Acid Mine Drainage

History of AMD Management and Proposed Future Management

Stockton Mine

1. What is Acid Mine Drainage

Primarily environmental issues arising from coal mining fall into two categories on the Buller Plateaux. Acid mine drainage (**AMD)** issues and non-AMD issues. The latter can and are addressed in the usual way.

AMD occurs when the iron sulfides in rock material unearthed by mining activity interact with water and air and oxidize. The process creates sulfuric acid, a corrosive acid capable of breaking down surrounding rocks, which can cause metals to enter and eventually dissolve into surrounding waterways.

AMD will continue to be produced from uncovered potentially acid forming (PAF) rock material until such time as the process is complete or the rock material is encapsulated in such a way that oxygen and/or water ingress is excluded or reduced to very minimal levels. A timeframe of 100 years is commonly applied to this process where the rock material is left exposed.

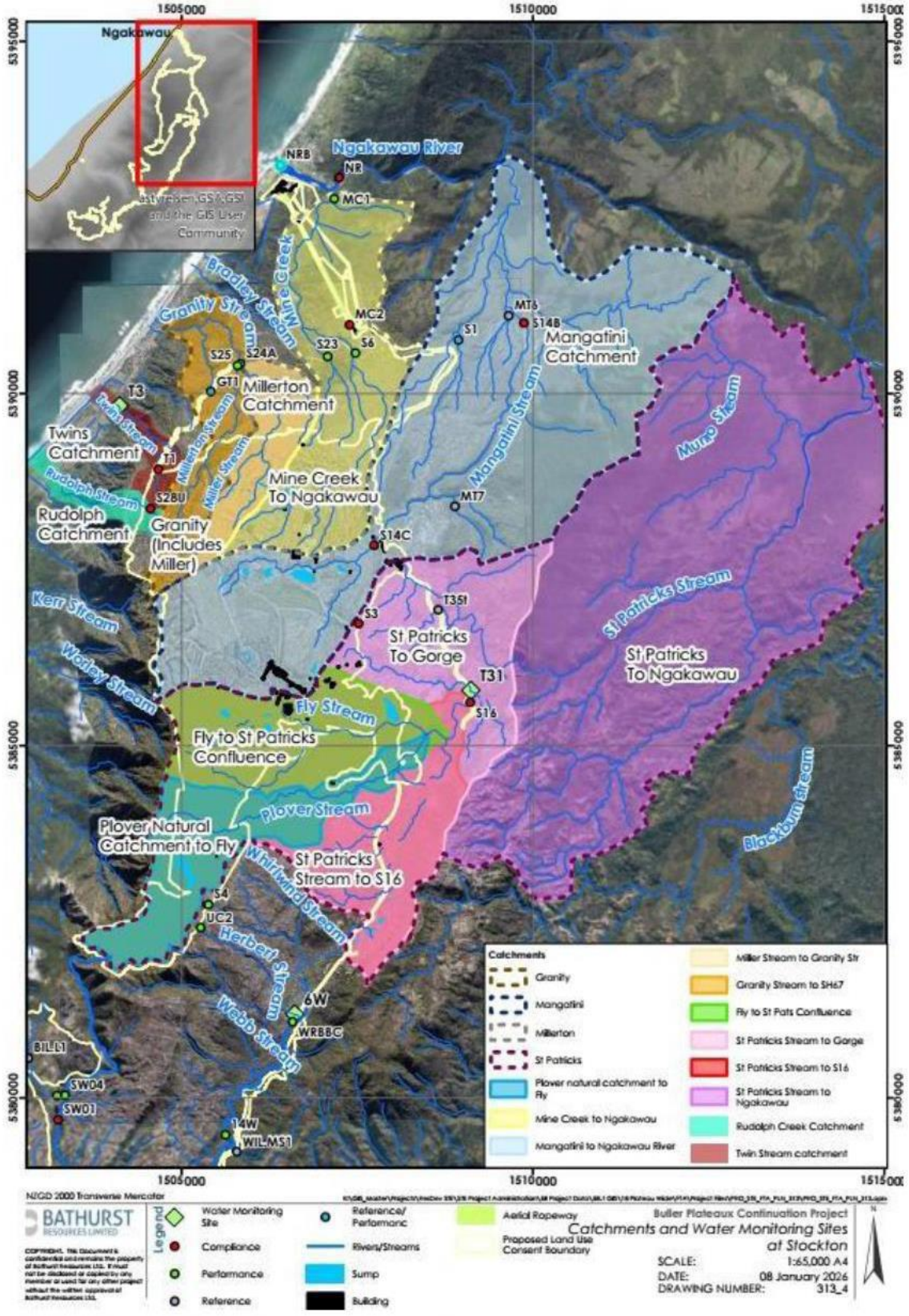


Figure 1: Catchment and Water Monitoring Sites at Stockton

2. AMD and the Stockton Plateau

The long history of mining on the Stockton Plateau means that some waterways have been affected by AMD for over 130 years with initially little to no knowledge of the issue and certainly no treatment of AMD until very recent times.

It is estimated that over 500 million tonnes of Brunner Coal Measures waste rock material has been disturbed by underground mining (1890-1969) and opencast mining (since 1950 - current) and that the majority (>80%) of the severe acid mine drainage legacy that needs treating (~11,000 tonnes of acid in streams per year) was already in existence by the time Stockton mine was put up for sale in 2016.

The Millerton catchment in the north of the Stockton mine is characterised by highly fractured sandstone overlying an extensive network of historic underground workings and ongoing opencast operations. Remnant fires that started pre 1970, continue to burn from the underground coal in several areas and have done so for many decades. These fires are managed operationally by fire suppression, which involves pumping water from pit sumps into the workings to cool or extinguish fires.

3. State Coal Mines and Solid Energy

