry periods. Consequently, the buffer zone between beach exposure and minimum freeboard is now greater, from 152.80mRL – 153.28mRL. This allows better water management options in heavy rainfall and long dry periods.

To guard against a sub-standard quality discharge, an automatic override shuts the pumps off in the event of trigger values for pH, conductivity or turbidity being exceeded. The trigger values are;

- $6.5 \leq pH \leq 9$
- Turbidity ≤ 30 NTU[1] (assumed to correspond to SS ≤ 20 g/m3)
- EC ≤ 80 mS/m[2]

In addition to these parameters, temperature and flow (when discharging) are also continuously metered. Routine water quality monitoring occurs upon discharge and a comprehensive sampling suite is taken every month whether the pond is discharging or not.

Flow monitors on several pipelines (tailings, dam return, decant, brine) that run close to Storage 2 provide security against a pipe burst that could discharge contaminants into Storage 2 and compromise its water quality. The flow meter alarms automatically shut down the pumps on that pipeline and the Storage 2 discharge pumps in the event of a pipe burst.

3.3.2 Objectives

- To maintain Storage 2 water quality to at least receiving water quality standards defined in consent conditions.
- To prevent any uncontrolled discharge from Storage 2 that could adversely affect the water quality of the Ohinemuri River and/or its biota.

3.3.3 Priorities

Rainfall on Storage 2 totals around 800,000 cubic metres per year. The excess rainfall is discharged directly to the Ohinemuri River and so does not contribute to the water balance in terms of treatment. However, if contamination of the Storage 2 impoundment occurred, the site would face a significantly greater volume of water requiring treatment prior to discharge with an attendant significant increase in difficulty in site water management. The Storage 2 discharge remains high in importance in the site water management system due to the large volume that would severely stress the site water management system if treatment were required.

There is no expectation that the water quality will deteriorate to a point where it requires treatment without intervention, unless either OGNZL makes a decision to add tailings or some other contaminants to Storage 2, or an incident occurs such as a tailings, decant or brine pipeline burst that discharges contaminants into Storage 2.

Prior to OGNZL making any decision to reuse Storage 2 for tailings deposition or disposal of any other materials, e.g. pond silt, WTP sludge, a detailed review of the impacts on the site water balance is essential to ensure that the inclusion of Storage 2 supernatant does not force the site into a positive water balance situation.

The risk of deteriorating water quality due to pipeline bursts is considered very low following the relocation of automatic flow monitoring equipment and the software modifications that provide fail safe lockouts on the pumps servicing the pipelines and the Storage 2 discharge pump.

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[2] OGNZL self-imposed trigger limit that is subject to review.

In practice, the management of the Storage 2 discharge requires little effort beyond monitoring, responding promptly to any incidents in its catchment, and ensuring any decisions about its future use consider the potential impact on the site's water balance. However, it remains a high priority due to the large volume of water involved if its quality deteriorates, preventing direct discharge.

3.3.4 Management Focus

The management focus, in order of priority for the Storage 2 discharge needs to be on;

1. Ensuring the water quality of the pond is equal to or better than the receiving water quality standards stated in discharge permit 971323 prior to switching on the discharge pump.
2. Managing any mining-related activities occurring around the crest of the impoundment to ensure that they do not adversely affect pond water quality.
3. Maintaining a maximum water level within the pond to provide water cover over the tailings while also maintaining a minimum freeboard to the lowest waste rock embankment crest level.

Performance Criteria

- Maintaining indicator water quality measurements as described in 3.3.1.
- Maintaining water quality in the receiving water within the limits set out in the conditions of consent.
- Maintaining the TSF2 pond level to ensure minimum freeboard and tailings coverage priorities are achieved.

While environmental monitoring occurs, and needs to continue, within the unnamed tributary upstream and downstream of the Storage 2 discharge point, it has been agreed with Waikato Regional Council that the tributary provides the mixing zone for the discharge. Compliance with the receiving water quality standards stipulated in the consents is therefore not required within the tributary.

It is necessary to include the effect of the Storage 2 discharge in assessing the total cumulative effect of all site discharges on the Ohinemuri River. Discharge permit 971323 requires that the Storage 2 discharge "in combination with all other discharges authorised for the site, shall not cause a significant adverse environmental effect on the receiving groundwater and surface water…".

3.3.5 Monitoring and Reporting

Storage 2 pond water quality is monitored against the full suite of discharge parameters routinely as per the site monitoring schedule. Additional to this the water is continuously monitored for both pH, EC and turbidity via permanent continuous sonde monitors. Water quality probes within these monitors are checked and calibrated monthly by a contracted hydrological equipment specialist. Data gathered through monitoring processes is collated and reviewed by OGNZL and external consultants each calendar year to form an annual report of the water quality and management of the TSFs. Once finalized this report is submitted to WRC.

3.3.6 Contingency

In the event of the continuous monitoring system indicating out-of-specification water quality, the automatic shut-down system of the discharge pump will prevent a non-compliant discharge. A water quality sample shall be taken and analysed. If the result indicates the water quality complies with the receiving water standards, the discharge can be manually restarted.

If a water analysis indicates the pond water does not comply with the receiving water quality standard, the contingency actions are either to;

1. Prevent discharge from Storage 2 until remedial actions and/or rainfall dilution return pond water quality to receiving water quality standards.
2. Investigate mining-related activities within the Storage 2 pond catchment and stop and remediate any activities that are affecting the pond water quality.
3. Should the water level in Storage 2 reach the minimum freeboard level before the water quality complies with receiving water quality standards, divert Storage 2 water to the WTP for treatment prior to discharge.

The necessity to treat Storage 2 water could seriously compromise the site's overall water balance, and any campaign of treatment will need to be carefully balanced against the other water management demands at that time.

3.4 Tailings Storage Facility Seepage Water Flows

3.4.1 Description

An extensive seepage collection system exists beneath both tailings storage facilities. This system is designed to capture upwelling groundwater, seepage from tailings, and leachate from the waste rock used to construct the tailings embankments. The term "seepage" describes the combined flows from these sources.

The characteristics of seepage depend on the source, quality and quantity of the individual flows.

Tailings underdrains collect seepage from the tailings as well as upwelling groundwater. During the initial period of tailings placement, the flow from tailings is relatively high and contains elevated levels of cyanide and soluble metals. As the tailings volume increases, the mass consolidates, and permeability of the tailings mass reduces significantly, resulting in a decrease in flow and an improvement in quality, at which time the characteristics of underdrain flows should approach those of natural groundwater.

Upstream cut off drains also collect tailings seepage and groundwater. Experience has shown that tailings liquor concentrations in these drains are highest when decant pond water is standing against the embankment and reduce as tailings levels rise and consolidate to provide a low permeability layer. The source of tailings liquors in the drains is typically from the areas adjacent to the embankment abutments where water levels are highest and tailings levels are low.

Leachate drain flows depend on the rainfall volumes that fall on the waste rock embankment between the time that the rock is placed and capped. Leachate drains collect water from potentially acid forming (PAF) waste rock and may contain elevated concentrations of sulphate and soluble metals. As the embankments are completed, and the Zone G capping extends reducing the exposed waste rock areas open to rainfall infiltration, the volume of leachate from this source will reduce. Over time, with the completion of capping, air will be excluded from the rock mass reducing sulphide oxidation and an improvement in leachate quality is expected.

Toe drains carry mainly groundwater that wells up below the embankment structure but may contain some waste rock seepage. Initial toe drains pick up seepage from the starter embankment.

Seepage flow derived from Storage 1A can be directed to either the process water tanks or the Water Treatment Plant. TSF2 seepage water is directed to the WTP for treatment prior to discharge.

Treatment of surplus seepage water is given priority over water from all other sources as, unlike these other sources, there is very little buffer storage capacity within the seepage collection system.

3.4.2 Objectives

- To prevent the uncontrolled discharge of seepage that could otherwise contaminate groundwater and surface water.
- To monitor individual drain flows and quality with a view to direct discharging clean water when appropriate.

3.4.3 Priorities

Seepage quantities are relatively minor compared with the volumes of water from elsewhere on the site. However, there is no storage capacity for these flows other than within the reticulation (drains, manholes, pumping stations and pipework), and a build-up of head within the seepage reticulation can be expected to result in increasing risk of seepage flows into the ground with resulting repercussions for site water management. It is the limited storage and the potential for adverse effects on groundwater that dictates that seepage be treated continuously and with priority.

3.4.4 Management Focus

The management focus, in order of priority for seepage needs to be on;

1. Maintenance of the pumping and reticulation system to avoid mechanical breakdown that could increase heads within the drainage system, thereby increasing the risk of seepage flows to groundwater or overflows from manholes to the perimeter drains, and prompt action to repair any system breakdowns if they occur.
2. Treating seepage continuously as a top priority for the WTP, when seepage is not diverted to the mill.
3. Monitoring and reporting water quality and flows from all underdrainage systems in order to verify the as-built structure is achieving predicted design performance objectives. Refer also to the TSF Monitoring Plan.

Seepage in some drains, for example those carrying tailings liquor, is expected to contain traces of cyanide. In 2010, OGNZL reviewed the cyanide monitoring procedures to establish the most relevant cyanide species, the most appropriate analytical methods, scientifically justifiable and robust minimum concentrations that demonstrate the presence of cyanide (i.e. avoid false positives), and list the actions required if a minimum concentration is met or exceeded. In summary, the reportable level for WAD cyanide is in the range 0.0028 to 0.0045 mg/L and for total cyanide 0.006 mg/L (Golders 2010, **Appendix D**). In addition, measurement of WAD cyanide is preferred as it is more reliable due to the sample being stabilised with sodium hydroxide, stored in opaque sample bottles and kept chilled. It is also the consented and more appropriate cyanide species in terms of potential effects on aquatic biota.

Ongoing monitoring of all seepage drains (as detailed in the TSF Monitoring Plan) should include assessment of chemistry trends, including cyanide, as the trends may indicate a change in seepage quality that warrants investigation.

3.4.5 Performance Criteria

All underdrainage from beneath Storage 1A and Storage 2 will be pumped to the WTP for treatment prior to discharge or for use in the process plant, unless otherwise authorised in writing by WRC. (For Storage 1A, refer Martha Mine Extended Project Resource Consents 11.0, Tailings and Waste Rock Disposal, consents 971303 to 971306, conditions 5 and 8). To date, no underdrainage from the tailings and waste rock portion of Storage 1A has been authorised for direct discharge and performance criteria do not apply. However, direct discharge of collection pond subsoil drains (SS3 and SS4) has occurred since commencement of the waste disposal. Discharge of this water was approved by Waikato Regional Council in 2000 (see letter **Appendix A**).

Prior to direct discharge of any seepage, appropriate performance criteria will need to be developed. Without restricting what these performance criteria might be, if discharge water quality meets or is better than that of the receiving water standards then its discharge would not have an adverse effect on the receiving waters or their biota.

3.4.6 Monitoring and Reporting

Refer to Tailings Storage Facility Monitoring Plan.

3.4.7 Contingency

None required. Seepage is given priority for treatment. Any applicable contingencies apply to the WTP and the management of treated water.

3.5 Silt, Collection and Contingency Ponds

There is an extensive system of silt, collection and contingency ponds around the site, each type of pond having a different function.

When the collection pond and silt pond consents were granted for the Martha Mine Extended Project in October 1999, it was anticipated that runoff from catchments that may contain sediment, but no chemical or elevated soluble metal contaminants would be directed to silt ponds, where much of the sediment would settle before the water discharged to natural surface water. Silt ponds were placed below areas of active earthworks that contained no exposed PAF material and down-catchment of rehabilitated areas.

Collection ponds were sited to receive runoff from active working catchments that would contain PAF material and that might therefore contain elevated concentrations of soluble metals. Water from collection ponds was until recently pumped to the WTP for treatment prior to discharge except under heavy rainfall conditions where the runoff volumes exceeded the capacity of the pond/pump/treatment system. Under these conditions the receiving waters would have been in flood, providing sufficient dilution to the overflow that no adverse effects have occurred.

Over recent years, due in part to the regular addition of limestone to the waste rock, the collection pond water quality improved to the extent that direct discharge subject to conditions has now commenced. Contingency ponds are sited to capture chemical spills, e.g. at the mill (Mill Contingency Pond MCP), and at strategic locations on either side of the Ohinemuri River (Tailings Contingency Ponds TCP1 and TCP2).

The management of ponds has, at times in the past, been a challenge due to:

- Heavy rainfall events;
- Some misclassification of NAF (non-acid-forming) and PAF rock;
- An increase in the overall footprint of the operation with the addition of facilities to service Favona and Trio; and,
- Consequential changes in catchment areas coupled with limitations in available area in which to construct or increase the capacity of ponds.

As a result, the management of ponds has been a specific focus in the past. A number of actions were put into place to address the misclassification of PAF rock and the water quality of that runoff subsequently improved. OGNZL also improved its limestone addition to the PAF rock, resulting in consistently good water quality in the collection ponds which allowed the Company to seek approval from WRC to direct discharge the collection pond water, subject to conditions. In summary, a considerable amount of work has been done to address the previous pond issues.

The following section of the Plan provides a detailed background section on the ponds, including a brief description of the context and of the issues associated with each type of pond and/or specific ponds. The background section first discusses silt ponds, followed by collection ponds then contingency ponds. The site originally operated with only silt ponds that discharged (and contingency ponds that did not) until runoff quality dictated a more rigorous runoff management regime, from which was developed the collection pond concept.

Collection ponds are required to have a minimum water storage capacity including pumping equivalent to the volume of runoff generated from within their catchment during a 10-year return period, 72-hour duration, design storm, whereas for silt pond either the 2-year return period, 2-hour duration or 2-year return period 1-hour duration storage capacity is required. The methods for determining rainfall event periods and for calculating pond volumes is set out in **Appendix B**.

3.5.1 Background

3.5.1.1 Silt Ponds

Overview

During initial site development and for the first five or six years of operation, site earthworks and mining involved the reworking and excavation of benign surface soils and oxidised rock respectively. The only contaminant in the surface runoff from the active areas of the site was sediment. A purpose-designed study prior to the start of project development in 1987 showed that a settling time of two hours was sufficient to drop the majority of sediment from the flow to a level where the discharge could be considered "substantially free from suspended solids", as required under the legislation of the time, and which legal precedent generally defined as no more than 100 mg/L of suspended solids. The settling characteristics of natural sediments occurring on-site and the design criterion of a two-hour retention time were confirmed during work undertaken around 1997 in preparation for the Martha Mine Extended Project consent applications.

Silt ponds were designed and built to provide the requisite two-hour retention under rainfall events with a return period of no more than 2 years. During rainfall/flood events with return periods of greater than 2 years, the suspended solids concentrations in the discharge could potentially be greater than 100 mg/L. Baseline studies indicated that the receiving waters of the Ohinemuri River could have an equivalent suspended solids concentration under rainfalls of this magnitude. Therefore, the suspended solids concentration in the discharges would not differ substantially from those in the river and the 100mg/L limit did not apply under these large flows.

For water discharged from the silt ponds under rainfall events having a return period of no more than 2 years, condition 7 of consent 971311 requires a quality that has:

- pH 6.0 – 9.0; and
- A suspended solids concentration of no greater than 100 g/m[3].

Waste Rock Embankment

The three ponds serve the Storage 2 waste rock storage areas, North Stockpile Silt Pond (NSPSP), West Silt Pond (WSP) and South 1 (S1). Technically Storage 1A has no Silt Ponds, however S3, S4 and S5 can operate as silt ponds and be direct discharged.

The construction of the stockpile associated with NSPSP is covered under discharge permit 971295 (which then refers to the silt ponds discharge consent 971311) from the Extended Project.

[3] Turbidity is used as a surrogate for total suspended solids concentration (TSS). The relationship between TSS and turbidity has been demonstrated to be 100gTSS/m3≈110NTU.

For WSP and S1, water quality is assessed by an instrumented monitoring system (measuring pH, turbidity), which operates continuously, automatically controlling a gravity decant system. In addition, the discharge pumps are manually turned on when it rains if water quality parameters permit. The continuous monitoring system shuts down the pumped discharge if the monitoring indicates a drop-in water quality below set trigger values. The discharge can then be manually diverted to the WTP prior to discharge.

The quality of runoff reporting directly to S1 is typically within specification, and the catchment reporting to this pond is now so small that it seldom overflows during rainfall events.

The water quality in WSP is also typically within specification, although in the past its quality has at times been adversely affected when North Collection Pond (NCP) overflowed as it discharged into WSP via the perimeter drain. When the water quality deteriorates, the continuous monitoring automatically shuts off the discharge pump and gravity decant system. Discharge to the river from WSP ceases, and the water is diverted to the WTP.

In 2007, the pH of the runoff to NSPSP and SSPSP regularly dipped below the allowable range of 6.0 to 9.0. It was discovered that a type of rock from the South Stability Cutback had been improperly classified as NAF, which led to it being dispersed through what was supposed to be NAF stockpiles, adversely affecting the runoff quality. While sufficient to affect runoff quality, the quantity of PAF material within the stockpile was relatively minor and OGNZL received specialist advice at the time that the material was suitable for use as final capping layers following the addition of specified quantities limestone that render it NAF.

To address this issue, and until the PAF-contaminated material had been removed, runoff from the north and south stockpiles was diverted away from NSPSP and SSPSP to NCP and S5 respectively. For NSPSP and SSPSP, prior to discharge a pH and TSS test is taken and the discharge valve opened to allow gravity discharge if the parameters are within specification. The changes made have resulted in much improved water quality in those ponds.

Upon removal of the Surplus Soil Stockpile, the catchment of SSPSP was rehabilitated to pasture in 2013. OGNZL previously sought feedback from the councils and peer reviewers on this matter, and as a result, OGNZL intended to decommission SSPSP in 2015. Changing priorities have meant that the pond has not been decommissioned yet. It is possible that the pond may be utilised in the future.

At the time of writing, material may be removed from the North Stockpile for use as backfill underground. Silt traps have been constructed to control silt that would otherwise flow into NSPSP. Monitoring of the pond water will continue to demonstrate compliance and assess the need for any further mitigation.

Other Silt Ponds

There were originally three conveyor silt ponds (CSP1, otherwise known as Barry Road silt pond), CSP2N (north) and CSP2S (south) otherwise known as the Union Hill silt ponds). CSP2N originally collected stormwater runoff from a drain on the northern side within the conveyor trench. The sump in the conveyor trench would block and for that reason, the flow was directed into CSP2S, with CSP2N capturing stormwater runoff from the surrounding area only, and CSP2S capturing runoff from the length of the conveyor. For this reason, CSP2S was undersized, and was enlarged in 2014 to increase its containment capacity in accordance with the conditions of consent.

CSP1 discharges to the Eastern Stream and is authorised under consent W1742 which was granted for the original Martha project in 1987. CSP2N and CSP2S discharge to an unnamed tributary of the Ohinemuri River under consent W1743 issued for the original Martha mine.

Conditions 5 and 6 of these consents require that discharge water quality is characterised by way of a monitoring programme. Should the monitoring results show that the discharge water would cause damage to receiving waters it shall be diverted to a treatment plant. To date this has not been required. Crushed limestone is

periodically spread along the conveyor corridor to manage the runoff quality. It is noted that while consents W1742 and W1743 expired on 24th July 2017, the consents continue to be exercised while a new application is being processed (S124(1) RMA 1991).

Collection Ponds

Overview

In late 1993, routine monitoring revealed low pH water with elevated metals concentrations in the silt ponds around the Waste Disposal Area of Storage 2. Subsequent investigations revealed the cause to be partially oxidised waste rock that was being mined for the first time as the pit floor was excavated below the level of full oxidation.

An interim solution comprising liming the waste rock and pumping of the silt pond contents to the WTP for treatment prior to discharge was implemented. The liming of the waste rock placed in the embankment provided buffering that delayed the onset of acid generation until the material could be covered. The new reticulation system reduced the frequency and volumes of poor quality water discharging from the silt ponds. Hydrated lime addition to the ponds was also practiced for a period to improve pond water quality by increasing pH and precipitating soluble metals.

The permanent solution that followed comprised a hopper feeding limestone onto the conveyor belt carrying waste rock to the Waste Disposal Area and larger ponds and pumps for the catchments containing exposed PAF rock that further reduced the frequency and volumes of discharge from these catchments. Silt ponds without exposed PAF in their catchments would continue to operate as they had during the previous decade. The system was formalised during the consenting process for the Extended Project and the lime hopper and three large “collection ponds” around Storage 1A (South 3 or S3, S4 and S5) and one large collection pond at the North End of Storage 2 (NCP) were constructed as part of the Extended Project development works.

The philosophy for the collection pond design was to:

1. Retain the runoff from PAF waste rock on-site for treatment under any rainfall event with a return period of less than 10 years. The basis for this criterion was that the streams and rivers would be in flood during events with return periods of more than 10 years and would thus provide adequate dilution for the collection pond discharges to avoid damage to aquatic biota.

2. Provide sufficient retention within the ponds to delay any overflow by a day or so based on the observation that the peak river flows generally occurred during the second or third day of a major rainfall event, thus increasing the chances that an overflow would coincide with the peak flood flows, maximising dilution and reducing the risk to aquatic biota. The resulting design criterion was for the ponds to have a live capacity (i.e. a combination of storage and pump capacity) sufficient to contain the volume of runoff generated within its catchment by a 72-hour, 10-year return period rainfall event.

3. Give the treatment of collection pond water priority at the WTP following significant rainfall events so as to empty the ponds as quickly as possible thereby maximising their available working storage capacity for the subsequent rainfall event(s).

4. To provide continuous in-line monitoring of pH and turbidity to indicate whether or not the water was safe for direct discharge, based on an empirically derived relationship between the continuously monitored parameters and soluble metals concentrations that was developed from the decade of pond water monitoring data available at that time.

5. Where the in-line monitoring indicated water of adequate quality, a pond would be allowed to overflow rather than be pumped to the WTP for treatment, i.e. would revert to being a silt pond.

One final matter worthy of note in this background discussion is the expectations for discharges from collection ponds if two large rainfall events occur within a short period of time. This aspect was considered during the development of the collection pond operating philosophy in 1997, and the conclusion was;

1. The WTP and the collection pond reticulation have a finite capacity, which means that treatment of the total retained volume of runoff in the collection ponds will take time.
2. It is therefore likely that there will be times when a rainfall event occurs before the full working capacity of all of the ponds has been restored.
3. Under these circumstances, the ability for OGNZL to prevent a pond discharge, even under rainfall events of less than the 10-year return period required by the consent, may be limited or non-existent.
4. However, two heavy rainfall events in quick succession would result in an extended period of high river levels, and the waste rock liming would result in a discharge quality that was better than the assumed worst-case, meaning that the risk to aquatic biota should not be significant (which would be confirmed by the water quality monitoring during discharge events required by the consents).

It is noted that since the collection pond direct discharge has been approved, there is a greater opportunity to maintain the ponds at lower levels between events, so that the storage capacity can be recovered in the event that the collection pond water does require treatment in subsequent rainfall events.

<u>Waste Rock Embankment</u>

The three collection ponds serving Storage 1A waste rock storage areas are S3, S4 and S5. The fourth collection pond, North Collection Pond (NCP) receives runoff from the waste rock load-out area at the end of the conveyor and from nearby haul roads. Up until approval was granted to direct discharge the collection ponds, the principle had been to treat all collection pond water as soon as practicable to recover the available live storage capacity prior to the next rainfall. That is currently still the case for NCP.

<u>Favona Stockpile</u>

The Favona (or polishing pond) Stockpile Collection Pond (FSPCP) captures runoff from the stockpile located north of the Water Treatment Plant. There is currently no material on the stockpile. In 2009, the footprint of the polishing pond stockpile was increased by about 1 hectare to accommodate additional quantities of Martha ore mined during a four-month enforced mill shut; the result of a fire in the mill motor control centre in May 2009. Included with this work was the construction of a second collection pond that, together with the original FSPCP, provides the design capacity for both the increased stockpile footprint as well as that of the haul road. Discharge permit 109744 authorises the discharge of waste rock and ore into the stockpile and also provides for the collection pond discharge.

The two ponds, known as the FSPCP and FSPCP2 operate together, runoff from the stockpile first reporting to the original pond from which it is pumped either to treatment or to Storage 1A. When water levels approach full capacity of the original pond FSPCP during periods of heavy rainfall, water will overflow back into the new pond FSPCP2. Following rainfall, water stored in the new pond will be pumped back into FSPCP and thence to treatment or to Storage 1A.

Given the potential for poor water quality within this pond due to stockpile runoff, the treatment of this water is prioritised with the aim of preventing overflows into surface waters.

3.5.1.2 Contingency Ponds

Overview

The site was originally developed with three contingency ponds; one for mill runoff (mill contingency pond, MCP), the other two located on each side of the Ohinemuri River adjacent to the mill bridge to capture spills from the tailings, dam return or decant pipelines (tailings contingency ponds, TCP1 and TCP2). A later opportunity was identified, and an embankment was constructed across a gully down-catchment of the water treatment plant, to create a fourth contingency pond (water treatment plant contingency pond, WTPCP).

The concept for these ponds was different from both silt and collection ponds, being more closely aligned to bunds around chemical or hydrocarbon tank facilities. Stormwater reporting to these ponds should typically be benign and suitable for direct discharge except following a pipeline burst or chemical spill.

In the event of a spill, the contents would be contained within the ponds and would be disposed of appropriately, reducing the risk of an uncontrolled discharge to the receiving environment. However, the contingency ponds differ from the silt and collection ponds insofar as they typically have no specific discharge permit. Contingency ponds are not designed to contain runoff indefinitely, the expectation being that should a spill report to these ponds, the contents would be pumped out and disposed of in an appropriate manner and not discharged to the receiving waters. The more recent WTPCP is an anomaly and is the only contingency pond for which there is a specific discharge permit.

The basis for the original sizing of the MCP is not known, but may have been based on the volume of the largest tank plus some margin. The volume of the tailings contingency ponds was calculated on the maximum volume of tailings from a pipeline burst; the volume of the pipe from the low point at the Ohinemuri River to the high point of the pipe adjacent to Storage 2.

The volume of the WTPCP was determined by the shape of the gully that became contained by the embankment constructed between the western abutment of the mill bridge and the polishing pond embankment. A discharge permit was later sought and granted for this pond. The discharge permit names the pond as the Water Treatment Plant Collection Pond, as opposed to the Water Treatment Plant Contingency Pond. The conditions cross reference to the Collection Ponds Discharge Consent 971312.

Mill Contingency Pond

The catchment for the MCP includes the mill, stores, Favona portal, ore stockpiles, ore treatment facilities and associated chemical storage. Each of these has potential for contaminating runoff that, in the case of some chemicals, cannot be readily assessed by simple water treatment tests, e.g. acidic waste rock runoff with high sulphate that is detectable using pH and conductivity.

The catchment to the MCP has increased over the years and in response, OGNZL has made several upgrades to the MCP to increase its capacity to that of a collection pond in recognition of the nature of the materials and activities within its catchment.

In the past, mine water from underground was pumped to two settling ponds to reduce the sediment load before overflowing to the MCP, from where it was pumped to the WTP for treatment. This followed an assessment of the design of the MCP at the time Favona was being consented that showed that its capacity could meet the collection pond design criteria with the increased flow provided the installed pump capacity was increased. A bigger pump was installed.

In 2015, a pipeline was constructed which takes water directly from the underground mine to the Water Treatment Plant. The mine dewatering water is currently directed to a manifold where water can be sent either direct to the

Water Treatment Plant or to the Favona settling ponds. The uppermost pond is kept full in case it is needed for firefighting.

The mine dewatering is now most often pumped direct to the Water Treatment Plant, and the ponds now mostly only contain stormwater from the site. The potential exists however to top up the upper pond if required during dry weather.

Under moderate rainfall conditions, water from the MCP is used for process water make-up, or is directed to the WTP for treatment. Under heavy rainfall events, excess MCP water, including Favona settling pond water if these ponds are overflowing, is pumped to the tailings sump and on to Storage 1A for later treatment as decant.

Until now, the use of the tailings sump as part of the water management system has meant that at times Martha ore treatment rates have been reduced, or the mill shut down completely, in order to maximise the water-handling capacity of the tailings sump. Also at times of heavy rainfall, dewatering of the underground mine has had to cease to restrict further inflows to MCP. The expectation is that this will be less of an issue now that mine dewatering water is able to be sent direct to the Water Treatment Plant.

Water Treatment Plant Contingency Pond

As occurs in the mill, all liquid chemical storage facilities within the WTP are bunded. However, if for some reason chemical (or fuel[4]) loss occurs outside the bunds in sufficient quantities to cause contamination of site runoff, the spill can be contained and would be collected in the water treatment plant contingency pond (WTPCP). Following a spill, pond contents would be disposed of in the most appropriate manner, e.g. recovered and returned to on-site storage, pumped to the tailings storage facility, or tankered off-site for treatment/disposal at appropriately licensed facilities.

In addition, overflows from the conveyor transfer station silt ponds (TSSPs) report to the WTPCP, although the normal and preferred mode of operation for the TSSPs is to recirculate settled wash water back to the conveyor belt wash system. During the past year this has been minimal with the greatly reduced volumes of material being conveyed from the open pit. The final contribution to the WTPCP comes from a cut-off drain constructed in the embankment forming the WTPCP, seepage collected in the drain being pumped back to the pond.

The concept of the WTPCP originated after the initial site development but before the upgrades associated with the Extended Project occurred. The WTPCP was formalised as part of the Extended Project consenting process, and unlike the other contingency ponds has a discharge permit (971315) that requires the pond to meet the design and operational specifications of the collection ponds.

The pond is equipped with pumps and an automatic level control system to manage the pumps. A smaller duty pump delivers water to the process water make-up tank when levels within the ponds remain low. If the water level in the pond exceeds a set point, a larger pump that discharges to the brine pipeline and thence to Storage 1A automatically switches on. High level alarms are installed in the WTPCP.

Tailings Contingency Ponds

Several critical pipelines cross the Ohinemuri River on the northern side of the mill bridge, including the tailings, dam return, decant and RO brine pipelines. There are two tailings contingency ponds (TCP1 and TCP2) which are located on the western and eastern banks of the Ohinemuri River, respectively, that would capture pipeline contents resulting from ruptures or spillages.

[4] All fuel tanks are bunded and have a concrete pad for vehicles to park on while refueling. Spills are collected to an oil-water separator which is serviced regularly.

TCP1 contains no monitoring or pumping equipment, and its catchment is a small area immediately adjacent to the WTPCP pond. The operation of this pond remains as originally designed in which it provides temporary containment of a spill to allow time for the spill to be cleaned up manually. The pond was not designed to contain surface runoff, or to overflow to the Ohinemuri River. Should TCP1 overflow, the contents would report to WTPCP, which has a significantly greater capacity, and level alarms and a pumping system for recovery of the spilt materials.

The catchment for TCP2 includes the trench in which the pipelines to and from the tailings storage facilities are laid and in which the tailings booster pumps are sited. Gland sealing water from the booster pumps drains to TCP2 and can contain low concentrations of cyanide. TCP2 comprises two ponds in series, with level controls and alarms in the second pond. TCP2 operates in the same way as WTPCP, i.e. has a smaller duty pump that discharges to the process water make-up tank at low pond levels, a larger pump discharging to Storage 1A via the brine line that automatically starts at higher pond water levels, and a high-level alarm.

3.5.2 Favona Stockpile Collection Ponds

3.5.2.1 Description

A description of FSPCP and FSPCP2 is given above in s3.5.1.2.

