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Nyrstar Port Pirie Smelter Transformation Proposal

Public Environmental Report

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PREFACE

Nyrstar Port Pirie Pty Ltd has published this Public Environmental Report (PER) to seek approvals from the Australian and South Australian Governments to undertake a major development of the smelter in Port Pirie, South Australia.

Community views are a very important consideration for Nyrstar and government in planning and assessing the proposed Port Pirie Smelter Transformation.

Our future plans for the smelter are based on delivering an innovative and sustainable solution that significantly improves our environmental performance and reduces the sites environmental footprint.

Our policy is to provide the foundation for a sustainable business by operating in an environmentally responsible way while focussing on preventing harm to the environment and the community. We recognise the environmental impact from 124 years of continuous operation of the smelter and will focus on addressing legacy issues by applying leading practice, innovation and sound science. We will apply this policy to our approach to the Port Pirie Smelter Transformation.

We thank all those who have contributed to this point and now we welcome any comments you may wish to make about this PER.

Glenn Poynter
General Manager, Port Pirie Smelter
Director, Nyrstar Port Pirie Pty Ltd

EXECUTIVE SUMMARY

This executive summary, prepared to accompany the Port Pirie Smelter Transformation Public Environmental Report (PER), provides an overview of the project, technical studies completed and the management measures proposed by Nyrstar Port Pirie Pty Ltd (Nyrstar) to minimise potential negative impacts arising from the Port Pirie Smelter Transformation. The PER has been prepared by COOE Pty Ltd on behalf of Nyrstar.

Introduction

Nyrstar proposes to redevelop their primary lead smelting process located at the Nyrstar Port Pirie, approximately 225 km north of Adelaide in South Australia.

The smelter has been in continuous operation for 124 years, and is an integral part of the Port Pirie community, creating approximately 3,250 jobs, and sustaining the ongoing operation of multipurpose, multiuser infrastructure, such as the port facilities.

As a member of the community, Nyrstar has taken an active role in improving social outcomes in Port Pirie, providing support through a wide range of programs and initiatives. It has been an ongoing priority for Nyrstar to reduce blood lead levels in children in the Port Pirie community. Programs and upgrades implemented to date have reduced emissions from the facility and community exposure to contemporary and legacy lead. Reduction of blood lead levels has plateaued, and a step change in ongoing emissions from the smelter is required to facilitate the next phase of emission and blood lead reductions.

PORT PIRIE SMELTER TRANSFORMATION

The primary objective of the Port Pirie Smelter Transformation is to facilitate that step change by upgrading the smelter's primary lead production facilities. The Transformation will replace the out-dated sinter plant with modern enclosed bath smelting technology, install a modern sulphuric acid facility, and update ancillary equipment. The modern facilities will run more efficiently and have significantly reduced lead and sulphur dioxide emissions.

The Transformation will secure the facility's long term future in Port Pirie, meet stringent environmental standards, improve environmental conditions and public health, and support the continuing reduction of blood lead levels in Port Pirie children.

PUBLIC ENVIRONMENTAL REPORT

The proposed Transformation has been declared a Major Development requiring approval under Section 46C of the *Development Act 1993.* Hence, a PER has been developed in accordance with the *Guidelines for the preparation of a Public Environmental Report: Port Pirie Smelter Transformation (Mid North)* (Guidelines) issued by the South Australian Development Assessment Commission in May 2013. The Guidelines set out the matters requiring investigation and evaluation with regard to the Transformation.

The PER provides a framework for the government, industry and community to make informed decisions about the environmental, social and economic effects of the proposed Transformation.

PROPONENT

Nyrstar Port Pirie Pty Ltd (Nyrstar) is a subsidiary of a globally integrated mining and metals business (Nyrstar NV), which has mining, smelting, and other operations located in Europe, the Americas and Australia.

PER APPROVALS PROCESS

This PER and its associated technical studies have been reviewed for compliance with the Guidelines. The PER addresses the Guidelines, and has been endorsed for exhibition by the South Australian Minister for Planning.

The completed PER will be on public exhibition for a period of 30 business days during August and September 2013 to seek public comment on the proposed development. A public meeting will be held to provide information on the development, to explain the PER, and to assist interested persons to make submissions regarding the development.

Nyrstar will then prepare and submit a written response to submissions to the Minister. The Minister will then prepare an Assessment Report, taking into account any submissions and Nyrstar's response to them.

The Governor of South Australia will decide whether the development receives approval to proceed.

Project need, benefits and alternatives

Nyrstar Port Pirie operates sections of the smelter with out-dated equipment, some nearly obsolete. This means that emissions from the existing sinter plant cannot sustain continued efforts to reduce blood lead levels in the community. Replacement of this aged equipment is crucial to a viable smelter and continued blood lead level reductions.

The Transformation will deliver a step change reduction in air lead emissions, contribute to the reduction of blood lead levels in the community, improve environmental performance and reduce the smelter's environmental footprint. It will increase overall carbon emissions; however due to greater efficiency, modern technology, and increased production of sulphuric acid , carbon emissions generated per tonne of production will be lower than the smelter's current carbon intensity.

The Transformation will continue Nyrstar's contribution to the economic development of Port Pirie and South Australia. Nyrstar will continue to support community health and environmental initiatives. These efforts align with the Premier's strategic priority to improve health outcomes for children, particularly in the first five years of life.

Alternatives to the Transformation include continuation of current operations and resulting social and environmental impacts, potentially resulting in closure of the facility due to environmental or mechanical issues. Closure of the facility would result in significant direct and indirect social, environmental and economic impacts. Closure will likely result in the loss of employment opportunities, significant outflow of private investment, closure of local schools, hospitals and associated service industry, loss of revenue from the port facilities and significantly reduced tax revenue to national, state and local governments and export income.

Stakeholder and community engagement

As an integral component of Port Pirie, a significant employer, and a contributor to the local economy, the Port Pirie community is strongly supportive of the smelter's continued operation.

Nyrstar has been actively and openly engaging and communicating with the community and key stakeholders, including implementation of high profile community initiatives such as the initial *tenby10 project* (the Port Pirie community blood lead reduction program), launched in 2006. Since then two further community blood lead engagement and awareness campaigns have been run: *tenforthem* and the *thumbs up for low levels* campaigns.

For a significant period leading up to and during the preparation of this PER, stakeholders including Nyrstar personnel, government staff and the Port Pirie community have been engaged in the Transformation process.

To provide the community with the opportunity to gain a good understanding and to comment on the Transformation, Nyrstar will continue to engage with the community and stakeholders during the public consultation period.

As part of the pre-Transformation process, and continuing post-commissioning, Nyrstar will participate in the development and implementation of a new program to complement the change in contemporary lead emissions. The Targeted Lead Abatement Program (TLAP) will identify current and potential future community lead exposure reduction strategies and assess which are likely to have the greatest impact in reducing children's blood lead levels. Nyrstar and the South Australian Government have made a commitment to pursue the TLAP for a period of 10 years to achieve the long term objectives of the program.

Policy and legislative framework

This PER has considered relevant statutory and strategic planning in relation to the Port Pirie Smelter Transformation. The proposed development is consistent with relevant legislation and policy, including:

-Commonwealth legislation and policies

- *-Environment Protection and Biodiversity Conservation Act 1999*
- *-National Environment Protection Council Act 1994*
- *-National Health and Medical Research Council Act 1992*
- *-National Greenhouse and Energy Reporting Act 2007*

-South Australian legislation and policies

- *-Environment Protection Act 1993*
- *-Aboriginal Heritage Act 1988*
- *-Coast Protection Act 1972*
- *-Harbors and Navigation Act 1993*
- *-Marine Parks Act 2007*
- *-Native Vegetation Act 1991*
- *-Climate Change and Greenhouse Emissions Reduction Act 2007*
- *-Development Act 1993*
- -South Australia's Strategic Plan
- -State Infrastructure Plan

-Regional planning policies

- -Planning Strategy for Mid North Region
- -Port Pirie Regional Council Development Plan

Overview of existing smelter and operations

Nyrstar Port Pirie processes a wide range of lead-rich concentrates and smelting industry by-products, producing lead, sulphuric acid, zinc, copper, silver and gold.

The smelter is located on a highly modified brownfield site that has been in constant industrial use for 124 years. Flora and fauna at the smelter is limited and of low quality, with much of native vegetation in surrounding areas previously cleared for residential, agricultural and industrial uses. Mangrove and seagrass habitats are found adjacent to the smelter however the Transformation is not expected to cause any additional impact.

Nyrstar owns or leases all land parcels on which Port Pirie Smelter Transformation works will be conducted. Current land uses align with local and regional planning zones and uses. There are a limited number of sensitive receptors located near the current and proposed production facilities, most of which are buffered from noise and air emissions by areas of vegetated land.

The existing and historical production processes have consistently emitted elevated quantities of lead-bearing particulate and sulphur dioxide gas. Adjacent land has been impacted by airborne lead-bearing particulate emissions during the operating life of the smelter, causing legacy contamination. Overall the Transformation will reduce these emissions and result in corresponding environmental improvements.

Description of the proposal

Nyrstar proposes to update and upgrade the smelter to address air lead emissions and reduce blood lead concentrations in the community. This chapter describes the nature of the proposed Port Pirie Smelter Transformation and its location, including a description of the principal processing plants and likely emissions. It discusses land parcels likely to be affected by the proposal, including off-site infrastructure. Management arrangements for the construction and operational phases are addressed, and a process flow diagram is provided for production processes to be used, showing inputs and outputs in the form of raw materials, products, wastes and emissions.

The proposed Transformation has been designed and developed with the EPA, SA Health and other key agencies requirements being consulted, as well as site constraints and the potential impacts and benefits of

the development. The level of detail presented in this document is considered sufficient for an assessment of potential project impacts for the purposes of a PER. Following approval, the project would undergo a detailed design phase during which specifications for the project would be defined. This process would take into account requirements identified by the PER process. Mitigation measures identified during the PER process relating to construction and operation controls would be applied via the preparation and implementation of environmental management plans.

The Port Pirie Smelter Transformation is the first step in Nyrstar's strategy to upgrade the Port Pirie lead smelter into an advanced poly-metallic processing and recovery facility employing cleaner production techniques and best available technology.