It is notable that when the Stockton mine was transferred from the ownership of the Crown (State Coal Mines) to the newly created Coal Corporation of New Zealand Limited (name changed later to Solid Energy New Zealand Limited) (**Solid Energy**) in the 1980's [redacted]

[1] Agreement for Transfer of Assets between the Minister of Finance, the Minister for State-owned Enterprises and Coal Corporation of New Zealand Limited dated 31 March 1988

In the early 2000's there was a focus on the state of the waterways draining off the Stockton Plateau and in particular the Ngakawau River. In 2004 Solid Energy established the Stockton Community Consultative Group to enable the community to raise concerns about its mining operations. The Group included local residents, iwi, non-government and government organisations, regulators and local schools.

In 2005, as a result of an aquatic ecology survey in Mine Creek Stream, Mangatini Stream and St Patricks showing all were in poor health and fish were absent (Harding et al., 2006), it was recognised that AMD from these tributary streams entering the Ngakawau River were generating chemical barriers in the river and preventing migratory fish passage. Solid Energy then, in consultation with the Stockton Community Consultative Group, agreed a number of performance targets for water quality in the lower reaches of the Ngākawau River. The targets were that within five years the water quality at monitoring point NR would be:

- pH greater than or equal to 4.7 for 99% of the time.
- Dissolved aluminium less than 1 mg/L for 99% of the time.
- Turbidity no greater than 25 NTU based on a 30-day rolling median.
- Clarity greater than 54cm (NIWA clarity tube) for 90% of the time during base flow conditions

The objective of these agreed targets was to set a benchmark for improving the water quality of the Ngākawau River to a level where whitebait could migrate past the AMD affected discharges into the upper Ngakawau River and the Ngakawau River would return to an aesthetically and recreationally acceptable state.

In order to meet these targets, Solid Energy committed to a five-year programme to improve the water quality in Ngākawau River. The Programme included the development of significant AMD management systems, (including granite capping of PAF rock to reduce AMD generation) and the