Due to the reactive nature of the Favona waste rock on the stockpile, the pond water has in the past contained significant concentrations of iron. At present there is no stockpiled material. The preferred management option for FSPCP water is to pump it to the Water Treatment Plant, but a secondary option is to pump to Storage 1A via the RO Concentrate System if necessary.

3.5.2.2 Objectives

To prevent any uncontrolled discharge of potentially contaminated surface runoff from the Favona (or polishing pond) stockpile, that could adversely affect the water quality of the Ohinemuri River and/or its biota.

3.5.2.3 Priorities

The water collected in the FSPCP has at times been the worst-quality runoff from the site, being high in iron and other trace elements and with a low pH due to the reactive nature of the Favona waste rock stored on the stockpile. The FSPCP water therefore warranted priority treatment along with the MCP and TCP2, due to the absence of discharge permits for those ponds. Although the water quality has improved, the priority of treatment at the WTP remains.

3.5.2.4 Management Focus

The management focus for FSPCP water needs to be on maintaining the maximum live capacity within the ponds to minimise the chance of overflow. This will involve ensuring that;

1. The pumps and control systems are well maintained and available for use whenever required in response to a rainfall event.
2. Pumps are turned on at the start of every rain event to maximise live storage capacity during each rainfall event.
3. Regular de-silting occurs to prevent silt build-up that reduces the total live storage capacity (combination of live volume and pump capacity) of the ponds (refer s3.5.10 for further detail).
4. Ensuring the addition of limestone to the waste rock stockpile to manage runoff water quality.

3.5.2.5 Performance Criteria

FSPCP and FSPCP2 will be permanent features throughout the life of the adjacent stockpiles. All stormwater runoff from around the Favona stockpile area where potentially acid forming (PAF) waste rock is exposed will be diverted to the FSPCP. (Refer to the Favona Mine consent 109744, condition 5(a)).

The FSPCP ponds are designed to have a minimum water storage capacity equivalent to the volume of runoff generated from within its catchment during a 10-year return period, 72-hour duration, design storm. The methods for determining rainfall event return periods and for calculating pond volumes are set out in Appendix B. (Refer to the Favona Mine consent 109744, condition 7(b)).

For rainfall events with a return period of less than or equal to 10 years, all stormwater reporting to the ponds will be pumped to the WTP for treatment (Refer to the Favona Mine consent 109744, condition 7(c), and to **Appendix C**, which provides the method for determining rainfall event return periods and whether an overflow event complies with the consent conditions), or pumped to the tailings sump for pumping to Storage 1A.

De-silting of FSPCP and FSPCP2 is required to maintain the minimum live storage capacity of the pond (volume/pump capacity equivalent to the volume of runoff generated from within its catchment during a 10-year return period, 72-hour duration, design storm). For the purposes of complying with this criterion, silt quantities shall be maintained at less than 3,000m^3 (≈25% of the original combined pond volume).

Apart from exceptional circumstances maintenance and de-silting of these ponds will only occur during periods of projected fine weather. All silt removed will be disposed of in the Storage 1A tailings storage facility.

No chemicals or additives will be used in the collection ponds or the discharge from those without the prior written approval of WRC.

3.5.2.6 Monitoring and Reporting

The monitoring and reporting requirements for FSPCP mirror those of the other collection ponds whose discharges are authorized by the Collection Pond Discharges consent, i.e. NCP, S3, S4 and S5.

3.5.2.7 Contingency

The option exists to treat the water either through the Water Treatment Plant or to send it to TSF1A. Spreading of crushed limestone over the waste rock stockpile has been carried out periodically in the past to manage pond water quality prior to water treatment. This pond is less of an issue now that there is no material on the stockpile.

3.5.3 Mill Contingency Pond

3.5.3.1 Description

A general description of the MCP is given above in s3.5.1.3.

There are no discharge permits associated with the MCP. Progressive upgrades have been made to the MCP so that it complies with the collection pond design and operational criteria, i.e. it has a minimum water storage capacity equivalent to the volume of run-off generated within the catchment during a 10-year return period, 72-hour duration, design storm, taking into account a combination of both storage volume and pumping rate.

The pond is operated in such a way to prevent overflows to the Ohinemuri River.

3.5.3.2 Objectives

To prevent discharges of potentially contaminated surface runoff from the mill, stockpiles, stores and Favona portal areas to the Ohinemuri River.

3.5.3.3 Priorities

The potential for chemical spills, including cyanide spills, within MCP catchment is the reason that MCP is given high priority in the water management system hierarchy. The potential for chemical contamination justifies a management approach that minimises the chance of an overflow to the Ohinemuri River. This includes giving MCP relatively high priority access to water treatment.

The MCP catchment includes existing contingency measures and safety systems that significantly reduce the chances of contaminated runoff reporting to the pond. These include;

1. Bunds around tanks that store or contain chemicals, and in particular around the cyanide handling facilities and reticulation and the leach tanks that contain cyanide solution.

2. Warning systems that notify the occurrence of an incident that might potentially result in the uncontrolled discharge of chemicals, allowing remedial action to be taken to avoid contamination of runoff or to respond promptly to an incident that causes contamination.

3. The obvious nature of a failure of a major vessel, e.g. a leach tank that would allow remedial action to be taken to avoid contamination of runoff or to respond promptly to an incident that causes contamination.

4. The safety margin between the collection pond design criteria and the combined volume/pump capacity installed in the MCP is greater than that of the FSPCP and the NCP, making it less likely that the MCP will overflow during rainfall events.

In the unlikely event of a major spill or leak within the catchment of the MCP, these contingency measures would provide the opportunity to capture and clean up the spill before it can materially affect runoff quality. In the event that runoff to the pond becomes contaminated, the option exists to initiate truck-mounted pump-out of the pond contents and appropriate disposal, either on- or off-site. This would typically be the preferred approach.

3.5.3.4 Management Focus

The management focus for MCP water needs to be on maintaining the maximum live capacity and preventing a significant deterioration in water quality within the pond to minimise the chance and effect of an overflow. This will involve ensuring that;

1. The occurrence of spills and discharges within the MCP catchment that potentially affect the quality of water in the MCP are minimised through using good practice when handling chemicals and maintaining vigilant monitoring and observation practices to guard against activities that might result in spills and uncontrolled discharges.

2. Timely and appropriate clean-up responses occur in the event of a spill, including the shutting down of the MCP pumping system and truck mounted pump-out of pond contents if necessary.

3. The pumps and control systems are well maintained and available for use whenever required in response to a rainfall event.

4. Pumping to the process water tank or WTP starts as soon as possible after the start of every rain event to maximise live storage capacity during each rainfall event.

5. There is a timely change from pumping to the process water tank or WTP to pumping to the tailings sump to minimise the chance of pond overflow.

6. Regular de-silting occurs to prevent silt build-up that reduces the total live storage capacity (combination of live volume and pump capacity) of the pond (refer s3.5.10 for further detail).

3.5.3.5 Performance Criteria

De-silting of the MCP is required to maintain the minimum live storage capacity of the pond (volume/pump capacity equivalent to the volume of runoff generated from within its catchment during a 10-year return period, 72-hour duration, design storm). For the purposes of complying with this criterion, silt quantities shall be maintained at less than 1,000m^3 (≈25% of the original pond volume).

Apart from exceptional circumstances, maintenance and de-silting of collection ponds will only occur during periods of projected fine weather. All silt removed will be disposed of in the Storage 1A tailings storage facility.

3.5.3.6 Monitoring and Reporting

This is expected to be minimal given that the pond is to be managed in such a way that it will not discharge to the receiving waters.

3.5.3.7 Contingency

By definition, MCP itself is a contingency measure. OGNZL has in place a system that ensures that various actions are taken depending on the pond water level. This includes ceasing milling of the ore to ensure that MCP water can be directed to the Storage 1A tailings pond via the tailings pipeline, and ceasing dewatering of the underground mine when the water could enter MCP. The need to do either is expected to be less now that the mine dewatering is routinely being diverted direct to the Water Treatment Plant.

3.5.4 NCP, S3, S4 and S5

3.5.4.1 Description

A general description of the NCP, S3, S4 and S5 is given above in s3.5.1.2.

3.5.4.2 Objectives

- To maintain the quality of the collection pond water through appropriate limestone addition to the waste rock.
- To achieve "silt pond" status so that the water can be direct discharged where appropriate.

3.5.4.3 Priorities

A priority is to maintain the water quality in the collection ponds to allow direct discharge of the water. Provided the current programme of NAF/PAF identification, limestone application to PAF material, PAF slurry testing and progressive rehabilitation is maintained there should be no issue achieving acceptable water quality on a consistent basis.

As previously described, during the coming year OGNZL intends to look at whether approval can be gained to direct discharge NCP and some of the tailings underdrains. In addition, the potential to discharge additional water to the Ruahorehore Stream and/or the Ohinemuri River will be investigated. This would have a number of benefits including increased operational flexibility at the WTP, reduced water treatment costs and the demonstration of progress from a closure perspective.

3.5.4.4 Management Focus

As described above, the management focus is:

1. Ensuring that the water quality of the collection ponds is maintained through adequate limestone application of the waste rock and ongoing progressive restoration.
2. Discharging S3, S4 and S5 to receiving waters whenever possible to free up the Water Treatment Plant for treating other water sources.

3.5.4.5 Performance Criteria

The collection ponds are expected to be permanent features throughout the life of the mine.

When ponds S3, S4 and S5 are operating as silt ponds, the performance criteria for silt ponds apply.

When NCP, S3, S4 and S5 are operating as collection ponds, the performance criteria for collection ponds apply. When operating as collection ponds, for rainfall events with a return period of less than or equal 10 years, all stormwater reporting to the ponds will be pumped to the WTP for treatment (refer WRC Resource Consent Section 9.0, Collection Ponds, condition 5, and to **Appendix C**, which provides the method for determining rainfall event return periods and whether an overflow event complies with the consent conditions).

De-silting of the collection ponds is required to maintain the minimum live storage capacity of the pond (volume/pump capacity equivalent to the volume of runoff generated from within its catchment during a 10-year return period, 72-hour duration, design storm). For the purposes of complying with this criterion, silt quantities within NCP will be maintained at less than 1,000m^3 (≈10% of the original combined pond volume). Silt quantities within S3, S4 and S5 shall be maintained at less than ≈20% of the original pond volume (10,000m^3 for S3 and S4, and 5,000m^3 for S5) to ensure that pond water can be pumped down to just below the level of the (earth covered) HDPE liner that was installed in the bottom of the pond to provide for dead water storage.

Apart from exceptional circumstances maintenance and de-silting of collection ponds will only occur during periods of projected fine weather. All silt removed will be disposed of in the Storage 1A tailings storage facility.

No chemicals or additives will be used in the collection ponds or the discharge from those without the prior written approval of WRC.

3.5.4.6 Monitoring and Reporting

When the ponds are operating as collection ponds, the water will be sampled and analysed for pH, EC, suspended solids, cyanide (WAD), total ammonia, iron, manganese, copper, nickel, zinc, silver, antimony, arsenic, selenium, cadmium, chromium (VI), lead, mercury during every overflow event. (Refer Martha Mine Extended Project consent conditions Section 9.0 Collection Ponds condition 12). During every overflow event, a water sample from the Ohinemuri River will be taken from sites both upstream and downstream of the pond discharge and analysed for the same parameters listed above for the collection pond water.

Metals in the discharge will be ‘acid-soluble’ concentrations determined on unfiltered samples (Refer consent conditions Section 9.0 Collection Ponds, condition 12.), while the ‘soluble’ fraction of the metals will be analysed in the receiving waters samples.

Unless otherwise agreed in writing by WRC; all water quality sampling and analysis will be undertaken using Standard Methods for the Examination of Water and Wastewater (19th Edition 1995, or updates), APHA, AWWA and WEF; analyses will be undertaken at an appropriately qualified laboratory. (Refer consent conditions Section 9.0 Collection Ponds 971312, condition 15). The Company uses RJ Hill Laboratories in Hamilton and SGS Laboratories in Waihi for environmental water analyses.

Monitoring results will be forwarded to WRC quarterly. (Refer Martha Mine Extended Project consent conditions Section 9.0 971312 Collection Ponds, condition 14).

During commissioning of the collection pond direct discharge (with the ponds operating as silt ponds) an intensive monitoring and reporting programme was followed as described in the 2015 Water Management Plan. OGNZL sought, and on 23 June 2016 WRC approved the Company’s request to cease the direct discharge sampling (refer **Appendix A**). The SCADA telemetry data is now reported quarterly. Monthly monitoring of the Ruahorehore Stream at RU1, RU1b and RU3 continues, and the Ohinemuri River water quality is sampled on a

weekly basis. In addition the biological monitoring programme and river sediment monitoring provide an assessment of the effects of the collection pond direct discharge.

Pond discharges are tested for acid soluble metals and stream samples are tested for soluble metals, with the exception of mercury which is based on acid soluble concentrations from unfiltered samples.

3.5.4.7 Contingency

None required. The provision, and default operation (pumping to treatment) of the collection ponds is itself a contingency measure against poor quality runoff from the waste rock embankment.

3.5.5 West Silt Pond

3.5.5.1 Description

WSP is operated as a silt pond (Refer **Appendix C** for approval letter for WSP and S1). However, if the pH reduces below 6 and/or the turbidity increases above 110NTU, (due to overflows from the NCP or otherwise) the water must be sent to the Water Treatment Plant for treatment.

3.5.5.2 Objectives

The water management objectives for WSP are to;

- Maintain the pH of the pond above 6 and the turbidity below 110 NTU so that the pond water can be direct discharged,
- Treat water that has a pH<6 and turbidity>110 NTU,
- When operating as a collection pond in conjunction with NCP, to treat all water for rainfall events less than the 10-year return period storm,
- Prevent significant adverse environmental effects as a result of the pond discharge to the receiving groundwater and surface water, to aquatic biota, or on other users of these resources. To this end, the silt pond discharges, either separately or in combination with all other site discharges, will not cause exceedance of the receiving water standards as specified in the consents.

3.5.5.3 Priorities

When the pH is greater than 6 and the turbidity less than 110NTU, there is no priority set for treating the water through the WTP because it will be direct discharged. If the pH of the water falls below 6 or the turbidity increases above 110NTU, the water will require treatment. If several collection ponds require treatment it is most likely that NCP and WSP would take precedence given that S3, S4 and S5 have greater capacities for storage. However during prolonged and repeat rainfall events the priorities would be reassessed on a daily basis.

The direct discharge of the collection pond water provides significant relief to the WTP to the extent that there should be capacity to treat the remaining ponds in the event that they require treatment.

3.5.5.4 Management Focus

The management focus for WSP needs to be on maintaining its direct catchment to avoid deterioration of runoff quality, which should include;

1. Limiting areas of disturbance that could result in increased sediment loads in the runoff.

2. Advancing and maintaining revegetation as part of the operation's routine progressive rehabilitation to minimise sediment loads in the runoff.

3. Avoiding activities that could result in the exposure of PAF within the catchment (excluding the activities in the NCP catchment).

4. Maintaining the pumps and control systems so that they operate reliably whenever required in response to a rainfall event, allowing the discharge of the maximum volumes of water when quality allows and preventing the discharge of poor quality water to the extent possible.

The latter is particularly important when NCP overflows, especially if the pH and turbidity of NCP do not meet the criteria for "silt ponds".

3.5.5.5 Performance Criteria

When WSP is operating as a silt pond, the performance criteria for silt ponds apply.

When WSP operates as a collection pond, the performance criteria for NCP apply.

3.5.5.6 Monitoring and Reporting

When WSP is operating as a silt pond, the monitoring and reporting requirements for silt ponds apply (refer s.3.5.8.6).

Condition 9 of the consent states that pH and suspended solids shall be monitored in silt pond discharges on a monthly basis for the purposes of defining the impacts on the receiving water. This condition is met when the continuous monitoring system, that incorporates a pH and turbidity probe and programming on SCADA, automatically shuts off the pumped discharge to the river. Overflow events are sampled as per the procedure NWO-INT-009-ENV-S13 River Water Quality Sampling.

When WSP operates as a collection pond, the monitoring and reporting requirements for collection ponds apply (refer s3.5.4.6).

3.5.5.7 Contingency

The following contingencies exist for WSP when operating as a silt pond.

If the pond water does not meet the suspended solids compliance limit of 100 g/m^3, coagulants (e.g. alum or potable water grade polyelectrolytes) may be used to assist settling of sediment within the pond prior to discharge. If coagulants or chemicals are used, written approval is required from WRC prior to their use. (Refer WRC Resource Consent regarding Silt Ponds, 971311, condition 5).

If monitoring shows the pH of the water to be outside the 6.0-9.0 compliance range, the protocol set out below may be followed:

1. If the pond water pH is low, the contributing catchment (excluding the NCP catchment) will be inspected for PAF material or acidic chemicals.

2. If found, the PAF materials will be removed from the site, covered with a compacted layer of NAF material and/or limed, and in the interim, runoff will be collected and treated via the WTP.

3. Limestone chips may be added to the flow channels that report to the ponds to assist with the management of runoff pH.

Non-compliance with the specified oil and grease condition is considered unlikely, and the only feasible source is earthmoving machinery through either a hydraulic hose or fuel tank rupture, from fuel spills during refilling, or hydrocarbon contaminated soil disposal within the bulk fill zone of the TSF embankment. In the event that a rupture or spill occurs, or if oil and/or grease is noted in pond discharges, a check will be made of possible sources. Any spill will be contained and contaminated soils will be excavated and removed from the catchment. Contaminated soil is disposed of to the tailings storage facility after mixing with superphosphate to assist with the breakdown of hydrocarbons. To date, there have been no non-compliances of the oil and grease condition.

3.5.6 Water Treatment Plant Contingency Pond

3.5.6.1 Description

A general description of the WTP contingency pond is given above in s3.5.1.3. Discharge permit 971315 for the WTPCP requires it to be designed, constructed and operated in accordance with the conditions specified in Waikato Regional Council consent 971312.

3.5.6.2 Objectives

- To prevent uncontrolled discharges to the Ohinemuri River of potentially contaminated surface runoff from the WTP area and/or from leaks and spills from pipelines that cross the Ohinemuri River Bridge and that can contain cyanide (tailings, dam return, decant pipelines) or other chemical contaminants (RO brine line).

3.5.6.3 Priorities

The issues that relate to the WTPCP are similar to those for the MCP in that runoff normally reporting to the pond may contain some sediment, and significant contamination of the runoff can only result from an incident within the catchment. In that case, there exists a suite of contingency measures and safety systems that minimise the chances of any major incident going undetected, including;

1. Bunds around tanks that store or contain chemicals.
2. TCP1, which would contain any initial flow from a pipeline burst (refer s3.5.7).
3. Flow meters on the pipelines that provide a warning system for bursts or significant leaks of pipelines.
4. The obvious nature of a failure of a major vessel, e.g. a chemical storage tank, that would allow remedial action to be taken to avoid contamination of runoff or to respond promptly to an incident that causes contamination.

In the unlikely event of a major spill or leak within the catchment of the WTPCP, these contingency measures would provide the opportunity to capture and clean up the spill before it can materially affect runoff quality. In the event that runoff to the pond becomes contaminated, the option exists to initiate truck-mounted pump-out of the pond contents and appropriate disposal, either on- or off-site. This would typically be the preferred approach.

The consent for the WTPCP requires treatment of all water from events less than or equal to the design storm, i.e. equivalent to the runoff generated from within the catchment during a 10-year return period design storm. For that reason, this pond has the same priority as other ponds on site operating under “collection pond” status.

3.5.6.4 Management Focus

The management focus for WTPCP water needs to be on maintaining the maximum live capacity within the pond to minimise the chance and effect of an overflow. This will involve ensuring that;

1. The occurrence of spills and discharges within the WTPCP catchment that potentially affect the quality of water in the WTPCP are minimised through using good practice when handling chemicals and maintaining vigilant monitoring and observation practices to guard against activities that might result in spills and uncontrolled discharges.
2. Timely and appropriate clean-up responses occur in the event of a spill, including the shutting down of the WTPCP pumping system and truck mounted pump-out of pond contents if necessary.
3. The belt wash ponds are regularly de-silted and the recycling pump(s) operate properly to avoid discharges that potentially consume WTPCP capacity.
4. The WTPCP pumps and control systems are well maintained and available for use whenever required in response to a rainfall event.
5. Pumping to the process water tank or brine line starts as soon as possible after the start of every rain event to maximise live storage capacity during each rainfall event.
6. There is a timely change from pumping to the process water tank or brine line to minimise the chance of pond overflow.
7. Regular de-silting occurs to prevent silt build-up that reduces the total live storage capacity (combination of live volume and pump capacity) of the pond. For the purposes of complying with this criterion, silt quantities shall be maintained at less than ≈25% of the original pond volume, or approximately 250m3. (refer s3.5.10 for further detail).

3.5.6.5 Performance Criteria

WTPCP has its own, specific discharge permit that requires the pond to be designed, constructed, managed, monitored and reported upon in accordance with the conditions specified in Waikato Regional Council consent 971312. As a contingency against spills, there is no current intention to reclassify this pond.

3.5.6.6 Monitoring and Reporting

Once during each shift, a visual inspection is made of the WTP area, in particular the chemical load-out bunded containment areas, and all above-ground pipelines within the WTP collection pond catchment, to identify possible sources of runoff contamination and, where observed, to initiate appropriate additional monitoring and clean-up procedures.

Under the current regime with WTPCP operating as a collection pond, the monitoring and reporting requirements outlined in s3.5.10 apply.

3.5.6.7 Contingency

None required. The WTPCP is itself a contingency measure, guarding against minor levels of contamination in runoff from the WTP by pumping the runoff to either the process water tank when WTPCP water levels are low or to Storage 1A via the brine line when levels increase.

3.5.7 Tailings Contingency Ponds

3.5.7.1 Description

A general description of the two tailings contingency ponds is given above in s3.5.1.3.

3.5.7.2 Objectives

To prevent uncontrolled discharges to the Ohinemuri River of leaks and spills from pipelines that run between the mill and the waste disposal area that can contain cyanide and may contain tailings (tailings, dam return, decant pipelines) or other chemical contaminants (RO brine line).

3.5.7.3 Priority

There are no discharge permits for the tailings contingency ponds. TCP1 does not have a pump and the water would flow from TCP1 into WTPCP. In contrast TCP2 would overflow into the Ohinemuri River, so treatment of the TCP2 water has the same priority as the MCP.

The continuous monitoring system provides immediate warning of a flow differential at three locations along the lines that would indicate a burst, allowing for prompt remedial action to be taken. The ponds have been sized to adequately contain a pipeline volume in the unlikely event of a burst. In the unlikely event of a failure, the response to discontinue pipe flows and to initiate clean-up needs to be immediate due to the potential harm likely to occur if the pipeline contents discharge to the environment. This is especially the case with TCP2.

3.5.7.4 Management Focus

The management focus for the two TCPs shall be on;

1. Maintaining the continuous monitoring system on the tailings, decant, dam return and brine pipelines in good working order and responding immediately to any alarms raised by this system.
2. Maintaining vigilant monitoring and observation practices to guard against activities or incidents that might result in spills and uncontrolled discharges that report to the TCPs.
3. Maintaining the TCP2 pumps and control systems to ensure that they are available for use whenever required in response to a rainfall event.
4. Pumping from TCP2 to the process water tank as early as possible after the start of every rain event and a timely change to pumping to Storage 1A via the brine line if water levels rise to maximise live storage capacity during each rainfall event to minimise the chance of pond overflow.
5. Timely and appropriate clean-up responses occur in the event of a spill, including the shutting down of the TCP2 pumping system and truck mounted pump-out of pond contents if necessary.
6. De-silting to prevent silt build-up that reduces the total live storage capacity of the pond (refer s3.5.10 for further detail).

3.5.7.5 Performance Criteria

The tailings contingency ponds have no resource consents under which they can discharge to the Ohinemuri River. The items listed under management focus therefore provide the performance criteria.

3.5.7.6 Monitoring and Reporting

There are no specific monitoring or reporting requirements for the TCPs. However, TCP2 is included in the monthly sampling regime and in the unlikely event of an overflow, the water would be sampled as if it was an NCP/WSP, S3, S4 or S5 collection pond discharge. A water sample from the Ohinemuri River would also be taken from sites both upstream and downstream of the pond discharge and analysed for the same parameters as the TCP2 discharge.

Metals in the discharge will be ‘acid-soluble’ concentrations determined on unfiltered samples, while the ‘soluble’ fraction of the metals will be analysed in the receiving waters samples.

Unless otherwise agreed in writing by WRC; all water quality sampling and analysis will be undertaken using Standard Methods for the Examination of Water and Wastewater (19th Edition 1995, or updates), APHA, AWWA and WEF; analyses will be undertaken at an appropriately qualified laboratory. The Company uses RJ Hill Laboratories in Hamilton and SGS Laboratories in Waihi for environmental water analyses.

WRC will be advised of an overflow within 12 hours of its occurrence, and the above monitoring results will be forwarded to WRC as soon as possible thereafter.

3.5.7.7 Contingency

None required. The TCPs are contingency measures against uncontrolled discharges from site.

3.5.8 Silt Ponds

3.5.8.1 Description

A description of the silt ponds is given above in s3.5.1.1.

3.5.8.2 Objectives

Reduce sediment concentrations in the site runoff to a level that enables the runoff to be discharged without having a significant adverse effect on the receiving waters of the Ohinemuri River and Ruahorehore Stream.

To prevent significant adverse environmental effects as a result of site discharges to the receiving groundwater and surface water, to aquatic biota, or on other users of these resources. To this end, the silt pond discharges, either separately or in combination with all other site discharges, will not cause exceedance of the receiving water standards as specified in the consents.

3.5.8.3 Priority

Provided the catchments that contribute runoff to the silt ponds do not contain exposed PAF material, the mine-related activities remain construction or rehabilitation related, and the sediment levels within the pond remain low, the silt ponds can be expected to operate satisfactorily with relatively little management effort.

3.5.8.4 Management Focus

The management focus for silt ponds needs to be on maintaining the contributing catchments to avoid deterioration of runoff quality, which should include;

1. Limiting areas of disturbance that could result in increased sediment loads in the runoff.
2. Advancing and maintaining revegetation as part of the operation’s routine progressive rehabilitation to minimise sediment loads in the runoff.
3. Avoiding activities that could result in the exposure of PAF within the catchment, including the regular clean-up of conveyor belt spillage that can report to the conveyor silt ponds.
4. For the waste embankment silt ponds, maintaining the discharge components, whether these be gravity, pump, manual or automated control systems, so that they operate reliably whenever required in response to a rainfall event. Automatic systems should allow for the discharge of the maximum volumes of water when quality allows while preventing the discharge of poor quality water to the extent possible. Manual discharges should be initiated after water quality monitoring indicates that a discharge can occur safely without risk to the receiving waters.
5. De-silting to prevent silt build-up that reduces the total live storage capacity (combination of live volume and pump capacity) of the pond (refer s3.5.10 for further detail).

6. Spreading crushed limestone to manage runoff water quality where necessary.

3.5.8.5 Performance Criteria

Silt Ponds - General

For any construction or activities in catchments without existing silt ponds, sediment control is required in accordance with the following WRC document;

- Erosion and Sediment Control Guidelines for Soils Disturbing Activities, Environment Waikato Technical Report No. 2009/02, January 2009. (http://www.waikatoregion.govt.nz/PageFiles/2947/TR0902.pdf)

Unless otherwise agreed with WRC, the contributing catchments to silt ponds will contain no contaminated or potentially acid-forming (PAF) soil or rock. In this regard, "non-acid-forming" is defined as:

1. having a Net Acid Generation (NAG) pH of no less than 4 and,
2. having a Net Acid Producing Potential (NAPP) equal to or less than 0 (Refer Martha Mine Extended Project Consents, Silt Ponds, Resource Consent 971311, condition 6.)

Throughout their operational life, silt ponds will be regularly cleaned of silt and maintained so as to retain the design capacity. (Refer consent conditions Silt Ponds, 971311 and Favona consent 109743, condition 4).

Condition 3 of Favona resource consents 109743 (relating to the diversion and discharge of ground and surface water around the project area) and 109744 (relating to the discharge of waste rock and ore and discharge of seepage from temporary stockpiles into the ground) requires sediment minimisation plans, including measurable criteria to be included within the Plan. Sediment minimisation plans in the past included a temporary silt pond and collection pond.

Condition 2 of resource consents 109743 (relating to the diversion and discharge of ground and surface water around the project area) and 109744 (relating to the discharge of waste rock and ore and discharge of seepage from temporary stockpiles into the ground) requires that OGNZL be responsible for the structural integrity and maintenance of the works associated with these consents and for any erosion control and energy dissipation works that may become necessary as a consequence of the exercise of these consents.

Conveyor Silt Ponds – CSP1, CSP2N and CSP2S

The minimum live storage capacity must be equivalent to the volume of runoff generated during a 2-year return period, 1-hour duration, design storm. (Refer **Appendix B** for the method for calculating pond volumes).

The maximum suspended sediment concentration in the stormwater discharge is 100g/m^3 for the peak discharge during an event with a return period up to and including two years. (Refer **Appendix B** for the method of determining rainfall event return periods).

For storms with a return period in excess of two years the suspended sediment concentration in the discharge shall be no greater than that of the receiving waters (refer W1742 condition 5 and W1743 condition 4).

Waste Embankment Silt Ponds – NSPSP, WSP, S1

The minimum live storage capacity must be equivalent to the volume of runoff generated during a 2-year return period, 2-hour duration, design storm. (Refer **Appendix B** for the method for calculating pond volumes).

For rain events having a return period of no more than 2 years pond discharges are subject to compliance with the conditions of consent 971311, which, under condition 7, requires the discharges to:

- Contain no oil or grease;
- Have a suspended solids concentration of no greater than 100 g/m^3;
- Have a pH within the range of 6.0-9.0 units.

Under condition 8, pond overflows during rain events with a return period of more than 2 years, either separately or in combination with other site discharges, shall not cause any in-river exceedance of the receiving water quality standards stipulated in Table 1 of 971311. (Refer **Appendix B** for the method of determining rainfall event return periods).

3.5.8.6 Monitoring and Reporting

A site inspection will be conducted annually, and following major rain storms, to check the structural integrity of the works.

Where the inspection indicates remedial or maintenance work is required, this will be undertaken as soon as practicable, and inspected upon completion to ensure that the work has been undertaken satisfactorily.

In terms of discharges, water quality monitoring for all silt ponds will be undertaken in accordance with consent number 971311. In this regard, condition 9 requires monthly monitoring of pH and suspended solids in silt pond discharges for the purpose of defining the impacts of the silt pond discharges on the receiving water. As far as practicable, monitoring is undertaken when the silt ponds are discharging. The results of the monitoring programme will be forwarded on a quarterly basis to the WRC.

Notwithstanding the requirements of condition 9, as the primary objective of the water management regime must be to prevent adverse effects on the receiving waters of the Ohinemuri River and Ruahorehore Stream, it is more important to monitor pond and river quality when the ponds are discharging than to sample monthly at times when the ponds are not overflowing. Accordingly, this Plan requires that sampling of the silt ponds coincide with pond discharges, and that sampling be conducted at least once per month during overflow events.

3.5.8.7 Contingency

If silt pond discharges do not meet the suspended solids compliance limit of 100 g/m^3, coagulants (e.g. alum or potable water grade polyelectrolytes) may be used to assist settling of sediment from the runoff. If coagulants or chemicals are used, written approval is required from WRC prior to their use. (Refer WRC Resource Consent Silt Ponds, 971311, condition 5).