The Transformation will replace the out-dated sintering technology in the lead smelting process with an oxygen-enriched, enclosed bath smelting (EBS) oxidation furnace, coupled to a new sulphuric acid plant. The modern, proven technology will convert feed concentrates and residues (recycled internally or sourced from Nyrstar smelters and third parties) into primary lead bullion and slag precursors for the further recovery of lead and the recovery of copper, silver, gold, zinc and other minor metals.

The proposed development will also include the upgrade or replacement of associated environmental controls, acid production facilities and the installation of an electricity cogeneration facility.

Replacement of the existing blast furnace with a second EBS furnace is being considered and may be included in the final project scope.

Some ancillary equipment associated with the Transformation, including water systems, will be either refurbished to extend their operating lives, or upgraded to meet the changed operational demands of the new smelting assets.

Many of the intermediate materials stored in the intermediate storage area will no longer be required, and will be processed through the new facility, thus removing a source of dust on high wind days.

The feed requirements of the EBS technology will enable concentrate handling and air hygiene improvements to be implemented during the Transformation.

No modifications are proposed for the slag fumer as part of the Port Pirie Smelter Transformation.

Effects on air quality

The Transformation will lead to major improvements in Port Pirie's air quality due to:

-replacement of the existing sinter plant with an EBS oxidation furnace and the associated reductions in material movements

-improved blast furnace drafting

-a new acid facility with increased capacity.

The annual average air lead concentrations are predicted to reduce to approximately 50% of current levels. It is predicted that following the Transformation, all except a small area near the smelter will be compliant with the NEPM standard of 0.5 µg/m3 for annual average air lead concentrations.

Sulphur dioxide concentrations are also predicted to decrease on average to 50% of current values. In addition, it is predicted that post-Transformation there will be no exceedances of the 1-hour NEPM standard of 0.20 ppm SO2 at the Oliver Street monitoring site, compared to the current situation with exceedances averaging 36 days per year over the last 3 years. However, it is predicted that there will still be occasional exceedances (less than 5 per year) in a small area along the river, close to the smelter.

The improvements to air quality resulting from the Transformation, particularly with respect to lead and sulphur dioxide, will positively impact Port Pirie's community health and the environment.

Effects on health

The primary effects on health to result from the Transformation will be the reduction of emissions of lead-bearing particulates, sulphur dioxide (SO2) and particulate matter (PM10).

LEAD

The most significant and studied effect on human health from the existing Nyrstar operations is lead. It has been an ongoing priority for Nyrstar to reduce blood lead levels in children in the Port Pirie community. Numerous programs and upgrades implemented to date have reduced emissions from the facility and community exposure to legacy lead. Reduction of blood lead levels has plateaued, and a step change in ongoing emissions from the smelter is required to drive emissions and blood lead concentrations lower.

The proposed Transformation, including installation of EBS technology and modern emissions capture and treatment technology, will reduce air lead, and hence reduce blood lead levels in young children of Port Pirie. The facility is being designed to optimise health outcomes for the community.

Installation of best available technology economically achievable as part of the Transformation, and ongoing continual improvement of smelter emission controls, will minimise contemporary air lead. The Targeted Lead Abatement Program (TLAP) will identify current and potential future community lead exposure reduction strategies and assess which are likely to have the greatest impact in reducing children's blood lead levels.

Projections indicate that the Transformation, in combination with the TLAP and ongoing continual improvement activities, will increase the percentage of children with blood lead levels within the guidelines to 95% over a decade.

SULPHUR DIOXIDE

The Transformation will also capture over 95% of sulphur rich off-gases from the EBS oxidation furnace, removing 90% of sulphur dioxide from the tall stack emissions. The proposed sulphuric acid facility will then convert approximately 99.8% of the captured sulphur dioxide into saleable sulphuric acid.

Currently, sulphur dioxide emissions cause concentrations in the town of Port Pirie to exceed the 1-hour NEPM standard on 30–40 occasions each year. Modelling of post-Transformation emissions predicts that standard will be exceeded around 50% less frequently than currently occurs. That is, asthmatics and others sensitive to sulphur dioxide will potentially be exposed to levels that may trigger adverse symptoms on 20 fewer days each year.

PARTICULATE MATTER

PM10 is the indicator used for describing particulate matter relevant to human health. It refers to the mass concentration of particles with a diameter of less than 10 micrometres (µm). The Australian NEPM and WHO standard for PM10 is 50 micrograms per cubic metre (µg/m3), with a target of not more than 5 exceedances per year. Nyrstar monitoring shows that PM10 emission standard exceedances in 2011, 2012, and so far in 2013 have remained within the target of 5 per year. The Transformation is expected to deliver further reduction in particulate emissions, benefitting PM10 susceptible groups in the community.

Effects on community

The proposed Transformation will have a number of significant beneficial effects on the community.

The Transformation will not have any impact on known places of Indigenous or European heritage significance.

The Transformation will have a positive impact on employment in the area during construction, and maintain at least existing employment levels in the operational phase. It will provide a continued economic base for Port Pirie that will assist, in turn, in supporting existing schools and the Port Pirie TAFE campus.

When operating, the Transformation design will satisfy all relevant EPA noise guidelines. There will be no significant increase in noise or vibration for nearby sensitive noise receivers, such as residential properties. There will be some noise impact above EPA guidelines on the nearest residences during the construction phase. Nyrstar will minimise this by scheduling noisier works, such as pile driving and compacting, to avoid very early or evening time periods, and providing adequate warning of possible noise generating activities to residents of potentially affected locations.

Considering historical, current and proposed uses of the smelter, the existing visual amenity of the area will be protected. The Transformation will be implemented over 350 m from the southern boundary, where there are interfaces with other zones. The proposed buildings, equipment and infrastructure will replace existing similar industrial facilities. Some temporary, short term visual impacts will occur during construction.

The smelter is designated as a special industry, and is located on land for which the Policy Area and Zone anticipate this land use. The proposed Transformation will align with these regional planning designations.

The proposed Transformation will have negligible adverse impacts, and will have significant beneficial impacts on the community, including significantly reduced emissions.

Effects on economy

Economic activity in Port Pirie is concentrated in the manufacturing sector, particularly at the smelter currently operated by Nyrstar. The concentration of Port Pirie's economic activity in a single facility means the region is vulnerable to shocks to the minerals processing sector.

The smelter currently faces a number of challenges with respect to its ongoing operation, predominately associated with high lead emissions. The South Australian Environmental Protection Authority (EPA) has indicated its intention to require Nyrstar to meet higher environmental standards, which would reduce lead emissions to an acceptable level. However, given the smelter's age, the new standards cannot be met with the existing technology.

To comply with the new environmental standards proposed by the EPA, Nyrstar needs to either undertake substantial re-investment to upgrade the technology (estimated at $350 million), or cease operations.

Nyrstar's economic impacts were explored by Deloitte Access Economics (DAE). They identified seven themes demonstrating Nyrstar's importance to Port Pirie's socioeconomic viability and its contribution to the State's strategic objectives.

The seven themes identified by DAE are:

1. Nyrstar's importance to underpinning Port Pirie's employment base
2. Nyrstar's critical role in the region's manufacturing sector
3. Nyrstar's role in maximising the use of major infrastructure
4. Nyrstar as a critical anchor against population drift
5. Nyrstar's role in maintaining community wealth (property values)
6. Nyrstar's role in maintaining community sustainability
7. Nyrstar's contribution to the South Australian Strategic Plan.

The economic analysis has demonstrated that Nyrstar is integral to Port Pirie's economy. If operations were to cease, there would be reductions in economic output and employment at local, regional and national scales.

The investment to upgrade the technology and enable Nyrstar to continue operations will have positive environmental outcomes and will support the long term socioeconomic viability of Port Pirie.

Effects on soil, groundwater and surface water

The Transformation will have no net negative impacts on the surface water, soil or groundwater conditions, provided the identified risks are managed in accordance with the established protocols and standards.

The reduction in emissions and the removal of potentially contaminating materials from the intermediate storage area and the old sludge dewatering dams will reduce soil, groundwater and surface water contamination. Potential impacts associated with sub-surface contamination will be reduced by: replacing the existing acid plant; improving contamination management; auditing implementation of contamination management measures; maintaining existing strategic groundwater monitoring and contingency plans; and incorporating these considerations into the design.

Mitigation measures to be incorporated into the Transformation include:

- minimising risk of introducing hydraulic connectivity between groundwater aquifers
- incorporating management of groundwater evaporation, recharge and flow into the design
- incorporating procedures for handling contaminated materials into the CEMP and OEMP.

The Transformation presents net benefits to soil, groundwater and surface water management on-site. These benefits will be principally realised through the removal of some existing sources of contamination. The risk of negative impacts will be managed by the implementation of the existing ISO 14001 certified environmental management system, a project specific CEMP and OEMP, and other environmental management procedures. Each management measure will be reviewed and approved by the SA EPA accredited Contamination Auditor who has been voluntarily engaged by Nyrstar.

Effects on coastal and marine communities

The PER investigated potential effects from the Transformation on coastal and marine communities inhabiting First Creek, Port Pirie River and Spencer Gulf. The Transformation's primary marine-related activities are the increase in cooling water discharge from the smelter, and the increase of shipping traffic during construction. The cooling water may be discharged to First Creek or to Port Pirie River, and effects of both options have been considered.

Potential effects studied include thermal effects, cooling water discharge, erosion of sediments, fish and larvae mortality, construction and shipping impacts, listed species, invasive species and climate change.

The effects relating to cooling water will vary, depending on whether the cooling water will be discharged to First Creek or into the Port Pirie River.

THERMAL EFFECTS

Cooling water discharge to the Port Pirie River may cause a two degree Celsius temperature increase above ambient levels within 200 m of the outlet. Impacts of this increase on marine communities, seagrasses and mangroves were studied. Findings suggest that marine, mangrove and seagrass communities will not be adversely affected by the Transformation.

EROSION OF SEDIMENTS BY COOLING WATER

Two discharge location options were studied, one being First Creek and the other Port Pirie River. This confirmed the following: Discharge of cooling water into the Port Pirie River via a diffuser would not mobilise contaminated sediments on the floor of the estuary.

An increased flow of cooling water in the confined upper reaches of First Creek may initially mobilise and move contaminated sediments down First Creek. However, the sediments would be re-deposited in the less confined middle reaches of First Creek as the velocity of cooling water decreased to that of ambient tidal levels.