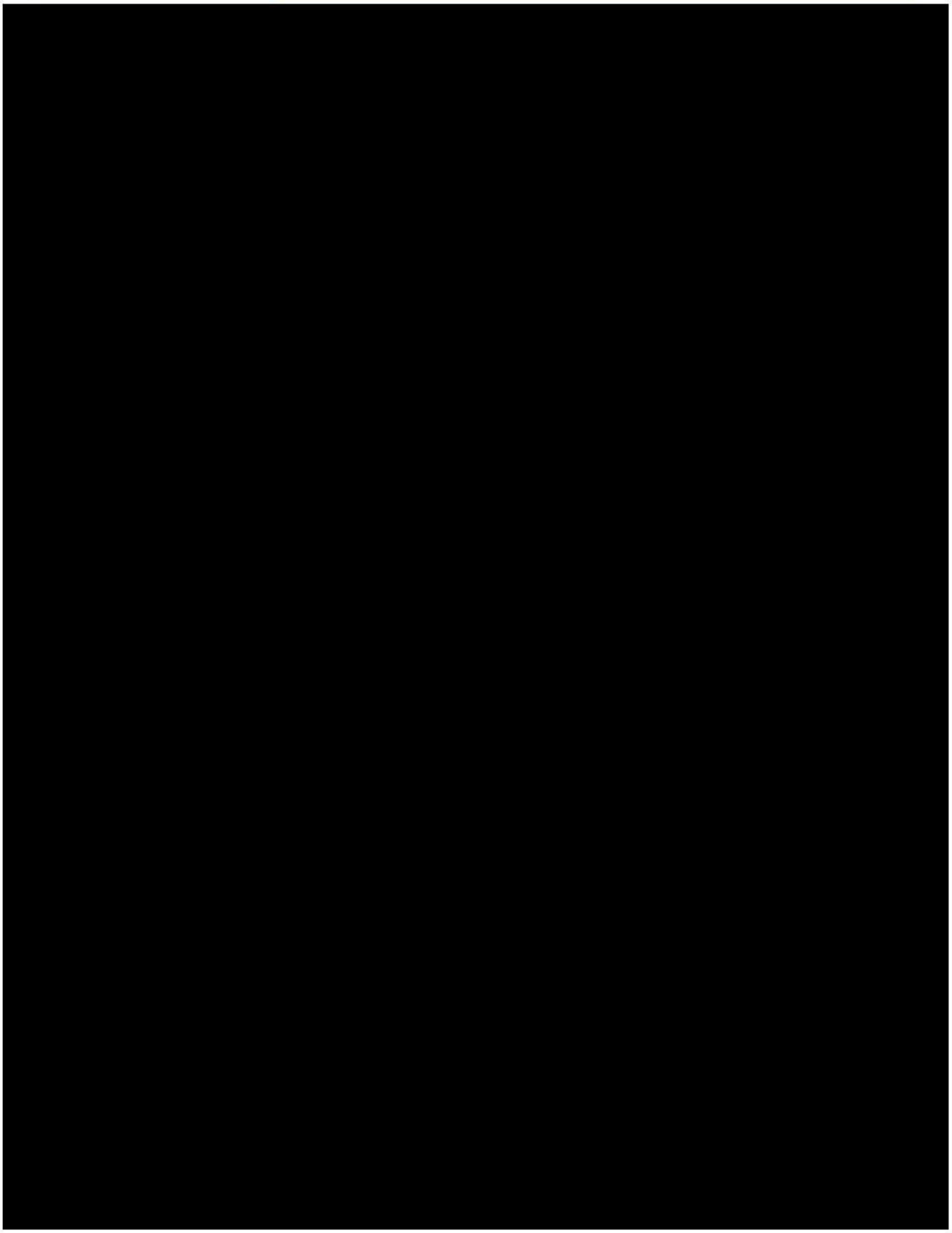
[2] Tenth Schedule of the Agreement for Transfer of Assets referred to above