If pond monitoring shows the pH of the discharge to be outside the 6.0-9.0 compliance range, the protocol set out below may be followed:

1. If the discharge pH is low, the contributing catchment will be inspected for PAF material or acidic chemicals.
2. If found, the PAF materials will be removed from the site, covered with a compacted layer of NAF material and/or limed to achieve a runoff pH within the accepted range.
3. Limestone chips may be added to the flow channels and source areas that report to the silt ponds to assist with the management of runoff pH.

4. As a short term emergency action, hydrated lime may be added to the pond. The most effective method of lime addition will need to be determined at the time, but in the past has involved a hopper, into which bags of hydrated lime can be tipped, mounted on a venturi through which pond water is pumped and returned to the pond.

5. If required in the interim due to the risk of a discharge adversely affecting receiving water/biota, runoff will be collected and treated via the WTP.

6. If the preceding measures do not provide a robust means of improving the discharge quality, pumps should be installed to return silt pond water to the WTP for treatment prior to discharge.

Based on around 30 years of operational performance, non-compliance with the specified oil and grease condition is considered unlikely.

In the event that oil and/or grease is noted in pond discharges, a check will be made of possible areas of spillage. Any spill will be contained and contaminated soils will be excavated and removed from the catchment. Contaminated soil will be disposed of to the tailings storage facility after mixing with superphosphate to assist with the breakdown of hydrocarbons.

3.5.9 Pond Catchments

For all of the ponds except S1, an assessment of the contributing catchment and live capacity was carried out at different times during 2014 (see dates below Table 2) with the purpose of checking that the design criteria required by the consent conditions was being met. The locations of each pond are shown in **Figure 1**, and an assessment of the pond capacity against design criteria is tabulated in **Table 2**.

Table 2 shows that all silt and collection ponds were compliant with the design criteria specified in the consents when both storage volume and pumping rates are considered. It also shows that the WTPCP and the MCP comply with the collection pond design specifications. S1 was not measured in 2014, however the pond catchment is rehabilitated and receives very little silt. The pond consistently meets the consent conditions in terms of suspended solids.

Assessing compliance for the ponds in isolation does not provide the complete story. There are restrictions in the reticulation, and with the WTP capacity, that means that the combination of ponds also needs to be considered, **Table 2** therefore includes an assessment of the normal pond combinations.

The reticulation from S3, S4 and S5 is a bottleneck, preventing delivery of water to the WTP at a rate equal to the sum of the individual rated pump capacities. However, provided the water quality within these ponds remains acceptable, the ability to direct discharge the collection pond water provides significant relief compared to the bottleneck that existed in previous years.

The following ponds were cleaned in the summer of 2017/2018:

- NCP,
- S3,
- S5.

The ponds have not been resurveyed but would be expected to be well within compliance due having had silt removed over this time.

Table 2 – Pond Capacity and Compliance Check

	Pond ID	Catchment Area (see dates below)	Design Rainfall Event								Compliant?		Consent	Comments
			Return Period (yrs)	Duration (hours)	Depth (mm)	Runoff Factor	Required Live Storage Capacity (m^3)	Surveyed Live Storage Volume (m^3)	Pump (m^3/h)	Total (m^3)	Storage Only	Including Pumping		
Silt Ponds														
Conveyor CSP1	CSP1	1.9416	2	1	30.0	0.6	349	1029	0	1029	Yes	N/A	W1742	
Conveyor North CSPN	CSP2N	0.2138	2	1	30.0	0.7	45	580	0	580	Yes	N/A		
Conveyor South CSPS	CSP2S	1.0383	2	21	30.0	0.7	218	253	0	253	Yes	N/A	W1743	
West WSP	WSP	28.72	2	2	42.0	0.7	8444	12472	150	12772	Yes	Yes	971311/971312	
South S1	S1	7.77	2	2	42.0	0.7	2284	9625	280	10185	Yes	Yes	971311/971312	Automatic gravity discharge when water quality in spec
North Stockpile NSPSP	NSPSP	13.24	2	2	42.0	0.5	2780	5737	0	5737	Yes	N/A	971311	Quality check prior to manual discharge
Collection Ponds														
Favona Stockpile FSPCP	FSPCP	9.8052	10	72	285.0	0.45,0.6,1.0	13445	10572	130	19932	No	Yes	109744	Silt to be less than 3000m^3
North NCP	NCP	9.58	10	72	285.0	0.7	19112	10357	280	30517	No	Yes	971312	
South 3 S3	S3	27.46	10	72	285.0	0.7	54783	44688	300	66288	No	Yes	971311/971312	
South 4 S4	S4	17.61	10	72	285.0	0.7	35132	45100	300	66700	Yes	Yes	971311/971312	
South 5 S5	S5	20.5	10	72	285.0	0.7	40898	34465	280	54625	No	Yes	971311/971312	
Contingency Ponds														
Mill MCP (incl. Favona Settling Ponds)	MCP	8.6	10	72	285.0	0.7,1.0	18896	4015	800	61615	No	Yes		Various pumps initiated as water level increases
Water Treatment Plant WTPCP	WTPCP	1.79	10	72	285.0	0.8	4081	1019	48	4475	No	Yes	971315	
Tailings 1 TCP1	TCP1	0.46	2	2	42.0	0.7	135	268	0	268	Yes	N/A		
Tailings 2 TCP2	TCP2	1.03	2	2	42.0	0.7	303	1241	50	1341	Yes	Yes		
Pond Combinations (assessment includes reticulation limitations)														
NCP+WSP		38.3	10	72	285.0	0.7	27556	22860	430	53820	No	Yes		
S4+S5		38.11	10	72	285.0	0.7	76029	86162	200	100562	Yes	Yes		

Notes:

- TCP ponds designed to collect spills and have no design criteria. Catchment area of TCP2, TCP2A and TCP 3 combined is 1.03 ha, and pond capacity of TCP2, TCP2A and TCP3 combined is 1241 m^3.
- MCP design capacity assumes 100 m^3/hr overflow from Favona sediment settling ponds, which is conservative.

Date of Survey of Catchment Area/Pond Volumes

	Date of Survey	Comment
CSP1	12 February 2014	
CSP2S	21 July 2014	R Dix survey following enlargement of the pond in 2014
WSP	6 February 2014	
S1	April 2012	
NSPSP	17 February 2014	
FSPCP	12 February 2014	
NCP	14 February 2014	
S3	7 February 2014	
S4	7 February 2014	
S5	7 February 2014	
MCP	11 March 2014	
WTPCP	12 February 2014	
TCP1	12 February 2014	
TCP2	12 February 2014	

3.5.10 Silt Removal

3.5.10.1 Collection Ponds

The collection ponds need to be regularly inspected for silt build-up as these serve areas of active earthworks. Excessive sediment build-up in the ponds decreases storage capacity and the effectiveness of the ponds. There have in the past been practical difficulties with de-silting these ponds, the principal difficulty being identifying a method that would not damage the ponds' HDPE liners, a requirement of the conditions of the Extended Project. In recent years, greater emphasis has been placed on cleaning the ponds and surveying them after cleaning to ensure that they meet the conditions of consent.

In addition, OGNZL constructed silt retention ponds within S3, S4 and S5, and above S3 to help to remove silt.

OGNZL has previously recommended that de-silting must occur before silt build-up reaches 25% of pond volume, which equates to the following volumes:

- FSPCP – 3,000m^3
- MCP – 1,000m^3
- WTPCP – 250m^3
- S3 and S4 – 10,000m^3
- S5 – 5,000m^3
- TCP – 460m^3

Based on the pond/pump capacities shown in Table 2, compliance with the design storm capacity would still be achievable with these silt volumes. A number of the ponds could contain significantly larger quantities of silt and still comply.

3.5.10.2 Silt Ponds

The silt ponds are regularly inspected for silt build-up and de-silted as required to maintain the design storage capacity and effectiveness.

3.6 Mine Dewatering/Rewatering

3.6.1 Description

Mine water is the term used to describe the combined groundwater and surface water that reports to the Martha pit and the underground mines. It includes the groundwater from the old mine workings, pit wall runoff, the surface water directed into the pit from the surface facilities area and service water used within the mines.

In the past, water was pumped directly from the Martha Mine and under normal operating conditions, the water level in the workings was maintained at least 10 m or more below the pit floor. The volume of workings between the water level and the pit floor provided buffer storage for storm-generated surface water, allowing work to continue at the base of the pit even following extended or intense rainfall.

The slip on the North Wall in April 2015 resulted in a loss of access to the pit dewatering pumps. All mine dewatering is now dewatered via pumps located in the underground mines. The dewatering level is now determined by the requirements to carry out underground mining. Underground mining requires the ground to be dewatered/depressurised ahead of the working areas of the mine. The water is collected in sumps close to the working faces and pumped to surface via the portal. Currently treated water is used as service water underground e.g. for drilling, because the water pumped from the mine has a relatively high sediment load.

As stated earlier the site is now operating under the Correnso dewatering consent 124860. The Correnso consent allows dewatering at an unspecified rate and allows dewatering to 700mRL.

3.6.2 Objectives

- To ensure that mine dewatering does not have any adverse effects on receiving waters.
- To collect water quality data that enables refinement of the pit lake water quality modelling prior to the completion of mining.

The conditions of consent require the application of limestone to Trio and Correnso waste rock used for backfill underground on an “as required” basis. Sampling of discharges from temporary waste rock stockpiles and monitoring wells is carried out in order to geochemically model the water quality post closure, once the mines have been flooded.

3.6.3 Priorities

There is no means by which mine water can be discharged from the site other than through the WTP. In addition, there is essentially no ability to store water underground. For this reason, the treatment priority for mine water has increased compared to past years when some buffer storage was available in the open pit.

3.6.4 Management Focus

At the time of preparing the 2014 version of the Plan, the pit dewatering pumps were pumping at 200 m^3/hour, with the groundwater level being consistently maintained below the level of the pit floor.

Current pumping rates from the underground are ~150 L/s. Over the coming year, it is anticipated to dewater the mine to RL712m.

Sampling of the backfill continues. The Correnso waste rock is non-acid forming. Sampling of the discharges from temporary stockpiles and monitoring wells is also carried out routinely.

The management focus is:

1. Mine dewatering at a rate sufficient to maintain production and ensure safety.
2. Applying limestone on an as required basis to the Trio backfill (refer condition 3 of Discharge Permit 121694) and Correnso backfill where necessary.
3. Sampling of discharges from temporary waste stockpiles and monitoring wells in order to collect data to carry out geochemical modelling of the water quality post closure (refer Dewatering and Settlement Monitoring Plan, November 2016).

Mine dewatering water acts as a diluent to treated decant water. Its treatment priority needs to be balanced against those of water from more contaminated sources that could discharge to the receiving waters.

3.6.5 Performance Criteria

The previous average and maximum permitted daily water takes specified in the consents no longer apply. The focus now is to dewater at a rate necessary for production.

3.6.6 Monitoring and Reporting

Consent 109742 condition 3 requires the volume of water abstracted from the mine to be monitored on a weekly basis and reported to the Council on a quarterly basis. Dewatering volumes are monitored and recorded in the SCADA system managed by the Mill/Water Treatment Plant.

A Settlement, De-watering and Water Quality Monitoring Plan is prepared and provided to WRC for its written approval (refer schedule 2 to consents 109742 to 109746 inclusive, condition 2). Requirements of the Settlement, De-watering and Water Quality Monitoring Plan include monitoring of the dewatering line and service water line(s) to determine the net amount of water extracted from the mine. Reporting of dewatering volumes etc is undertaken annually and the results presented in the Dewatering and Settlement Monitoring Report. Note that a similar condition is included in consent 124860 for Correnso.

The Favona Water Quality Monitoring Annual Reports include all of the data necessary to meet condition 4 of Schedule Two – General conditions of Favona Consents 109742 to 109746 inclusive. The report includes a section entitled “Backfill Prediction Review”.

3.6.7 Contingency

The geochemical/hydrogeological modelling/predictions will be repeated as the number of sample records increases. The purpose of the modelling is to identify any potential problems with respect to groundwater quality before they develop. If results from the revised geochemical/hydrogeological model indicate a likely deterioration in groundwater at or following closure that will have more than minor adverse effects on other users of the groundwater or the pit lake, OGNZL will have to identify mitigation measures.

3.7 Storage 1A Pond

3.7.1 Description

Water in the Storage 1A pond contains elevated concentrations of cyanide and metals derived from the ore treatment process. A relatively large proportion of this water (called dam return water) is returned to the process plant for reuse in the ore treatment process. Excess water (decant) goes directly to the WTP for treatment prior to discharge.

Within the WTP, the decant goes through two phases of treatment; oxidation of the cyanide to destroy the cyanide complexes, followed by metals precipitation and removal.

3.7.2 Objectives

- To prevent unauthorised discharges to receiving waters.
- To minimise the effects of pond water quality on birdlife.
- To maximise the reuse of dam return water through the processing plant.
- To monitor pond water quality to:
    - Observe trends e.g. changes due to ore type or seasonal fluctuations;
    - Identify water treatment requirements.
- Upon the cessation of tailings discharge, identify opportunities for direct discharge of tailings pond water or reuse.

3.7.3 Priorities

Decant must be treated prior to discharge, and its management priority is set by the WTP (refer s3.2). The water must be treated at a rate necessary to maintain the necessary freeboard, as required by condition 9 of consents 971303 to 971306. The freeboard level provides capacity for the impoundment to contain the surface runoff generated by the Probable Maximum Precipitation (PMP) event without overtopping, plus an additional 1 metre, below the embankment crest. This equates to a freeboard limit of 2.63 metres

3.7.4 Management Focus

- Maximising the reuse of dam return water.
- Maintaining the water level below the consented maximum defined as 2.63 metres below the lowest point of the embankment crest at all times.
- Reducing the pond water level to optimize tailings beaching in line with best practice while monitoring tailings, supernatant water and birdlife to ensure no adverse effects.

3.7.5 Performance Criteria

The embankment structures shall incorporate a minimum freeboard above all material in the tailings pond (i.e. solid and liquid). This level shall be sufficient to impound the surface runoff arising from the Probable Maximum Precipitation (PMP) event without overtopping, plus 1.0 metre (Refer Storage 1A tailings and waste rock disposal consents 971303 to 971306, condition 9, and Tailings Storage Facility Monitoring Plan.)

For the rehabilitated tailings ponds, performance criteria exist as conditions of consent number 971323.

3.7.6 Monitoring and Reporting

- Pond water levels are monitored and recorded up to 3 times a week.
- Decant quality is monitored fortnightly.
- Tailings is monitored for WAD CN and acid generating capacity (refer TSF Monitoring Report – Geochemistry),
- Tailings supernatant water is monitored (refer TSF Monitoring Report – Geochemistry)
- Bird counts continue to be carried out.

3.7.7 Contingency

The allowable freeboard provides a contingency against overtopping of the tailings pond water.

3.8 Diversion Channels

3.8.1 Scope

The following diversion channels apply to the project:

- Diversion of natural water around an oxidised stockpile N2 at northern end of Storage 2; and discharge to an unnamed tributary (water permit 971296/971297)
- Diversion of an unnamed tributary (unnamed Stream 2) of Ohinemuri River at Northern end of Storage 2 (water permit 971298)
- Diversion of an unnamed tributary (Stream 1) of Ohinemuri River by way of culverting at the northern end of Storage 2 (water permit 971299)
- Diversion of natural water around surplus soil stockpiles at the southern diversion drain (Area D) (and discharge into unnamed tributary 3) (water permit No. 971300 and 971301)
- Diversion of unnamed tributary of Ruahorehore Stream at eastern end of the eastern stockpile (eastern diversion drain) (water permit 971302)
- Diversion of natural water around eastern side of Storage 1A via the southern diversion drain and discharge to unnamed tributary (water permit 971307 and 971308)
- Diversion of natural water around Storage 2 (and part of Storage 1A) via the northern diversion drain (Water permit 971309) and discharge into unnamed Stream 2 via northern diversion drain. (discharge permit 971310).
- Diversion of natural water to the south on the western side of the process plant site area, within area D (Water permit No. 971310) and discharge into the Ohinemuri River. (discharge Permit 971317).
- All of these diversion drains have now been installed and are operational. In terms of the Favona Mine Consents the following is relevant:
- Diversion and discharge of ground and surface water (farm runoff and intercepted groundwater) from around the project area (Water permit 109743 for the Favona Underground Mine).

3.8.2 Objectives

To divert natural water away from areas of mining activity wherever practicable in order to minimise the volumes of water affected by the activities and to reduce the volumes of water generated on-site that require treatment.

3.8.3 Performance Criteria

- For Martha Mine Extended Project, diversion channels and associated works were designed to convey the peak runoff generated by a 10-year return period storm. (Refer Martha Mine Extended Project consents Section 3.0, Consents 971296-971302, 971308 to 971310, 971316 and 971317 Clean Water Diversions, condition 4).
- For the Favona Mine consent 109743, condition 4 requires that any earthworks or structures installed for the diversion and discharge of stormwater shall be designed to manage a 10% AEP (Annual Exceedence Probability) flood event and pass a 1% AEP flood event. Secondary flowpaths shall be away from the stockpiles.
- For the Favona Mine consent 109743, condition 3 requires that sediment control practices shall be undertaken which are in general accordance with the principles outlined in the document prepared by

the Waikato Regional Council entitled "Erosion and Sediment Control – Guidelines for Soil Disturbing Activities" dated 2003, or updates.

- All construction works have been and will be implemented under the supervision of persons with appropriate experience in the supervision of civil engineering construction works (Refer: WRC Resource Consent Section 3.0, Clean Water Diversions, Consents 971296-971302, 971308 to 971310, 971316 and consent 971317, condition 5, and 109743, condition 5.)
- The area of disturbance during construction of the diversion works has been and will be kept to a minimum in order to reduce the volumes of sediment-laden runoff. (Refer WRC Resource Consent Section 3.0, Clean Water Diversion, Consents 971296-971302, 971308 to 971310, 971316 and 971317, condition 6 and consent 109743, condition 6.)
- All works associated with the diversions and associated works, including erosion control and energy dissipation works, will be and have been designed, built and maintained to ensure their structural integrity throughout their operational life. (Refer WRC Resource Consent Section 3.0, Clean Water Diversions, Consents 971296-971302, 971308 to 971310, 971316 and 971317, condition 2).
- The Company shall advise the Council in writing in advance of the proposed construction of each of the diversion channels, and shall provide plans of the proposed works, and advise as to proposed start times for construction (Refer 109743 condition 7).

3.8.4 Monitoring and Reporting

- A site inspection will be conducted six-monthly, and following major rain storms, to check the structural integrity of the diversions and associated works.
- Where the inspection indicates remedial or maintenance work is required, these will be undertaken as soon as practicable, and inspected upon completion to ensure that the work has been undertaken satisfactorily.

3.8.5 Contingency

None required.

3.9 Elution Water Take

3.9.1 Scope

OGNZL holds consent 114554 which authorises the Company to take up to 430 m3/day at a rate not exceeding 5 L/s from the Ohinemuri River for elution water purposes. It is noted that while the consent expired on 15th July 2017, the consent continues to be exercised while a new application is being processed (S124(1) RMA 1991).The water is taken from a location close to the Mill Bridge, adjacent to the Processing Plant.

3.9.2 Objectives

The objective is take water for elution purposes while ensuring that there are no adverse effects on the river.

3.9.3 Performance Criteria

The objective is achieved by meeting the conditions of consent relating to flow volume and rate, intake velocity and mesh screen size and ceasing the take when issued with a water shortage direction from WRC.

3.9.4 Monitoring and Reporting

The conditions of consent specify limits for the flow volume and rate. The consent flow volume is achieved by using a pump that cannot exceed 5 L/s. The water is metered and records of flow volume are forwarded to WRC in the quarterly water reports.

3.9.5 Contingency

In the event of a dry summer that results in a direction from WRC to cease the take, the Company would treat TSF2 water through the Reverse Osmosis Plant and use that for the purposes of elution water.

3.10 Service Water

3.10.1 Scope

Potable water drawn from the town supply is used:

- in the office blocks and amenities buildings,
- for all safety showers around the site,
- as a standby for pump gland water, and,
- for reagent mixing at the Water Treatment Plant.

It is also used for stock drinking water and for residential use on farms surrounding the embankments.

Treated water is used within the fire main system which travels along the conveyor. It is also used for tailings pumps and tailings boost pumps gland sealing. It is used for surface and underground drilling. It is also available for use around the open pit for dust control and irrigation, and for crushing and conveying including conveyor belt wash and vehicle washing. An underground crib room was constructed recently and treated water is used for hand washing following UV treatment (refer Appendix E).

For TSF2, the South Gully spring is used as stock drinking water on the embankment. For TSF1A, a combination of S5 subsoil drain and WG1 is used as stock drinking water on the embankment.

TSF2 pond water is used for dust control on the TSF embankments.

3.10.2 Objectives

The objectives are to:

- Provide a consistent supply of potable water where it is required while minimising the potable water take especially during dry periods,
- Ensure that a consistent supply of water is available for stock grazing on the TSF embankments and surrounding farm,
- Ensure that treated water is available for use where needed as service water around the site.

3.10.3 Performance Criteria

There are no performance criteria.

3.10.4 Monitoring and Reporting

Potable water use around the site is metered and the Hauraki District Council charges for its use. The volumes are monitored and reviewed by OGNZL and any significant increases that may indicate leaks in the system or inefficient use are investigated.

Water used for stock is sampled on a six monthly basis and checked against the Stock Drinking Water standards.

3.10.5 Contingency

If the Water Treatment Plant needs to be shut down for maintenance, the water that would normally be treated is sent to the TSF1A pond. There is sufficient water available in the compliance ponds to service the site until the Water Treatment Plant is back on line.

3.11 Water Storage Options

While the collection ponds and underground can provide some storage, the principal water storage option for the site is the Storage 1A impoundment.

3.12 Monitoring, Reporting & Calibration of Monitoring Equipment

Site documentation details the following to ensure all applicable standards are met:

- The overall monitoring and reporting requirements for the site water management system;
- Details of monitoring methods and quality control procedures;
- Calibration and maintenance schedules and procedures for monitoring equipment.

4. Definitions

Term	Description
OGNZL	Oceana Gold (New Zealand) Ltd
NAF	Non-acid forming – relates to waste rock
PAF	Potentially acid forming – relates to waste rock
WRC	Waikato Regional Council
RMA	Resource Management Act

5. Associated Documents

Item	Title	Location
Procedure	River Water Quality Sampling	SharePoint – WAI-200-PRO-017
Procedure	Collection and Silt Pond Management	SharePoint – WAI-200-PRO-018
Procedure	Water Treatment Plant Discharge Sampling	SharePoint – WAI-200-PRO-027
Procedure	Underdrain Sampling and flow Measurement	SharePoint – WAI-200-PRO-034

6. References

EGL, 1998: Extended Project Collection Pond Design. Engineering Geology Ltd.

WWC, 1997: Martha Mine Extension Site Water Management. Final Report. Woodward –Clyde.

WGC, 1999: Collection Pond Design Report. Waihi Gold Company Extended Project MP04

WRC, 1999: Reclassification of Collection Ponds Report. Waikato Regional Council, WRCDOCS-#538100-v1-Letter.

NWG, 2009: Engineering Geology Ltd letter, 11 August 2009. In: Application to Vary Discharge Permit 109744 (NWG File ref: Polishing Pond Extension Notice-b 090820).

APPENDIX A – COLLECTION POND DIRECT DISCHARGE CORRESPONDENCE

19 April 2013

Hi Kathy/Kerry,

I do apologise for taking so long to respond back to you in writing despite previously committing to getting it to you last week. However, as discussed with Kathy earlier this week the issues I raise below are largely administrative.

Overall I found the document informative and easily readable. It provides a good description of the priorities applied when determining which water process to treat and overall describes the water balance on site very well. My comments are as follows:

1. There is a reference to changes to the WMP "as required" at the beginning of the document. Please note resource consents 109743, 971311, 971318-971320, require that the WMP be updated annually – there may be additional updates "as required" but at this stage my expectation is that an annual update will be provided.
2. Who is the Surface Mining Manager referenced in s1.4?
3. Reference to Environment Waikato Regional Council on page 8.
4. Where does the scale (gypsum) get disposed of following routine maintenance?
5. Page 31 there is reference to a monitoring regime for CSP2N and CSP2S. Is there specific monitoring of these or part of the overall monitoring associated with the site in general?
6. Page 51 - are the documents referenced at the bottom of the page still available? I suggest that they are not as the web site references are incorrect.
7. The WRC Erosion Guidelines have been updated as of 2009. I will find these and send to you.
8. Page 48 WTPCP "compliance criteria" where has this come from? I note that it is not in the consent (971312).

I consider that the document sufficiently addresses the matters raised in my letter dated 1 September 2011.

Also I have reviewed the document "Request for WRC Approval to Direct Discharge Collection Ponds NCP, S3, S4 and S5". The document is in line with how I envisage the conditions allowing reclassification of the ponds working. I would like to take up NWG's offer to observe the continuous monitoring that is installed. I can incorporate this into my next site visit which is due around June/July.

The next step is to formally approve the WMP. Any approval of the WMP will not include approval of the reclassification of the ponds. I consider that to be a separate process.

Any questions feel free to ring me or email.

Regards

Sheryl

OCEANAGOLD

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19 June 2014

The General Manager,
Waikato Regional Council,
Private Bag 3038,
Waikato Mail Centre
Hamilton 3240

Attention: Ms Sheryl Roa

RE: Collection Pond Direct Discharge

Thank you for your site visit of 13 May 2014. Since your visit, NWG has been installing the necessary equipment and anticipates being in a position to be able commence direct discharge from collection ponds S3, S4 and S5 by mid June 2014. NWG intends to seek approval to direct discharge NCP at a later date. Now that winter is here, NWG is keen to commence the collection pond direct discharge as soon as possible.

We are aware that the direct discharge cannot commence until WRC grants its final approval. The purpose of this letter is to document progress and address any remaining matters in the hope that approval can be granted as soon as possible without any unforeseen delays.

The approach taken is to start with a conservative discharge and monitoring regime that can be revised as experience with the system is gained and monitoring data confirms that it is operating as required.

Background

NWG previously supplied WRC with a document entitled "Request for WRC to Direct Discharge Collection Pond NCP, S3, S4 and S5". The document has since been included as Appendix 1 to the Water Management Plan. Since then, things have progressed and in the following sections we:

- provide a description of the newly installed monitoring system,
- review and update the relevant water quality data to see whether anything has changed that is of significance,
- review the trigger limits for the continuous monitors to ensure that they remain appropriate,
- describe the proposed discharge regime,
- review the previously proposed programme of monitoring and reporting to determine whether it remains appropriate,
- consider risks and contingencies,
- request approval for the catchment of WSP, NCP, S3, S4 and S5 to contain PAF or potentially PAF material.

1. The New System

As previously described, in order for direct discharge to occur the pond water quality will have to pass two tests. The first test is that water cannot be direct discharged unless it meets the necessary pH and turbidity conditions as monitored by continuous monitors. Water that fails that test will be sent to the Water Treatment Plant. If the water passes the first test, it needs to be direct discharged at a rate that ensures that all of the site discharges will meet the receiving water criteria after mixing (the second test).

NWG has invested in the order of $225,000 to purchase equipment that will provide a robust and automated monitoring and discharge system. In doing so, NWG looked at the system that has been operating for WSP and S1 with a view to making any necessary improvements and updates.

To achieve final signoff from WRC, the assumption has been that the system will need to be appropriately responsive to ensure that out-of-spec water is not direct discharged, all necessary flows are monitored and recorded, and the system is automated to eliminate the chance of human error. With that in mind, the system has been designed as detailed below.

With the old system, S1 and WSP were monitored at 15 minute intervals using continuous monitors, however the pond instrumentation (Sonde) is aging, parts are expensive and will soon be unobtainable. In addition the sonde probes are currently located on the pump pontoons or on separate piers which is not ideal. When the pond levels are low they are either in mud, in air or are placed in bucket of water which results in premature failure of the probes. As you saw on your recent visit, the new system will use standard process instruments that will allow inline measurement. This will ensure that the probes are always wet. The proposed new in-line monitors are self-checking and maintenance/calibration can be carried out by NWG staff with a planned maintenance regime using the NWG SAP system to ensure there is a record of calibration.

The previous PLC/SCADA connections via radio telemetry were also aging (approximately 10 to 12 years old) with replacement parts no longer available. The existing radio telemetry was slow with updated every 15 minutes which limited its ability to react to process changes. The situation would be exacerbated if more ponds were added because the master could only talk to one item at a time, so 15 minutes could easily become one hour. It was considered that the system would need to react more quickly to facilitate automatic changeover from WTP to river discharge and vice versa.

Ethernet radios have been recently installed which are extremely fast. These are already used on site and have proven to be successful, and will allow continuous measurements to be taken. With the previous radio system the RTUs were no longer available and have been updated.

The previous manual control of operating the valves has been replaced with an automated control system to ensure that water goes to the WTP and is diverted and discharged to the river only when it meets consent requirements. All of this equipment has now been installed and the intention is to commence direct discharge as soon as approval from WRC has been received. In the meantime the system is being tested by pumping water without commencing direct discharge.

Monitoring will include flows from each pond to the WTP/receiving water, the pond levels and the river levels and flows which determine the treated water flow. The overall system is monitored on

the PLC/SCADA system and the data is recorded in a historical database which is accessible site wide with Active Factory.

2. Review of Site Discharge Data

The original spreadsheet included water quality data covering approximately five years ranging from 2007 to 2011. This included all of the relevant site discharges i.e. WSP, S1, S3, S4, S5, NCP, NSPSP, SSPSP, the TSF2 pond discharge and the treated water discharge as well as the upstream receiving water quality for RU10 and OC2. The spreadsheet has since been updated to include all relevant up to date data. While this has resulted in some minor changes to the maximum concentrations recorded in the ponds for some parameters, overall these have been minor.

3. Ensuring In River Compliance

The decision to commence direct discharge from S3, S4 and S5 only at this stage has meant that a more simplified spreadsheet can be used to assess the discharge conditions that ensure compliance. Combined with that, the site wanted to put in place a system that was very simple to use to essentially engineer out the possibility of human error. For that reason, the spreadsheet has been changed, and a revised version is attached. The spreadsheet indicates that provided the site discharges from S3, S4 and S5 either separately or in combination are no more than 13% of the flow measured at the Ruddocks flow gauge, then the receiving water criteria will always be met within the Ruahorehore Stream at RU1 (Ruahorehore Stream, just upstream of the Ohinemuri River confluence).

The spreadsheet uses the data from 2007 to the present for RU1 as the ambient water into which S3, S4 and S5 will discharge. This ensures that historic water quality data from S1 and SSPSP discharges and any other inputs via springs etc have been considered and incorporated. In using the RU1 data, it was noted that this data may have included some overflows from S3, S4 and S5. Unfortunately in the past, records were not always kept to indicate whether an overflow from those ponds was taking place when RU1 was sampled. There were also times when the ponds were sampled when they were not discharging and often at very low levels. For this reason, NWG has chosen to use the 97 percentile data for the parameters for the ponds and the receiving water. This is consistent with the USEPA methodology and the need to meet the chronic criteria 97% of the time, which is also transferred through to the Treated Water Discharge Consents. It ensures that any abnormally high and spurious data are excluded without any loss of integrity.