OTHER DISCHARGES TO THE MARINE ENVIRONMENT

The increased cooling water discharge will be dosed with a surfactant to prevent fouling organisms from attaching to infrastructure, rather than dosing with the toxic, conventional anti-fouling chemicals.

The movement of contaminated groundwater beneath the smelter and discharge of contaminated groundwater to the Port Pirie River is not expected to change.

Run-off from demolition and construction sites will be controlled and directed to the existing sedimentation ponds prior to discharge to the marine environment.

During demolition and construction, measures will be taken to manage potentially dusty sites, including by wetting, to minimise dust emissions to the marine environment.

FISH AND LARVAE MORTALITY

Mortality of larvae and adult fish arising from entrainment or impingement was found to be negligible in comparison to natural mortality rates.

CONSTRUCTION IMPACTS

Construction of new cooling water caisson and the outlet pipeline would result in a short term increase in turbidity, noise and vibration in the Port Pirie River. However, turbidity and sedimentation effects on seagrass communities in Port Pirie River would be minor, and recovery is likely to be good.

Potential construction of the cooling water outfall pipeline through a 10 m section of tidal flats adjacent to the smelter, to enable discharge into the Port Pirie River, would result in the temporary loss of up to 100 m2 of Eelgrass Zostera sp. This loss may require a Sustainable Environmental Benefit offset payment to be made to the Native Vegetation Council.

Impacts of noise and vibration increases would be slight in the context of the ongoing smelting and port operations. Effects would be temporary and ecologically negligible.

INCREASED SHIPPING

During construction there will be an estimated 24 additional shipping movements in the Port Pirie River per year. The slight increase in shipping traffic will result in minor short term increases in the mobilization of contaminated sediments, turbidity and siltation in Port Pirie River. However, effects on marine communities would be negligible.

Annual shipping movements will return to within normal operating range after construction.

EFFECTS ON LISTED SPECIES

Studies determined that the risk of adverse effects on listed marine or coastal species from the Transformation is considered to be negligible. No listed species are likely to use the smelter for habitat, and none of the habitat potentially used by listed species will be cleared or adversely affected by the Transformation.

INVASIVE SPECIES

The risk of introduction of invasive marine species would be minimised by strict adherence to the national ballast water management guidelines by all shipping.

CLIMATE CHANGE

Temperature effects associated with the proposed increased cooling water discharge would be negligible compared with potential increases in ambient temperatures predicted under climate change scenarios.

Effects on native vegetation and fauna

The PER assesses the potential effects of the Transformation on terrestrial vegetation, habitat and fauna in the vicinity of the smelter. The following conclusions were drawn:

- No terrestrial vegetation or habitat removal will be required for the Transformation.
- The Transformation will reduce tall stack emissions of sulphur dioxide by 90%. Consequently, the health of the vegetation in the vicinity of the smelter may improve.
- A temporary reduction in habitat value immediately adjacent to the smelter may result from construction noise and light, but would have negligible effect on the viability of fauna in the area.
- The risk of listed terrestrial species or communities being adversely affected by the Transformation is negligible.

Effects on transport and infrastructure

Infrastructure providing access to Nyrstar Port Pirie enables road, rail and sea transport.

TRANSPORT

Approximately 80% of the Transformation's transport requirements during construction will be met using vessels carrying prefabricated modules by sea. The remaining 20% of equipment, materials and resources will be transported by road. Rail transport is not expected to be used for the construction phase of the Transformation.

Prefabricated modules will be delivered by vessels capable of docking at the Port Pirie wharf, with current projections indicating a rate of two ships per month. Modules will be off loaded and transported via smelter roads to their final positions. This additional shipping traffic is not expected to impact port operations, and no infrastructure modifications will be required.

It is estimated that construction phase road transport will increase road traffic by 20–40%. Construction personnel will be accommodated at or near Port Pirie and buses will be used to transport construction workers from their accommodation to the smelter. Increased road traffic during the construction phase of the Transformation is likely to have intermittent and localised impacts in Port Pirie. All car parking requirements for the construction and operational phases of the Transformation will be provided on-site.

Oversized loads are not anticipated, although road registered mobile cranes may be required for the positioning of the modules, and would access the smelter by road. These vehicles have no special requirements in terms of traffic management or infrastructure upgrades.

Operational traffic, via sea, road and rail will be similar to current traffic volumes.

The current transport infrastructure servicing the smelter, including the Port Pirie wharf and associated shipping channel, local and arterial roads, level crossings, bridges and rail lines, are considered adequate and do not require upgrade.

INFRASTRUCTURE

The smelter is currently serviced by electricity, gas and water utilities and has on site sewerage infrastructure including a sewage treatment facility.

Electricity is supplied to the smelter by SA Power Networks via the Allendale electricity substation. The smelter currently consumes approximately 300 MWh annually. It is estimated that approximately 20 MW of additional electricity will be required for operations following the Transformation. A portion of this will be supplied by a cogeneration facility, which converts waste heat to electricity. The remainder will be sourced from SA Power Networks. A pre-feasibility study indicates

that the Allendale substation is operating at capacity and requires upgrading to meet the forecast increased energy demand.

Post-Transformation gas demand is expected to be higher than current consumption. At this stage the existing gas infrastructure is considered adequate to meet the increased demand. The Transformation is expected to achieve a reduction in potable use and increased water recycling with reduced smelter effluent.

The existing sewerage system and on-site sewage treatment facility is adequate to service the construction and operational phases of the Transformation.

Existing stormwater systems will be adequate to service the construction and operational phases of the Transformation. Temporary stormwater control measures will be implemented during the construction phase of the project in accordance with the construction environmental management plan (CEMP).

The current communication systems and emergency services will continue through the construction and operational phases of the Transformation and do not require upgrade or change.

Sustainability and climate change

The Port Pirie Smelter Transformation is focused on delivering an innovative and sustainable solution to the current environmental and technical challenges facing the smelter. Sustainability, community health and environmental benefits and features of the Transformation include:

-significant reduction in airborne metal and dust emissions

-increased capture of sulphur dioxide and conversion to useable sulphuric acid

-enclosure of transfer points and filtration

-recovery of energy from the smelting process

-a reduction in carbon emissions per tonne of production

-a reduction in potable water consumption

-reduction of construction waste by prefabrication, transport and delivery of modules to the smelter.

Energy efficiency gains associated with the upgrades will be realised, including the cogeneration of electricity from heat recovered from the new smelting process.

Management of hazard and risk

Nyrstar has an established risk management framework aligned with AS/NZS ISO 31000:2009.

The Port Pirie Smelter Transformation is an outcome of sound risk management principles. Its design and implementation aims to reduce the long term risk exposure to the local community, whilst delivering beneficial economic and social outcomes for the local population.

A semi-quantitative risk assessment was conducted to identify, assess and manage the risks associated with the Transformation, with outcomes documented in a risk profile. Risk ratings considered the likelihood and consequence of potential impacts occurring. Risks were rated before and after proposed mitigation and management measures.

Of the 64 inherent risks identified during the workshop, 13 were initially rated as having unacceptable (high) potential risk to the environment, and 27 received initial ratings of acceptable (medium) but would require ongoing monitoring.

Following identification of mitigation and control measures, all 64 identified risks received ratings of acceptable, and risks were deemed to have been reduced to as low as reasonably practicable.

The risk profile highlights many of the legacy issues that the plant faces from its many decades of operation. These issues are well known by Nyrstar, the local community and external agencies. Nyrstar's partnerships with environmental specialists, and the ever increasing availability of technology and techniques in construction, will allow Nyrstar to manage risks to an acceptable level during the construction phase.

Following the Transformation, operational risks include emissions to air, water, soil and groundwater, as well as seismic risk. Where these risks can be mitigated through better engineering, measures will be incorporated into the design phase. Residual risks will be documented in the operations environmental management plan, and subjected to ongoing monitoring and management processes in accordance with the ISO 14001 certified environmental management system.

Nyrstar is committed to the operation of the smelter with minimal risks to the surrounding environment. This hazard and risk identification process has identified a number of control measures that are necessary to manage risks to an acceptable level. Implementation of these control measures is achievable and practical and where the residual risk levels are medium, there will be ongoing environmental performance monitoring and implementation of trigger mechanisms should they be required.

Waste management

The Nyrstar Port Pirie facility is licenced by the EPA for a variety of waste management and recycling activities (EPA licence 775) including the on-site landfill which accepts waste generated on-site and includes dedicated and licenced asbestos cells.

Nyrstar manages on-site waste according to a waste management hierarchy, a preferred order of waste management practices, aligning with current waste management policy and strategies.

Construction waste will be minimised by the off-site manufacture of prefabricated modules. This procurement methodology significantly reduces construction waste and impact on the environment, supporting sustainability principles. On-site construction wastes will mainly arise from decommissioning, demolition and civil works associated with the preparation of the smelter for module installation. Demolished materials will be salvaged for reuse or recycling where possible. Spoil from excavations will be stockpiled at designated sites prior to being processed through the smelter to recover metals or used as fill elsewhere on-site.

The Transformation involves upgrading the primary lead production facilities, with the outputs becoming feed for secondary processes such as the zinc and copper facilities or the refinery. A major operational waste stream from the smelter is black sands, which is on-sold as a product or stored on-site. The Transformation will not introduce new operational waste streams.

Process water from the new facilities will be treated through the existing Process Effluent Treatment System (PETS). The PETS treats the process effluent to remove contaminants including metals, and either returns water back to the process water system for reuse, or discharges treated water via the monitored licenced discharge point.

The Transformation includes the construction and operation of an additional sea water intake for cooling water. Like the current system, this will be a single pass non-contact system and will include a trim cooler to adjust the sea water discharge temperature.

General maintenance wastes will continue to be managed post-Transformation in accordance with existing waste management protocols.

Environmental management

The Transformation is expected to reduce the overall environmental and social impacts from the smelter. To prevent any unintended impacts, a comprehensive Environmental Risk Assessment was undertaken to identify control measures to minimise the environmental footprint of the Port Pirie Smelter Transformation.

A draft construction environmental management plan and a draft operations environmental management plan have been developed and will be finalised prior to commencement of construction. The existing Environmental Monitoring and Reporting Program will be upgraded to provide a basis for the public review and approvals process. Nyrstar proposes to introduce controls to reduce the level of impact to as low as practically possible.

