



**New Zealand Aluminium Smelters Limited  
NZAS Closure Preliminary Study  
Contaminated Sites Detailed Site Investigation Report**

12533899-2200-CS-RPT-00003

CAL.11-2200-H-REP-00002

Revision 0

WBS 2200: Detailed Site Investigation Report

August 2021

# Executive summary

GHD Limited (GHD) were engaged by Rio Tinto on behalf of New Zealand Aluminium Smelters Ltd (NZAS) to complete a Contaminated Sites work package at the NZAS Tiwai Point Aluminium Smelter located at 1429-1530 Tiwai Road, Awarua (the 'Site'). The Contaminated Sites work package forms part of the broader NZAS Closure Preliminary Study.

This report, the NZAS Detailed Site Investigation (DSI), forms part of the Contaminated Sites work package. The following paragraphs explain the typical contaminated land investigation process and where the DSI sits within the process.

## *The Contaminated Land Investigation Process*

Contaminated land investigation is a phased process which comprises a succession of investigation steps, which are set out in the Ministry for the Environment's (MfE) Contaminated Land Management Guidelines (CLMG). Each successive step provides an increase in knowledge gathering that helps build the understanding of contaminant risks that may exist at the relevant site. This process begins with a Preliminary Site Investigation (PSI) which assesses existing information and identifies areas of potential contamination for further investigation. The PSI is followed by a DSI where the areas of potential contamination are targeted and includes the collection of environmental samples (e.g. soil, water) for laboratory analysis. The data collected during a DSI then allows comparison with regulatory criteria that are protective of human health and the environment, and areas where remediation may be required. This allows further refinement of the risk profile for the site, which is typically captured in a Conceptual Site Model (CSM). The CSM can take a variety of forms but is used within the DSI report to summarise the potential contamination source(s) on the Site, the pathways these contaminants could travel through, and the potential receptors they could affect. These are typically described as source-pathway-receptor linkages or exposure pathways.

The DSI is not necessarily the end point of sampling investigations. Conclusions from DSI reports will often identify areas of impact that require further investigation. For example, the DSI may indicate an area where a single sample exceeds a regulatory criterion. Typically, further investigation is then undertaken to try and understand the extent of the impacts within the surrounding area. Further investigations also help provide additional data to inform the remediation required.

## *The NZAS Contaminated Land Investigation Process*

The purpose of the Contaminated Sites work package is to provide an initial snapshot of the contamination status of the Site, specifically in the vicinity of the operational smelter area. This is principally to provide NZAS with information to consider within the broader NZAS Closure Preliminary Study. In addition, NZAS recognises the requirements to provide relevant report information to comply with specific Environment Southland Regional Plan rules.

The purpose of the PSI was to identify areas of potential contamination based on the current and historical activities at the Site. This comprised a review of existing NZAS information from historical studies including an assessment of the quantity, type and spatial distribution of previous data collection. An important tool in the PSI was the pre-existing NZAS Contamination Register which contained a list of sites where historical incidents had occurred or where potentially contaminating activities had occurred. In addition, a detailed site inspection was undertaken by GHD to identify other potential sources of contamination not apparent from the existing information sources. This information review, coupled with the site inspection was used to compile a list of potential investigation targets for the subsequent DSI.

The PSI phase identified a number of investigation targets, these comprised a mixture of specific point source locations (e.g. fuel tanks) and broader areas with a history of high use (e.g. lay-down yards and storage areas). As a consequence, the subsequent DSI design used a mixture of targeted sampling around specific point sources and a more systematic sampling approach across wider areas of high use. The laboratory analysis was chosen in relation to the substances used in each potential target area and therefore, the types of analytes tested varies across the site.

The DSI field works involved the excavation of 29 soil bores to the groundwater interface, 128 test pits, 39 hand dug samples from areas of limited access and within drainage features and the installation of 16 groundwater monitoring wells to expand the current monitoring well network at the site. A subsequent groundwater monitoring event of the 16 new and 13 pre-existing monitoring wells was then undertaken. Some areas of the site were not accessible due to operational or significant health and safety (high voltage electricity) risks and as a consequence samples have not been collected within those areas. These areas will be assessed in the later stages of the Closure Study process.

The data collected from the field investigation has been compiled within this DSI report. It is designed:

- To assess the presence and risk from potential contaminant exposure pathways highlighted in the PSI;
- To understand the spatial extent and depth of potential contamination that may require management, further assessment and/or remediation. It should be noted that this investigation is unrelated to routine environmental monitoring or consent required environmental monitoring;
- To use this information to guide potential remedial options studies and trade off studies that encompass a range of options for rehabilitation of the site; and
- To guide and inform implications for future resource consent status under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES CS) and the Proposed Southland Water and Land Plan.