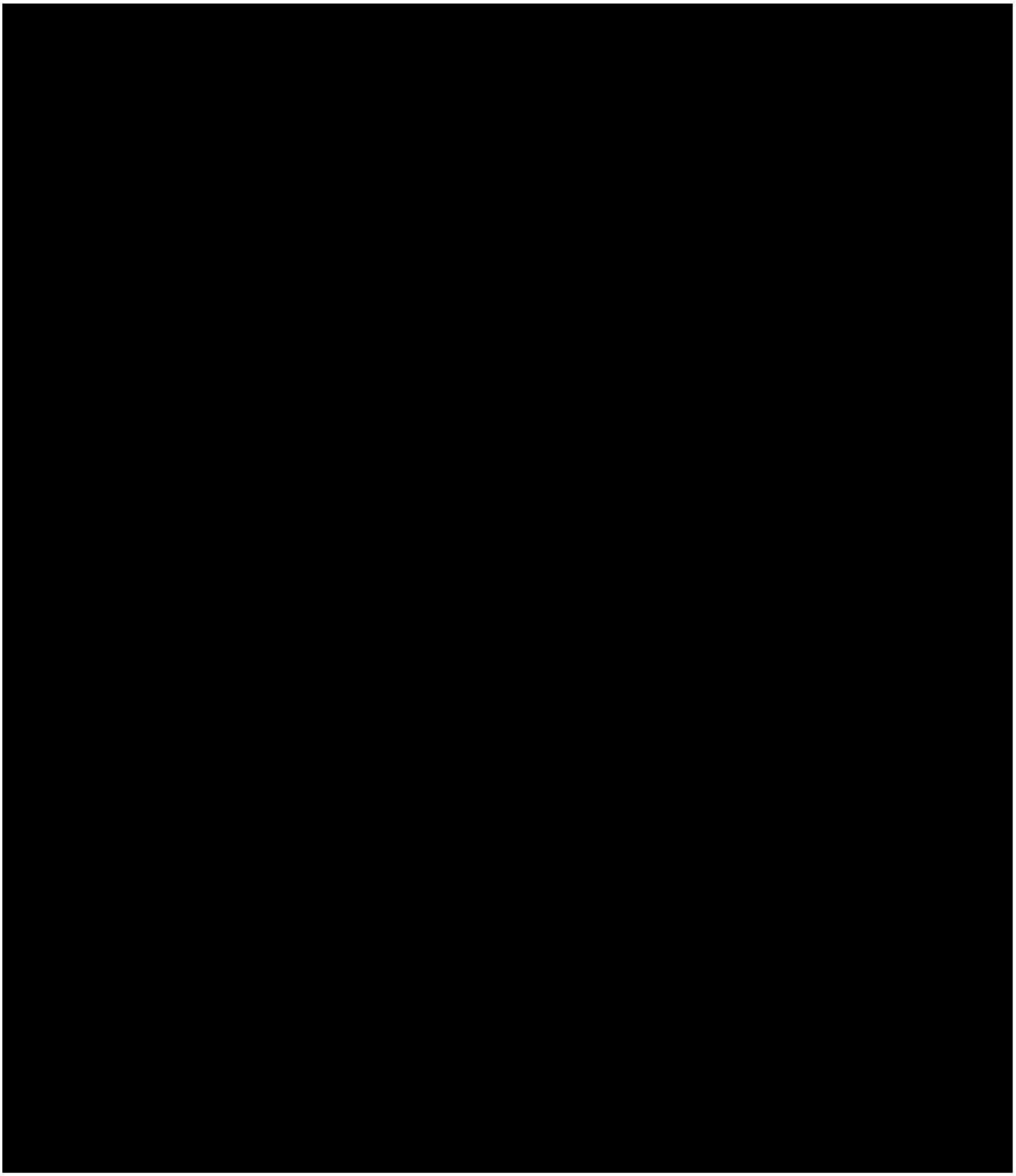
construction of AMD management infrastructure including the Mangatini limestone dosing plant/LDP1 (operational from April 2007) and the Mangatini Sump (operational from July 2009). Preventative measures were also taken including staff education programmes and raising general awareness of environmental issues in the company.

[redacted]

[redacted] However much remained to be done to treat ongoing historic AMD on the Stockton Plateau. Independent annual fish surveys in the Upper Ngakawau River continue to be reported to stakeholders and prove that migratory fish are returning due to the success of the existing AMD management/treatment approach.

[redacted]





6. Three Generation Approach to Water Quality Improvement through AMD Treatment

In recent years the Crown has been reviewing whether or not there are practicable economic alternatives to treat AMD on the Stockton Plateau. The current AMD management approach has been thoroughly reviewed by the Crown using a team of internationally recognised experts in AMD management and aquatic ecology. The results indicate that the current AMD management approach to progressive improvement of the impacted streams with the objective of sustaining mahinga kai values within 3 generations (or 80 years approximately) is currently the optimal approach and is supported by iwi, the local councils and the Crown.

The 80 year recovery approach recognises that the AMD treatment is complex due to 130 years of coal mining (open cast and underground with various mine owners and individual liabilities), leading to over 11,000 tonnes of acid a year draining to waterways. The extent of the degradation to water quality and aquatic ecology in waterways draining the Stockton plateau and the long term decay of acid concentrations from historic mining areas (some of which are outside the current Coal Mining Licence held by BT Mining) make the AMD management improvements a complicated, costly and medium to long term process.

The context of three generations remains critical for cultural considerations as it brings with it a concept of long-term stability for the values attributed to the area by the community in the future.

Tikanga Ngā Wai - refers to Māori customs, protocols, and principles related to water (ngā wai), guiding how people interact with and care for freshwater resources. It involves values such as kaitiakitanga (guardianship), manaakitanga (care and support), and the interconnectedness of all living things, informing decisions about water use, management, and conservation from a Māori perspective.