Facilities constructed by the Transformation will be incorporated into Nyrstar's ISO 14001 certified Environmental Management System (EMS), and integrated into the regular performance assessment, mitigation and review process.

Conclusion

Nyrstar Port Pirie is enthusiastic and committed to delivering the Transformation, reducing lead and sulphur dioxide emissions to air and improving the health of the community, thus delivering a sustainable future for the facility, Port Pire and the wider region.

While the Transformation will address the most significant environmental issue at the smelter, air lead emissions, Nyrstar's continual improvement program is already focussing on the next opportunity to improve environmental and community performance.

NYRSTAR'S COMMITMENTS

The Nyrstar Way

The Nyrstar workforce has a unique culture which defines the way we work and sets us apart from our competitors. Our employees believe in the company's future and they share a set of common values known as the Nyrstar Way. At Nyrstar, we strive for world class safety and environmental performance and our unrelenting commitment to the health and safety of our employees, contractors and communities is the foundation for everything we do.

Living the Nyrstar Way defines and guides our approach to engaging with our stakeholders. We commit to preventing harm, being open and honest, keeping our word and creating value.

Nyrstar Way comprises of seven elements. These are the way we do business. They underpin what we stand for and guide our actions. Everyone in the company is encouraged to understand, embrace and enact these behaviors, as to do so will help us achieve our goals and objectives. We go to great lengths to assist all employees to understand and appreciate the implications of each of these elements, and apply them to their daily work.

Sustainability

Our aim is to manage our business to balance economic, environmental and social considerations and we recognise that our continued success is dependent upon the way we manage our approach to sustainability and corporate responsibility.

The sustainability of our operations will be the result of our ability to provide economic benefits to our shareholders, our customers and the communities in which we operate, while not harming our people, our neighbours or the environment.

Our aim is to be a welcomed and valued part of the community in which we participate, and acknowledge our reputation is greatly influenced by our interactions with our stakeholders.

We apply a holistic approach to our business sustainability which is recognised in our Nyrstar2020 Strategy, the Nyrstar Way and our Code of Business Conduct.

The Transformation

Nyrstar is seeking government approval for the Transformation proposed at the existing smelter. The activities proposed for the expansion are described in Chapter 6 with the remaining chapters of the PER presenting the findings of environmental, social, cultural and economic assessments of the Transformation.

For the purpose of the PER, commitments are defined as those safeguards to which Nyrstar can commit, at this time. They include:

- project design decisions that avoid impact
- outcome based commitments e.g. fugitive emissions will be significantly reduced
- environmental performance improvements that complement the Transformation project

Nyrstar is committed to operation of the Smelter with minimal risks to the surrounding environment.

The following table provides a summary of Nyrstar's commitments.

Air quality: Health, Air lead, and particulate management

The Port Pirie Transformation will result in a step change reduction of lead-based emissions to air. Post-Transformation, the continual improvement approach will address other activities at the smelter.

ISSUE	COMMITMENT	JUSTIFICATION
Lead-bearing dust and fume is generated during the smelting process and can be harmful to personal health if not controlled and captured.	Real-time particulate monitoring of the tall stack emissions will continue to be used.	Allows the assessment of the adequacy and effectiveness of the tall stack baghouse system (process gas cleaning system).
	Ensure that the new smelter configuration has hygiene and process gas capture and ventilation systems designed to eliminate or minimise emissions into the workplace and surrounding environs.	Cooling water for the proposed Transformation is seawater, sourced from Port Pirie River. Cooling water passes once through a non-contact system. As such, seawater extracted from the river is returned to the river. To assess the effectiveness of this design, real-time alarms for particulate emissions provide the best indicators of performance.
	Occupational exposure monitoring will continue to be conducted.	Allows the monitoring and management of employee exposure.
Roads and pavement onsite can be a significant source of fugitive emissions. Designing, constructing and maintaining good roads and pavements as well as using appropriate dust suppressants and cleaning techniques, combined with operator training can be effective in controlling fugitive emissions.	Emissions will be further reduced and monitoring will continue to be improved via the Lead emissions to air EIP (due to be submitted to EPA 16 August 2013). This will include (but not limited to): -improved road conditions -improved management and pavement cleaning techniques.	The Transformation Environmental Improvement Program (EIP) will contain a number of compliance actions aimed at further reducing smelter air lead emissions.

There is a need for ongoing reductions of lead emissions to air from the smelter. Continual improvement efforts are critically important to the ongoing improvement of air quality in Port Pirie. The ability to measure and monitor the conditions that may cause fugitive dust concentrations to exceed targets is essential in managing the intermediate materials storage area and materials handling facilities. Installation of the monitoring system would provide information that assists management in identifying, controlling, minimising and ultimately eliminating emission sources.	A mobile real-time ambient Air Lead monitoring unit (Xact Monitor) (for use external to the smelter), combined with real time meteorological monitoring will be used for the purpose of lead emissions reduction / performance improvement for the smelter. Real time dust monitoring units would be used at the smelter, on a campaign basis as required, monitoring dust concentrations at specific interest locations.	This approach will allow the timely identification of smelter emission sources or activities. This will form the basis of the future environmental improvements (with respect to Air Lead) at the smelter. Provides information for operational control of dust.
It is expected that following the significant reductions in emissions from the sinter plant/blast furnace region of the smelter, as well as major reductions in intermediate storage area emissions, there will be further improvement opportunities for the smelter.	Retain the current network of monitoring sites for air lead at least for the duration of the construction phase and until all associated works and changes planned for the intermediate storage area materials and stockpiles are completed.	Enable ongoing assessment of the improvements in air quality in Port Pirie.
	Undertake more targeted monitoring to confirm areas for ongoing improvements.	

Air quality: Intermediate materials storage area

Nyrstar recognises that an important part of a sustainable business includes effective on-site materials management. The Transformation will increase Nyrstar's capacity to convert many of the existing intermediate materials into valuable product, thus reducing on-site stockpiles and significantly reducing the source of lead-bearing airborne dust.

ISSUE	COMMITMENT	JUSTIFICATION
The intermediate materials storage area (pit) is currently a significant source of lead-bearing particulates associated with the operation of the sinter plant. The application of EBS technology allows a substantial volume of the intermediate storage area materials to be substantially reduced.	Consume the sinter plant related intermediate materials (currently stored in the intermediate storage area), including all the lead oxide-bearing sinter material, within the first 3-5 full operating years, post-Transformation.	The consolidation (and ultimate closure) of the intermediate materials storage area will enable land remediation to further eliminate sources for wind mobilisation and vehicle tracking of lead-bearing materials.
	Using the EIP to continually investigate opportunities for recovery and reuse of the remaining intermediate storage area materials, with the long term goal of closing this area.	

Air quality: Sulphur dioxide management

The Transformation is expected to result in a significant decrease in sulphur dioxide emissions. Sulphur dioxide is generated during the smelting process and can be harmful to personal health. The proposed new facility has been designed to minimise emissions into the workplace and the wider environment via improved sulphur dioxide emission management and capture. To assess the effectiveness of this design, real-time monitoring of sulphur dioxide emissions provides the best indicator of performance.

ISSUE	COMMITMENT	JUSTIFICATION
The installation of EBS technology, improved drafting (and hence dust and fume capture), improved emissions management and an advanced acid management facility will enable capture of 90% of generated SO2, further benefitting community health.	Real time monitoring of the sulphur dioxide emissions from the: -tall stack -acid plant stack.	Used to assess the continuing adequacy and effectiveness of the sulphur dioxide capture systems.
	Retain the current network of monitoring sites (town) for SO2 for the duration of the construction phase and until steady state operations are achieved with the transformed smelter. Monitoring sites should be left in place for as long as possible to demonstrate new performance level.	Enable ongoing assessment of air quality improvements in Port Pirie.

Community

After 124 years of constant operation, the Nyrstar Port Pirie Smelter has a strong association with the Port Pirie community. Nyrstar is conscious of its social responsibilities to the community and plays a key role contributing to, and improving, social outcomes within Port Pirie.

ISSUE	COMMITMENT	JUSTIFICATION
Crime and antisocial behaviour.	Work in conjunction with local service providers to address any concerns relating to crime and anti-social behaviour.	To reduce the likelihood of adverse impacts associated with the construction workforce.
Ongoing monitoring of social impacts and stakeholder and community liaison	In collaboration with government and other stakeholders, continue to develop the Targeted Lead Abatement Program.	Ensures long-term continued focus on reducing blood lead levels in the community of Port Pirie.
	Continue to monitor and respond to social issues as they arise. This is done as part of daily stakeholder relationship management by Nyrstar.	Ensures good community relations.

Groundwater and sub-surface hydrology

Nyrstar is committed to improving groundwater performance and quality and as such has voluntarily appointed an SA EPA accredited contamination auditor. This arrangement has been in place since early 2012. Legacy contaminants are being addressed through continual improvement of groundwater, surface water and sub-surface management at the Smelter. Nyrstar is implementing design features of any new plant that prevents cross contamination of aquifers at the smelter. Existing conditions will be used as the basis to optimise the environmental performance.

ISSUE	COMMITMENT	JUSTIFICATION
Geotechnical testing and piling activities – This has the potential to interconnect aquifers and mobilise contaminants, particularly from the Fill Aquifer to underlying aquifers.	Employ the following: -dedicated pile design(s) that will hydraulically isolate the aquifers -appropriate drilling methodologies to assess the impedance of groundwater flow by piles using results from the smelter's numerical groundwater model	Required to satisfy the SA EPA requirements and industry standards. This has been successfully completed on the smelter to the satisfaction of the auditor.
Pavements – Removing pavements will increase the rate of recharge and the risk of further groundwater contamination.	Where required, pavement improvement will be designed to reduce the potential for groundwater recharge and contaminant migration.	Need to minimise the groundwater recharge.
Contaminated materials – Handling potentially contaminated materials, including acid sulphate soils and waste construction materials can have an impact on soil, groundwater and surface water.	The CEMP and OEMP will outline strategies and procedures for handling contaminated materials. The auditor will review and approve these parts of the CEMP and the OEMP.	Required to satisfy the SA EPA requirements.
Cooling water pipeline – The cooling water pipeline may alter groundwater flow potentially impacting groundwater quality.	The cooling water pipeline will be designed with the aid of numerical modelling to avoid further contamination. The pipeline construction is being assessed as a potential opportunity to assist with groundwater contamination management.	The hazard and risk identification process has identified a number of control measures that are necessary to manage risks to an acceptable level. PER Section 16.1 Required to satisfy the SA EPA requirements. The pipeline construction is being assessed as a potential opportunity to assist with groundwater contamination management.