### ***Future Land Use and Regulatory Criteria***

The measured concentrations from DSI sampling are assessed against applicable regulatory criteria. The selection of criteria for comparison is related to the intended land use for the site in question. The future land use at NZAS is currently undefined so comparison with regulatory criteria for industrial (to reflect current and potential future land uses) and recreational (potential future land use) scenarios were adopted as the most likely scenarios for comparison with the DSI results.

The uncertainty in future land use means that there are various regulatory criteria to be applied when comparing laboratory analytical data from samples. The selection of individual criteria is based upon a hierarchical approach set down in the CLMG. This typically involves the use of New Zealand based criteria first, followed by the use of international criteria where no New Zealand criteria exist.

### ***DSI Results***

The Site was divided into three Domains (Peninsula, Landfill and Smelter) which were in turn split into thirteen investigation Zones (A – M).

### ***Peninsula Domain***

Analytical results within soil samples collected from the Peninsula Domain (including those collected around the SCL Pad) reported analyte concentrations below the applicable human health and environmental criteria for the current and future potential land uses.

In 2006, Environment Southland agreed that the area around the SCL Pad and associated groundwater plume would be allowed to remediate naturally and the reporting of routine monitoring of groundwater quality bores around the SCL Pad was no longer required unless the membrane in the SCL Pad was damaged or removed. Since 2006 NZAS has undertaken voluntary monitoring of the groundwater quality bores, which is currently completed on a six-monthly frequency.

### ***Land Fill Domain***

The landfill comprises a number of closed and active waste disposal cells, which contributes to leachate contamination in the underlying groundwater that is actively monitored by NZAS and reported to Environment Southland as part of the landfill consent. The extent of investigation within the Landfill Domain comprised of a review of water sample data from an additional well installed between the Smelter Domain and the coast and a review of the 2019 NZAS Annual Environmental Report<sup>1</sup>. Detailed hydrogeological assessment of the landfill is outside the scope of the DSI, the findings of a separate assessment will inform closure design planning.

### ***Smelter Domain***

Background concentrations are defined in the CLMG as the natural concentration of a substance that would exist in the absence of any anthropogenic input. The collection of background samples can help to assess the extent to which the identified conditions reflect natural background concentrations and are not human health or environmental criteria. As no local background concentrations were available for the Tiwai Peninsula, shallow soil samples were collected from the Peninsula, distant from the Smelter area and adopted for use as a background concentration. All samples from the Smelter Domain reported one or more analyte concentrations above the adopted NZAS background soil concentrations (primarily for aluminium and fluoride).

Over 200 individual locations and 400 samples were collected during the DSI. Analytical results within soil samples collected from the Smelter Domain reported analyte concentrations above the applicable human health criteria for an industrial land use within 1% of the soil samples analysed. Exceedances were primarily within Zone B where spent cell liner is stored within sheds and external areas are used as lay down yards, and within isolated locations in the carbon processing and bulk material storage area in the west of the Smelter Domain.

The more stringent recreational land use criteria was exceeded in 9% of soil samples analysed. The criteria were exceeded in a wider number of locations including Zone B where spent cell liner is stored within sheds and external areas are used as lay down yards, the northern contractor yard and reconstruction area, within the central portion of the Smelter (the stack) and there were also isolated locations in the carbon processing and bulk material storage area in the west of the Smelter.

Substances that exceeded soil criteria were primarily aluminium, polycyclic aromatic hydrocarbons and fluoride with lesser exceedances of arsenic, vanadium, lead and total petroleum hydrocarbons. Impacts found in soils were predominantly found in shallow, near surface soil samples, with slightly deeper samples at 1.0 m typically being compliant with applicable regulatory criteria.

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<sup>1</sup> New Zealand Aluminium Smelters Limited – Annual Environmental Monitoring Report 2019.

Of note was the lack of criteria exceedances for some of the key contaminants of concern identified in the PSI. Cyanide, asbestos and PFAS chemicals were not measured at concentrations in excess of criteria for an industrial or recreational land use.

Sediment samples were collected from within the site drainage features (the North, West and South Drain and a stormwater outlet from the electrical substation). The applicable default guideline value (DGV) was exceeded in approximately two-thirds of the samples analysed and the upper guideline value or 'GV High' criteria was exceeded in approximately half of the samples analysed. The guidelines used are designed to provide an indication at which unacceptable effects may be occurring and are to be used in conjunction with other lines of evidence. In this instance they provide an indication that unacceptable effects may occur as a result of the concentrations measured. The substances measured were dominantly metals (typically 6-8 different metals) and hydrocarbons. However, the highest analytical concentrations were measured within the site, upstream of the oil traps located in each of the three main drains, with concentrations dropping markedly downstream of the oil traps. For example, cadmium, fluoride, copper and arsenic were noted in the upper reaches of the South Drain but not downstream. A single set of coastal sediment samples were collected from the exit points of North, West and South Drains to provide a baseline for future comparison. The coastal drain samples that showed exceedances of criteria were limited to nickel and zinc at the exit point of the North and South Drains.