BT Mining recognises that its AMD management approaches need to ensure the health of waters (Waitai and Waimāori) draining Mangatini ki Ngākawau (Stockton Plateau) are conducive to mahinga kai within three generations. In consultation with Ngati Waewae it is agreed that this means:

a) Mahinga kai resources including kai, (food), rokoā, (medicine) and other materials such as feathers and fibres are available and safe to harvest;

b) The waters where these resources are gathered from enable the survival and reproduction of taonga species and the practices used for collection;

Achieving this enables mana whenua to exercise kaitiakitanga over the waters (Waitai and Waimāori), habitats and species within the awa and the tai to ensure they are passed on in as good a state, or indeed better, to the many generations that follow.

Traditional and contemporary mahinga kai species are regarded as taonga species. Taonga ika species that have been identified by Ngāti Waewae as being culturally important species in the Kawatiri / Buller catchment area are noted in Table1:

Table 1: Taonga ika species (source: Tregaskis Brown and Tonkin + Taylor for Te Tai Ōhanga – The Treasury (2024)- Stockton AMD Management Plan- Appendix C)

Ingoa Māori	Common name	Current state[20]
[redacted]		

Ingoa Māori	Common name	Current state[22]
Taonga ika species		
[redacted]		

Taonga tuaiwi-kore species

[redacted]

BT Mining will continue to seek advice from Ngāti Waewae on a regular basis to enable their kaitiakitanga over the waters, habitats and species. BT Mining has prepared an 80 year AMD management plan in consultation with iwi and New Zealand expert stream ecologists, hydrologists and geochemists to recover the health of the AMD impacted waterways draining Stockton mine to achieve water health conducive to mahinga kai within the three generations or 80 years.

A key objective of long-term AMD treatment is achieving ecological recovery in waterbodies draining the Stockton Mine. PDP (2026) derived ecological recovery thresholds for individual taxa and overall invertebrate communities from ecological literature and an extensive data set collected from streams on the Stockton and Denniston Plateaux. The study focussed on pH and dissolved aluminium as broad proxies for AMD. These parameters were used because they were available for the majority of sites that had associated ecology data and are considered to be suitable proxies for the gross effects of AMD within the streams draining the Buller coal measures.

Collectively the assessments indicated that from an Aluminium (Al) perspective:

- Ecological recovery will begin at residual Al concentrations of less than 2.8 mg/L; and
- Ecology will return to comprehensive recovery status at residual Al concentrations of less than 1 mg/L.

Commensurate numbers for pH are:

- Ecological recovery will begin at pH of greater than 4; and
- Ecology will return to comprehensive recovery status at pH greater than 4.5, noting that pH is permissibly lower if derived from natural processes.

The Al recovery thresholds are compared to the forecast annual 75th percentile Al concentration as an indicator of long-term AMD treatment effectiveness and ecological recovery. PDP (2026) have indicated that the recovery thresholds are equivalent to 75th percentile targets.

It is anticipated that as water quality improves, freshwater ecosystems will increasingly reflect the diversity and abundance of species that would reasonably be expected in this environment within the context of habitat conditions. This includes maintaining the current diversity of freshwater species, enabling additional species to re-colonise areas of rivers and streams, and resulting in a more natural distribution of species over time. Translocation of some species may be required. Existing examples of successful recovery of aquatic ecological communities following water quality remediation are the

[redacted]

This three generation or 80 year plan reflects other long term river improvement programmes being undertaken in New Zealand – for example the improvement of the Waikato River (Waikato Regional Council, 2025) – which acknowledge that it will take time to undo the mistakes of the past. BT Mining monitors the progressive improvements to water quality and aquatic ecology via annual fish surveys

in the Ngakawau River.

Betterment is used to provide short to medium term water quality objectives within the long term recovery process. Betterment is also applied when the proposed water and AMD management infrastructure can only address part of the overall AMD source within a give catchment.