Marine

The marine related Transformation issues are dependent upon construction effects and the location of cooling water discharge.

ISSUE	COMMITMENT	JUSTIFICATION
Potential erosion of the upper reaches of the earth channel immediately below the 1M.	If First Creek is the preferred cooling water discharge path then monitor the upper reaches of the earth channel immediately below the 1M flume for erosion activity. If erosion is problematic then identify and implement the most appropriate mitigation measure.	Maintain the channel.
During demolition and construction operations there will be an increased risk of surface run-off becoming contaminated by sediments and metals and discharging into the marine environment.	As with existing stormwater, run-off from demolition and construction will be controlled and directed, as required, to the sedimentary basin prior to discharge into First Creek. The details of how stormwater will be controlled will be described in the CEMP. Similarly, during demolition and construction operations there will be an increased risk of contaminated dust blown into the marine environment. During demolition and construction, measures will be taken to ensure that potentially dusty sites are controlled to minimise dust emissions. The CEMP will provide more details of how dust will be controlled.	Minimise impacts and satisfy SA EPA requirements.
Salt water intake structure installation - silt plumes would be generated in the Port Pirie River during installation. This needs to be managed.	The CEMP will include the measures necessary to mitigate impacts associated with any necessary dredging and installation activities (This may include the use of silt curtains and measures to appropriately dispose of contaminated dredge spoil should this be required).	Minimise impacts and satisfy SA EPA requirements.
-Cooling water discharge dosing to prevent fouling organisms from attaching to infrastructure.	Dose with a surfactant rather than the more toxic, conventional anti-fouling chemicals.	Minimise impacts and satisfy SA EPA requirements.
During demolition and construction potentially dusty sites could result in emissions to the marine environment.	Dust emission control measures will be included for such areas in the CEMP.	Minimise impacts and satisfy SA EPA requirements.

Water supply and treatment

Port Pirie's dry climate increases the demand for potable water supplies. Nyrstar is conscious of its responsibilities to the community and plays a key role contributing to, and improving, outcomes within Port Pirie with regard to fresh water availability

ISSUE	COMMITMENT	JUSTIFICATION
Port Pirie's dry climate results in increasing demands for potable water supplies	Cooling water for the proposed Transformation is sourced from seawater. Cooling water is also contained in a non-contact system so what is taken is also returned.	Ongoing investigations and implementation of programs to reduce reliance on fresh water supplies by recycling or reusing water.
	A jointly funded treatment (reverse osmosis) and recycling plant for wastewater. This is a recent initiative of the current operations and is primarily aimed to support the Port Pirie Regional Council town greening program.	The reverse osmosis technology provides high quality water which can be reused in the Port Pirie process, reused in the community to irrigate recreational or revegetated areas, or for dust suppression and cleaning. In addition to reducing the reliance on fresh water supplies at the smelter, the water recycling plant also supports 'Thumbs up for low levels' community lead exposure reduction initiatives, both of which are strategically important in Port Pirie's dry climate.

Native vegetation and fauna

The Transformation is contained on the existing smelter, thus reducing or eliminating any negative impact on native vegetation and fauna. Nyrstar carries out native vegetation and fauna monitoring as required.

ISSUE	COMMITMENT	JUSTIFICATION
Lights may attract large numbers of insects that would in turn provide foraging opportunities for bats, some birds and ground dwelling fauna.	The CEMP will include 'light spillage' mitigation measures (such as screens or directional lighting) where appropriate.	Minimise impacts and satisfy SA EPA requirements
Potential loss of seagrass associated with one of the Port Pirie River cooling water discharge options.	If the Port Pirie River is the preferred cooling water discharge area then offset the potential loss of seagrass (associated with one of the discharge options) by making a monetary payment to the Native Vegetation Fund.	This would achieve a Significant Environmental Benefit (SEB) in compliance with the *Native Vegetation Act 1991.*

Transport

It is anticipated that an increase in traffic frequency will occur during the construction period of the Transformation. Nyrstar will use existing transport and infrastructure available, thus eliminating the need to change or impact upon existing infrastructure

ISSUE	COMMITMENT	JUSTIFICATION
Safe road transport for construction materials.	Notification of road usage and interruptions through regular community announcements.	Minimises the inconvenience to the general public and ensures the safe and efficient transport of large loads and pre-assemblies to Port Pirie.
	Aim to transport loads at times that are out of peak periods.	
	Utilise transport load sizes that do not exceed existing capacity of infrastructure.	

Sustainability and climate change

Reduce the smelter's environmental footprint and provide a sustainable future for the community of Port Pirie.

ISSUE	COMMITMENT	JUSTIFICATION
At some facilities, depending on process inputs and off-gas treatment, undesirable chemicals can form in the off-gases.	The off-gas management is to include a quenching tower.	This is a preventative measure, in case production feedstocks change in the future. All necessary approvals would be sought should Nyrstar change feedstock types in the future.
Sustainability of activities – construction and operational phases.	Auditing of sustainability of activities will be conducted during the construction and operational phases of the Transformation. This requirement will be included in the CEMP and OEMP.	Minimise impacts and satisfy SA EPA requirements.
Future potential sea level rise.	A levee bank is being constructed on-site. Continue to work with the PPRC to ensure that the levee bank is serviceable.	To meet the requirements of the Coastal Protection Board's minimum site levels and floor levels for coastal developments.

Construction and Operations Environmental Management Plans

Both the Construction and Operations Environmental Management Plans are developed so appropriate environmental management practices are followed during a project's construction and operation phases.

ISSUE	COMMITMENT	JUSTIFICATION
Construction activity management must achieve the required environmental performance.	A construction environmental management plan (CEMP) will be finalised and implemented to ensure that environmental impacts of construction activities are eliminated or minimised. The CEMP will include (but not limited to) details on the following: Earthmoving/ spoil management (including spoil placement authorisation), demolition, waste management and recycling, top-down cleaning and post clean inspections, pre-collection pits, stakeholders and communications, silt curtains, smelter location and design, Caisson installation, dust management, traffic management, schedule management, Ballast water management, smelter operations and contingency planning.	Eliminate and minimise impacts on the local environment.
To manage the generation and removal of contaminated materials during decommissioning and transition.	The generation and removal of contaminated materials during decommissioning and transition will be described in the CEMP.	Management of materials in accordance with South Australian regulations.
	Remaining legacy contamination will be managed under the OEMP.	
Operational activities require the necessary controls to minimise the risk of environmental impact.	An operations environmental management plan (OEMP) will be written and will outline strategies to minimise potential environmental impacts. The OEMP will include (but not limited to) details on the following: commissioning plan, operations and maintenance planning, materials handling, stakeholders and communications, start-up and operating procedures (including acid plant, caisson and diffuser), intermediate materials consolidation, Ballast water management, smelter operations and contingency planning.	Eliminate and minimise impacts on the local environment.

	A final OEMP will be developed prior to commissioning the Transformation facilities.	
	The OEMP will be monitored, reviewed, re-evaluated and communicated throughout the operational phase in accordance with the Nyrstar risk management framework.	
	Noise mitigation measures will be incorporated into the OEMP, and will include any necessary mitigation measures.	
The CEMP and OEMP will be adhered to during the construction and operational phases of the project.	The CEMP will be finalised and implemented prior to construction and the OEMP will be finalised and implemented prior to commissioning. A 'Transformation Environmental Officer (TEO)' will be employed for the duration of construction and commissioning. The TEO will support the various construction and operations personnel in the implementation of the CEMP and the OEMP and conduct daily site inspections and scheduled internal audits of activities.	Compliance with the CEMP and OEMP.
	The process of finalising the EMP's will entail an education program to ensure awareness for all staff, contractors and consultants	Ensure CEMP and OEMP implementation.
Nyrstar Port Pirie has an ISO14001 certified Environmental Management System (EMS), which is internally and externally audited against the ISO14001 standard. The existing smelter EMS will need to be updated to account for the transformed smelter configuration.	The upgraded equipment associated with the Transformation will be incorporated into the existing site EMS. This will include the regular review of environmental aspects and impacts, suitability of mitigation measures, and inclusion in regular internal and external auditing.	Relevance of site EMS to the Transformation site configuration.
The following will be generated during the operational phase: dust, sediment, litter, noise, vibration and operations wastes. These will need to be managed appropriately.	The OEMP to include any necessary mitigation measures for the areas related to dust, sediment, litter, noise, vibration and operations wastes.	Eliminate and minimise impacts on the local environment.

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GLOSSARY

AARD	Aboriginal Affairs and Reconciliation Division
AHD	Australian Height Datum
AIPP	Australian Industry Participation Plan
Air EPP	*Environment Protection (Air Quality) Policy 1994*
Air NEPM	National Environment Protection (Ambient Air Quality) Measure
ALARP	As Low As Reasonably Practicable
AST	above ground storage tanks
AM&S Ltd	Australian Mining and Smelting Limited
ANZECC	Australian and New Zealand Conservation Council
BAT	best available technology
BATEA	best available technology economically achievable
BDBSA	Biological Databases of South Australia
BHAS	Broken Hill Associated Smelters
BSEA	black sand emplacement area
BTEX	benzene, toluene, ethyl benzene and xylenes
carbon intensity	The average emission rate of carbon dioxide from a given source relative to the rate of production, such as tonnes of carbon dioxide emitted per tonne of lead produced.
CCGER	*Climate Change and Greenhouse Emissions Reduction Act 2007*
CoPC	Contaminant of Potential Concern
CT	Certificates of Titles
DA	Development Application
DAC	Development Assessment Commission
DAE	Deloitte Access Economics
DEEWR	Department of Education, Employment and Workplace Relations (SA)
DEWNR	Department of Environment, Water and Natural Resources (SA)
DMITRE	Department of Manufacturing, Innovation, Trade, Resources and Energy (SA)
DPTI	Department of Planning, Transport and Infrastructure (SA)
DR	Development Report
EBS	enclosed bath smelting
EEO	equal employment opportunity
EHWP	Environmental Health Working Party
EIP	Environment Improvement Program
EIS	Environmental Impact Statement
EMRP	Environmental Monitoring and Reporting Program
EMS	Environmental Management System
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPBS	Enhanced Project By-Law Scheme