The spreadsheet is conservative for a number of reasons as described below:

- the highest 97 percentile numbers from any pond were applied for all ponds,
- acid soluble metals were used for the pond data, with the assumption being that following mixing, the metals will all be dissolved,
- the assumption is that the ponds will be discharging all parameters at the 97 percentile into the Ruahorehore Stream with parameters also at the 97 percentile at the same time.

While the spreadsheet will be overly conservative, it provides a good basis upon which to commence the direct discharge in conjunction with an appropriate monitoring programme and subsequent review.

4. Review of Trigger Limits

In the document entitled "Request for WRC to Direct Discharge Collection Pond NCP, S3, S4 and S5" it was demonstrated that all metals other than manganese would comply with the in-river standards within the ponds themselves provided that the pH remained greater than 6 and the turbidity remained less than 110 NTU. Manganese does not follow the same trend and it is for that reason that the water needed to pass a second test, with the result being that the water will not be discharged at greater than 13% of the flow measured at the Ruddocks site as explained above.

It is noted that while mercury is detectable in S5 on occasions, this is due to WG1 which at times discharges into S5. Until now, that has not been an issue because the water has been treated. Prior to the commencement of direct discharge from S5, WG1 will be rerouted from S5 to the seepage system which will result in mercury being less than the detection limit as it is in S3 and S4.

It is noted that the Collection Pond Discharges Consent 971312 and the Silt Pond Discharges Consent 971311 have a receiving water standard for pH of 6.5 to 9. To ensure that this is always met, NWG wishes to impose trigger limits for pH at a minimum of 6.5 and maximum of 9 pH units. At a pH of 9 with the aforementioned flow restriction the pH of the receiving water following mixing is expected to be no more than 7.7. At that pH the total ammonia limit will always be greater than around 2.3 g/m^3, even during summer when the temperature increases. The upper pH limit therefore provides considerable conservatism in terms of ammonia compliance.

It is possible that the trigger limits can be reviewed and revised in six months' time, but in the meantime operating the system in this way will ensure that compliance will always be achieved for pH in the river following mixing, as well as providing a high level of conservatism for total ammonia.

5. Review of Recently Recorded In-River Exceedences

NWG has reviewed the recent in-river data to ensure that nothing has happened in the interim that would change the proposal. It is noted that NWG wrote to WRC in February 2014 to advise that there were some pHs recorded in the Ruahorehore Stream that were less than pH 6.5. The cause has not yet been established. In any case, NWG's decision to increase the trigger limit for pH in collection ponds S3, S4, S5 and NCP will ensure that the receiving water standards for pH are complied with as a result of these discharges.

NWG also wrote to WRC in February 2014 to advise of a breach in the copper limit at OH3 on 25 September 2013. The recorded copper concentration was 0.0045 g/m^3 and the allowable concentration (with a hardness of 11.6 g/m^3) was 0.002 g/m^3. Site OH3 is upstream of the first treated water discharge point. Although NSPSP was discharging that day, it is highly unlikely that NSPSP would have been the cause because the maximum copper result recorded in NSPSP since 2007 is 0.0037 g/m^3 which is well below that recorded in the river. The TSF2 pond was not

discharging that day. This result remains unexplained and NWG does not believe that it was caused by mine related activities.

In summary, no changes to the proposal are required as a result of these investigations.

6. Review of Potential Impact of Lower Treated Water Discharge

While the spreadsheet indicates that a discharge rate of 13% of the Ruahorehore Stream flow will ensure that the receiving water standards will be complied with at RU1, NWG wanted to be sure that the combined discharges would still achieve compliance at OH6 (downstream of the 2nd treated water discharge point).

It is noted that the treated water discharge has very stringent limits for both manganese and iron. The maximum limit for manganese for Regime A is 1.3 g/m^3 compared to 2 g/m^3 in the receiving water. While Regime A has a maximum limit of 6.7 g/m^3 for iron, the normal compliance limit to be met 97% of the time is 1 g/m^3 which is the same as the receiving water criteria. For this reason, iron and manganese could not be pushed over the limit by the treated water.

The critical species for treated water have always been silver, copper and ammonia. There is no silver in the pond water. At OH6, the 97 percentile data shows that the copper discharged from the site makes up only around 24% of what could have been discharged while still meeting the consent conditions. For ammonia the figure is 47%. In summary, it is not conceivable that the collection pond direct discharges will result in exceedances of the receiving water criteria at OH6 if they are discharged at 13% of the Ruahorehore Stream flow measured at Ruddocks.

7. Proposed Monitoring, Reporting and Review

In the document entitled "Request for WRC to Direct Discharge Collection Pond NCP, S3, S4 and S5" NWG proposed a programme of monitoring and review in Section 5. NWG has scaled down the monitoring programme on the basis that discharge will only be occurring from S3, S4 and S5 only.

In summary, the proposal is to monitor as follows:

Frequency	Site	Parameters
Continuously	Ponds S3, S4,S5, Torrens (Ruddocks)	Pond flows to river/WTP, stream flow at Ruddocks, pH and turbidity within ponds
During each discharge event (or daily if discharge occurs >1 day)	Pond discharge(s), RU10 (upstream site), RU1 (downstream site).	pH, temperature, suspended solids, hardness, cyanide (WAD), total ammonia, manganese, iron, copper,
Two Monthly	Pond Discharges, RU10, RU1.	pH, temperature, conductivity, suspended solids, hardness, cyanide (WAD), total ammonia, iron, manganese, copper, nickel, zinc, silver, antimony, arsenic, selenium, cadmium, chromium (VI), lead, mercury

Pond discharges will be tested for acid soluble metals and stream samples will be tested for soluble metals, with the exception of mercury which will always be based on acid soluble concentrations from unfiltered samples.

In addition, NWG will keep records of all S3, S4 and S5 pond flows entering the receiving waters as well as flows to the WTP. NWG intends to forward the results of the monitoring programme to WRC every month for the first six months.

NWG has arranged a rapid turnaround of results for hardness, manganese and copper with Hills Laboratory for the first fourteen days of direct discharge to ensure that in the unlikely event of an in-river exceedence the issue can be identified early so that the discharge can cease. These results will be checked within one day of being received and any exceedences, should they occur, will be reported to WRC forthwith.

After six months if the results are as expected, the reporting frequency will be reduced to quarterly as required by the conditions of consent. It is proposed that following a six month timeframe a review of the monitoring programme will be carried out and that some changes may be proposed if required at that time.

8. Request for Approval for Ponds to Contain PAF or Potentially PAF Material

Condition 6 of the Silt Pond Discharges Consent 971311 states the following:

"Unless otherwise agreed by the Waikato Regional Council in writing, the contributing catchments to silt ponds shall contain no contaminated or potentially acid-forming soil or rock. In this regard, "non-acid-forming " is defined as :

(i) NAGpH no less than 4; and,
(ii) NAPP is equal to or less than 0,

where NAGpH is the pH of the solution produced from a Net Acid Generation test, NAPP is Net Acid Producing Potential (MPA-ANC), MPA is total Maximum Potential Acidity, and ANC is total Acid Neutralising Capacity."

WSP has been receiving overflows from NCP for some time now and during those times, it has been difficult to meet condition 6. In addition, once S3, S4 and S5 are reclassified to silt ponds, they will not be able to meet condition 6. Condition 6 was recently changed to add the words underlined above. NWG seeks WRC's agreement in writing to allow the catchments of ponds WSP, S3, S4 and S5 to contain contaminated or potentially contaminated material. The justification is as follows:

- While PAF or potentially PAF material is located within the catchment of these ponds, it is well managed and monitored to ensure that the pH and metals levels in the pond water remain acceptable,
- The site has a good record of limestone addition and monitoring that was not available when the consent was granted, and,
- The proposed new system with continuous monitors and the spreadsheet model will ensure that any discharges comply with the in-river standards.

9. Risks and Contingencies

As previously mentioned, NWG will be introducing pond pH triggers of 6.5 and 9.0 to eliminate the risk that the receiving water standards may not be met after mixing.

The only other risk that has been identified is that occasionally, some of the underdrainage water can flow from the manholes to the collection ponds for short periods due to pump failure. Until now, this has not been an issue because all of the collection pond water has been treated. However when the new system commences condition 8 of the Tailings and Waste Rock Disposal Consents becomes relevant:

"The consent holder shall, unless otherwise authorised in writing by Waikato Regional Council, collect all underdrainage flow from the tailings storage facility and divert it to the Water Treatment Plan for treatment or for use in the process plant."

NWG seeks the approval of WRC to discharge any underdrainage water that might find its way to the collection ponds between the time that the issue is picked up and corrective action is taken. The justification is as follows:

- Overflows of underdrainage are infrequent, and the volumes are small,
- Any overflow is expected to be of short duration and is unlikely to have a measurable effect on the pond water quality,

- The data in the spreadsheet already accounts for those instances when these overflows have occurred in the past and has not highlighted any issues, and,
- The continuous monitors within the ponds will ensure that out-of spec discharges are avoided.

Overall, the new system is expected to reduce risks because up until now it has been difficult to manage all of the wastewater streams at times under high rainfall conditions. The new system will reduce the load on the WTP allowing waters with greater priority to be treated.

We look forward to your next site visit on 25 June 2014.

Kind regards,

Kathy Mason.

Kathy Mason,
Senior Environmental Officer - Permitting

7 July 2014

The General Manager
Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
HAMILTON 3240

Attention: Ms S Roa

Re: Collection Pond Direct Discharge

Dear Sheryl,

Thank you for visiting site on 25 June 2014 to:

- discuss the letter that we forwarded to you on 19 June 2014,
- catch up on progress and,
- inspect the new instrumentation.

You will recall that when you visited, the new equipment had all been installed but there were a few small practical issues still to be resolved. The main issue was that water was siphoning back leaving the sampling chamber dry when the pumps turned off. Non-return valves have since been ordered and installed so this issue has now been resolved.

The system has now been changed over from the old original sondes to the new in-line pH and turbidity probes, and as discussed, invalid data from the meters that will be collected when the pump is not running will be recorded as “zeros” to ensure no confusion with relevant data. WG1 has also been diverted away from S5 to the seepage system. With these changes now made, from a practical perspective NWG is ready to commence the direct discharge.

Accordingly, we formally seek your written approval to allow the direct discharge to commence subject to the conditions described below. Referring again to our letter of 19 June, we require approval to:

- Reclassify the collection ponds to silt ponds subject to their water quality, (refer Collection Pond Discharge Consent condition 13),
- Allow the catchments of WSP, S3, S4 and S5 to contain potentially acid forming material (refer Silt Ponds Discharge Consent 971311 condition 6),
- Authorise limited volumes of discharge of underdrainage water via the collection ponds (when classified as silt ponds).

The conditions are as follows:

- in order for the collection ponds to be classified as silt ponds and allowed to direct discharge, the water quality within the individual ponds must be between the range 6.5 to 9, and turbidity must be less than or equal to 110 NTU (equivalent to 100 g/m^3 suspended solids), AND
- flow from S3, S4 and S5 either individually (if discharged one at a time) or in combination will be managed such that it does not exceed 13% of the flow measured at the Ruddock’s flow gauge in the Ruahorehore Stream,
- provided the above two conditions are met, the Silt Pond Discharge Consent 971311 will apply and the conditions of that consent (which includes the receiving water standards) will be complied with,
- if the ponds do not meet these conditions then they will be classified as collection ponds and the conditions of the Collection Ponds consent 971312 will apply,
- NWG will advise you via email when pond discharges to the Ruahorehore Stream commence and again when they cease, until you advise that this is no longer necessary,
- the discharge will be subject to the monitoring regime as specified in the letter dated 19 June,

- following six months of operation, the data will be reviewed with a view to making any necessary improvements at that time (also referred to in the letter dated 19 June).

In closing, we would like to thank you for the various site visits and discussions that we have had with you, and also previously for your assistance in changing the necessary conditions of consent 971311 and 971312 to make this possible. We look forward to receiving approval to commence.

If you have any further queries please contact me on 021 190 2690 or at kerry.watson@newmont.com.

Yours sincerely,

Kerry Watson

Environment Manager

IRIS Document No:11391
File No:60 59 02A

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

17 July 2014

401 Grey Street
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Waihi Gold Company Ltd
PO Box 190
Waihi 3641
Attn: Kerry Watson

Dear Kerry

Reclassification of Collection Ponds S3, S4 and S5

I have reviewed the documentation provided being "Request for WRC Approval to Direct Discharge Collection Ponds NCP, S3, S4 and S5", your letter titled "Re: Collection Pond Direct Discharge" and the associated draft documents supplied by Kathy Mason on this matter. I ntoe that the original request for the collection pond titled NCP to be reclassified has subsequently been withdrawn.

Following a review of the documents and subsequent meetings on site I note that the continuous monitoring programme that is in place is key to the discharge of water occurring direct without any further treatment. Further early detection of the water quality is essential to enable for further treatment if necessary. Approval is given as follows:

1. In accordance with condition 13 of resource consent number 971312 direct discharges from S3, S4 and S5 into the Ohinemuri River and Ruahorehore Stream are authorised and are now subject to the conditions of resource consent number 971311. Consequently these ponds are now considered silt ponds unless compliance with condition 8b of resource consent number 971311 cannot be achieved in which case they will revert back to being collection ponds and again be subject to the conditions of 971312; and
2. The catchments of WSP, S3, S4 and S5 may contain potentially acid forming material subject to the conditions of resource consent number 971311. (in accordance with condition 6 of resource consent 971311);
3. Following mixing within the ponds, limited volumes of under drainage are permitted to be discharged direct to waterways under circumstances when under drainage overflows from the manholes to the collection ponds occur for short periods following pump failure. This is authorised for the volume entering the ponds between the time that the issue occurs and is picked up and corrective action is taken (in accordance with condition 8 of resource consents 971303, 971304, 971305 and 971306).

Should you require any further information with regard to the above, please contact me on 07 859 0731 or email at Sheryl.Roa@waikatoregion.govt.nz.

Yours faithfully

S. S. Roa

Sheryl Roa
Principal Project Leader
Resource Use Group

18 February 2015

Waikato Regional Council

401 Grey Street,

Private Bag 3038,

Waikato Mail Centre,

HAMILTON EAST 3240

For: Sheryl Roa

Dear Sheryl,

Re: Collection/Silt Pond Direct Discharge Weekend/Public Holiday Sampling

The direct discharge of pond S3 commenced on 22 July 2014, followed by S4 on 23 July 2014 and S5 on 5 September 2014. The attached table shows the number of days that direct discharge occurred for each of the ponds and the volumes of water discharged. During each day that the ponds discharged, water quality monitoring of the discharge and the Ruahorehore Stream, upstream and downstream of the discharge has been undertaken.

In summary, S3 has direct discharged for 37 days or part days, S4 has direct discharged for 30 days or part days and S5 has direct discharged for 24 days or part days. When added together, this discharge and associated sampling has been undertaken over 51 days (with more than one pond sometimes discharging on the same day). When the ponds have direct discharged on the weekends and during public holidays, it has been necessary for an on-call environmental staff member to sample during those times.

NWG's original intention was to undertake a review of the direct discharge after approximately six months to review the discharge and monitoring regime, identify any necessary improvements and seek WRC's approval to implement them. However NWG is of the view that the best time to do that is following the autumn sampling of sediment, periphyton, macrophytes and macroinvertebrates which is timed to occur in March/April 2015. The summer fish survey is being carried out this week.

In the interim however, NWG wishes to discontinue sampling during the weekends and on public holidays. The reasoning is as follows:

- Sampling has been undertaken every day that the collection ponds have been direct discharged, and for all Ruahorehore downstream samples there has been 100% compliance with the receiving water standards[5],

- NWG now has confidence that the continuous monitors are working the way that they were intended to,

- The requirement for PAF slurry testing on the waste rock embankment provides good control in terms of limestone addition and in combination with the continuous monitors will ensure that the water quality remains of a high standard,

- For now, the existing water quality monitoring will continue at all other times except weekends and public holidays.

You will recall that at the commissioning stage, NWG paid extra for a rapid turnaround of results from Hill Laboratories. Subsequent to that, and once NWG had confidence that the system was working as it should, the laboratory turnaround time reverted back to normal. For that reason, the laboratory data will not stop an out-of-spec discharge. It simply provides confirmation that the continuous monitors are working as intended to prevent an out-of-spec discharge.

In summary, we seek your approval to discontinue the laboratory sampling on the weekends and public holidays. Once approved, the Water Management Plan will be amended and a full review of all of the data will take place following the autumn sampling in March/April. At that time we may approach you again with any proposed amendments to the discharge/monitoring regime.

We look forward to your response.

Kind regards,

Kerry Watson

Environmental Manager

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[5] The one exception is for suspended solids where elevated levels have been measured at the downstream site due to other discharges (not NWG's) into tributaries of the Ruahorehore Stream

	Collection Pond Discharge Volumes (m^3)		
	S3	S4	S5
22-Jul-14	469.00		
23-Jul-14		739.00	
30-Jul-14	976.00		
03-Aug-14	2,257.00		
04-Aug-14		1,323.91	
12-Aug-14	976.86		
14-Aug-14	1,250.80		
15-Aug-14	1,798.68		
16-Aug-14	1,057.95	1,782.29	
17-Aug-14		814.85	
18-Aug-14	115.58		
19-Aug-14	2,138.20		
20-Aug-14	3,729.06	2,962.47	
21-Aug-14	4,000.71	5,187.75	
22-Aug-14	4,791.95	3,054.70	
23-Aug-14	2,321.37		
31-Aug-14	1,555.34		
01-Sep-14	4,567.30	3,305.91	
02-Sep-14	3,905.55	436.39	
04-Sep-14		470.69	
05-Sep-14	3,253.24	2,054.01	107.78
06-Sep-14	3,181.69	435.77	2,911.81
07-Sep-14	1,053.91	953.78	
11-Sep-14		468.82	330.62
12-Sep-14	45.48	740.04	2,245.44
13-Sep-14	3,023.05	3,871.33	4,200.26
14-Sep-14	4,791.95	6,366.95	4,501.44
15-Sep-14	4,792.50	463.64	1,012.41
16-Sep-14	550.25		
19-Sep-14	2,615.36	505.84	2,212.90
20-Sep-14	2,536.03	2,787.87	200.24
21-Sep-14	3,434.62	1,841.11	4,620.55
22-Sep-14	3,156.73	1,070.29	1,296.30
23-Sep-14			190.26
29-Sep-14	837.02	0.99	
30-Sep-14		498.23	52.70
05-Oct-14	1,897.59		
06-Oct-14		522.99	3.88
07-Oct-14	193.58		
10-Oct-14	434.32	203.44	1.11
19-Oct-14	105.39		616.27
22-Oct-14	76.55		
17-Nov-14	3,086.84		
14-Dec-14	363.88	178.05	3,135.65
15-Dec-14	560.23	196.17	1,137.66
17-Dec-14			2,959.26
18-Dec-14		938.80	4,792.50
19-Dec-14		1,403.41	4,791.95
20-Dec-14			4,792.50
21-Dec-14			4,791.95

22-Dec-14			662.85

File No: 60 59 02A
Document No: 18262
Enquiries to: Sheryl Roa

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18 February 2015

Waihi Gold Company Limited
PO Box 190
Waihi 3641
Attn: Kerry Watson

Dear Kerry

Re: Collection/Silt Pond Direct Discharge Weekend/Public Holiday Sampling

This letter is in reply to your letter dated 18th February requesting that the current practice of taking manual samples when direct discharges occur on weekends or public holidays cease.

Following an assessment of your letter I agree that this practice is not required for the reasons outlined within your letter. As discussed I will provide approval for this via the updated Water Management Plan – soon to be submitted.

Should you require any further information with regard to the above, please contact me on 07 859 0731 or email at Sheryl.Roa@waikatoregion.govt.nz. If responding in writing, please quote your file number 60 59 02A

Yours faithfully

S. S. Roa

Sheryl Roa
Principal Advisor - Consents
Resource Use

File No: 60 59 02A
Document No: 33657
Enquiries to: 847

Waikato
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23 June 2016

Waihi Gold Company Limited
PO Box 190
Waihi 3641
Attn: Kerry Watson

Dear Kerry

Request for Cessation of Sampling During Direct Discharge Events

I refer to your letter dated 12 April 2016. Your request to cease sampling of collection/silt pond water during direct discharge events has been considered. Dr Ngaire Philips has undertaken a technical assessment of your request and her assessment is attached for your information.

Given Dr Philips assessment and consideration of the matters the Waikato Regional Council assesses compliance for, it is agreed that the direct sampling currently occurring can cease and further the supply of SCADA data from direct discharge events can now be provided as part of the quarterly reporting requirements as per the conditions of consents.

Thank you for undertaking this exercise.

Should you require any further information with regard to the above, please contact me on 07 859 0731 or email at Sheryl.Roa@waikatoregion.govt.nz

Yours faithfully

S. S. Roa

Sheryl Roa
Principal Advisor - Consents
Resource Use Directorate

Attachment 2 – Spreadsheet Model Results for Identified Scenarios

10 February 2012 – Rainfall and Flow Data

Table 1 - Flow Calculation Sheet

					Rainfall (mm)	
		Enter flow data & rainfall only			24.0	
Silt Ponds	**To Ohinemur**	**To Ruahorehore,**	**OH1**	**RU1**	**OH5**	**OH6**
WSP	4704		3.8		4.5	3.6
S1		1382.4	1.1	7.6	0.0	1.1
NSPSP	2342.4		1.9		2.2	1.8
SSPSP		710.4	0.6	3.9	0.0	0.6
St 2 Disch	0.0		0.0		0.0	0.0
Collection ponds						
S3		190.0	0.2	1.0	0.0	0.1
S4		0.0	0.0	0.0	0.0	0.0
S5		0.0	0.0	0.0	0.0	0.0
NCP	0.0		0.0		0.0	0.0
Treated water	**To Upper DP, Flow**	**To Lower DP, m3/day**				
Regime A			0.0		0.0	0.0
Regime B			0.0		0.0	0.0
Regime D	7266.0	5909.0	5.9		6.9	10.2
Rivers						
Frendrups	93100.0					
OC2	90757.6		73.7		86.4	70.3
Ruddocks	18100.0					
Ruahorehore	15817.2		12.8	87.4		12.3
Total flow at OH1	123170		100.0	100.0	100.0	100.0
Total flow at Ruahorehore	18100					
Resultant OH5	105070.0					
Resultant OH6	129079					
Hardness (g/m3 in receiving water)			101.7	45.4	111.4	157.9

10 February 2012 – Compliance Status

	Compliance at OH1 (d/s Ruahorehore Confluence)			Compliance at RU1 (lower Ruahorehore Stream)			Compliance at OH5 (u/s Ruahorehore Confluence)			Compliance at OH6		
	Resultant	Consent Condition	Compliance Status at OH1	Resultant	Consent Condition	Compliance Status at RU1	Resultant	Consent Condition	Compliance Status at OH5	Resultant	Consent Condition	Compliance Status at OH6
CN (WAD)	0.0059	0.093	Compliance	0.0048	0.093	Compliance	0.0060	0.093	Compliance	0.0076	0.093	Compliance
Fe	0.35	1	Compliance	0.70	1	Compliance	0.29	1	Compliance	0.34	1	Compliance
Mn	0.68	2	Compliance	0.83	2	Compliance	0.65	2	Compliance	0.65	2	Compliance
Cu	0.003	0.012	Compliance	0.002	0.006	Compliance	0.003	0.012	Compliance	0.003	0.017	Compliance
Ni	0.005	0.159	Compliance	0.003	0.081	Compliance	0.005	0.172	Compliance	0.005	0.231	Compliance
Zn	0.018	0.106	Compliance	0.013	0.054	Compliance	0.018	0.115	Compliance	0.017	0.154	Compliance
Ag	0.00026	0.0029	Compliance	0.00010	0.00086	Compliance	0.00029	0.00335	Compliance	0.00032	0.00567	Compliance
Sb	0.0039	0.03	Compliance	0.0002	0.03	Compliance	0.0045	0.03	Compliance	0.0058	0.03	Compliance
As	0.0013	0.19	Compliance	0.0012	0.19	Compliance	0.0013	0.19	Compliance	0.0015	0.19	Compliance
Se	0.0023	0.006	Compliance	0.0013	0.006	Compliance	0.0025	0.006	Compliance	0.0031	0.006	Compliance
Hg	0.00008	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.000084	0.000012	LOD Issue
Cd	0.0001	0.0010	Compliance	0.00028	0.0006	Compliance	0.00010	0.0011	Compliance	0.00013	0.0014	Compliance
Cr(VI)	0.014	0.01	LOD Issue	0.010	0.01	Compliance	0.014	0.01	LOD Issue	0.014	0.01	LOD Issue
Pb	0.00062	0.0026	Compliance	0.00029	0.0011	Compliance	0.00067	0.0028	Compliance	0.00061	0.0041	Compliance

16 March 2012 – S3 and S5 Discharging to Ruahorehore Stream, Rainfall and Flow Data

Table 1 - Flow Calculation Sheet

					Rainfall (mm)	
		Enter flow data & rainfall only			5.0	
Silt Ponds	To Ohinemur	To Ruahorehore,	OH1	RU1	OH5	OH6
WSP	980		0.7		0.8	0.6
S1		288	0.2	1.1	0.0	0.2
NSPSP	488		0.3		0.4	0.3
SSPSP		148	0.1	0.6	0.0	0.1
St 2 Disch	5202.0		3.5		4.2	3.4
Collection ponds						
S3		2208.0	1.5	8.7	0.0	1.4
S4		0.0	0.0	0.0	0.0	0.0
S5		1488.0	1.0	5.9	0.0	1.0
NCP	0.0		0.0		0.0	0.0
Treated water	To Upper DP, Flow	To Lower DP, m3/day				
Regime A	7664.0	6306.0	5.2		6.2	9.0
Regime B			0.0		0.0	0.0
Regime D			0.0		0.0	0.0
Rivers						
Frendrups	114300.0					
OC2	108610.0		73.2		88.3	70.2
Ruddocks	25400.0					
Ruahorehore	21268.0		14.3	83.7		13.8
Total flow at OH1	148344		100.0	100.0	100.0	100.0
Total flow at Ruahorehore	25400					
Resultant OH5	122944.0					
Resultant OH6	154650					
Hardness (g/m3 in receiving water)			114.0	151.4	106.2	162.7

16 March 2012 – S3 and S5 Discharging to Ruahorehore Stream, Compliance Status

Table 2 - In-River Compliance Calculator

	Compliance at OH1 (d/s Ruahorehore Confluence)			Compliance at RU1 (lower Ruahorehore Stream)			Compliance at OH5 (u/s Ruahorehore Confluence)			Compliance at OH6		
	Resultant	Consent Condition	Compliance Status at OH1	Resultant	Consent Condition	Compliance Status at RU1	Resultant	Consent Condition	Compliance Status at OH5	Resultant	Consent Condition	Compliance Status at OH6
CN (WAD)	0.0067	0.093	Compliance	0.0127	0.093	Compliance	0.0055	0.093	Compliance	0.0090	0.093	Compliance
Fe	0.34	1	Compliance	0.81	1	Compliance	0.24	1	Compliance	0.33	1	Compliance
Mn	0.62	2	Compliance	2.39	2	Non Compliance	0.25	2	Compliance	0.60	2	Compliance
Cu	0.005	0.013	Compliance	0.003	0.016	Compliance	0.006	0.012	Compliance	0.006	0.017	Compliance
Ni	0.008	0.176	Compliance	0.025	0.223	Compliance	0.005	0.165	Compliance	0.009	0.237	Compliance
Zn	0.018	0.117	Compliance	0.028	0.149	Compliance	0.016	0.110	Compliance	0.018	0.158	Compliance
Ag	0.00028	0.0035	Compliance	0.00013	0.00532	Compliance	0.00031	0.00311	Compliance	0.00035	0.00593	Compliance
Sb	0.0051	0.03	Compliance	0.0006	0.03	Compliance	0.0060	0.03	Compliance	0.0084	0.03	Compliance
As	0.0013	0.19	Compliance	0.0015	0.19	Compliance	0.0013	0.19	Compliance	0.0014	0.19	Compliance
Se	0.0031	0.006	Compliance	0.0018	0.006	Compliance	0.0034	0.006	Compliance	0.0045	0.006	Compliance
Hg	0.00008	0.000012	LOD Issue	0.00009	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.000083	0.000012	LOD Issue
Cd	0.0001	0.0011	Compliance	0.00037	0.0014	Compliance	0.00006	0.0011	Compliance	0.00012	0.0015	Compliance
Cr(VI)	0.014	0.01	LOD Issue	0.010	0.01	Compliance	0.014	0.01	LOD Issue	0.014	0.01	LOD Issue
Pb	0.00054	0.0029	Compliance	0.00032	0.0039	Compliance	0.00059	0.0027	Compliance	0.00053	0.0043	Compliance

16 March 2012 – S3 and S5 Discharging to Ohinemuri River, Rainfall and Flow Data

Table 1 - Flow Calculation Sheet

					Rainfall (mm)	
		Enter flow data & rainfall only			5.0	
Silt Ponds	**To Ohinemur**	**To Ruahorehore,**	**OH1**	**RU1**	**OH5**	**OH6**
WSP	980		0.6		0.8	0.6
S1		288	0.2	1.1	0.0	0.2
NSPSP	488		0.3		0.4	0.3
SSPSP		148	0.1	0.6	0.0	0.1
St 2 Disch	5202.0		3.4		4.1	3.3
Collection ponds						
S3	2208.0		1.5	0.0	1.7	1.4
S4		0.0	0.0	0.0	0.0	0.0
S5	1488.0		1.0	0.0	1.2	0.9
NCP	0.0		0.0		0.0	0.0
Treated water	**To Upper DP, Flow**	**To Lower DP, m3/day**				
Regime A	7664.0	6306.0	5.0		6.1	8.8
Regime B			0.0		0.0	0.0
Regime D			0.0		0.0	0.0
Rivers						
Frendrups	114300.0					
OC2	108610.0		71.4		85.8	68.6
Ruddocks	25400.0					
Ruahorehore	24964.0		16.4	98.3		15.8
Total flow at OH1	152040		100.0	100.0	100.0	100.0
Total flow at Ruahorehore	25400					
Resultant OH5	126640.0					
Resultant OH6	158346					
Hardness (g/m3 in receiving water)			111.6	18.3	130.3	159.3