The definition of 'Betterment' in the context of the Buller Plateaux Continuation Project (BPCP) is (italicised):

> *The term betterment has been applied to rivers in New Zealand (i.e. Waikato River) that have experienced long term anthropogenic contamination. It is recognised that managed improvement will take 3 generations (80-100 years) and require a collective, sustained, and sustainable effort between stakeholders.*
>
> *Betterment is the process of active and progressive improvement of river health over the long-term.*
>
> *The betterment pathway for a given waterbody is marked by a combination of discrete events and long-term decay in AMD sources. Performance monitoring is used to track short- to medium-term water quality improvements along the betterment pathway. These improvements are site / project specific, but contribute to overall long-term recovery.*

7. The Stockton AMD Treatment Plan

AMD management at Stockton is in the context of dealing with ~11,000 tonnes of active acidity treatment per year in an environment with a mean rainfall of 6 meters per annum.

The 80-year improvement approach is based on ecological survey evidence of streams that are in recovery and acid load balance models showing continuous water quality improvements through to 80 years.

Due to the unique and unusual water chemistry of streams draining Brunner coal measures the standard ANZG water quality targets are not currently appropriate. In addition, the ANZG guideline values are designed for the protection of otherwise healthy streams, whereas at Stockton the focus is for water quality objectives that serve as long term targets for remediation and treatment from a state of sometimes gross impairment. The application of dissolved aluminium < 1mg/l and pH > 4.5 are suitable to guide the planning and implementation of water quality remediation, but upon being achieved will be supplemented with a broader suite of ANZG type targets until ecological recovery and suitability for consumption of mahinga kai has been achieved. Achievement of the proposed targets have resulted in improving aquatic ecological conditions in the Ngakawau river catchment water quality and ecological health.

There are 6 main catchments impacted by AMD at Stockton:

1. St Patricks stream catchment,
2. Mangatini stream catchment,
3. Mine Creek catchment,
4. Granity Stream catchment (including Miller tributary),

5. Twins stream catchment,
6. Upper Waimangaroa catchment (including Herbert and Whirlwind tributaries).

Note however that Mine Creek, Granity, and Twins catchments are addressed together as 'Millerton Block' due to interaction of historic underground workings linking these three catchments.

There are existing AMD management plans/actions specific to Mangatini and St Patricks catchments over the next 80 years to improve the downstream water quality to a level where aquatic ecology recovers and is sustainable in those waterways.

The Millerton catchments (Mine Creek, Granity Stream, and Twins Stream) have management plan/actions (as part of the BPCP) to improve downstream water quality in the period to the end of mine rehabilitation. The technical reports address these plans in more detail. The Crown continues to work on optimal AMD management plans with a further 5 year assessment period (https://www.treasury.govt.nz/publications/information-release/stockton-acid-mine-drainage) that commenced in October 2025 (and which is discussed further below), including the Upper Waimangaroa catchments which are not otherwise managed under the BPCP.

In summary AMD management plans/actions, using the current methodology of reduction of AMD at source through acidic waste rock encapsulation (351 hectares granite capping scheduled) and rehabilitation (873 hectares scheduled) of currently disturbed areas along with the treatment in sumps of acid mine drainage, predict the following:

St Patrick Catchment

A continued improvement in St Patrick Catchment water quality is anticipated due to ongoing AMD treatment through lime dosing to McCabes Sump (Lime dosing plant 2 (LDP2)), completion of 289 hectares rehabilitation (including 104 hectares of granite capping of PAF ELFs) by 2046, and treatment of Plover Stream commencing in 2034 (when Cypress acid loads cease to report to McCabes Sump). The long-term forecast S16 acidity and Al concentration shows (BRL 2026a):

- The annual 75th percentile Al concentration falls below the 2.8 mg/L criteria for ecological recovery starting in 2034; and
- It is anticipated that potential improvements in AMD treatment (i.e., further increasing S16 pH) and natural catchment dilution will result in the annual 75th percentile Al concentration falling below the 1.0 mg/L criteria for comprehensive ecological recovery in the reach of stream between S16 and the confluence with T35 within the 80-year timeframe.

Mangatini Catchment

A continued improvement in Mangatini Catchment water quality is anticipated due to ongoing AMD treatment through lime dosing to Mangatini Sump (Lime dosing plant 1 (LDP1)) and completion of 272 hectares rehabilitation (including 87 hectares of granite capping of PAF ELFs) by 2046. This improvement may plateau at current levels for the period that Millerton AMD is pumped to Mangatini for treatment (i.e., through to 2046). From 2047 onwards Millerton AMD will be treated in MW16 Sump and discharged via Mine Creek to Ngakawau River, reducing operational demands on existing

Mangatini AMD management infrastructure. The long-term forecast of S14C acidity and Al concentration shows (BT 2026a):

- The annual 75th percentile Al concentration falls below the 2.8 mg/L criteria for ecological recovery starting in 2047, as Millerton AMD treatment in MW16 commences; and
- It is anticipated that potential improvements in AMD treatment (i.e., further increasing S14C pH) and natural catchment dilution will result in the annual 75th percentile Al concentration falling below the 1.0 mg/L criteria in the reach of stream between S14C and S14B within the 80-year timeframe.