FEL	front end loader
FTE	full time equivalent
GSP	gross state product
Guidelines	*Guidelines for the Preparation of a Public Environmental Report for the Port Pirie Smelter Transformation Proposal (Mid North)*
HVAS	high volume air samplers
INP	Industrial Noise Policy
ML	megalitres
MNRP	Mid North Region Plan
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NES	national environmental significance, as defined under the Commonwealth EPBC Act.
NHMRC	National Health and Medical Research Council
NPI	National Pollutant Inventory
PDC	principle of development control
PER	Public Environmental Report
PIRSA	Department of Primary Industries and Regions South Australia
PPRC	Port Pirie Regional Council
PPRCDP	Port Pirie Regional Council Development Plan
RO	reverse osmosis
SES	socio-economic status
SOE	State of the Environment
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
SME	small and medium sized enterprises
TEO	Transformation Environmental Officer
TEOM	Tapered Element Oscillating Microbalance
TLAP	Targeted Lead Abatement Program – a program established by Nyrstar to re-scope community blood lead reduction initiatives and consider additional measures to improve results.
TSP	total suspended particles
TWA	time weighted average
UNA	Upper Natural Aquifer
mg/dL	micrograms per decilitre

nyrstar

Resources for a changing world

Public Environmental Report

1 Introduction

Nyrstar Port Pirie Pty Ltd proposes to upgrade and redevelop their existing lead smelter facility at Port Pirie, South Australia. The redevelopment requires Major Development approval under section 46C of the *Development Act 1993* and will be subject to the processes and procedures of a Public Environmental Report (PER).

The proposed works, referred to as the Port Pirie Smelter Transformation (Transformation), will upgrade and redevelop parts of the existing smelter, infrastructure and operations. In particular, the Transformation will upgrade the existing facility to an advanced poly-metallic processing and recovery facility that will deliver a step change reduction in airborne metal and dust emissions significantly improving associated air quality in the Port Pirie area. Once completed, the upgraded facility will meet more stringent environmental standards and enable Nyrstar to expand its business opportunities while delivering sustainability to its operation, the Port Pirie community and wider region. In addition, the Transformation will substantially improve public health and enhance the social and economic wellbeing of the Port Pirie community.

Specifically the Transformation involves replacing the sinter plant and removing the requirement for intermediate materials and their transfer and storage, which are the main sources of lead emissions to air. The sinter plant will be replaced with a modern enclosed bath smelting (EBS) oxidation furnace, largely eliminating these sources of emissions. In addition, emissions from the blast furnace will be substantially reduced via improved processing performance.

Located on the eastern shore of the Spencer Gulf in South Australia approximately 225 kilometres north of Adelaide, the smelter has been in constant operation for 124 years. The facility has a dedicated port adjacent to the site, operated by Flinders Ports and leased to Nyrstar. **Figure 1-1** shows an aerial image of the smelter.

Port Pirie, South Australia's fourth largest urban area, is a major manufacturing centre. Approximately 3,250 people are employed directly and indirectly as a result of the smelter. In addition, the smelter supports infrastructure, such as the port facilities, that rely on Nyrstar for ongoing viability (Parsons Brinkerhoff 2013).

The smelter is one of the world's largest primary lead smelting facilities and a major silver producer. The plant is an integrated multi-metals recovery facility with the flexibility to process a wide range of lead-rich concentrates and smelting industry by-products. The Port Pirie operation incorporates a lead smelter and refinery, a precious metals refinery, a copper plant and a zinc plant. It produces a range of metals including: 195,000 tonnes of lead; 30,000 tonnes of zinc; 4,000 tonnes of copper; 18,500,000 troy[1] ounces of silver; and 36,000 troy ounces of gold per annum.

1 1 troy ounce = approximately 31 g

Figure 1-1: Nyrstar Port Pirie Smelter

1.1 The proponent

The proponent submitting this Public Environmental Report (PER) for the Transformation is Nyrstar Port Pirie Pty Ltd (Nyrstar). Nyrstar is a subsidiary of a multi-national integrated mining and metals business (Nyrstar NV) with mining, smelting, and other operations located in Europe, the Americas and Australia. Nyrstar NV is incorporated in Belgium and has its corporate office in Switzerland. Nyrstar NV was created in 2007 by combining the zinc smelting and alloying operations of Zinifex (the former operator of the smelter and Australian mining company) and Umicore (a Belgian materials technology company). In addition to the Port Pirie smelter, Nyrstar operates a smelter in Hobart, a smelter in the United States and three smelters in Europe.

1.2 Staging and timing

Approval for the Transformation is required by the end of 2013. **Table 1–1** outlines the anticipated timing for the preparation, assessment and determination of the Development Application and the environmental assessment process.

Table 1–1: Transformation schedule

Activity	Indicative Timeframe
Declaration and Gazettal of Major Project	February 2013
Preparation and submission of Development Application	March 2013
Issue of assessment process and guidelines	April 2013
Preparation of Public Environmental Report	May to July 2013
Undertake environmental investigations	May to June 2013
Submission of assessment documentation	August 2013
Public Consultation period (30 business days)	August to September 2013
Response to Public Consultation submissions (Response Document)	October 2013
Preparation of Assessment Report	November 2013
Consideration of Major Project by Governor	December 2013
Approval of the Major Project and gazettal of decision	December 2013
Commencement of construction	2nd quarter of 2014
Operation of the project	1st quarter of 2016

Following final project approval by the Nyrstar Board in early 2014, it is anticipated that construction will commence shortly after Board approval and, assuming that the Transformation works remain on schedule, commissioning of the new facility is expected to occur in the first quarter of 2016.

1.3 Legislative requirements and approval process

The Transformation must meet certain legislative requirements, including obtaining permits or licenses for specific activities and whole-of-project approvals. This section identifies the South Australian Government's requirement that a PER be prepared, and the key legislation, policy, standards and codes of practice that are relevant to the proposed Transformation.

The PER assessment and approvals process includes a public consultation period, providing an opportunity for members of the public to provide comment and formal submissions to the

government during the public consultation period. Comments and submissions received in writing by the South Australian Department of Planning, Transport and Infrastructure (DPTI) will be addressed in a separate Response Document.

1.3.1 Assessment and approvals process

The key pieces of legislation that must be satisfied before final approval of the Transformation can be granted include the Australian Federal Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the South Australian Government's *Development Act 1993* (Development Act).

For the Transformation to proceed, approval must be granted by:

- the South Australian Minister for Planning under the Development Act

On 28 February 2013 the South Australian Minister for Planning declared the Transformation would be assessed as a Major Development under section 46 of the Development Act. The Development Assessment Commission (DAC), an independent statutory authority, considered the proposal's implications and determined it be subject to the processes and procedures of a PER. The range of issues requiring investigation includes:

- the ability to achieve proposed reductions of contaminated air emissions (especially for lead and sulphur dioxide) and the consequent benefits to public health and the environment
- the economic costs and benefits (including employment and investment opportunities)
- the sustainability and climate change implications
- the potential temperature and salinity impacts on the coastal and marine environment (including Upper Spencer Gulf Marine Park) from the discharge of cooling water
- the effect on infrastructure and the community (including road and traffic impacts).

The PER discusses how the Transformation will support a number of local, regional, State and Federal statutory instruments, including those listed below. Further details of the legislative requirements and the key approvals are provided in **Chapter 4**.

Federal legislation

- *Environment and Protection Biodiversity Conservation Act 1999*
- National Environment Protection Measure for Ambient Air Quality
- *National Greenhouse and Energy Reporting Act 2007*

State legislation

- *Aboriginal Heritage Act 1988*
- *Climate Change and Greenhouse Emissions Reduction Act 2007*
- *Coast Protection Act 1972*
- *Development Act 1993*

- *Environment Protection Act 1993*
- *Harbors and Navigation Act 1993*
- *Marine Parks Act 2007*
- *Native Title (South Australia) Act 1994*
- *Natural Resources Management Act 2004*

State and local government planning

- EPA Guideline for Air Quality Impact Assessment Using Design Ground Level Pollutant Concentrations (Environment Protection Authority, updated January 2006)
- South Australian Strategic Plan (Department of the Premier and Cabinet, 2011)
- South Australia Waste Strategy 2011–2015
- Strategic Infrastructure Plan for South Australia (DPTI, 2005)
- Planning Strategy for Regional South Australia (Planning SA, 2007)
- Tackling Climate Change, SA's Greenhouse Strategy 2007–2020
- Upper Spencer Gulf Marine Park Management Plan 2012

1.4 The Public Environmental Report process

This section outlines the development approvals process the Transformation must follow to satisfy the requirements of the Development Act**.** **Figure 1-2** provides a visual summary of the process.

The Minister declared the Transformation to be a Major Development pursuant to section 46 of the Development Act on 28 February 2013. This declaration signalled the first step in the Major Development assessment process.

Following the Major Development declaration, Nyrstar was required to submit a development application in accordance with Section 46(6) of the Development Act. Following submission on 8 March 2013, the Minister referred the application to the DAC to determine whether this Major Development would be subject to an Environmental Impact Statement (EIS), a Public Environment Report (PER) or a Development Report (DR).

The DAC determined that the proposal will be subject to the processes and procedures of a PER. In making its determination, the DAC issued *Guidelines for the Preparation of a Public Environmental Report: Port Pirie Smelter Transformation (Mid North)* (Guideline). This report is Nyrstar's PER, prepared in accordance with the Guideline, and marking the third step in the Major Development assessment process.

The process for lodging and assessment of a PER is outlined in Section 46C of the Development Act. During this stage, the Proponent is required to submit the PER to the Minister, addressing all the components of the Guideline. Following receipt of the PER, the Minister is required to refer it to impacted or interested government agencies and local authorities for comment and report. In particular, the Minister is required to refer the development to the EPA where the project involves an activity of environmental significance as defined by the EP Act. In addition, the PER will be made available for public inspection and comment for a period of 30 business days. During this time, at least one public meeting will be held.

Following conclusion of the referral and public comment stage, the Minister will provide the Proponent with a copy of all submissions made, and reports from referral agencies, in relation to the development. The Proponent will prepare a Response Document (RD). The Minister will then provide an assessment of the development based on the PER, any submissions made, and the Proponent's Response Document.