16 March 2012 – S3 and S5 Discharging to Ohinemuri River, Compliance Status

Table 2 - In-River Compliance Calculator

	Compliance at OH1 (d/s Ruahorehore Confluence)			Compliance at RU1 (lower Ruahorehore Stream)			Compliance at OH5 (u/s Ruahorehore Confluence)			Compliance at OH6		
	Resultant	Consent Condition	Compliance Status at OH1	Resultant	Consent Condition	Compliance Status at RU1	Resultant	Consent Condition	Compliance Status at OH5	Resultant	Consent Condition	Compliance Status at OH6
CN (WAD)	0.0066	0.093	Compliance	0.0019	0.093	Compliance	0.0075	0.093	Compliance	0.0088	0.093	Compliance
Fe	0.35	1	Compliance	0.71	1	Compliance	0.28	1	Compliance	0.34	1	Compliance
Mn	0.60	2	Compliance	0.20	2	Compliance	0.69	2	Compliance	0.59	2	Compliance
Cu	0.005	0.012	Compliance	0.002	0.003	Compliance	0.006	0.014	Compliance	0.006	0.017	Compliance
Ni	0.008	0.172	Compliance	0.001	0.037	Compliance	0.010	0.197	Compliance	0.009	0.233	Compliance
Zn	0.018	0.115	Compliance	0.005	0.025	Compliance	0.020	0.131	Compliance	0.017	0.155	Compliance
Ag	0.00027	0.0034	Compliance	0.00010	0.00022	Compliance	0.00031	0.00424	Compliance	0.00034	0.00574	Compliance
Sb	0.0050	0.03	Compliance	0.0002	0.03	Compliance	0.0059	0.03	Compliance	0.0082	0.03	Compliance
As	0.0013	0.19	Compliance	0.0010	0.19	Compliance	0.0014	0.19	Compliance	0.0014	0.19	Compliance
Se	0.0030	0.006	Compliance	0.0010	0.006	Compliance	0.0035	0.006	Compliance	0.0044	0.006	Compliance
Hg	0.00008	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.000083	0.000012	LOD Issue
Cd	0.0001	0.0011	Compliance	0.00029	0.0003	Compliance	0.00009	0.0013	Compliance	0.00012	0.0015	Compliance
Cr(VI)	0.014	0.01	LOD Issue	0.010	0.01	Compliance	0.014	0.01	LOD Issue	0.013	0.01	LOD Issue
Pb	0.00053	0.0028	Compliance	0.00020	0.0004	Compliance	0.00060	0.0034	Compliance	0.00052	0.0042	Compliance

4 July 2012 – Rainfall and Flow Data

Table 1 - Flow Calculation Sheet

					Rainfall (mm)	
		Enter flow data & rainfall only			4.0	
Silt Ponds	**To Ohinemur**	**To Ruahorehore,**	**OH1**	**RU1**	**OH5**	**OH6**
WSP	784		0.1		0.2	0.1
S1		230.4	0.0	0.1	0.0	0.0
NSPSP	390.4		0.1		0.1	0.1
SSPSP		118.4	0.0	0.1	0.0	0.0
St 2 Disch	0.0		0.0		0.0	0.0
Collection ponds						
S3		6960.0	1.0	3.7	0.0	1.0
S4		4092.0	0.6	2.2	0.0	0.6
S5		0.0	0.0	0.0	0.0	0.0
NCP	7272.0		1.1		1.5	1.1
Treated water	**To Upper DP, Flow**	**To Lower DP, m3/day**				
Regime A			0.0		0.0	0.0
Regime B	19826.0	5682.0	3.0		4.1	3.8
Regime D			0.0		0.0	0.0
Rivers						
Frendrups	454600.0					
OC2	454209.6		67.8		94.1	67.2
Ruddocks	187600.0					
Ruahorehore	176199.2		26.3	93.9		26.1
Total flow at OH1	670082		100.0	100.0	100.0	100.0
Total flow at Ruahorehore	187600					
Resultant OH5	482482.0					
Resultant OH6	675764					
Hardness (g/m3 in receiving water)			70.1	71.7	69.6	77.5

4 July 2012 – Compliance Status

Table 2 - In-River Compliance Calculator

	Compliance at OH1 (d/s Ruahorehore Confluence)			Compliance at RU1 (lower Ruahorehore Stream)			Compliance at OH5 (u/s Ruahorehore Confluence)			Compliance at OH6		
	Resultant	Consent Condition	Compliance Status at OH1	Resultant	Consent Condition	Compliance Status at RU1	Resultant	Consent Condition	Compliance Status at OH5	Resultant	Consent Condition	Compliance Status at OH6
CN (WAD)	0.0106	0.093	Compliance	0.0059	0.093	Compliance	0.0125	0.093	Compliance	0.0113	0.093	Compliance
Fe	0.38	1	Compliance	0.74	1	Compliance	0.25	1	Compliance	0.38	1	Compliance
Mn	0.56	2	Compliance	0.98	2	Compliance	0.40	2	Compliance	0.56	2	Compliance
Cu	0.008	0.008	Compliance	0.002	0.009	Compliance	0.010	0.008	Non Compliance	0.008	0.009	Compliance
Ni	0.007	0.116	Compliance	0.010	0.119	Compliance	0.005	0.116	Compliance	0.007	0.127	Compliance
Zn	0.016	0.077	Compliance	0.015	0.079	Compliance	0.017	0.077	Compliance	0.016	0.084	Compliance
Ag	0.00018	0.0017	Compliance	0.00011	0.00172	Compliance	0.00020	0.00164	Compliance	0.00018	0.00193	Compliance
Sb	0.0046	0.03	Compliance	0.0004	0.03	Compliance	0.0062	0.03	Compliance	0.0055	0.03	Compliance
As	0.0012	0.19	Compliance	0.0012	0.19	Compliance	0.0012	0.19	Compliance	0.0013	0.19	Compliance
Se	0.0029	0.006	Compliance	0.0013	0.006	Compliance	0.0036	0.006	Compliance	0.0033	0.006	Compliance
Hg	0.00009	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.00010	0.000012	LOD Issue	0.00009	0.000012	LOD Issue
Cd	0.0001	0.0008	Compliance	0.00032	0.0008	Compliance	0.00007	0.0008	Compliance	0.00014	0.0009	Compliance
Cr(VI)	0.013	0.01	LOD Issue	0.010	0.01	Compliance	0.015	0.01	LOD Issue	0.013	0.01	LOD Issue
Pb	0.00048	0.0017	Compliance	0.00025	0.0017	Compliance	0.00057	0.0017	Compliance	0.00048	0.0019	Compliance

14 August 2012 – Rainfall and Flow Data

Table 1 - Flow Calculation Sheet

					Rainfall (mm)	
		Enter flow data & rainfall only			1.0	
Silt Ponds	**To Ohinemur**	**To Ruahorehore,**	**OH1**	**RU1**	**OH5**	**OH6**
WSP	196		0.0		0.0	0.0
S1		57.6	0.0	0.0	0.0	0.0
NSPSP	97.6		0.0		0.0	0.0
SSPSP		29.6	0.0	0.0	0.0	0.0
St 2 Disch	4806.0		0.8		1.2	0.8
Collection ponds						
S3		6120.0	1.1	3.5	0.0	1.1
S4		5280.0	0.9	3.1	0.0	0.9
S5		5184.0	0.9	3.0	0.0	0.9
NCP	435.0		0.1		0.1	0.1
Treated water	**To Upper DP, Flow**	**To Lower DP, m3/day**				
Regime A			0.0		0.0	0.0
Regime B	19576.0	6079.0	3.4		4.9	4.4
Regime D			0.0		0.0	0.0
Rivers						
Frendrups	380300.0					
OC2	375396.4		65.5		93.7	64.8
Ruddocks	172800.0					
Ruahorehore	156128.8		27.2	90.4		26.9
Total flow at OH1	573307		100.0	100.0	100.0	100.0
Total flow at Ruahorehore	172800					
Resultant OH5	400507.0					
Resultant OH6	579386					
Hardness (g/m3 in receiving water)			71.8	89.6	64.2	80.9

14 August 2012 – Compliance Status

Table 2 - In-River Compliance Calculator

	Compliance at OH1 (d/s Ruahorehore Confluence)			Compliance at RU1 (lower Ruahorehore Stream)			Compliance at OH5 (u/s Ruahorehore Confluence)			Compliance at OH6		
	Resultant	Consent Condition	Compliance Status at OH1	Resultant	Consent Condition	Compliance Status at RU1	Resultant	Consent Condition	Compliance Status at OH5	Resultant	Consent Condition	Compliance Status at OH6
CN (WAD)	0.0067	0.093	Compliance	0.0079	0.093	Compliance	0.0062	0.093	Compliance	0.0076	0.093	Compliance
Fe	0.40	1	Compliance	0.75	1	Compliance	0.24	1	Compliance	0.39	1	Compliance
Mn	0.49	2	Compliance	1.28	2	Compliance	0.14	2	Compliance	0.49	2	Compliance
Cu	0.003	0.009	Compliance	0.002	0.010	Compliance	0.004	0.008	Compliance	0.004	0.009	Compliance
Ni	0.006	0.119	Compliance	0.015	0.143	Compliance	0.002	0.108	Compliance	0.006	0.131	Compliance
Zn	0.016	0.079	Compliance	0.018	0.095	Compliance	0.016	0.072	Compliance	0.016	0.087	Compliance
Ag	0.00017	0.0017	Compliance	0.00011	0.00241	Compliance	0.00020	0.00145	Compliance	0.00017	0.00207	Compliance
Sb	0.0046	0.03	Compliance	0.0004	0.03	Compliance	0.0065	0.03	Compliance	0.0059	0.03	Compliance
As	0.0012	0.19	Compliance	0.0012	0.19	Compliance	0.0012	0.19	Compliance	0.0013	0.19	Compliance
Se	0.0029	0.006	Compliance	0.0015	0.006	Compliance	0.0035	0.006	Compliance	0.0034	0.006	Compliance
Hg	0.00008	0.000012	LOD Issue	0.00009	0.000012	LOD Issue	0.00008	0.000012	LOD Issue	0.000083	0.000012	LOD Issue
Cd	0.0001	0.0008	Compliance	0.00033	0.0010	Compliance	0.00006	0.0007	Compliance	0.00015	0.0009	Compliance
Cr(VI)	0.013	0.01	LOD Issue	0.010	0.01	Compliance	0.015	0.01	LOD Issue	0.013	0.01	LOD Issue
Pb	0.00047	0.0018	Compliance	0.00027	0.0022	Compliance	0.00056	0.0015	Compliance	0.00047	0.0020	Compliance

Attachment 3 – Section 2 of "Reclassification of Collection Ponds", August 1999.

Section 2: Relationship Between Continuously Monitored Parameters and Critical Metal Species

2.1 Introduction

Section 1 proved that the quality of water reporting to W1 and S1 collection ponds meet the water quality requirements of resource consent 9.13, Table 2. However, the requirements of condition 9.13 also state that this must be demonstrable on a "*sustainable and continuous basis*". This is addressed as follows.

In order to demonstrate compliance on a continuous basis, two options were considered, namely:

- Installing automatic water samplers; and
- Installing continuous water quality probes to be used as a surrogate for metal species.

If automatic samplers were installed in the collection ponds they would only collect samples from approximately 5-10% of the time, mainly during storm events. It was decided that this option was inappropriate as it wouldn't demonstrate compliance on a continuous basis. The second option of installing continuous water quality probes could demonstrate compliance on a continuous basis if strong relationships were determined between the continuous data and metal species data.

The following parameters were determined to be the most appropriate for the continuous monitoring of the collection ponds, by the installation of probes measuring:

- electrical conductivity (as a surrogate for Hardness);
- turbidity (as a surrogate for suspended sediment, SS);
- temperature (a parameter required to determine Total Ammonia compliance); and
- pH (as a surrogate for copper).

This section of the report investigates the relationship between these parameters and their surrogate. If it can be demonstrated that a robust relationship between key metal species and the surrogates occurs, the use of these to measure the water quality of the collection ponds meets the requirements of resource consent condition 9.13 on a continuous and sustainable basis.

2.2 Available Data Set

Ten years of data were available for this analysis, from June 1988 to June 1998. The data consist of analysis results from water samples collected from the W1 and S1 collection ponds during the period.

2.3 Relationships

The relationships investigated in this section were those between:

- Electrical conductivity (EC) and hardness;
- pH and copper.

2.3.1 Electrical Conductivity and Hardness

As discussed in the previous sections the water quality criteria for some parameters is dependent on hardness. It is therefore desirable to be able to estimate water hardness using a continuous monitoring technique. Since magnesium and calcium (ie hardness) make the most significant contribution to the electrical conductivity of water, it is possible to correlate conductivity measurements with hardness for the total data set.

A very strong relationship was found between electrical conductivity and hardness in the collection ponds, with an R^2 value of 0.90. The relationship is outlined in Figure 6 below.

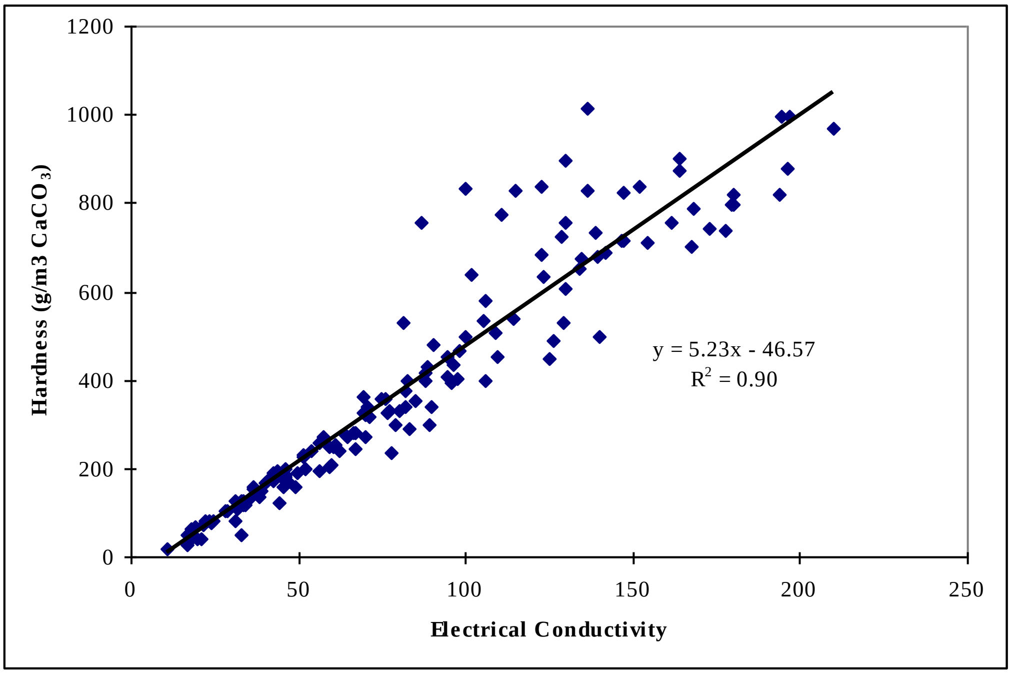

Figure 6: Relationship between Electrical Conductivity and Hardness in the W1 and S1 Collection Ponds.

2.3.2 pH and Copper

Copper has been identified as the most critical metal species with regard to the protection of aquatic life in the Ohinemuri River and Ruahorehore Stream. It is therefore desirable to be able to determine copper levels using a continuous monitoring technique. The dissociation of copper to its soluble form is dependent on the pH conditions of the water body. The relationship between pH and copper was therefore investigated and is outlined in this section.

The relationship between pH and copper was strong with an R^2 value of 0.67 as shown in Figure 7. A clear trend is apparent in that copper concentrations are relatively low at high pH, ie pH>5, but as soon as the pH drops below 5 the copper concentration increases rapidly.

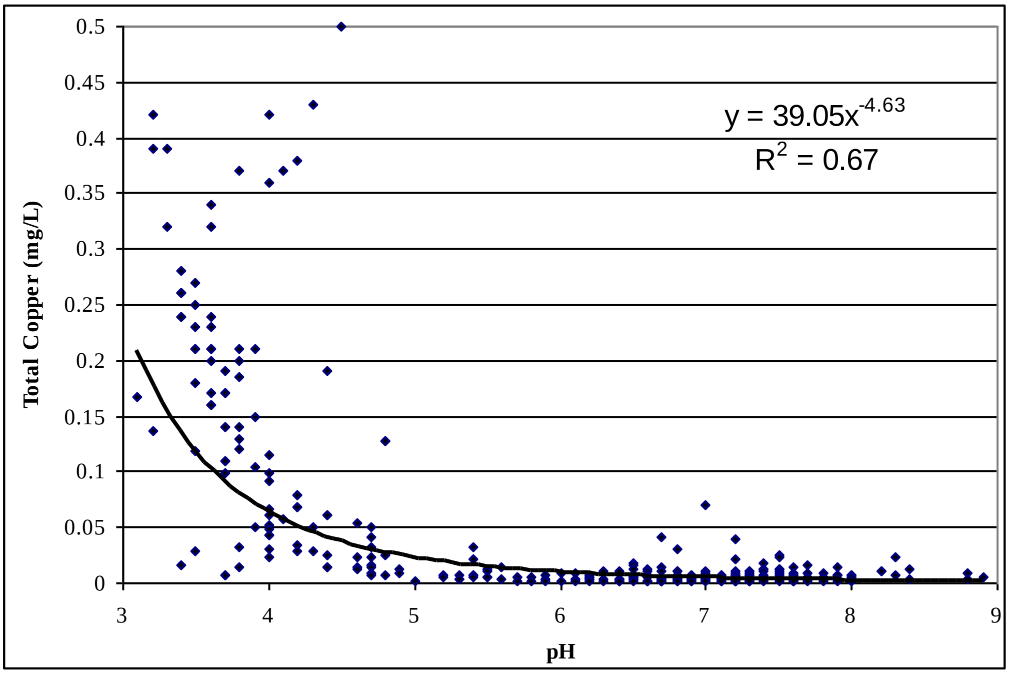

Figure 7: Relationship between pH and Total Copper in the W1 and S1 Collection Ponds.

2.4 Confidence Interval

Although it is possible to predict copper levels using pH as a surrogate, it is desirable to be able to associate a level of confidence with the prediction. This section determines the level of confidence associated with the relationship between pH and copper.

A clear trend in the relationship between copper and pH was observed as outlined in the previous section. If the pH in the collection ponds dropped below 5, ie pH<5, the copper concentration increases. A statistical analysis was performed on the available data to determine what confidence could be placed on this apparent trend.

To determine the copper concentration below which 95% of data would lie at a pH of 3, the following steps were followed:

- The full record of copper concentrations for S1 and WSP was edited to include only values where the pH on the same occasion was above, or equal to 3.
- The mean and standard deviation of this data set were calculated.

- The 95% confidence limit was calculated by taking the mean plus 2 standard deviations (0.044 g/m^3).

It can thus be stated that for 95% of the time, samples with a pH greater than or equal to 4.5 will have a total copper concentration less than 0.044 g/m^3.

This procedure was repeated for pH's from 3 to 9 at 0.1 unit intervals, and the results are outlined in Figure 8.

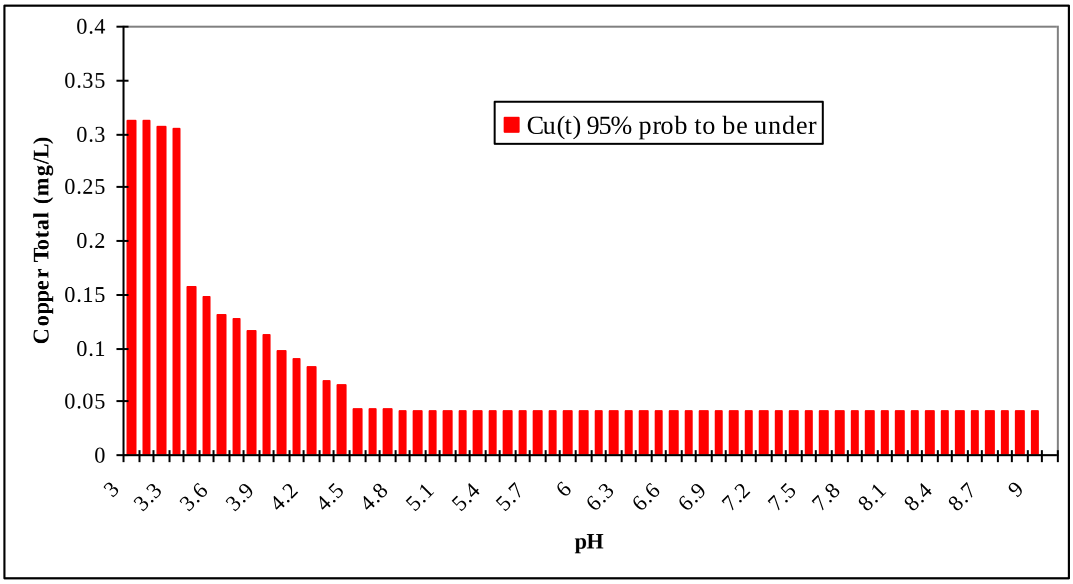

Figure 8: 95% Confidence Intervals Determined for the Relationship between pH and Total Copper in the W1 and S1 Collection Ponds.

The statistical analysis results supported the trend observed in the previous sections, ie that as pH increased the copper concentration decreased. The statistical analysis results indicated that:

- for pH $\geq$ 4.5 the predicted maximum total copper concentration (with 95% CI) plateaued;
- for pH < 3.4 the predicted maximum total copper concentration (with 95% CI) increases significantly; and
- for 3.4 $\leq$ pH < 4.5 the predicted maximum total copper concentration (with 95% CI) increases linearly with decreasing pH.

The significant result of this statistical analysis is that a level of pH can be chosen at random and the associated maximum predicted copper concentration is available with a 95% confidence level. This has a direct and very practical application for field purposes. If continuous real time pH data was available for the W1 and S1 collection ponds, then the maximum concentration of total copper in the collection ponds would be available on a continuous basis.

2.5 pH Threshold

The previous sections have demonstrated that copper concentration decreases as pH increases. It has also been demonstrated that for a given pH level the maximum concentration of copper can be predicted with a 95% confidence interval. It was therefore desirable to determine a pH threshold that would allow water to be safely discharged from the collection ponds without treatment. The determination of the pH threshold and associated compliance were determined using the following steps:

- Determine pH threshold;
- Determine the associated predicted maximum total copper concentration (with 95% CI);
- Input the predicted maximum copper concentration into the water quality model to demonstrate compliance with resource consent condition 9.13.

In addition to these steps the following condition needed to be considered. If the W1 and S1 collection ponds are reclassified as silt ponds they have to meet the resource consent conditions, section 7. Resource consent 7.7 states that:

"for rainfall events less than or equal to the 2-year return period, 2-hour duration design storm, the silt pond discharges shall:

- *Contain no oil or grease;*
- *Have a suspended solids concentration of no greater than 100 g/m^3;*
- *Have a pH within the range of 6.0 to 9.0."*

Therefore, the pH threshold of the W1 and S1 collection ponds should be 6.0. At pH of 6.0 the associated predicted maximum total copper concentration (with 95% CI) was 0.41 g/m^3.

The next step was to input this predicted copper level into the water quality model outlined in section 1. The other inputs also included in the water quality model were:

- The worst case water quality for the WTP, Ohinemuri River and Ruahorehore Stream;
- Hardness of 40 g/m^3; and
- Mixing ratios as outlined in Section 1.3.3.

The results are outlined in Table 6 below.

TABLE 6: Comparison of resultant water quality with receiving water criteria

Parameter (soluble fraction)	Receiving water compliance criteria after mixing at a hardness of 40 g/m^3 $CaCO_3$ (All values are g/m^3)	Resultant water quality in the Ohinemuri River after mixing (All values are g/m^3)
Cu	0.005	0.004

Table 6 above indicates that the water quality meets the requirements of condition 9.13. It is therefore demonstrable that the water in the W1 and S1 collection ponds with pH>6.0 meets (with a 95% confidence interval) condition 9.13 Table 2 on a "*sustainable and continuous basis*".

2.6 Turbidity Threshold

Resource consent condition 7.7 (detailed in the previous section) requires that discharge from silt ponds contain less than 100 g/m^3 of suspended sediment. It is impractical to monitor suspended sediment on a continuous basis, and therefore desirable to be able to continuously monitor turbidity as a surrogate for suspended sediment. In addition a turbidity threshold should be set to represent the suspended sediment threshold of 100 g/m^3.

Turbidity has been used as a surrogate for suspended sediment in stormwater in previous studies, for example Williams (1997) and Gippel (1995). There were insufficient turbidity data for the available data set to be able to determine a site specific relationship for the W1 and S1 collection ponds. In the absence of a current relationship the relationship outlined by Williams (1997), shown in Figure 9, should be adopted until the site specific relationship is developed. By substituting 100 g/m3 into the relationship outlined in Figure 8 a turbidity threshold of 110 NTU's results (where NTU is the international unit of turbidity).

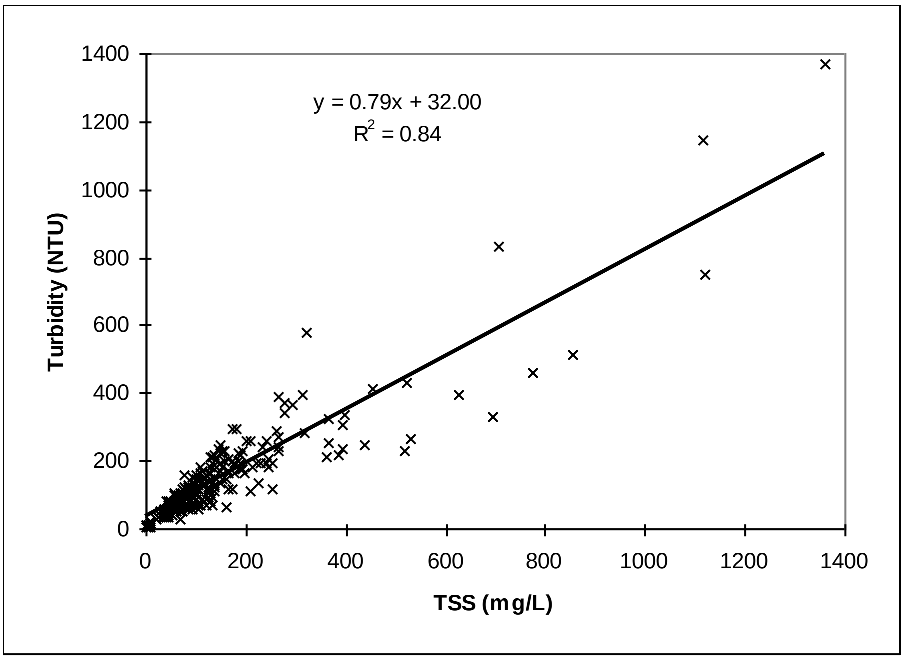

Figure 9**:** Correlation between suspended solids and turbidity for sequential sample data from the North Arm East Catchment (AU504101)

2.7 Continuous Monitoring System

This section outlines the details of the proposed continuous monitoring system that will be installed in the W1 and S1 collection ponds. The proposed system will contain the following main components:

- Continuous Monitoring probes of turbidity, electrical conductivity, pH and temperature in each pond;
- Datalogger;
- Data logging rate typically 10 minutes;
- Mains power with battery backup;
- Radio telemetry to transfer water quality data to base station;
- Pressure transducer to monitor pond level;
- Weather proof stainless steel cabinet; and
- Base station that receives water quality data and copies duplicate to computer network.

In addition to the above main components, the following will be required:

- regular calibration and maintenance of water quality continuous probes;
- sampling schedule to maintain and water quality relationships and analyse metal levels;
- water quality thresholds (such as outlined in Sections 2.5 and 2.6) and alarming systems when thresholds are exceeded.

2.8 Summary

In summary, it has been demonstrated that the continuous monitoring of pH, electrical conductivity, turbidity and temperature as surrogates for copper, hardness and suspended sediment meet the requirements of condition 9.13.

In addition the pH thresholds of 6.0 and a turbidity threshold of 110 NTU should be implemented to ensure that the water from the W1 and S1 collection ponds can be safely discharged without treatment. ie water in the W1 or S1 collection ponds with pH less than 6.0 and/or a turbidity of greater than 110 NTU would require treatment before being discharged to the Ohinemuri River.

APPENDIX B - ESTIMATING RAINFALL EVENT RETURN PERIODS ETC

C-1 RAINFALL EVENT RETURN PERIOD

C-1.1. Introduction

Conditions of consent require that discharges from silt and collection ponds occur only in heavy rainfall events, the magnitude of the events being specified in terms of rainfall return period. The following subsection outlines the method by which the return period of a given rainfall event can be calculated, and therefore the compliance of a pond discharge can be confirmed.

C-1.1.1. Silt Ponds

The conditions of consent impose different quality requirements for discharges within or above the specified design storm, which is typically the 2-year return period rainfall event. The conditions of consent impose slightly different conditions on discharge quality from the conveyor silt ponds than those imposed on other silt ponds. For the conveyor silt ponds, the threshold is stated as the 2-year return period 1-hour event. For other silt ponds, the threshold quality test includes a 2-hour rainfall duration.

In any event, discharge quality compliance needs to be checked against the 2-year return period event, which can be assessed as outlined in this appendix.

C-1.1.2. Collection Ponds

The conditions of consent require that each collection pond shall be designed and constructed to have a minimum water storage capacity equivalent to the volume of run-off generated from within its catchment during a 10-year return period, 72-hour design duration, design storm, taking into account both pond volume and pumping. For rainfall events with a return period less than or equal to ten years, all stormwater reporting to the collection ponds shall be pumped to the Water Treatment Plant for treatment.

C-2. RAIN EVENT RETURN PERIOD CALCULATION

The return period of a rain event is determined from the depth-duration-frequency relationship for a given location. The relationship for Waihi is given in Table C-1.

Table C-1: Waihi Rainfall Depth-Duration-Frequency (rainfall, mm)

	Duration	10min	20min	30min	1hr	2hr	6hr	12hr	24hr	48hr	72hr
Return Period (yrs)	2	12	17	22	30	42	78	111	150	179	195
	5	17	24	31	45	63	103	147	190	224	249
	10	20	28	37	56	77	119	171	217	254	285
	20	23	32	42	65	90	134	193	242	282	320
	50	27	38	50	78	108	155	228	276	319	365

OGNZL's automatic weather station records hourly rainfall in mm. Following a rainfall event, the rainfall data can be scanned to assess the greatest depth of rain falling during any given period from 1 to 72 hours. The maximum value for each duration can be compared with the values in Table C-1 to determine the maximum return period. It is this value that is used to report the return period of the rainfall event.

The calculation can be most readily done using a standard spreadsheet held by OGNZL's Environmental Department (Depth-Duration-Frequency.xls). The data contained in Table C-1 is already entered in the spreadsheet, which contains a plot of the curve for each return period.

The assessment is performed by dumping the automatically-generated hourly rainfall data into the tables set up on the "Storms" sheet, which calculates the maximum rainfall (mm/duration) and rainfall intensity (mm/h) for each period from 1 to 72 hours. The maximum rainfall for each duration is plotted on the same chart as the standard curves generated from the data in Table C-1. The return period reported for a given rainfall event is the maximum value generated for rainfall event under consideration.

An example is shown in Figure C-1. In this example, the return period to be reported is about 2 years (the example rainfall curve is slightly above the 2-year return period event but less than the 5-year return period event.

Note that because the shortest duration rainfall recorded at OGNZL's weather station is 1 hour, it is possible that shorter duration events with greater return period could have occurred but will not be available from the record.