### **Groundwater**

Concentrations were highest in the central portion of the site surrounding the reduction lines and washdown area (coincident with some of the areas of highest industrial activity) and generally reduced radially with distance from this area for all analytes towards the coast.

Laboratory analytical results were primarily compared against the proposed Environment Southland (ES) Land and Water Regional Plan Rule 46 (ES Rule 46) criteria which concerns passive discharges to the environment. These are defined by ES as *"The discharge of contaminants from land contaminated by a hazardous substance onto or into land in circumstances which may result in contaminants entering water"*.

Results were also compared against the New Zealand Drinking Water Standard (NZDWS) for comparative purposes. Site potable water which is obtained from the Peninsula Domain to the east of the Smelter Domain is regularly tested by NZAS and did not form part of this scope. The NZDWS were used to provide some context in the event that a future site user may consider installing a drinking water supply.

Analyte concentrations within groundwater reported exceedances of the NZDWS and ES Rule 46 criteria (83% of samples analysed). The exceedances were primarily for aluminium and fluoride with a lower number of exceedances for arsenic, iron and pH. Five Escherichia coli (E.Coli) were analysed, with all five samples reported E.Coli concentrations above the NZDWS – note these samples were from monitoring wells and are not from drinking water bores, with the NZDWS being used for comparative purposes only.

Concentrations within monitoring wells adjacent to Bluff Harbour and Foveaux Strait exceeded the ES Rule 46 criteria, however were generally within the same order of magnitude as the guideline criterion and will be subject to mixing within the receiving water body.

It should be noted that the exceedance of ES Rule 46 criteria is based on a single groundwater sampling round which has been used to provide an initial snapshot of groundwater concentrations. Further sampling rounds will be required to build up a data set of groundwater chemistry over different seasons and under different tidal conditions to provide a more comprehensive understanding of compliance against ES Rule 46.

## Summary

As the adopted NZAS background values were exceeded for multiple analytes in soil samples collected across the Site, the National Environmental Standard for Contaminated Soil (NESCS) regulations apply. The NESCS applies to five activities (subdivision, land-use change, soil disturbance, soil sampling, and removing fuel storage systems) which are relevant regardless of whether the site is within an operational or closure period. Any future soil disturbance and land use change activities associated with operations or closure will likely require NESCS consent.

There are multiple soil exceedances of the applicable human health criteria for industrial and recreational land uses. Given the site has been operating as a heavy industrial site for the last 50 years, exceedances of criteria are not unexpected. Contamination within these areas will require management and remediation as part of the closure works, the extent of which will be dependent upon the remedial option chosen. The DSI has provided an initial baseline understanding and further work will be required to delineate these areas.

Concerning future soil removal and disposal, on the basis of the soil testing (for total concentrations) undertaken by GHD, the soil in select areas of the Site did not meet the MfE Class A landfill acceptance screening criteria. As the MfE Class A screening criteria was exceeded within the vast majority of samples, additional Toxicity Characteristic Leaching Procedure (TCLP) analysis was undertaken to aid development of soil treatment methodologies and landfill disposal options. The results showed that despite a higher number of samples breaching the (total) landfill acceptance screening criteria, once leachability testing was completed the number of non-compliant samples dropped notably. The amount of samples that would not meet Class A leachability criteria based on TCLP testing was between 9% and 16%.

Soil in these select areas that were in excess of the leachability criteria will require pre-treatment prior to offsite disposal to a Class A landfill – this typically involves techniques such as mixing with other chemicals for stabilisation or pH adjustment. Should soil outside these areas (i.e. those with lower concentrations) require removal off-site in the future (e.g. during site closure works), it should be disposed of to a facility licenced to accept it.

Sediment samples collected from the site drainage network exceed the applicable guideline criteria. Despite the oil traps retaining the majority of contaminants, there is evidence of some metal impacts in sediment at the coast, therefore the drainage network is considered to be acting as a preferential pathway for contaminants emitting from the site to the receiving water bodies.

Groundwater analyte concentrations are highest in the centre of the site and reduce with distance towards the coast, however exceedances of the applicable criteria exist within groundwater wells adjacent to the coast. Further investigation of the potential impact to marine receptors or potential groundwater users from groundwater contamination is required to determine the consequence of this contamination.

In summary the DSI provides a baseline of data concerning the contamination status of the site. It supplements the ongoing data collection activities by NZAS and highlights areas for further investigation. The findings of exceedances of regulatory criteria at the site form part of the phased process of contaminated land investigation and provide an initial baseline, highlighting areas of elevated concentrations that require management, further investigation and/or remediation.

*This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions set out in section 1.7 and qualifications contained throughout the Report.*