The purpose of a PER is to describe the development, analyse issues relevant to the development and the means by which those issues or effects will be managed. The PER will detail anticipated environmental, social and economic effects of the development. The PER will also consider the extent to which the development is consistent with the provisions of the Development Plan, the Planning Strategy and any matter prescribed by regulation under the Development Act.

The PER will undergo a review by the South Australian Minister for Planning as well as a public review process.

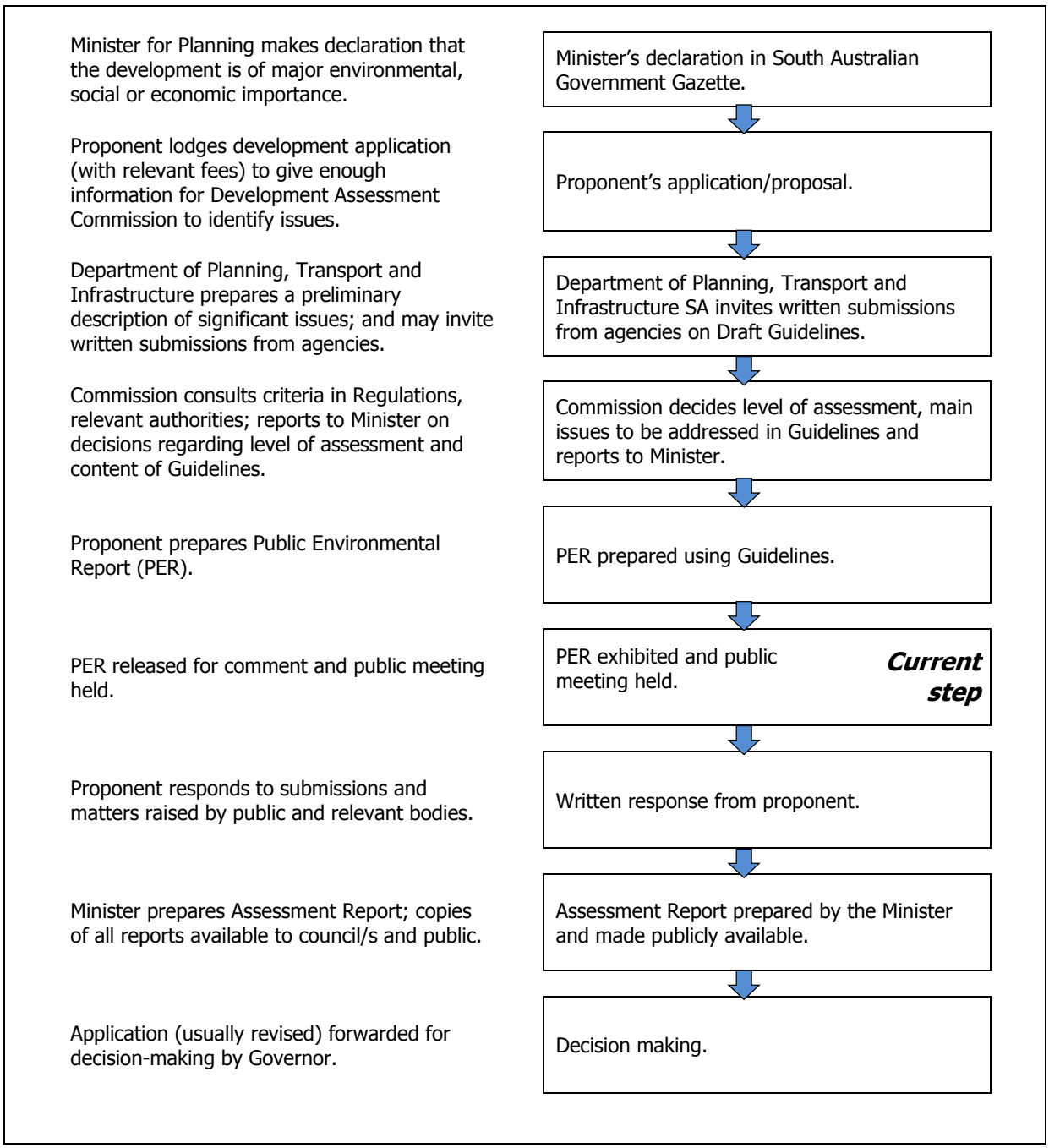

Figure 1-2: PER assessment processes and decision making pathways

1.5 Report structure

This PER identifies and discusses the potential environmental, social and economic impacts of the Transformation and proposes management and mitigation strategies to address these impacts. A brief description of the document's content is:

- Project need, benefits and alternatives — Background to the project, including project need and rationale, alternatives to development and strategic context.
- Planning and environmental legislation and policies — A description of how the Transformation supports targets and objectives expressed in the South Australian

Strategic Plan, and how it complies with the intent and provisions of State and local development priorities.

- Existing environment — Information on the locality and existing environment, including terrestrial and marine environments as well as adjacent land uses.
- Project description — Description of the Transformation, including the nature and location of the development, proposed works and construction/commissioning timeframes.
- Impact assessment — Details of the anticipated environmental, human health, social and economic effects of the proposed Transformation, including associated decommissioning and transitional arrangements.
- Risk assessment and mitigation — A qualitative risk assessment of potential environmental, human health and social impacts, proposed management, mitigation and monitoring measures.

1.6 Consistency with PER Guidelines

Table 1–2 summarises the major requirements of the government PER Guidelines and identifies the section of the PER where the requirement is addressed.

Table 1–2: Consistency with PER Guidelines

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
Development Act requirements	PER	*Development Act 1993*, Section 46C (4)(c)	Executive Summary, Nyrstar Commitments, Chapter 2, Chapter 6, Chapter 8, Chapter 16, Chapter 17, Chapter 18, 4.3.1, 7.6, 11.4, 11.5, 12.4, 12.5, 13.3, 15.4, 15.5,
4.5.1	Summary	Summary of matters set out in the Guidelines	Executive Summary
4.5.2	Introduction	Proposal and background objectives	Chapter 1
		Proponent details	1.1
		Staging and timing	1.2
		Legislative requirements	1.3
		PER process purpose and description	1.4
4.5.3	Need for the proposal	Proposal objectives and environmental standards	Chapter 2
		Expected local, regional and state benefits and costs	Chapters 9, 10
		'Do nothing' option	2.4, 2.5

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
4.5.4	Description of the proposal	Construction, decommissioning and demolition of existing buildings, facility and infrastructure	Chapter 6
		Land tenure and ownership details	5.3
		Site layout plans	Chapter 6
		Construction and commissioning timeframes	6.1
		Description of the existing environment	5.2
		Relevant Development Plan zones	5.3
		Management arrangements for the construction and operational phases	Chapter 16
		Operation of the proposed development	Chapter 6
4.6.1	Assessment of expected environmental, social and economic effects	Assessment of effects	Chapters 9,10, 11, 12, 13, 14, 15
4.6.2	Consistency with government policy	Consistency with the relevant Development Plan and Planning Strategy	Chapter 4
4.6.3	Avoidance, mitigation, management and control of adverse effects	Proponent's commitment	Nyrstar Commitments, Chapter 16
4.7.1	Sources of information	References and authorities consulted	Chapter 3, Chapter 19
4.7.2	Appendices	Technical and additional information relevant to the PER	Chapter 20
4.7.3	Other	Appropriate plans, drawings and elevations	Chapter 6
5.1	Planning and environmental legislation and policies		Chapter 4
5.1.1		Consistency with relevant Development Plan, Planning Strategy and South Australia's Strategic Plan	4.3.7, 4.3.8, 4.3.9, 4.3.10
5.1.2		Environment Protection Act 1993 and licence requirements	4.3.1
5.1.3		Relevant international and national health related policies	4.2.3, 8.2.7
5.1.4		Marine Parks Act and policy requirements	4.3.4
5.1.5		Greenhouse gas and climate change legislation and policy requirements	4.2.4, 4.3.5
5.1.6		Legislative and development approval requirements	4.3.2, 4.3.3
5.1.7		Surrounding community implications	Chapter 9
5.1.8		Other relevant plans or studies	
5.2	Need for the proposal		Chapter 2
5.2.1		Proposal rationale including reasons for proposed location, scale and staging	2.3
5.2.2		The "do nothing" option assessment	2.6, 9.8, 9.7, 10.4, 10.3

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.2.3		Implications for proposal not proceeding and cessation of smelter activities	Chapter 10
5.2.4		Finished product supply and demand	Chapter 10
5.2.5		Justify proposed process technology	6.1
5.3	Effects on communities		Chapter 3, Chapter 9
5.3.1		Community consultation	Chapter 3, 3.2, 3.3
5.3.2		Describe land uses and expected changes and impacts from odour, noise, dust and atmospheric contaminants	5.3, 9.2
5.3.3		Impacts to local and regional marine users	12.2.4, 12.5, 12.6
5.3.4		Construction workforce size, composition, accommodation requirements and employment opportunities	6.3, 10.3.1, 10.5.1
5.3.5		Aboriginal vocational training and employment	9.6
5.3.6		Existing social infrastructure and services impacts	9.7, 14.3.7
5.3.7		Visual amenity impacts	9.4
	Human Health Issues		Chapter 8
5.3.8		Human health impact assessment	8.1, 8.2, 8.3
5.3.9		Emissions air concentrations and their impact in both occupational and residential settings	8.2, 7.3, 7.5, 8.3
5.3.10		Human health issues from maximum likely exposures	8.3
5.3.11		Emissions routes and exposures to populations	8.3.4, 8.3.5, 8.3.9, Chapter 11
5.3.12		Dispersion modelling studies of atmospheric emissions	7.4, 7.5, 7.6
5.3.13		Risk assessment procedures and management plans	Chapter 16, Chapter 18
5.3.14		Air quality and human health monitoring and response procedures	7.2, 7.3, 8.3
	Traffic and Transport		Chapter 14
5.3.15		Traffic and transport implications for construction and operational phases	14.2.1
5.3.16		Infrastructure improvements and predicted transport volumes and frequencies	14.2.1, 14.2.3
5.3.17		Delivery and unloading of construction and operational materials, access arrangements	14.2
5.3.18		Finished product transportation	14.2.2
5.3.19		Safety and transport efficiency options for facility and equipment by rail and road	14.2
5.3.20		Safety and transport efficiency options for export operations at wharf	14.2
5.3.21		Car parking provisions	14.2.1, 14.2.3