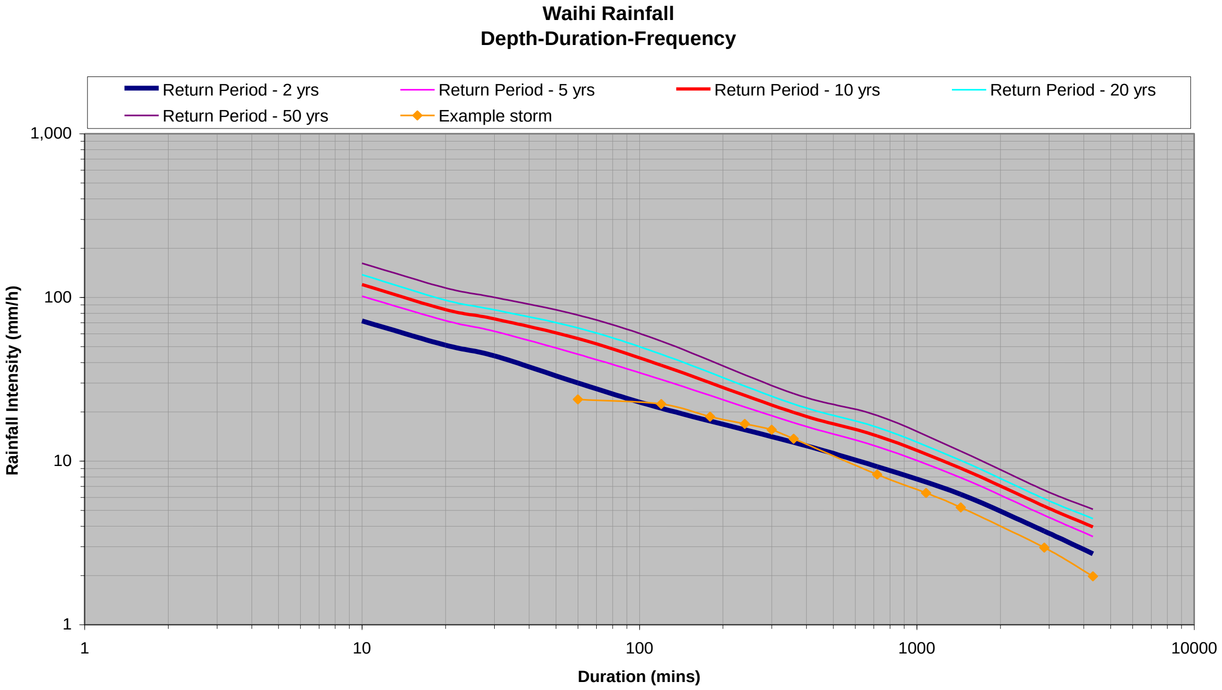

Figure C-1: Waihi Rainfall Depth-Duration-Frequency

C-3. POND CAPACITY AND COMPLIANCE CHECK

The calculation of pond design rain event, capacity and compliance is provided in a spreadsheet held by NWG's Environmental Department (Pond Criteria Check.xls). The basis of the calculations in that spreadsheet are set out below.

Catchment Areas

The catchment area contributing runoff to a pond needs to be determined by GIS or survey

Design Rainfall

There are three different design rainfall events used for sizing different types of ponds;

1. Conveyor silt ponds – 2 year-return period, 1-hour duration = 30mm (refer Table C-1).
2. All other silt ponds – 2 year-return period, 2-hour duration = 42mm (refer Table C-1).
3. Collection ponds – 10 year-return period, 72-hour duration = 285mm (refer Table C-1).

Pond Design Capacity

Pond effective working volume is calculated by multiplying the catchment area by the design rainfall by a runoff coefficient.

The runoff coefficient accounts for the proportion of the incident rainfall that reports to the pond. Unless there are good reasons for adopting another value, the runoff coefficient, C, to be used in the calculation is 0.6.

Pond Capacity

Can be either the volume of the pond, as derived by survey or from as-built drawings, or the combined pond volume and pump capacity.

When the pump capacity is included, the total pond capacity is the pond volume plus the pump rate, expressed as m3 per hour, multiplied by design rainfall duration (typically 2 hours for silt ponds and 72 hours for collection ponds.

Compliance

Compliance for pond capacity can be checked for pond volume with and without the pump capacity included. For compliance, the pond capacity needs to be less than or equal to the pond design capacity.

APPENDIX C - REGIONAL COUNCIL APPROVALS

010511-WRC-Diversion of drainwater.pdf

NWG-WAT-Reclassification of Collection Ponds-R99082.pdf

Storage 2 Discharge

Request for Cessation of Collection Pond Sampling During Discharge Events

Removal of Barium, Boron, Molybdenum, Strontium, Thorium and Tin from Monitoring Suite

Environment Waikato
REGIONAL COUNCIL

File No: 60 59 02E
Document No: 676821
Enquiries to: Dennis Crequer

11 May 2001

Attention: John McKinstry
Waihi Gold Co
PO Box 190
WAIHI

Dear John

Waihi Gold Co - Martha Mine - diversion of clean drainage water

You recently wrote to advise that as allowed for under condition 8 of the Tailings and Waste Rock Disposal consents, you wish to divert only some components of the overall underdrainage system to water treatment, following the initial commissioning of the Storage 1A facility.

This letter is to advise that as allowed for by condition 8, we agree that those water sources unlikely to be contaminated at least initially by the commissioning of the facility, do not need to be diverted to water treatment at this stage.

I accept that this will take effect almost immediately, but advise that I do not agree with the proposed monitoring regime and have some other concerns regarding this proposal. Those issues have been discussed with your staff, and an agreed outcome has been reached, and can be confirmed following further discussions to be held next week.

Yours faithfully

Dennis Crequer

Dennis Crequer
Manager, Special Projects
(Resource Use Group)

cc: Mike Maguire, Hauraki DC (by email)

→ Kathy, Bryan, Mike & LTS

File Ref: 60 59 02H
In Reply To: 517227
Enquiries to: Dennis Crequer/Oscar Diaz

COPY

Environment Waikato
REGIONAL COUNCIL

HAMILTON
401 Grey Street,
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TAUPO
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PAEROA
13 Opatito Road, Paeroa
Telephone 64-7-862 8376

22 October 1999

Keith Brodie
Environmental Superintendent
Waihi Gold Mining Co Ltd
P O Box 190
WAIHI.

Dear Keith

RECLASSIFICATION OF COLLECTION PONDS REPORT.

We acknowledge receipt of the report *Reclassification of Collection Ponds* dated August 1999 supporting your formal request to reclassify the West 1 (W1) and South 1 (S1) collection ponds to silt ponds in accordance with the procedures outlined in condition 13 of consent 971312. The consent 971312 is the version of the consents approved in the interim decision of the Environment Court dated 15 December 1998.

I would like to inform you that following review of your report *Reclassification of Collection Ponds* dated August 1999, and after our recent meeting at your office in Waihi, our staff agrees that the waters entering these ponds are of a sustainable quality and approval for reclassification is given. Our staff want to stress the importance of the continuous monitoring programme that is being put in place to ensure that the water from W1 and S1 can be safely discharged without treatment. If the quality of the water should deteriorate, sufficient early warning would enable the company to shut down the discharge in order to avoid any adverse effect, and if required, reverse the classification until all sources of contamination are cleared out.

Yours faithfully

Dennis Crequer

Dennis Crequer
Manager, Special Projects
(Resource Use Group)

RECEIVED
26 OCT 1999

Reclassification of Collection Ponds

Waihi Gold Mining Company, August 1999

Table of Contents

Appendices

List of Figures

List of Tables

I Executive Summary

This report demonstrates that the water reporting to the West and South 1 collection ponds is of a quality that meets or is better than the criteria outlined for the receiving water body by the Waikato Regional Council (WRC) resource consent conditions, specifically condition 9.13.

In addition, it is recommended that an application be made to the WRC to reclassify both the West and South collection ponds as silt ponds.

This report is divided into the following three sections:

- Section 1: Analysis of historical water quality data;
- Section 2: Relationship between continuously monitored parameters and critical metal species; and
- Section 3: Conclusions and recommendations based on the results from Sections 1 and 2.

II Preamble

Collection ponds and silt pond systems are primarily designed to intercept and temporarily store surface run-off. A distinction between collection ponds and silt ponds is made as the characteristics of the contributing catchment in each case differs. Contributing catchments to silt ponds contain no potentially acid-forming soil or rock, whereas contributing catchments to collection ponds can contain potentially acid-forming soil or rock.

This report concentrates on the West and South 1 collection ponds that collect stormwater runoff from the embankment of the tailings storage facility. They are both currently classified as *collection ponds*, and are bound by Section 9 of the resource consent conditions. This report will refer to the West and South 1 collection ponds as W1 and S1 respectively.

All collection ponds are covered by resource consent condition 9, which is outlined in Appendix A. In particular, the work in this report concentrates on the requirements of condition 9.13 which is discussed in the following section. Silt ponds are covered by resource consent section 7, which is outlined in Appendix B.

III Condition 9.13

Condition 9.13 states "*If the consent holder can demonstrate that the quality of water entering these ponds is of a sustainable quality such that on a continuous basis the effects of the discharge from these ponds after mixing:*

- *Meets or is better than the receiving water criteria defined in Table 2;*
- *Is capable of doing so on a sustainable and continuous basis; and,*
- *In combination with all other discharges authorised for this site, shall not cause a significant adverse environmental effect on the receiving ground water and surface water, or on users of these resources, or, in the case of surface, aquatic biota,*

1. Then the consent holder may seek the approval of the Waikato Regional Council to discharge directly from those ponds, and once that approval is given the ponds shall be deemed to be silt ponds and the conditions of consent 971311 shall apply."

The most pertinent parts of this condition are:

- The quality of the collection ponds must be proved on a sustainable and continuous basis;
- The water reporting to the ponds must meet the receiving water criteria defined by condition 9 Table 2 (see Appendix A); and
- The resultant water quality combination of all discharges must be considered.

The objective of this report is to demonstrated that the water quality reporting to the W1 and S1 collection ponds meets the above criteria so that approval may be sought from the Waikato Regional Council (WRC) to reclassify the collection ponds as *silt ponds*. Under the classification of silt ponds stormwater can be discharged directly to the Ohinemuri River and/or Ruahorehore Stream without treatment.

The location of the W1 and S1 collection ponds, the Ohinemuri River, the Ruahorehore Stream and the Water Treatment Plant Discharge (WTP) are outlined in Figure 1.

Figure 1: Location of collection ponds and related water monitoring sites

Development Site Collection & Silt Ponds

IV Background

This section provides background and historic information about the W1 and S1 collection ponds and describes the evolvement of management practices of their respective catchments over the last 5 years.

The W1 and S1 collection ponds were constructed during the 1990/91 period. The monitoring of runoff water quality entering the W1 and S1 collection ponds was not initiated until 1993/94, so little is known about the quality of runoff prior to that. From 1994, regular monitoring of embankment runoff has built up a substantial database of water quality as indicated by the pH data shown in Figure 2 below.

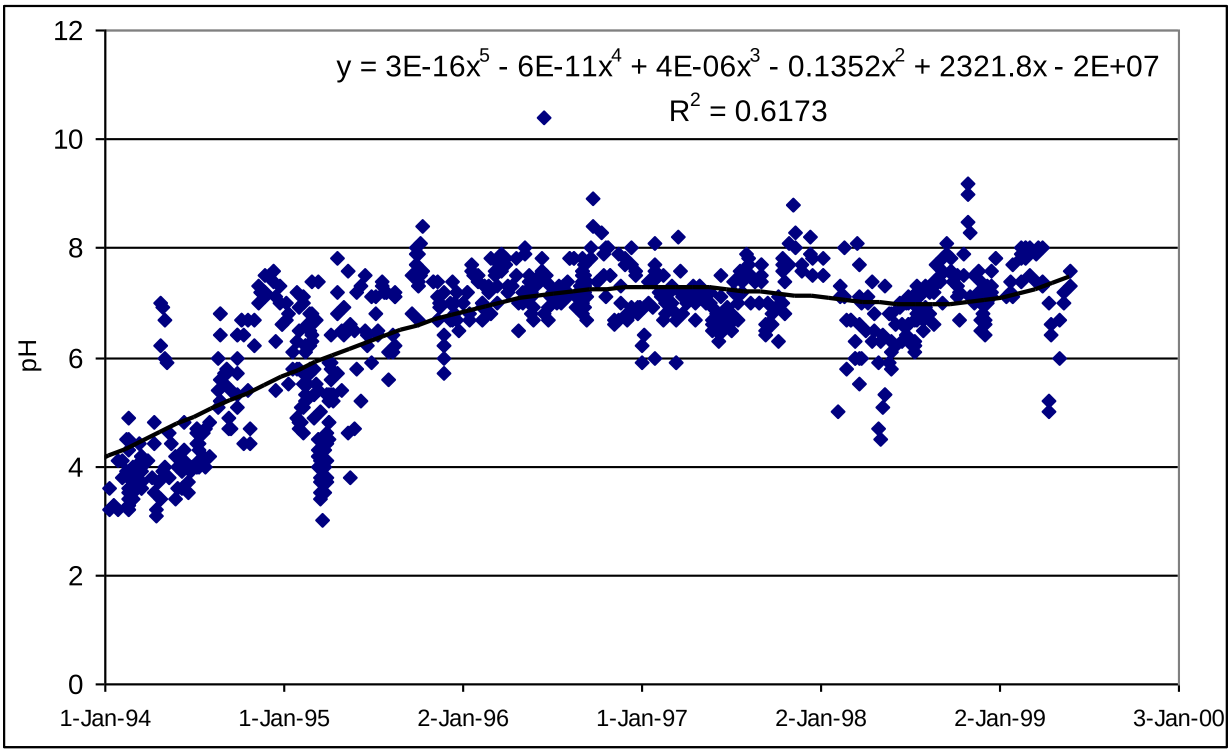


Figure 2: pH Data from W1 and S1 Collection Ponds (1994-1999, inclusive)

The pH data collected in 1994 showed that there was a problem with Acid Rock Drainage (ARD) from the Tailings Storage Facility as indicated by the low pH values. The period of poor water quality in 1994 indicated that the reaction kinetics of sulphidic rock were underestimated. The sulphidic or potentially acid forming material (PAF) was oxidising during construction resulting in the lowered pH of runoff.

As a consequence, in 1995 facilities were installed to enable the water in the collection ponds to be pumped back to the Water Treatment Plant (WTP) so that it could be treated prior to discharge, for all but the large storm events. And, in addition, a thorough review of the management of PAF material was undertaken. During this period the W1 and S1 ponds, formerly referred to as silt ponds, were reclassified as collection ponds. This classification was recently formalised by the resource consent conditions for the Extended Project, where a distinction is made between collection and silt ponds.

The review of the management practices for construction of the embankment brought about a number of changes in order to eliminate the above operational problems. The three main improvements to management practices that were identified were:

1. Neutralise incipient oxidation products of PAF materials initially by applying crushed limestone rock
2. Progressively encapsulating PAF material during construction by using intermediate seal layers.
3. Control water regimes

The effect of newly adopted management practices in 1995 provided a steady improvement in water quality over the following 12 months. The water quality in the W1 and S1 collection ponds has improved substantially as shown very clearly in Figure 2. The improvement is best shown by the trend of the 5th order polynomial equation outlined in Figure 2. There is a gradual improvement in water quality during 1994 and 1995 (as indicated by the increase in pH) before it plateaus for the period 1996-1999. The improvement can be broken down into 3 phases.

Phase 1 indicates the improvement of water quality by adopting improved management practices, phase 2 indicates the period of time (1995) for the water quality to recover, and phase 3 shows the improved water quality level that has be sustained over the past 3 years.

In summary, the management of PAF material at the tailings storage facility has evolved over the last five years. This includes neutralising and encapsulating the PAF material and controlling the water regimes. These improvements together with the successful rehabilitation of the catchments to pasture have resulted in a demonstrable improvement of the runoff water quality in the S1 and W1 collection ponds.

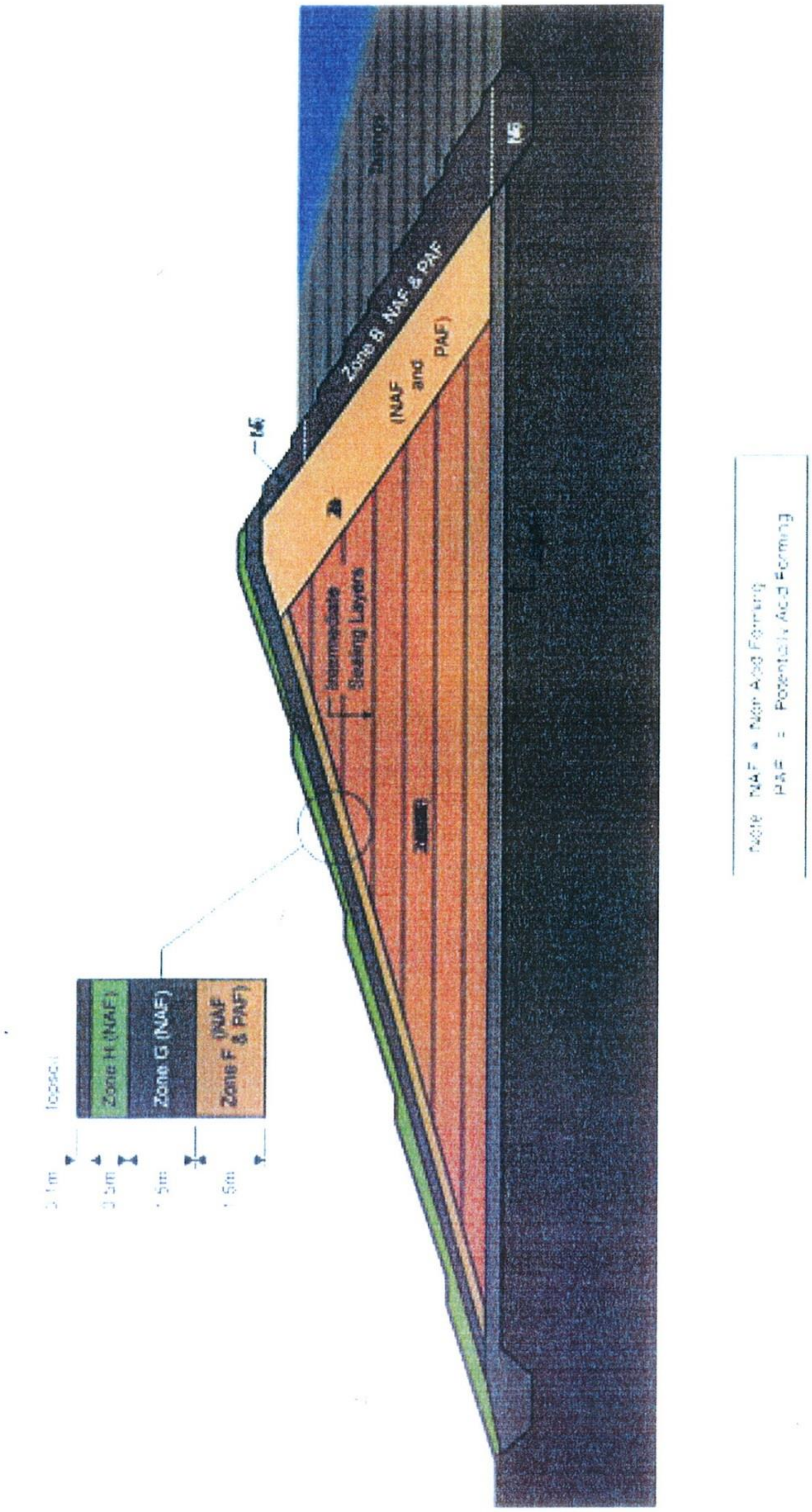
V Catchment Description

The catchments for the W1 and S1 collection ponds are similar as the management procedures for placing material are the same. As described in the previous section, the management of PAF material has improved since 1995 and as a result the runoff water quality from the catchments has also improved.

The best way to describe the catchments is with reference to Figure 3, a cross-sectional view of the embankment. Zones B, C, D and F contain both PAF and NAF material. No Zone E material was placed within the catchments above W1 or S1. The PAF material in Zone D was placed upon the Zone A NAF material. The PAF material in Zone D was encapsulated within intermediate sealing layers, which included the placement of lime as a neutraliser. Zone F was encapsulated beneath the NAF layer of Zone G. The NAF capping layer of Zone G was placed over Zone F before Zone H was placed and finally 100mm of topsoil. The embankments were then rehabilitated to pasture.

The final result is that there is no exposed PAF material in the catchments above the W1 or S1 collection ponds, and the PAF material that is located within the embankment has been completely capped beneath an outer cover of very low permeability NAF material (Zone G) that controls both water movement and availability of oxygen to PAF materials.

Figure 3: Embankment Structure Typical Section, Acid Generation Management



Section 1: Analysis of Historical Water Quality Data

1.1 Introduction

This section of the report investigates whether the actual water quality in the W1 and S1 collection ponds meets the resource consent condition 9.13.

1.2 Available Data Set

The data available for this investigation were collected over a period of 3 years, between January 1996 and December 1998 inclusive. The data set consists of water quality analysis results (total fractions) for the parameters specified in Condition 9.13 Table 2 namely cyanide, iron, manganese, copper, nickel, zinc, silver, antimony, arsenic, selenium, mercury cadmium and lead. The available data set is outlined in Appendix C.

Insufficient data was available for the parameters of total ammonia, chromium (VI), mercury and silver. However, these parameters will be included in the proposed sampling program outlined in Section 3.

1.3 Water Quality Model Inputs

In order to investigate whether the water quality of the data set meets condition 9.13 there were a number of variables to consider:

- Water quality of the Ohinemuri River and Ruahorehore Stream (total fractions);
- Water quality of the point discharges of W1, S1 collection ponds and Water Treatment Plant Discharge (WTP) (total fractions);
- Hardness of each water source;
- Point of compliance;
- Mixing ratios of all water sources; and
- Receiving water criteria (soluble fractions).

The most effective way to combine all of these variables was to set up a water quality model. The water quality model is discussed in more detail in a later section. The following sections outlined the details of the input variables (those listed above) to the water quality model:

1.3.1 Water Quality

In order to meet resource consent 9.13 the effect of all site discharges to the Ohinemuri River and Ruahorehore Stream were considered. This meant that all sources of water needed to be defined, quantified and combined. This creates a number of water quality variables in the water quality model which are outlined below:

- Ohinemuri River water quality;
- Ruahorehore Stream water quality;
- W1, S1, WTP point discharges;

- Combined water quality after mixing; and
- Water quality limits (condition 9.13 Table 2, some parameters dependent on hardness).

The location of the W1, S1, WTP point discharges were outlined in Figure 1 previously, and are also outlined in the simplified schematic diagram in Figure 4 below.

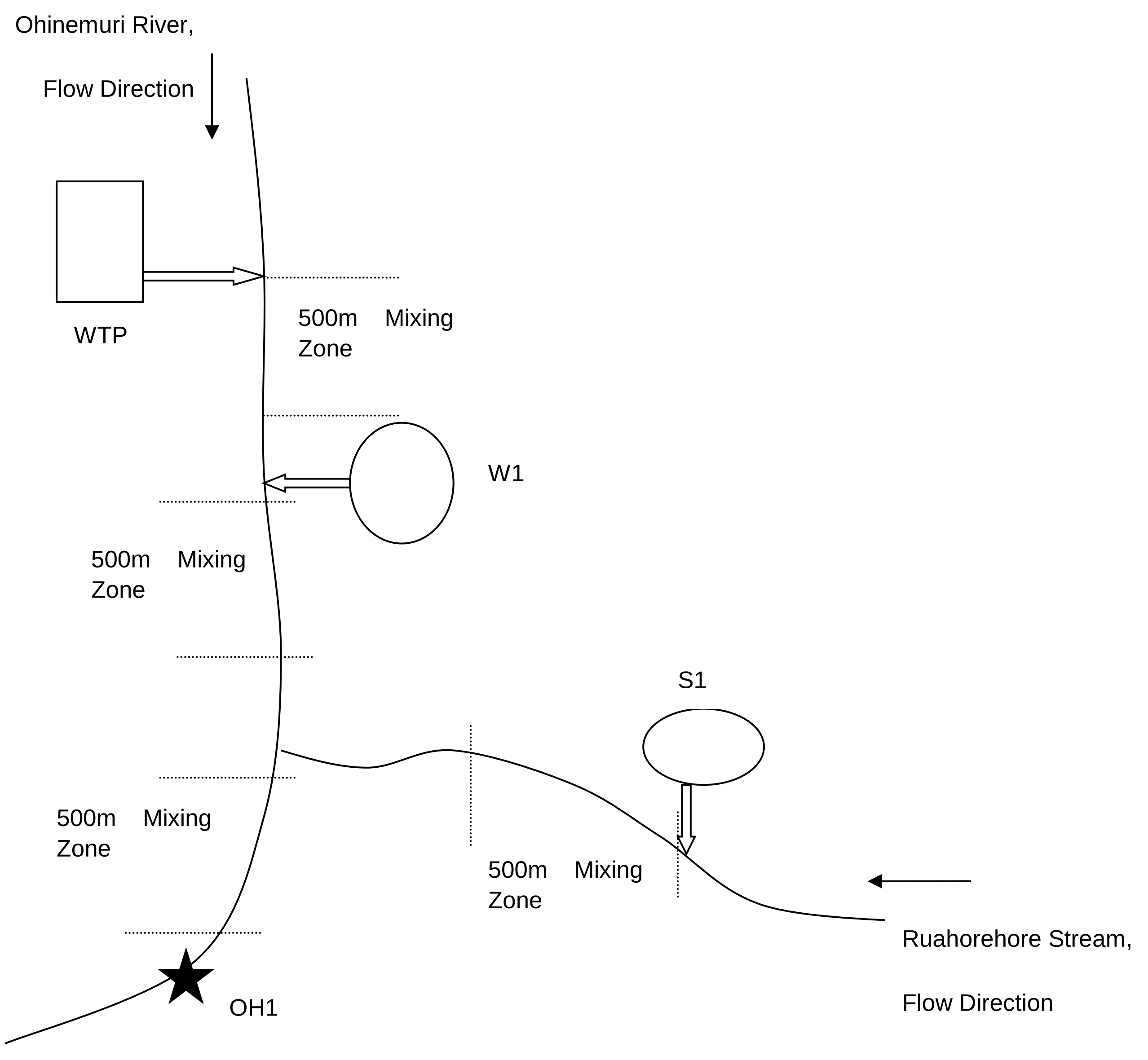


Figure 4: Schematic diagram of pond and sample locations

Once all site discharges were identified, the next step was to decide how to quantify the water quality of each source as an input to the water quality model. The options were either the mean, median or maximum water quality value for each water quality parameter (ie Cu, Zn, Mn) from the available data set. The worst case scenario was the maximum measured water quality value, and so this was used as it would produce the most conservative results. This approach was conservative because not only did it model the worst case water quality for each input source, it also assumed that the worst case water quality of each discharge point would occur at the same time, which was unlikely. However, if it could be shown that the resulting combined worst case water quality of all discharges complied with the receiving water quality criteria outlined in condition 9.13, then it could follows that all data in the available data set meets the water quality criteria.

The method of combining the worst case water quality of each water source is outlined in Section 1.3.3. The following section defines the point at which compliance with condition 9.13 was determined.

1.3.2 Point of Compliance

The point of compliance has to take into account all point discharges into both the Ohinemuri River and Ruahorehore Stream. The most appropriate monitoring site is therefore OH1, for the following reasons:

- It is downstream of the W1, S1 and treated water point discharges;
- There are sufficient mixing zones for each of the point discharges; and
- There are sufficient mixing zones for the Ohinemuri River and Ruahorehore Stream.

The following section outlines how the worst case water quality of all water sources were combined at the point of compliance, OH1.

1.3.3 Mixing Ratios at Point of Compliance

To determine the resultant water quality in the rivers after mixing, the worst case water quality of each water source needed to be combined. Woodward Clyde developed a water balance model which modelled the mixing ratios of the point discharges to the Ohinemuri River and Ruahorehore Stream. The results from this analysis are outlined in Table 1 below.

TABLE 1: Mixing ratios (River Water : Point Discharges) at point of compliance, OH1

Compliance Point	Treated Water Discharge	S1 Collection Discharge	W1 Collection Discharge	Ohinemuri River	Ruahorehore Stream
OH1	2.6	0.7	1.5	67.1	28.1

The assumptions made using this model are as follows:

2. The Treated Water discharge is 15,000m^3/day
3. There is a combined storage capacity in the West and South 1 collection ponds of 30,000m^3.
4. The collection ponds are empty at the start of the event.

The previous three sections described how the water quality of all sources were represented (using the worst case scenario), the point where compliance should be determined, and how the water quality was combined to determine the resultant water quality after mixing. The remaining step was to compare the resultant water quality at OH1 to the resource consent requirements of condition 9.13. However, some parameters in the receiving water criteria outlined in Table 2 in Appendix A are dependent on hardness. Therefore the hardness of the receiving water body must be determined in order to calculate the receiving water criteria. This is discussed in the following section.

1.3.4 Hardness

- Copper, Nickel, Zinc, Silver, Cadmium and Lead outlined in Table 2 of Condition 9 (post-source discharge and the total mass loading after mixing) are dependent on the hardness level in the receiving water body.
- The hardness of the receiving water body is a critical element of the receiving water criteria.
- The receiving water body hardness must first be defined in order to determine the receiving water criteria for nominated species.

The W1 collection pond discharges directly into the Ohinemuri River whereas the S1 collection pond discharges into the Ruahorehore Stream before joining the Ohinemuri River approximately 1km further downstream. Due to the South 1 collection pond discharging into a relatively short run of the Ruahorehore Stream the receiving water body for both collection ponds can be assumed to be that of the Ohinemuri River, ie the hardness of the Ohinemuri River determines the overall receiving water body criteria.

The monitoring locations on the Ohinemuri River were outlined in Figure 1. Table 2 below summarises the hardness results at various sampling points along the Ohinemuri River.

TABLE 2: Ohinemuri River Hardness

Sample Site	Location	Number of data points	Minimum Value (mg/l)	Maximum Value (mg/l)	Mean (mg/l)
OH1	Downstream of Ruahorehore	30	14	142	56.8
OH2	Upstream of Ruahorehore	51	7	480	69.3
OH3	Golden Valley	53	8	17	14.0
OH4	Highway 26	20	7	17	13.3
OH5	Upstream of W1, Downstream of WTP	47	5	200	56.8

Table 2 outlines the hardness at various sample points along the Ohinemuri River, however in Section 1.3.2, OH1 was defined as the point at which compliance with resource consent limits would be determined. The hardness at the point of compliance, OH1, had a minimum, maximum and mean of 14, 142 and 56.8 g/m^3 respectively. It was unrealistic to use the minimum hardness of 14 g/m^3 as an input to the water quality model as this rarely occurs. It was decided that a more appropriate input to the water quality model was a hardness of 40 g/m^3, as it was 30% lower than the average recorded hardness at OH1 and therefore produced a conservative result.