Millerton Block (Mine Creek, Miller Creek, and Granity Stream Catchments)

Baseline water quality is impacted by historic and current mining activities, including fire suppression (ceasing in 2028) in sub-catchments draining Millerton Block. Remnant historical underground workings outside the proposed Millerton opencast disturbance footprint are expected to prevent water quality recovering to ecological recovery threshold levels with the AMD management infrastructure described in the Millerton Block water and AMD report (BRL 2026b). Alternative water quality 'betterment' targets have therefore been developed to guide AMD improvement for Millerton AMD management.

To measure AMD improvement / betterment, the BPCP has adopted 2010 as the reference point for the Millerton Block water quality for the following reasons:

- 50+ years of AMD discharge from the historic underground workings to the Millerton streams has in effect defined the environment up until the commencement of modern open cast mining in 2010;
- 2010 reference point enables a high degree of separation between effects of new practices and contemporary AMD sources from the effects of remnant historic underground AMD sources that will remain outside the opencast disturbance footprint post BPCP;
- Acidity loads in 2010 were not influenced by the short term AMD generation / effects from the use of pit water required to cool or extinguish underground fires; and
- Sets the datum from which the trajectory of AMD improvement from contemporary activities can be sensibly measured.

Betterment reference values of acidity load, acidity concentration, and Al concentration have been developed for each site to guide long term AMD management. The betterment reference is intended to show what acidity loads and acidity / Al concentrations could have been if no opencast mining (post 2010) occurred in Millerton Block and historic underground workings continued to discharge AMD without treatment. Water and AMD management strategies were developed to keep the forecast long term acidity loads and acidity / Al concentrations below the betterment reference values from EOML onwards.

As discussed in paragraph 5, at present there are fires burning in the coal in the Millerton Block. These fires are managed operationally by fire suppression, which involves pumping water from pit sumps into the workings to cool or extinguish fires, allowing the areas to be worked. Fire suppression

increases acidity loads discharging the Millerton catchment as:

- Water sourced from pit sumps contains elevated acidity concentrations / loads;
- Additional acid loads are flushed from underground workings due to additional flow volumes; and
- Only a portion of these loads are currently recovered / recoverable for treatment.

Pit water is used for fire suppression for several reasons:

- Use of clean water is not feasible due to the prohibitively large volumes required for fire suppression;
- Use of treated AMD is not favourable due to transfer of AMD precipitates and sediments from treatment sumps into underground workings, creating clarity issues downstream; and
- Pit water is already captured and stored nearby and has good clarity after sedimentation.

The effect of extinguishing these fires (through mining out the coal that is acting as the fuel source) and rehabilitating these fire affected areas (with more granite capping and rehabilitation) on residual underground workings acid loads can only be estimated at this stage.

After cessation of mining and fire suppression in Millerton (i.e., by 2033), a residual acid baseline will be accurately measured for each sub-catchment rather than modelled. This will provide the baseline to optimise long term AMD treatment and management. The aim is to ensure the Al and acidity concentrations meet comprehensive recovery criteria (including mahinga kai values) within 80 years in the streams draining the Millerton Block, though achieving this is reliant on additional AMD management infrastructure administered by the Crown / LINZ.

Continued betterment in Millerton Block water quality is anticipated due to BT Mining's proposed AMD treatment through AMD capture in pit sumps and transfer to Mangatini Treatment System and completion of 312 hectares rehabilitation (including 161 hectares of granite capping of PAF ELFs) by 2046.

Continued removal of historic underground workings that contribute an average ~11 tonnes of acid/ha/year will also reduce acid loads. It is anticipated that 187 hectares of underground workings will have been removed (compared to pre-opencast 2010 areas) by mining by 2033.