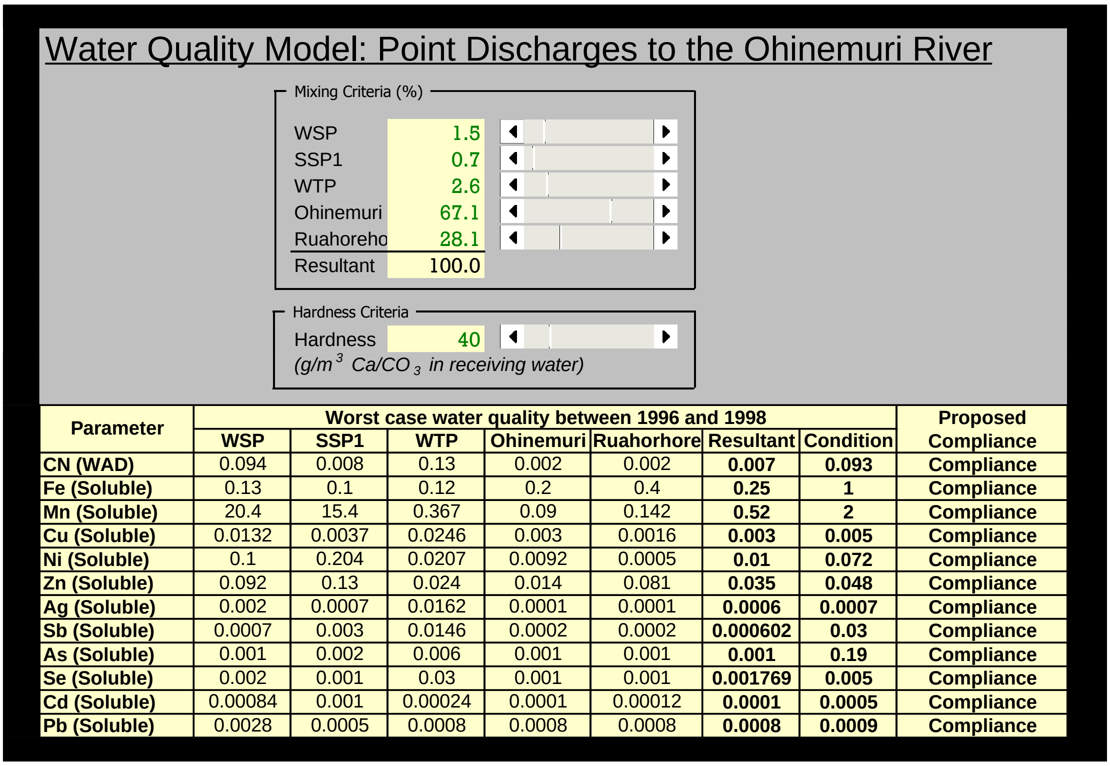
Now that all of the inputs and variables for the water quality model have been defined and described, the following sections describe the water quality model and outline the results that it produced.

1.4 Water Quality Model Description

The previous sections described the inputs to the water quality model whereas this section describes the water quality model itself. The water quality model was designed to meet the following requirements:

- The inputs of W1, S1 and WTP point discharges;
- The inputs of the Ohinemuri River and Ruahorehore Stream water qualities;
- A hardness criteria at the compliance point, OH1;
- Determine the water quality criteria to be met at OH1 in accordance with Condition 9.13 Table 2, based on the input hardness at OH1;
- Combine the input water qualities in the ratio specified in Section 1.3.3;
- Determine the resultant water quality at OH1 based on the previous 5 inputs;
- Determine compliance by comparing the resultant water quality to the water quality criteria; and
- Be flexible to allow the input hardness, mixing ratios and water qualities could be changed independently of the other variables.

Figure 5 shows an example of the water quality model input/output screen, which indicates that all of the requirements of the water quality model are fulfilled.



Parameter	Worst case water quality between 1996 and 1998							Proposed Compliance
	WSP	SSP1	WTP	Ohinemuri	Ruahorhore	Resultant	Condition	
CN (WAD)	0.094	0.008	0.13	0.002	0.002	0.007	0.093	Compliance
Fe (Soluble)	0.13	0.1	0.12	0.2	0.4	0.25	1	Compliance
Mn (Soluble)	20.4	15.4	0.367	0.09	0.142	0.52	2	Compliance
Cu (Soluble)	0.0132	0.0037	0.0246	0.003	0.0016	0.003	0.005	Compliance
Ni (Soluble)	0.1	0.204	0.0207	0.0092	0.0005	0.01	0.072	Compliance
Zn (Soluble)	0.092	0.13	0.024	0.014	0.081	0.035	0.048	Compliance
Ag (Soluble)	0.002	0.0007	0.0162	0.0001	0.0001	0.0006	0.0007	Compliance
Sb (Soluble)	0.0007	0.003	0.0146	0.0002	0.0002	0.000602	0.03	Compliance
As (Soluble)	0.001	0.002	0.006	0.001	0.001	0.001	0.19	Compliance
Se (Soluble)	0.002	0.001	0.03	0.001	0.001	0.001769	0.005	Compliance
Cd (Soluble)	0.00084	0.001	0.00024	0.0001	0.00012	0.0001	0.0005	Compliance
Pb (Soluble)	0.0028	0.0005	0.0008	0.0008	0.0008	0.0008	0.0009	Compliance

Figure 5: Water Quality Model input/output screen

The water quality model essentially combined all of the inputs described in Section 1.3, determined the water quality criteria, and then compared the resultant water quality to the water quality criteria to determine if the resultant was compliant with the resource consent conditions.

1.5 Water Quality Model Results

The water quality model used the following inputs:

- Worst case water quality in the Ohinemuri River and Ruahorehore Stream;
- Worst case point discharge water quality from W1, S1 and WTP;
- Mixing ratios outlined in section 1.4.4; and
- Hardness of 40 g/m^3 $CaCO_3$ at compliance point OH1.

The results from the water quality model are outlined in Table 3 below.

TABLE 3: Comparison of resultant water quality with receiving water criteria

Parameter (soluble fraction)	Receiving water compliance criteria after mixing at a hardness of 40 g/m^3 $CaCO_3$ (All values are g/m^3, soluble fraction)	Resultant water quality in the Ohinemuri River after mixing (All values are g/m^3, total fraction)
CN(WAD)	0.093	0.007
Fe	1.0	0.25
Mn	2.0	0.52
Cu	0.005	0.003
Ni	0.072	0.01
Zn	0.048	0.035
Sb	0.03	0.0006
As	0.19	0.001
Se	0.005	0.0018
Cd	0.0005	0.0001
Pb	0.0009	0.0008

Table 3 indicates that the resultant water quality at OH1 after mixing meets the water quality guidelines of resource consent condition 9.13.

1.6 Overflow Event Sampling

On December 3 and 4 1998 a large storm event, with a recorded rainfall of 139mm, fell over the Waihi area and caused the W1 and S1 collection ponds to exceed their capacity and discharge directly to the Ohinemuri River and Ruahorehore Stream respectively. Comprehensive sampling of all point discharges and river water quality was undertaken so that the actual effect on the Ohinemuri River could be determined. This would enable a comparison between the actual water quality results and those modelled.

Water quality Samples were collected from the following sites:

- Ohinemuri River sites OH1, OH2, OH3 and OH5;
- Ruahorehore Stream sampling sites RU1a and RU2;
- Point discharges W1, S1 and WTP.

The water quality model described in the previous section was used to combine the water quality results. The hardness entered into the water quality model was that at point OH1 which was 11 g/m^3 $CaCO_3$. Continuous flow monitoring of all of the water sources involved enabled the determination of the actual mixing ratios for the event. The mixing ratios are outlined in Table 4 below.

TABLE 4: Overflow event 3-4/12/1998

	December 3, 1998		December 4, 1998	
Sampling Site	Volume (m^3)	Mixing Ratio (%)	Volume (m^3)	Mixing Ratio (%)
W1	10,000	1.9	14,500	0.3
S1	2,500	0.5	5,500	0.1
WTP	8,500	1.7	7,500	0.1
Ohinemuri River	354,240	68.9	3,254,688	60.1
Ruahorehore Stream	139,104	27.0	2,137,536	39.4
Total	514,344	100.0	5,419,724	100.0

It should be noted that the mixing ratios for the event on December 3 were similar to the ratios predicted by the Woodward Clyde model, which indicated that the mixing ratios used in the water quality model were realistic. It should also be noted that the mixing ratios of the point discharges on December 4 were significantly less than those predicted by the Woodward Clyde model.

The mixing ratios that were entered into the water quality model for the December 3-4 event were those that occurred on December 3 as these were more conservative (ie they represent a greater proportion of point discharge water to the Rivers). The results from the water quality model are outlined in Table 5 below.

TABLE 5: Comparison of resultant water quality with receiving water criteria

Parameter (soluble fraction)	Receiving water compliance criteria after mixing at a hardness of 11 g/m^3 $CaCO_3$ (All values are g/m^3, soluble fraction)	Actual water quality at compliance point OH1 (All values are g/m^3, soluble fraction)	Modelled water quality at compliance point OH1 (All values are g/m^3, soluble fraction)	% Difference in Water Quality Model Prediction
CN(WAD)	0.093	<0.001	0.0013	23
Fe	1.0	0.11	0.097	-14
Mn	2.0	0.031	0.165	81
Cu	0.002	0.0007	0.0009	25
Ni	0.024	<0.0005	0.0016	68
Zn	0.016	0.003	0.0043	31
Ag	0.0001	<0.0001	0.0001	9
Sb	0.03	<0.0002	0.0003	27
As	0.19	<0.001	0.0010	0
Se	0.005	<0.001	0.0012	13
Hg	0.0005	<0.0001	0.0001	0
Cd	0.0002	<0.00005	0.0001	9
Cr (VI)	0.01	<0.01	0.01	0
Pb	0.0002	<0.0001	0.0001	2

Table 5 compares both the modelled and actual water quality at OH1 against the requirements of the resource consents. The results indicate that both the modelled and actual water quality at OH1 meets or is better than the receiving water criteria outlined in condition 9.13 Table 2.

Table 5 also presents the difference of the water quality model at predicting the water quality at OH1. The average difference in the water quality model was 19.6%. It should be noted that the difference in the water quality model was generally an over estimate of the water quality at OH1, which makes its prediction conservative. The only parameter that the water quality model underestimated was soluble iron, but the water quality levels both predicted and actual at OH1 were an order less than the resource consent requirements.

In summary, section 1 indicates that the water quality reporting to the W1 and S1 collection ponds meets the resource consent requirements of condition 9.13.

Section 2: Relationship Between Continuously Monitored Parameters and Critical Metal Species

2.1 Introduction

Section 1 proved that the quality of water reporting to W1 and S1 collection ponds meet the water quality requirements of resource consent 9.13, Table 2. However, the requirements of condition 9.13 also state that this must be demonstrable on a "*sustainable and continuous basis*". This is addressed as follows.

In order to demonstrate compliance on a continuous basis, two options were considered, namely:
- Installing automatic water samplers; and
- Installing continuous water quality probes to be used as a surrogate for metal species.

If automatic samplers were installed in the collection ponds they would only collect samples from approximately 5-10% of the time, mainly during storm events. It was decided that this option was inappropriate as it wouldn't demonstrate compliance on a continuous basis. The second option of installing continuous water quality probes could demonstrate compliance on a continuous basis if strong relationships were determined between the continuous data and metal species data.

The following parameters were determined to be the most appropriate for the continuous monitoring of the collection ponds, by the installation of probes measuring:
- electrical conductivity (as a surrogate for Hardness);
- turbidity (as a surrogate for suspended sediment, SS);
- temperature (a parameter required to determine Total Ammonia compliance); and
- pH (as a surrogate for copper).

This section of the report investigates the relationship between these parameters and their surrogate. If it can be demonstrated that a robust relationship between key metal species and the surrogates occurs, the use of these to measure the water quality of the collection ponds meets the requirements of resource consent condition 9.13 on a continuous and sustainable basis.

2.2 Available Data Set

Ten years of data were available for this analysis, from June 1988 to June 1998. The data consist of analysis results from water samples collected from the W1 and S1 collection ponds during the period.

2.3 Relationships

The relationships investigated in this section were those between:

- Electrical conductivity (EC) and hardness;
- pH and copper.

2.3.1 Electrical Conductivity and Hardness

As discussed in the previous sections the water quality criteria for some parameters is dependent on hardness. It is therefore desirable to be able to estimate water hardness using a continuous monitoring technique. Since magnesium and calcium (ie hardness) make the most significant contribution to the electrical conductivity of water, it is possible to correlate conductivity measurements with hardness for the total data set.

A very strong relationship was found between electrical conductivity and hardness in the collection ponds, with an R^2 value of 0.90. The relationship is outlined in Figure 6 below.

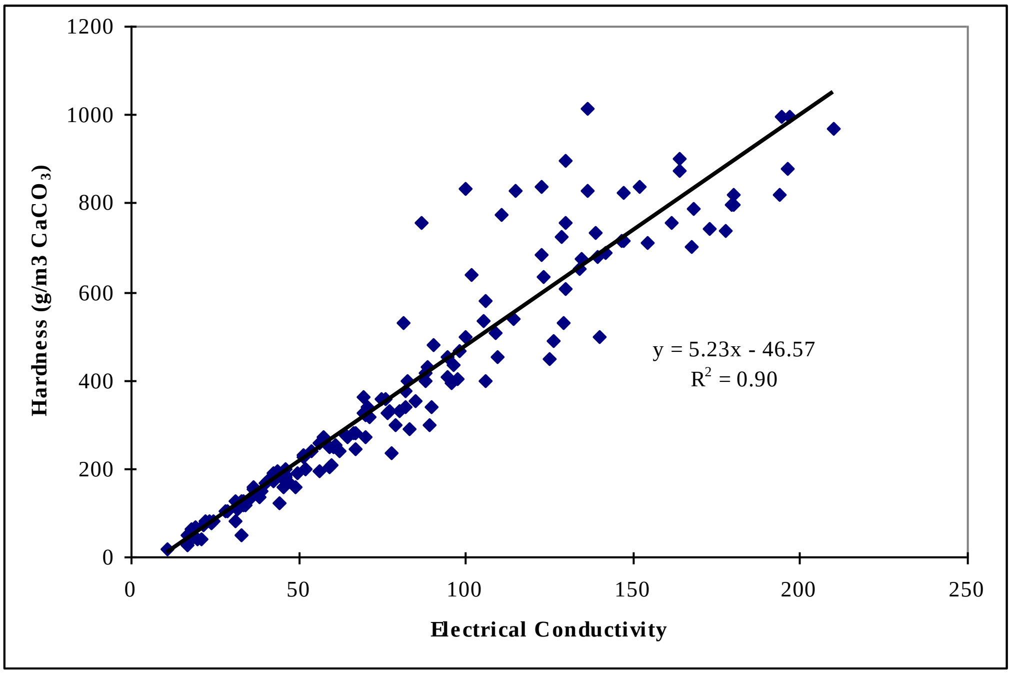


Figure 6: Relationship between Electrical Conductivity and Hardness in the W1 and S1 Collection Ponds.

2.3.2 pH and Copper

Copper has been identified as the most critical metal species with regard to the protection of aquatic life in the Ohinemuri River and Ruahorehore Stream. It is therefore desirable to be able to determine copper levels using a continuous monitoring technique. The dissociation of copper to its soluble form is dependent on the pH conditions of the water body. The relationship between pH and copper was therefore investigated and is outlined in this section.

The relationship between pH and copper was strong with an R^2 value of 0.67 as shown in Figure 7. A clear trend is apparent in that copper concentrations are relatively low at high pH, ie pH>5, but as soon as the pH drops below 5 the copper concentration increases rapidly.

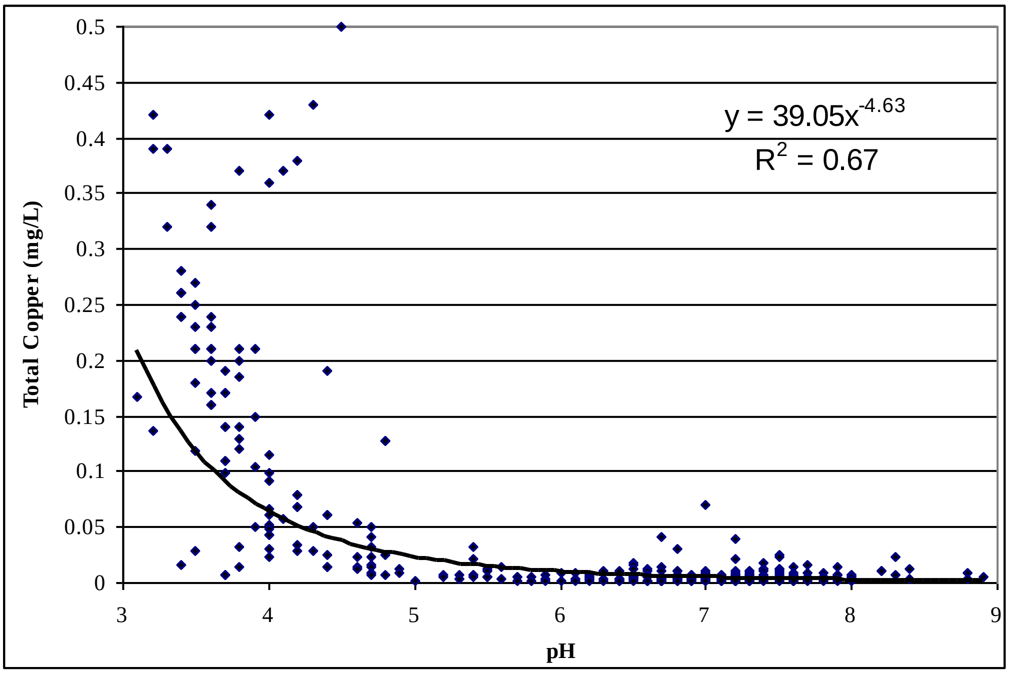


Figure 7: Relationship between pH and Total Copper in the W1 and S1 Collection Ponds.

2.4 Confidence Interval

Although it is possible to predict copper levels using pH as a surrogate, it is desirable to be able to associate a level of confidence with the prediction. This section determines the level of confidence associated with the relationship between pH and copper.

A clear trend in the relationship between copper and pH was observed as outlined in the previous section. If the pH in the collection ponds dropped below 5, ie pH<5, the copper concentration increases. A statistical analysis was performed on the available data to determine what confidence could be placed on this apparent trend.

To determine the copper concentration below which 95% of data would lie at a pH of 3, the following steps were followed:

- The full record of copper concentrations for S1 and WSP was edited to include only values where the pH on the same occasion was above, or equal to 3.
- The mean and standard deviation of this data set were calculated.
- The 95% confidence limit was calculated by taking the mean plus 2 standard deviations (0.044 g/m^3).

It can thus be stated that for 95% of the time, samples with a pH greater than or equal to 4.5 will have a total copper concentration less than 0.044 g/m^3.

This procedure was repeated for pH's from 3 to 9 at 0.1 unit intervals, and the results are outlined in Figure 8.

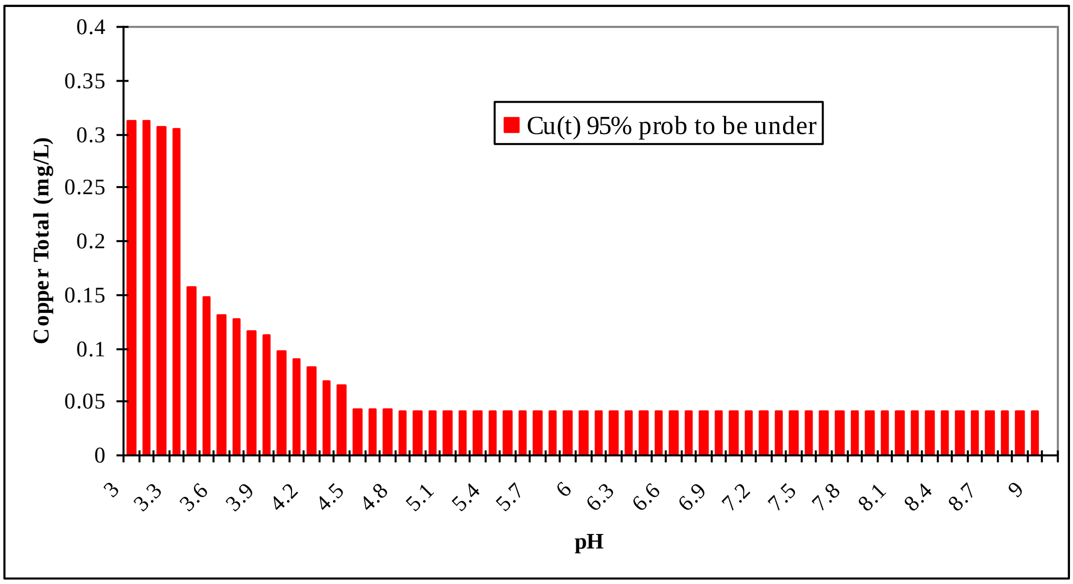


Figure 8: 95% Confidence Intervals Determined for the Relationship between pH and Total Copper in the W1 and S1 Collection Ponds.

The statistical analysis results supported the trend observed in the previous sections, ie that as pH increased the copper concentration decreased. The statistical analysis results indicated that:

- for pH $\geq$ 4.5 the predicted maximum total copper concentration (with 95% CI) plateaued;
- for pH < 3.4 the predicted maximum total copper concentration (with 95% CI) increases significantly; and
- for 3.4 $\leq$ pH < 4.5 the predicted maximum total copper concentration (with 95% CI) increases linearly with decreasing pH.

The significant result of this statistical analysis is that a level of pH can be chosen at random and the associated maximum predicted copper concentration is available with a 95% confidence level. This has a direct and very practical application for field purposes. If continuous real time pH data was available for the W1 and S1 collection ponds, then the maximum concentration of total copper in the collection ponds would be available on a continuous basis.

2.5 pH Threshold

The previous sections have demonstrated that copper concentration decreases as pH increases. It has also been demonstrated that for a given pH level the maximum concentration of copper can be predicted with a 95% confidence interval. It was therefore desirable to determine a pH threshold that would allow

water to be safely discharged from the collection ponds without treatment. The determination of the pH threshold and associated compliance were determined using the following steps:

- Determine pH threshold;
- Determine the associated predicted maximum total copper concentration (with 95% CI);
- Input the predicted maximum copper concentration into the water quality model to demonstrate compliance with resource consent condition 9.13.

In addition to these steps the following condition needed to be considered. If the W1 and S1 collection ponds are reclassified as silt ponds they have to meet the resource consent conditions, section 7. Resource consent 7.7 states that:

"for rainfall events less than or equal to the 2-year return period, 2-hour duration design storm, the silt pond discharges shall:

- *Contain no oil or grease;*
- *Have a suspended solids concentration of no greater than 100 g/m^3;*
- *Have a pH within the range of 6.0 to 9.0."*

Therefore, the pH threshold of the W1 and S1 collection ponds should be 6.0. At pH of 6.0 the associated predicted maximum total copper concentration (with 95% CI) was 0.41 g/m^3.

The next step was to input this predicted copper level into the water quality model outlined in section 1. The other inputs also included in the water quality model were:

- The worst case water quality for the WTP, Ohinemuri River and Ruahorehore Stream;
- Hardness of 40 g/m^3; and
- Mixing ratios as outlined in Section 1.3.3.

The results are outlined in Table 6 below.

TABLE 6: Comparison of resultant water quality with receiving water criteria

Parameter (soluble fraction)	Receiving water compliance criteria after mixing at a hardness of 40 g/m^3 $CaCO_3$ (All values are g/m^3)	Resultant water quality in the Ohinemuri River after mixing (All values are g/m^3)
Cu	0.005	0.004

Table 6 above indicates that the water quality meets the requirements of condition 9.13. It is therefore demonstrable that the water in the W1 and S1 collection ponds with pH>6.0 meets (with a 95% confidence interval) condition 9.13 Table 2 on a "*sustainable and continuous basis*".

2.6 Turbidity Threshold

Resource consent condition 7.7 (detailed in the previous section) requires that discharge from silt ponds contain less than 100 g/m^3 of suspended sediment. It is impractical to monitor suspended sediment on a continuous basis, and therefore desirable to be able to continuously monitor turbidity as a surrogate for suspended sediment. In addition a turbidity threshold should be set to represent the suspended sediment threshold of 100 g/m^3.

Turbidity has been used as a surrogate for suspended sediment in stormwater in previous studies, for example Williams (1997) and Gippel (1995). There were insufficient turbidity data for the available data set to be able to determine a site specific relationship for the W1 and S1 collection ponds. In the absence of a current relationship the relationship outlined by Williams (1997), shown in Figure 9, should be adopted until the site specific relationship is developed. By substituting 100 g/m3 into the relationship outlined in Figure 8 a turbidity threshold of 110 NTU's results (where NTU is the international unit of turbidity).

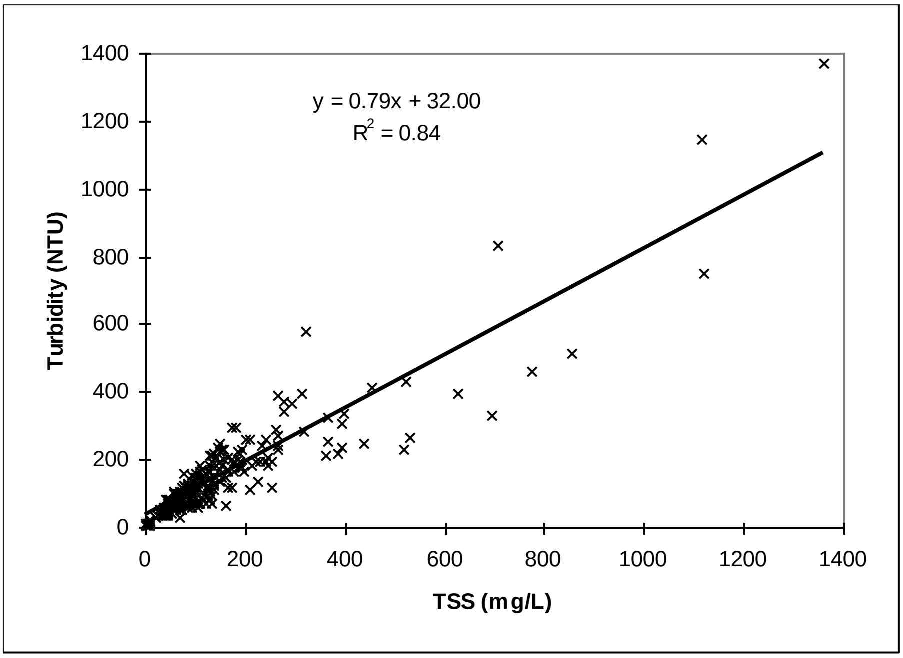


Figure 9**:** Correlation between suspended solids and turbidity for sequential sample data from the North Arm East Catchment (AU504101)

2.7 Continuous Monitoring System

This section outlines the details of the proposed continuous monitoring system that will be installed in the W1 and S1 collection ponds. The proposed system will contain the following main components:

- Continuous Monitoring probes of turbidity, electrical conductivity, pH and temperature in each pond;
- Datalogger;
- Data logging rate typically 10 minutes;
- Mains power with battery backup;
- Radio telemetry to transfer water quality data to base station;
- Pressure transducer to monitor pond level;
- Weather proof stainless steel cabinet; and
- Base station that receives water quality data and copies duplicate to computer network.

In addition to the above main components, the following will be required:

- regular calibration and maintenance of water quality continuous probes;
- sampling schedule to maintain and water quality relationships and analyse metal levels;
- water quality thresholds (such as outlined in Sections 2.5 and 2.6) and alarming systems when thresholds are exceeded.

2.8 Summary

In summary, it has been demonstrated that the continuous monitoring of pH, electrical conductivity, turbidity and temperature as surrogates for copper, hardness and suspended sediment meet the requirements of condition 9.13.

In addition the pH thresholds of 6.0 and a turbidity threshold of 110 NTU should be implemented to ensure that the water from the W1 and S1 collection ponds can be safely discharged without treatment. ie water in the W1 or S1 collection ponds with pH less than 6.0 and/or a turbidity of greater than 110 NTU would require treatment before being discharged to the Ohinemuri River.

Section 3: Conclusions and Recommendations

3.1 Conclusions

- The water quality reporting to the W1 and S1 collection ponds is of a quality such that it meets or is better than the receiving water compliance criteria outlined in condition 9.13 Table 2.
- Compliance with the resource consent water quality criteria was demonstrable even though the data analysis was conservative. The parts of the analysis that were conservative are summarised by the following points:
  - The worst case water quality (for the available data set) of each water source was modelled;
  - It was assumed that the worst case water quality of each water source occurred at the same time;
  - The hardness input to the water quality model of 40 g/m^3 $CaCO_3$ was 30% lower than the average hardness recorded at the compliance point, OH1; and
  - The worst case mixing ratios of the point discharges were modelled.
  - The water quality model in Section 1 used total metal fraction as an input, however, the results were compared against soluble fraction water quality limits outlined in the consent conditions.
- The continuous monitoring of certain water quality parameters can act as surrogates for other critical species such as copper concentration.
- A pH threshold of 6.0 should be implemented to restrict the water discharged to the Ohinemuri River in accordance with resource consent condition 7.7.
- A turbidity threshold of 110 NTU should be implemented to restrict the water discharged to the Ohinemuri River in accordance with resource consent condition 7.7.

3.2 Recommendations

- An application should be made to the Waikato Regional Council to reclassify the W1 and S1 collection ponds as silt ponds.
- The reclassification of the W1 and S1 collection ponds to silt ponds should require that the following steps are followed:
  - The installation of continuous monitoring probes in the W1 and S1 collection ponds for the parameters of pH, EC, turbidity and temperature.
  - The installation of continuous monitoring probes at OH1 in the Ohinemuri River for the parameters of pH, EC, turbidity and temperature.
  - A pH threshold of 6.0 be implemented so that water with **pH < 6.0** is pumped to the water treatment plant for treatment.
  - A turbidity threshold of 110 NTU be implemented so that water with **turbidity > 110 NTU** is pumped to the water treatment plant for treatment.
  - A site specific relationship between turbidity and suspended solids be developed.
  - A data management and retrieval system should be implement to control the above water quality thresholds and an associated alarm system installed to alert the appropriate persons when the thresholds are exceeded.

  - The W1 and S1 ponds are sampled and data reported in accordance with the Waikato Regional Council resource consent conditions once they are reclassified to silt ponds.

    - A sampling program is established to maintain and improve the water quality relationships outlined in section 2 of this report.
- Compliance with resource consent conditions should be determined at sample point OH1, downstream of all point discharges. In addition, samples collected at point OH1 should be accompanied by samples from OH3 and RU3 to determine the background water concentrations of metal species in the Ohinemuri River and Ruahorehore Stream respectively.

References

Waikato Regional Council (1998) “Consents and Conditions for the Extended Martha Mine Project by Waihi Gold Company” 28 August 1998, Strike-out version of Agreed consents.

Williams, B. G. (1997) “Monitoring Stormwater Runoff entering the MFP Barker Inlet Wetland, Wingfield, South Australia.” Master of Engineering Science Thesis, The University of Adelaide. p.232

Gippel, C. J. (1995). “Potential of Turbidity Monitoring for Measuring the Transport of Suspended Solids in Streams.” Hydrological Processes **9**: 83-97.

Appendix A: Collection Pond Conditions of Consent

Appendix B: Silt Pond Conditions of Consent

Appendix C: Available Data Set, 1996 -1998

Note:

The negative water quality concentrations are values that are below detection limits. For example a water quality value less than the detection limit for Nickel of 0.004 (ie Ni < 0.004 g/m^3) would appear on the graph as –0.004 g/m^3.

File No: 60 59 02A/60 59 02E

Document No: 1239013

Enquiries to: Brent Sinclair

23 October 2007

Newmont Waihi Gold Co Ltd

PO Box 190

WAIHI

Attention: Malcolm Lane

Dear Malcolm

Approval for Direct Discharge from Tailings Storage Facility 2

We have received and reviewed your letter dated 19 September 2007 entitled "Direct Discharge of Storage 2 Tailings Pond Water" in which you note the intent of Newmont Waihi Gold to commence exercising resource consent 971323, which authorises the direct discharge of water from the tailings ponds.

I note that the proposal involves utilising the existing pumps to deliver the water to the tributary of the Ohinemuri River and that the pond outlet structure has yet to be installed. That being the case, condition 2 of consent 971323, which provide performance specifications for the outlet structure, is not yet relevant.

Condition 6 of the consent requires that the discharge, in combination with other discharges from the site, does not cause a significant adverse effect on the environment, and in turn refers to specified receiving water quality criteria.

We are satisfied that the data provided shows that the discharge quality meets the receiving water quality criteria and it is unlikely that the combined discharges will exceed the receiving water quality criteria.