Planned future management of Millerton water through the remaining LOM (to 2033) includes continued use of in-pit sumps until permanent sumps are constructed in final landform pit voids. These permanent sumps are located in the topographic low points in all subcatchments and are typically bounded by highwalls and coal floor. Underground workings intersecting the permanent pit sump voids will be sealed to minimise water losses. The location of these permanent pit sumps allows for collection and control of runoff / seepages from AMD impacted surfaces / dumps within the Millerton disturbance footprint, enabling AMD management; primarily 'Pump and treat' at Mangatini Treatment System.

Once mining is completed in the Mine Creek MW16 pit, the natural syncline located in this area will be utilised by 2032/33 as the major MW16 Sump (estimated volume > 718,000 m^3). Millerton ELF is designed to direct as much runoff and seepage to MW16 Pit Sump as possible. AMD collected in MW16 Pit Sump (and excess loads in other pit sumps across Millerton) will continue to be pumped to

the Mangatini Treatment System until 2046. Between 2033 and 2046 pit sump AMD will be managed to meet specific betterment targets in Twins, Granity, and Miller sub-catchments.

From 2047 onwards AMD (primarily generated from the Millerton ELF) will be treated in MW16 Sump by an alkaline dosing pipeline from LDP1.

The effect of Millerton ELF discharge and MW16 Sump AMD management is assessed at MC1 and achieving betterment will involve a phased approach:

- EOML Phase (2033 – 2046)
    - Limited high-flow (>90th percentile volumes) bypass / spilling of untreated AMD from MW16 Pit Sump to Mine Creek (S6 tributary); and
    - Controlled discharge of a small portion of untreated MW16 Sump acidity load to Mine Creek (S6 tributary), equivalent to <20% of the overall MW16 Sump acidity load, such that MC1 water quality does not exceed the betterment reference values.
- Closure Phase (2047 onwards) – once acidity loads decrease sufficiently for effective LDS management in MW16 Sump
    - A lime slurry pipeline from LDP1 to MW16 Sump will be commissioned to treat AMD in-sump (targeting ~75% treatment), with treated AMD discharging to Mine Creek (S6 tributary), such that MC1 water quality does not exceed the betterment reference values.

AMD management at MW16 Sump (from 2034 onwards) is forecast to result in an AMD modelled site in Ngakawau River (NRB River) downstream of the Mine Creek confluence (but excluding tidal effects) meeting the annual 75th percentile dissolved Al concentration target of <1 mg/l criteria, reflecting comprehensive ecological recovery.

8. Future Crown / LINZ administration – not part of BPCP (but related to future optimised AMD treatment plan)

The Crown (through LINZ) has, as indicated above, commenced a further management project involving multiple parties (Ngati Waewae, the councils and BT Mining) to refine AMD treatment across the Stockton Mine. This covers the Millerton catchments including the areas being mined and proposed to be mined under the BPCP, but also other areas outside the BPCP application area which are also producing AMD impacted water. This includes the remnant historic underground workings located outside of the Millerton BPCP opencast disturbance footprint that limit ecological recovery in Mine, Miller, and Granity catchments. BT Mining's Millerton AMD management plan will aid the optimising and implementation of the Crown project by providing greater separation of contemporary opencast AMD and historic underground workings AMD. This will minimise residual acid loads discharging the contemporary opencast footprint and concentrate acid in specific sub-catchment sumps (i.e. MW16- S6 Mine Creek catchment) for more efficient long term management. This approach will allow long term optimised AMD treatment downstream of the Project area via the Crown led long term AMD management project. https://www.treasury.govt.nz/publications/information-release/stockton-acid-mine-drainage

Further stages of Millerton AMD capture and treatment outside of BT Mining's Millerton opencast

disturbance footprint area in Mine Creek and Granity Stream including Miller tributary of Granity S24A, GB1, S23, S6 and MC1 are anticipated to all fall below the 75th percentile 2.8 mg/L Al criteria for ecological recovery starting within the 80 year period, once the long term Crown led AMD management project is implemented (BRL, 2026a). It is anticipated that comprehensive ecological recovery could be achieved in these streams with a higher degree or optimised AMD treatment.

9. References

BRL 2026a. Stockton Mine 80-year water quality forecast. BRL memorandum, 2 April 2026.

BRL 2026b. Millerton water and AMD management report. BRL Report, April 2026.

PDP 2026. Stockton Plateau Aquatic Ecology: history, thresholds and long-term management. PDP report prepared for Bathurst Resources Limited. March 2026

Waikato Regional Council (2025) Proposed Waikato Regional Council Plan Change 1 (PC1)