That said, there will be an increase in the authorised mass load of contaminants into the river. We have recently received the suite of monitoring reports assessing the effects of the various discharges on the river and are having these reports reviewed by NIWA. If that review process identifies adverse effects, albeit whilst receiving water criteria are being met, then we may need to look closely at the receiving water quality criteria and the mass load of contaminants being discharged. That review is due to be completed by the end of November.

However, we note that the minimum freeboard level at TSF2 has been exceeded due to recent rainfall events and agree that it would be appropriate to ensure that minimum freeboard is maintained.

Therefore, we have decided to provide condition approval for the direct discharge from TSF2. This would enable discharge to occur to the point where the minimum freeboard level can be maintained.

Please accept this letter as provided approval (as required by condition 5 of consent 971323) to discharge directly from Tailings Storage Facility 2, to the extent that the discharge enables the minimum freeboard level to be achieved until further notice.

I note that Condition 2 – Schedule 1 requires that we be given two weeks notice in writing prior to the consent being first exercised. Given that more than two weeks has passed since we received your letter of 19 September, direct discharge can commence immediately.

If you have any questions, feel free to contact me on (07) 859 0823.

Yours faithfully

Brent Sinclair

Programme Manager

Resource Use Group

cc: Mark Buttimore, Hauraki District Council (via email)

File No: 60 59 02A
Document No: 33657
Enquiries to: 847

Waikato
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23 June 2016

Waihi Gold Company Limited
PO Box 190
Waihi 3641
Attn: Kerry Watson

Dear Kerry

Request for Cessation of Sampling During Direct Discharge Events

I refer to your letter dated 12 April 2016. Your request to cease sampling of collection/silt pond water during direct discharge events has been considered. Dr Ngaire Philips has undertaken a technical assessment of your request and her assessment is attached for your information.

Given Dr Philips assessment and consideration of the matters the Waikato Regional Council assesses compliance for, it is agreed that the direct sampling currently occurring can cease and further the supply of SCADA data from direct discharge events can now be provided as part of the quarterly reporting requirements as per the conditions of consents.

Thank you for undertaking this exercise.

Should you require any further information with regard to the above, please contact me on 07 859 0731 or email at Sheryl.Roa@waikatoregion.govt.nz

Yours faithfully

S. S. Roa

Sheryl Roa
Principal Advisor - Consents
Resource Use Directorate

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9 June 2015

Waikato Regional Council
401 Grey Street,
Private Bag 3038,
Waikato Mail Centre,
HAMILTON EAST 3240

For: Sheryl Roa

Dear Sheryl,

Re: Monitoring Review for Barium, Boron, Molybdenum, Strontium, Thorium, and Tin

In January 2011, EGi produced a report entitled "Review of the Geochemical Performance of the Tailings and Waste Rock Storage Facilities". The EGi report was appended to the 2011 Groundwater Effects Interpretive Report. The report recommended the addition of a number of elements to the monitoring programme. The EGi report went on to state that the results should be regularly reviewed to reflect the characteristics of individual water types and trends.

A review of the data has been carried out. While there are some parameters that should continue to be monitored at least for some additional period, NWG is of the view that there is justification to remove barium, boron, molybdenum, strontium, thorium and tin from the monitoring programme, on the basis that continued monitoring of these parameters provides no value.

It is noted that NWG has collected considerably more data for barium, boron, molybdenum, strontium and thorium than the annual sampling that was recommended in the EGi report. In addition, NWG has been monitoring tin, which was not recommended in the EGi report.

NWG engaged Golder Associates (NZ) Limited (Golder) to prepare a table of receiving water guidelines for these parameters (refer Attachment 1). NWG then compared the data for the parameters of interest to the relevant guidelines to determine whether the results seen in the various waters around the site have any environmental significance. If the results seen were below guidelines, then there appears to be little value in continuing their monitoring.

In reviewing the guidelines, NWG gave preference to the USEPA guidelines where they existed as USEPA standards form the basis for the existing water quality limits. Where USEPA standards were absent, NWG looked at the other water quality guidelines that were available to provide a comparison with the data collected from the site. The Storage 2 seepage database is very large, and for this reason data for the last five years only was used.

In determining maximum, median and minimum values for each of the parameters, NWG has grouped individual sources of water together as follows:

Name	Includes
Treated water	Treated water
Storage 1A decant water	Storage 1A decant water
Storage 1A seepage[1]	LD06, LD07, LD08, LD09, LD10, LD11, LD13, leachate manhole 01 – composite, leachate manhole 01-drain, leachate manhole 01-drain A, leachate manhole 01-drain B, leachate manhole 01-drain C, leachate manhole 02-drain, leachate manhole 03-composite sample, leachate manhole 03-drain, leachate manhole 03-drain A, leachate manhole 04-composite, leachate manhole 04-drain A, leachate manhole 05-drain A, LM6, LM7, MH11, MH11- 130mRLsubsoil, MH12, MH13A, MH14, S3 sub, S4 sub, S5 sub, T15, T15-A, T15-B, T15-C, T15-D, T15-E, T15-F, T15-G, T15-H, T16, T16 combined, T16-A, T16-B, T17, T17-A, T17-B, T17-D, T18, T18-A, T19, T19-B, T19-C, T19-D, T19-E, T21, T22, TU, T15, T15-C, T15-D, T15-E, T15-F, T15-G, T15-H, T16, T16 combined, T17, T18, T19, T19-E, T19-S5, UCD
Storage 2 seepage[1]	K1, K2, K3, K4, K5, K5-North, K5-South, K6, K6-North, K6-South, IT1, IT2, L1, L2, L3, L4, L5, L6, L8, L9, L10, L11, L12, L13, L14, L15, L16, MH17, MH4-SS drain storage, SPS, T1, T10, T11, T11A, T11B, T12, T13, T13-East, T13-N, T13-S, T13-subsoil, T14, T14-N, T14-S, T1-N, T1-S, T1-SS, T2, T2-North, T2-South, T3, T3-N, T3-S, T4, T4-N, T4-S, T5, T5-N, T5-S, T6, T6-North, T6-South, T6-subsoil, T7, T7-N, T7-S, T8, T8-N, T8-S, T9, T9-N, T9-S, U1, U2, U3, U4, WTP K6.
OC2	Upstream site OC2
OH6	Downstream site OH6
Storage 2 groundwater	MW15S, MW1S, MW2C15D, MW2C6D, MW2C7S, MW2C8S, MW2D, MW6D
Storage 1A groundwater	MW1C12D, MW1C1S, MW1C2S, MW1C4S, MW1C7S, MW1C9D, MW1C9S, MW1CSPD, MW1D11D, MW1D11S, MW1D18D, MW1D18S, MW1D2S, MW1D3D, MW1D5D, MW1D7D, MW1D8S, MW1D9D, MW1DSPD, MWCT3S, shed spring, WG1
Ponds – collection	NCP, S3, S4 and S5

Note 1: The seepage data for TSF2 and TSF1A are analysed and reported on a drain-by-drain basis, i.e. the maxima are the greatest values recorded for all drains, rather than flow-weighted maxima from the combined TSF1A and TSF2 drain flows. Furthermore, as some of the individual drain flows make up a very small proportion of the overall seepage volumes, the treatment of the drain data, and hence the reported results, is considered very conservative.

For some parameters, the laboratory reported more than one detection limit. In order to account for "less thans" in the following statistical analyses, the absolute value of the detection limits was used. The results are described below, with acid soluble results shown as "AS" and dissolved (or soluble) results shown as "S". In the column headed "Mean + 2SD" (mean plus two standard deviations, or the 98th percentile level of confidence result), the term "ID" indicates that there was insufficient data to generate a meaningful result.

Barium

Barium exists above the detection limit in all of the waters investigated below. It appears to be naturally higher in groundwater than in surface water, and while it is slightly elevated in the decant water, there is essentially no difference between the upstream and downstream river sites. There are no water quality guidelines for barium.

The continued monitoring of barium is unlikely to provide anything of value to the site or Waikato Regional Council, therefore the recommendation is to remove it from the monitoring suite.

	Units g/m3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	160	0.022	0.047	0.057	0.137	0.27
TSF1A Seepage (S)	438	0.0068	0.033	0.04	0.092	0.193
TSF2 Seepage (S)	752	0.0044	0.026	0.048	0.167	0.33
Collection Ponds (AS)	21	0.005	0.013	0.016	0.037	0.041
Treated Water (AS)	13	0.014	0.023	0.025	0.04	0.038
TSF1A Groundwater (S)	665	0.018	0.119	0.128	0.27	0.37
TSF2 Groundwater (S)	169	0.021	0.134	0.133	0.301	0.5
OC2 (u/s Ohinemuri) (S)	3	0.027	0.031	0.032	0.042	0.038
OH6 (d/s Ohinemuri) (S)	3	0.037	0.038	0.039	0.042	0.041

Boron

The USEPA guideline for boron is 0.75 g/m^3, which is significantly higher than any of the results seen in the data below.

The continued monitoring of boron is unlikely to provide anything of value to the site or council, therefore the recommendation is to remove it from the monitoring suite.

	Units g/m3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	401	0.007	0.08	0.085	0.168	0.285
TSF1A Seepage (S)	442	0.008	0.022	0.027	0.06	0.123
TSF2 Seepage (S)	903	<0.005	0.024	0.034	0.109	0.35
Collection Ponds (AS)	22	<0.005	0.012	0.018	0.051	0.079
Treated Water (AS)	87	0.029	0.05	0.051	0.081	0.1
TSF1A Groundwater (S)	678	<0.005	0.013	0.020	0.067	0.13
TSF2 Groundwater (S)	243	<0.005	0.009	0.01	0.018	0.028
OC2 (u/s Ohinemuri) (S)	13	0.009	0.01	0.012	0.013	0.013
OH6 (d/s Ohinemuri) (S)	23	0.007	0.012	0.012	0.018	0.022

Molybdenum

There is no USEPA guideline for molybdenum. Exceedances of the ANZECC (2000) 95% level of protection trigger value (0.034 g/m^3) are highlighted red within the table. Although molybdenum is elevated in the Storage 1A decant water, the concentrations in the treated water and all other site waters are considerably lower. The concentrations of molybdenum at the downstream river monitoring site are always considerably lower than the ANZECC (2000) 95% level, with maximum concentrations of around one order of magnitude less than the trigger value.

The continued monitoring of molybdenum is unlikely to provide anything of value to the site or to the Council, therefore the recommendation is to remove it from the monitoring suite.

	Units g/m^3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	312	<0.0002	0.064	0.071	0.139	0.24
TSF1A Seepage (S)	627	<0.0002	<0.0002	0.0003	0.0012	0.011
TSF2 Seepage (S)	766	<0.0002	0.0002	0.0004	0.001	0.002
Collection Ponds (AS)	161	<0.0002	0.0002	0.0006	0.0039	0.018
Treated Water (AS)	246	<0.0002	0.0027	0.0068	0.026	0.053
TSF1A Groundwater (S)	733	<0.0002	0.0002	0.0003	0.0017	0.0076
TSF2 Groundwater (S)	174	<0.0002	0.0002	0.0002	0.0007	0.0016
OC2 (u/s Ohinemuri) (S)	235	<0.0002	0.0002	0.0002	0.0002	0.0002
OH6 (d/s Ohinemuri) (S)	340	<0.0002	0.0003	0.0006	0.002	0.0043

Strontium

There is no USEPA water quality guideline for strontium. McPherson et al. (2014) examined available effects data for strontium in freshwater environments, and from these data derived a strontium chronic effects benchmark of 10.7 g/m^3. Further information about this guideline is provided in Attachment 1. The strontium concentrations measured in the waters around the site are well below this guideline.

The continued monitoring of strontium is unlikely to provide anything of value to the site or Council, therefore the recommendation is to remove it from the monitoring suite.

	Units g/m^3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	160	0.079	1.08	1.07	1.45	1.7
TSF1A Seepage (S)	435	0.016	0.28	0.856	2.61	2.9
TSF2 Seepage (S)	752	0.034	0.23	0.516	1.534	2.2
Collection Ponds (AS)	4	0.073	0.251	0.446	1.48	1.21
Treated Water (AS or S)	No data					
TSF1A Groundwater (S)	665	0.0099	0.05	0.09	0.303	1.25
TSF2 Groundwater (S)	169	0.0152	0.054	0.067	0.276	1.34
OC2 (u/s Ohinemuri) (S)	1	0.018	0.018	0.018	ID	0.018
OH6 (d/s Ohinemuri) (S)	1	0.031	0.031	0.031	ID	0.031

Thorium

There are no published guidelines for thorium. However, Kempster et al. (1980) identified a water quality criterion for river and dam waters in South Africa of 0.1 g/m^3. NWG has sampled the waters around the site many times for thorium, with most results being below the detection limit and all results several orders of magnitude below the water quality criterion in Kempster et al. (1980).

The continued monitoring of thorium is unlikely to provide anything of value to the site or Council, therefore the recommendation is to remove it from the monitoring suite.

	Units g/m^3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	144	<0.0005	0.001	0.002	0.004	0.003
TSF1A Seepage (S)	426	<0.0005	0.0005	0.0008	0.002	0.003
TSF2 Seepage (S)	743	<0.0005	0.0005	0.0008	0.0025	0.005
Collection Ponds (AS)	4	<0.0005	0.0005	0.0006	0.001	0.001
Treated Water (AS or S)	No data					
TSF1A Groundwater (S)	616	<0.0005	0.0005	0.0005	0.0006	0.001
TSF2 Groundwater (S)	146	<0.0005	0.0005	0.0005	0.0005	0.001
OC2 (u/s Ohinemuri) (S)	1	<0.0005	0.0005	0.0005	ID	0.0005
OH6 (d/s Ohinemuri) (S)	1	<0.0005	0.0005	0.0005	ID	0.0005

Tin

There is no USEPA guideline for tin. ANZECC (2000) was unable to derive a guideline for inorganic tin, as there were insufficient data. However, a low reliability freshwater trigger value of 3 mg/m^3 was derived by applying a universal assessment factor of 1,000 to the lowest Tubifex tubifex 96-hour LC_{50}.

In the following table, exceedances of the ANZECC (2000) low reliability freshwater trigger value for tin (0.003 g/m^3) are highlighted red. Tin concentrations in the decant water are slightly elevated, with maxima close to the guideline value, although this is expected to have little environmental significance as tin concentrations should be reduced through treatment.

In the Storage 1A seepage, while tin is occasionally elevated, the maximum level recorded in the individual drains (0.004 g/m^3) is very close to the ANZECC (2000) low reliability trigger value and the 98th percentile level of confidence concentration does not exceed the guideline. In the Storage 2 seepage, most of the results are less than the detection limit and the maximum recorded is double the ANZECC (2000) low reliability trigger value.

The expectation is that the occasionally elevated tin results in individual drains would be diluted by other drain waters, so that the combined seepage would always meet the guideline value without the need for water treatment or dilution.

The continued monitoring of tin is unlikely to provide anything of value to the site or the Council. In addition, the monitoring of tin was not recommended by either EGi. The recommendation is to remove it from the monitoring suite.

	Units g/m^3					
	Number of results	Minimum	Median	Mean	Mean + 2SD	Maximum
TSF1A Decant (S)	152	<0.0005	0.001	0.002	0.004	0.003
TSF1A Seepage (S)	435	<0.0005	0.0008	0.001	0.0027	0.004
TSF2 Seepage (S)	503	<0.0005	0.0005	0.0006	0.0015	0.006
Collection Ponds (AS)	4	<0.0005	0.0005	0.0006	0.001	0.001
Treated Water (AS or S)	No data					
TSF1A Groundwater (S)	585	<0.0005	0.0005	0.0006	0.001	0.0024
TSF2 Groundwater (S)	169	<0.0005	0.0005	0.0006	0.0013	0.003
OC2 (u/s Ohinemuri) (S)	1	<0.0005	<0.0005	<0.0005	ID	<0.0005
OH6 (d/s Ohinemuri) (S)	1	<0.0005	<0.0005	<0.0005	ID	<0.0005

To provide further justification for dropping these parameters, it is noted that Golder carries out biological monitoring of the Ohinemuri River and Ruahorehore Stream on a regular basis. The results show that there are no adverse effects resulting from NWG's discharges.

Our intention is to forward this letter to the relevant peer reviewers (James Pope) and (Chris Kidd) with a view to discontinuing the monitoring referred to above as soon as possible. While there are other parameter that we believe could be discontinued, we would like to collect more data to confirm that this is appropriate. We anticipate a subsequent review once that data has been collected.

If you have any questions, please contact Kathy Mason.

We look forward to your response.

Yours sincerely,

Kerry Watson,
Environmental Manager

Friday 9 June 2015

Kathy

I have reviewed the information in the letter of 9 June 2015 attached to your email and concur with the recommendations to drop barium, boron, molybdenum, strontium, thorium and tin from the monitoring suite. However, one or more of these may need to be reinstated should testing of tailings originating from new ore bodies, especially those outside the boundaries of the current mine developments, indicate elevated concentrations compared with tailings from the ore bodies mined to date by NWG.

Regards

Chris

30 June 2015

Hi Kathy

I have reviewed the letter and agree with dropping B, Ba, Mo, Sr, Th and Sn from the monitoring suite.

If ore bodies are developed in future where these metals are enriched then these metals can be reinstated – but currently there is little value in continued monitoring.

Cheers

James

James Pope
General Manager – South Island
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APPENDIX D - CYANIDE DETECTION LIMIT ASSESSMENT

Golder Associates

CELEBRATING 50 YEARS in 2010

05 May 2010

Project No. 1078206137

Peter Carruthers
Newmont Waihi Gold Ltd
PO Box 190
WAIHI

MDL/ML ASSESSMENT - WADCN

Dear Peter

At your request we have reviewed the methodology you have provided relating to the sample collection for the MDL/ML cyanide study. The sample collection steps are all appropriate and will ensure samples are not contaminated and correctly preserved; hence they should arrive at the laboratory in a condition suitable for analysis. We note, however, there are no instructions regarding labeling of samples for filling out any chain of custody form.

We have also reviewed the Hill Laboratories data you provided relating to the same study and have the following comments. The first step in the data analysis should be scrutiny of the blanks. Both the Code 40 (WAD-CN) and Code 50 (WAD-CN and TOT-CN) blanks are below the reported method detection limit, indicating there has been no blank contamination.

Next, the replicates need to be analysed to see if there are any outliers. It is immediately apparent that one of the Code 40 replicates (sample 40279) is different to the others in the group; it is below the method detection limit. Conducting a student t-test for outliers on the Code 40 replicates indicates sample 40279 is, indeed, an outlier and should be removed from the data set before the MDL/ML calculations are conducted. Of course just why sample 40279 was below detection is another issue. There doesn't appear to be any difference in any of the other parameters in this sample compared with the rest in the group; so this is something worth following up with the laboratory.

Once a consistent data set for the Code 40 samples had been established, the MDL/ML calculations (see the attached spreadsheet) can be performed. The t-statistic provided to Newmont by Dr Terry Mudder is correct for a group of seven samples, which is what we now have after the removal of the outlier. Hence for the Code 40 (WAD-CN) replicates we obtain:

MDL = 0.0014 mg/L

ML = 0.0045 mg/L

The same process is followed for the Code 50 samples. Once again the blanks are all below the lab's stated method detection limit, but this time the Student t-test for outliers indicates there are none in either the WAD-CN or TOT-CN replicate data. Since we now have consistent data sets of eight samples each for both the Code 50 WAD-CN and TOT-CN replicates, we need to use a different t-statistic for the calculation of the MDL: 2.998. The ML is still ten times the standard deviation (which is 3.34 x MDL). Hence for the Code 50 (WAD-CN) replicates we obtain:

MDL = 0.00083 mg/L

ML = 0.0028 mg/L

The fact that the Code 50 WAD-CN replicates afford a lower MDL/ML is simply a function of the data being less variable than the Code 40 WAD-CN data. Either way, the laboratory is reporting a method detection limit of 0.001 mg/L, which is about right.

For the Code 50 (TOT-CN) replicates we obtain:

MDL = 0.0018 mg/L

ML = 0.0060 mg/L

Based on this series of data, the method detection limit reported by the laboratory for TOT-CN (0.001 mg/L) is slightly underestimated; it should be 0.002 mg/L.

We trust these comments are helpful. Please contact the undersigned if we can be of further assistance in this matter.

Yours sincerely

GOLDER ASSOCIATES (NZ) LTD

Mike Fitzpatrick
Principal Environmental Chemist

MF/dmj

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APPENDIX E – TREATED WATER FOR USE AS HANDWASHING

Memorandum to Dave Townsend re Treated Water Quality and Potential for Use for Hand Washing

Follow up memorandum with E Coli Results

- **Note that the E coli results for treated water in this memorandum are pre-UV treatment**

To:	Dave Townsend
Item:	Underground Crib Room – Water for Hand Washing
Date:	21 January 2016

Dave,

You have asked us whether treated water can be used for hand washing in the underground crib room. There are no guidelines or standards that are specific to hand washing, and for this reason we have compared the available treated water data to the Drinking-Water Standards for New Zealand 2005 (revised 2008) referred to hereafter as “DWSNZ”.

The DWSNZ includes maximum acceptable values (“MAVs”) for various chemical determinands with health significance. The MAV is the highest concentration of a determinand in the water that, on the basis of present knowledge, is considered not to cause any significant risk to the health of the consumer over 70 years of consumption of that water. The MAV uses a body weight of 70 kg to represent the average weight of New Zealand adults, and for most chemicals the assumption is that 2L per day is ingested.

It is recognised that a direct comparison with the DWSNZ is overly conservative given that the intention is to use the water for hand washing only and not drinking water, and this needs to be kept in mind when interpreting the results.

As well as MAVs for chemical elements, the DWSNZ also includes MAVs for micro-organisms. To date, there has been no need to regularly monitor for micro-organisms in the treated water, and for that reason there is a lack of data that can be compared to the DWSNZ MAVs. For this reason we intend to carry out some additional testing, as described later in this document.

The DWSNZ also includes guideline values (GVs) for aesthetic determinands. Again, in many cases these have limited relevance considering the intended use of the treated water, however a comparison is made for completeness.

Results

Table 1 below summarises the results. The figures that are highlighted yellow are greater than the DWSNZ MAVs and the figures that are highlighted blue are greater than the aesthetic guidelines.

Table 1: Comparison of Treated Water Data to DWSNA MAVs and Guidelines for Aesthetic Determinands

Parameter	Treated Water May 2014 to January 2016				DWSNZ MAV	Aesthetic GVs
	Max	Min	Mean	n		
Aluminium	0.089	0.041	0.06	14		0.1[1]
Ammonia	0.88	0.038	0.26	11		1.5[2]
Antimony	0.027	0.0002	0.004	75	0.02	
Arsenic	0.005	0.001	0.002	13	0.01	
Cadmium	0.0003	0.00005	0.0001	13	0.004	
Chloride	65	47	52	4		250[3]
Chromium	0.003	0.0005	0.0009	62	0.05	
Copper	0.0142	0.0005	0.004	75	2	1[4]
Fluoride	0.93	0.23	0.48	23	1.5	
Hardness	1860	75	1264	61		200[5]
Iron	0.1	0.04	0.046	13		0.2[6]
Lead	0.0005	0.00013	0.0002	13	0.01	
Manganese	0.055	0.0038	0.016	75	0.4	0.04[7]
Mercury	0.00008	0.00008	0.00008	21	0.007	
Nickel	0.005	0.001	0.002	13	0.08	
Nitrate	11.5	2	4.55	10	50	
Nitrite	0.6	0.17	0.353	10	0.2[8]	
pH	8.9	7.7	8.6	84		7-8.5[9]
Selenium	0.035	0.0002	0.006	75	0.01	
Sodium	126	44	65	4		200[10]
Sulphate	1770	720	1359	19		250[11]
Total CN	0.041	0.0015	0.017	8	0.6	
Uranium	0.00004	0.00002	0.0000229	14	0.02	
Zinc	0.005	0.003	0.0039	13		1.5[12]

[1] Above this, complaints may arise due to depositions or discolouration
[2] Odour threshold in alkaline conditions
[3] Taste, Corrosion
[4] Staining of laundry and sanitary ware
[5] High hardness causes scale deposition, scum formation
[6] Staining of laundry and sanitary ware
[7] Staining of laundry. Note there is a GV of 0.10 g/m^3 which is a taste threshold.
[8] Note that 0.2 g/m^3 is long-term only, short term is 3 g/m^3. The short term exposure MAVs for nitrate and nitrite have been established to protect against methaemoglobinaemia in bottle-fed infants.
[9] Waters with a high pH have a soapy taste and feel.
[10] Taste threshold
[11] Taste threshold
[12] Taste threshold

Species Greater than the MAVs

Antimony

For antimony, the maximum value (0.027 g/m^3) is greater than the MAV of 0.02 g/m^3. It is noted however that the 99 percentile value is 0.02 g/m^3, i.e. the same as the MAV.

Given that the MAV assumes drinking of 2L of the water over a lifetime, antimony is not considered to be of concern for hand washing.

Nitrite

There are two MAVs for nitrite; short term exposure 3 g/m^3 and long term exposure 0.2 g/m^3. The short-term exposure MAV has been established to protect against methaemoglobinaemia in bottle-fed infants, and is not relevant for the intended use.

Both the maximum (0.6 g/m^3) and mean (0.353 g/m^3) results for nitrite are greater than the long term MAV of 0.2 g/m^3. For this reason further information was sought on the internet. The attached Nova Scotia Environment document states the following:

*"…Well water with nitrite-nitrogen levels greater than **1 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing,handwashing, and dishwashing."* (emphasis added).

The levels of nitrite in the treated water are consistently less than 1 mg/L (equivalent to 1 g/m^3) therefore nitrite is not considered to be a concern for hand washing. It is noted that one of the main sources of ingested nitrite originates from sodium nitrite used as a food preservative in cured meats, fish and some cheeses.

Selenium

For selenium the maximum value (0.035 g/m^3) is greater than the MAV of 0.01 g/m^3. The 99 percentile value of 0.03 g/m^3 is also greater than the MAV of 0.01 g/m^3.

Selenium is an essential element in our diets, and adverse health effects can occur if intake is too low. Adverse effects can also occur if intake rates are too high. Fish and other seafood is the principal source of selenium in New Zealanders' diets (MoH 2003[6]).

Although the maximum, mean, and 99 percentile values are higher than the MAV for selenium, it is noted that the main source of selenium is through the diet. Given that the water will be used for hand washing and not drinking water, selenium is not considered to be of concern for hand washing.

Species Greater than the Aesthetic Guidelines

Hardness

For hardness, the maximum (1860 g/m^3) and the mean (1264 g/m^3) results are greater than the GV of 200 g/m^3. It is noted that high hardness causes scale deposition and scum formation. The relatively high hardness could result in the need for more frequent

[6] MoH 2003. Food and Nutrition Guidelines for Healthy Adults: A background paper. Wellington. Ministry of Health. October 2003.

maintenance of taps, washers and pipelines. In addition, some soaps may not lather well in the water.

Past analysis of the scale present in the river has indicated high concentrations of some metals. However provided the water is not used for drinking, and the scale is appropriately disposed of within the TSF1A tailings pond, scale formation should not be a health issue for workers.

Manganese

For manganese the maximum value (0.055 g/m^3) is greater than the GV of 0.04 g/m^3. The GV relates to the staining of laundry which is not relevant for the intended use. Manganese is not considered to be of concern for hand washing.

pH

For pH the maximum value (8.9) and the mean value (8.6) is outside of the GV range of 7.0 to 8.5. Waters with a high pH have a soapy taste and feel. However this is not important with respect to the intended use. pH is not considered to be of concern for hand washing

Sulphate

Sulphate within the treated water is consistently greater than the GV of 250 g/m^3. The GV is however a taste threshold, which is not relevant for the intended use. The relatively high levels of sulphate are not considered to be of concern for hand washing.

<u>Additional Testwork</u>

As previously mentioned, the DWSNZ also includes MAVs for micro-organisms. To date, there has been no need to regularly monitor for micro-organisms in the treated water, and for that reason there is a lack of data that can be compared to the DWSNZ MAVs.

With this in mind, OGNZL contacted Hill Laboratories in Hamilton for advice. As a result, a six week sampling programme is being initiated to test for Escherichia coli (E. coli) which is a representative organism for bacteria. E. coli is used as an indicator of bacterial risk because it indicates the presence of faecal material and, therefore, the potential presence of pathogenic bacteria. The six week sampling programme will include the following water types:

- Underground dewatering,

TSF1A decant,
Collection ponds,
Treated water.

If E. coli is found to be present, a UV treatment stage can be incorporated.

<u>Summary</u>

With respect to human health, the chemistry of the treated water when used for hand washing should not be an issue. There may be some maintenance issues associated with relatively high hardness, and possible scale formation. Provided that water is not used for drinking, and any scale is appropriately disposed of there should be no issue.

There is a lack of microbiological data and for this reason sampling and analysis for E. coli will be carried out over six weeks. If required, a UV treatment stage can be incorporated at minimal cost.

Yours faithfully

Kathy Mason
Senior Environmental Advisor – Consenting.

To:	**Bernie Murphy**
From:	**Kathy Mason**
Item:	**E coli Results**
Date:	**9 May 2016**

Bernie,

Last Friday 6th May we sent you the document entitled "Underground Crib Room – Water for Hand Washing" dated 21 January 2016. In that document it was stated that monitoring for Escherichia coli ("E coli") would be carried out over a number of weeks. In the interim, UV treatment was installed because it was inexpensive and would allow progress to be made in terms of using treated water for handwashing in the underground crib room.

Five E coli sampling events subsequently took place and it is understood that the results could be useful to you from an occupational health perspective. This memorandum summarises the data.

Attachment 1 contains the laboratory analysis reports[7]. The intention at the time was to test the underground dewatering water, the treated water, TSF1A decant and a collection pond. Regarding the latter, samples were taken from collection pond S3 when there was sufficient representative water in the pond to collect a sample.

The results are summarised as follows[8]:

Date	Decant – TSF1A (MPN/100mL)	Treated Water Discharge (MPN/100mL)	Underground Dewatering (MPN/100mL)	S3 (MPN/100mL)
27 January 2016	2	2	4	
3 February 2016	1	1	1	10
12 February 2016	<1	2	1	
18 February 2016	6	5	29	222
3 March 2016	<1	43	15	222

It is noted that the New Zealand Drinking Water Standards 2005 (revised 2008) specify a Maximum Acceptable Value ("MAV") for E Coli of less than 1 in 100 mL of sample. For the purposes of any notification requirement set in Part 1 of Schedule 2 of the Public Health Act 2008, 10 in 100 mL of sample is the limit for drinking water.

The data indicates the presence of E coli in all of the samples at times. It is possible that birds contribute to the E coli found in the TSF1A decant water, and stock contributes to the E coli found in the collection ponds. If we had tested the river water, E coli would most probably have been found there as well.

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[7] Note that the analysis reports include an analyst's comment advising caution when interpreting the results as the sample was >24 hours old. Anne advises that all samples except the first would have been received within a 24 hour timeframe.

[8] Default detection limit is 1 MPN/100mL

E. coli is used as an indicator of bacterial risk because it indicates the presence of faecal material and, therefore, the potential presence of pathogenic bacteria. The data indicates the need for hand washing after handling this water.

We can carry out further sampling for E coli if you need it.

Kind regards,

N**ame** **Kathy Mason**

Title *Senior Environmental Officer - Consenting*