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.4	Risk and hazard management		Chapter 16
5.4.1		Measures to prevent further site contamination during construction and operation including potential acid sulphate soils	Chapter 11, 16.1, 16.2, 16.4, 16.5, 18.1
5.4.2		Describe plant operations, start-up and shutdown issues, and the transport, unloading, storage, handling and use of hazardous materials.	6.3, 16.4, 16.5
5.4.3		Risks associated with the unloading, storage and use of hazardous materials	6.4, 16.4, 16.5, Chapter 18
5.4.4		Management and mitigation strategies for spills or leaks	Chapter 11, 16.3
5.4.5		Storage arrangements for hazardous materials and dangerous substances	6.4, 16.4, 16.5
5.4.6		Dangerous substances accident effects on the environment and public health	Chapter 11
5.4.7		Fire or explosion risks and impacts to human health and environment	Chapter 16, Appendix G
5.4.8		Risk zone designation, management and implications for on-site planning and land use	16.2, 16.3, 16.4, 16.5
5.4.9		Seismic risk potential and implications	16.6
5.4.10		Flooding risk, coastal inundation, extreme rainfall events, climate change effects (especially sea level rise)	15.5, Chapter 16, Appendix G
5.4.11		Australian Standard risk assessment	16.2
5.4.12		Risk assessment assumptions, methodologies, data sources and results	16.2, 16.3, 16.7, 16.8 Appendix G
5.4.13		Public safety strategies during construction	6.3.1
5.4.14		Site security (especially for hazardous materials)	6.3.1
5.5	Environmental issues		Chapters 11, 12, 13, 15, 16, 17, 18
	Sustainability and Climate Change		Chapter 15
5.5.1		Proposal's sustainable objectives	15.1
5.5.2		Sustainability design guidelines	15.1
5.5.3		Sustainability audit	15.2
5.5.4		Production process flow diagram	5.4, 6.2.2, 15.3
5.5.5		heat and mass balance	15.3
5.5.6		Waste management strategies for both the construction and operational phases	17.3, 17.4
5.5.7		Treatment and disposal of process wastes	17.2, 17.4
5.5.8		Measures to minimise or reduce materials and resources	6.2.3, 6.2.4, 17.2
5.5.9		Power supply provisions	14.3.3
5.5.10		Alternative energy sources, energy efficiency measures and energy conservation	15.3

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.5.11		Adaptive management strategies for the cumulative effects of climate change	15.4, 15.5
5.5.12		Sources and levels of greenhouse gas emissions from transport and the operation of the plant and infrastructure	15.4, 15.5
5.5.13		Fossil fuel quantities and tonnage of CO2 emitted	15.3
5.5.14		Measures to minimise, reduce and ameliorate greenhouse gas emissions and barriers to implementation	15.3
	Emissions		Chapters 7, 11
5.5.15		Routes and fate of all potential emissions via air, water and soil	Chapter 11, 7.3, 7.4, 7.5, 8.3.4
5.5.16		Dispersion modelling of atmospheric noxious, hazardous or environmentally damaging emissions	Chapter 7, Appendix B, Appendix C
5.5.17		Management of emissions within statutory limits including proposed control measures and the type of equipment to be used and their efficiency	Nyrstar Commitments, Chapter 1, 4.3.1, 6.2, 7.2, 8.3.7
5.5.18		Protecting environmental values for air quality, achieving, monitoring, auditing and managing standards	Chapters 7, 8
5.5.19		List of chemical species and concentrations	Chapters 7, 8
5.5.20		Stockpiles and management to prevent dust generation	6.2.3, 6.2.4, 6.2.5
5.5.21		Noise and vibration sources and predicted levels at sensitive receivers	9.3
5.5.22		Noise emissions and vibration reduction and containment	9.3
	Coastal and Marine		Chapter 12
5.5.23		Ecological assets current levels of disturbance or contamination	12.2
5.5.24		Impacts on the coastal and marine environment and proposed mitigation measures considering changes to surface water flows, groundwater movements/discharges and cooling water discharges	Chapter 11, 12.5
5.5.25		Increased intake and discharge of cooling water requirements and alternative cooling water treatment and discharge methods	12.3
5.5.26		Water quality characteristics for the cooling water discharge receiving environment	12.4, 12.5
5.5.27		Spencer Gulf water temperature and salinity regime with hydrodynamic modelling of the discharge water to quantify the exposure and potential for impacts on sensitive or significant species and communities	12.4, 12.5

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.5.28		Cooling water discharge impacts and mitigation measures on the physical environment	12.5
5.5.29		Cooling water discharge constituents and concentration impacts on the coastal and marine environment	12.5
5.5.30		Entrainment and entrapment of marine organisms and extraction of water from the Port Pirie River estuary	12.5
5.5.31		Deposition impacts of airborne heavy metals, particulates and sulphur dioxide on water quality	12.5
5.5.32		Plankton or algal bloom triggers from discharge, runoff or dust from unloading/loading activities or stockpiles	12.1, 12.4
5.5.33		Construction and operational phase effects on the Upper Spencer Gulf Marine Park	12.4
5.5.34		Shipping activity impacts (vessel movements and anchorage) on the Port Pirie River estuary and the Spencer Gulf, including the values of the Upper Spencer Gulf Marine Park	12.4, 12.5
	Native Vegetation and Native Fauna		Chapter 13
5.5.35		The extent, condition and significance of terrestrial, coastal and marine native vegetation cleared or disturbed during construction or operation and its ability to recover, regenerate or be rehabilitated	13.2, 13.3
5.5.36		Terrestrial, coastal and marine native vegetation clearance and compensation	13.2, 13.3
5.5.37		Extent of fauna and/or habitat loss or disturbance during the construction and operation phases (both on and around site) for threatened or significant species and ecological communities	13.2, 13.3
5.5.38		The effect of noise emissions, vibration and light pollution during construction and operation on terrestrial, coastal and marine native fauna	13.2, 13.3, 9.3, Appendix A
5.5.39		Identify impact avoidance, minimisation and mitigation measures and their effectiveness.	Chapter 16
	Physical Environment		
5.5.40		Existing surface water, groundwater and land related environmental conditions	Chapter 11
5.5.41		Potential changes to hydrology and improvements or stabilisation of current groundwater pollution levels	Chapter 11
5.5.42		Measures to be taken to manage and monitor any surface water and groundwater resources and to mitigate surface and groundwater contamination	Chapter 11

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.5.43		Identify impact avoidance, minimisation and mitigation measures	Chapters 16, 18
	Water		
5.5.44		Provision of adequate water supply including information on the quantity and quality of water required	14.3.1, 15.6, 12.3, 12.5
5.5.45		Approach to water sustainability	15.6
5.5.46		Stormwater runoff and drainage management	14.3.5, 14.3.4
	General		
5.5.47		Performance standards of buildings, structures and plant	Chapters 5, 6
5.5.48		Existing environmental conditions and levels of existing pollutants	5.2
	Management and Monitoring		
5.5.49		Impact management measures on the terrestrial, coastal and marine environment	Chapter 18
5.5.50		Pest management	12.5
5.5.51		Environmental impact management measures	Chapter 18
5.5.52		Construction and operations environmental management and monitoring plans	Appendix J, Appendix K
5.6	Economic Issues		Chapter 10
5.6.1		Economic analysis of the proposal and long-term economic viability of the development.	Chapter 10
5.6.2		Employment and investment opportunities	Chapter 10, 9.6
5.6.3		Potential to attract and enhance business operations of other industries	Chapter 10
5.6.4		Local and regional economic effects of the construction and on-going workforce	Chapter 10, 9.6
5.7	Effects on infrastructure requirements		Chapter 14
5.7.1		Supply requirements for the location of distribution networks for gas, electricity, water, sewerage, stormwater management, communications systems and roads	14.3
5.7.2		Need for upgraded infrastructure beyond the site boundaries	14.2.3
5.7.3		Impact on the existing Port Pirie regional city and need for infrastructure upgrading	14.2.3, 6.2.1
5.7.4		Outline opportunities to incorporate best practice infrastructure design	6.2
5.7.5		Detail emergency services arrangements.	14.3.7
5.8	Construction and operational effects		
5.8.1		Site construction plan and strategies to minimise effects on the local environment	6.2, 6.3
5.8.2		Construction timing.	6.3

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.8.3		Transport and storage of construction materials to minimise effects on the local environment	Appendix J, 14.2
5.8.4		Construction phase traffic mitigation and management measures and the impact on local and arterial roads in terms of road safety, traffic routes and hours of activity	Appendix J, Appendix G, 14.2
5.8.5		Control measures for dust, vibration, noise, litter and other emissions	Appendix J, Appendix K
5.8.6		Chemical storage facilities and plant feedstock stockpiles and materials handling, storage bay design, shed enclosures, bunding, drainage, and the handling and recovery of spills and emergencies	6.2.1, 6.2.3, 11.3.2, 14.3.7
5.8.7		Disposal and management of solid and liquid waste types (especially contaminated waste)	Appendix G, Appendix J, Appendix K
5.8.8		Measures to prevent stormwater and other run-off from affecting the coastal and marine environment	Chapter 11, 14.3.5
5.8.9		Management controls for construction activities to minimise social and environmental impacts	Appendix J, Appendix K, 9.3, 9.4, Appendix B
5.8.10		Adverse impacts from similar industrial plants	Appendix L, 6.3.1
5.8.11		Conduct of existing operations during the construction phase	6.3
5.8.12		Implementation of environmentally acceptable work practices and monitoring programs	Appendix J, Appendix K
5.8.13		Impact monitoring during and after construction, including reporting and auditing measures	Appendix J, Appendix K, Chapter 11
5.8.14		Construction process (including piling process), risk assessment protocols and management measures to prevent migration of existing groundwater contamination	Appendix J, Chapter 11
5.9	Decommissioning and transitional arrangements		
5.9.1		Measures to manage and schedule the removal of contaminated materials	Appendix J, 6.3, 17.3
5.9.2		Transitional arrangements from decommissioning the old plant and commissioning the upgraded and expanded plant	6.3, 6.3.3

Guidelines section number	Guidelines section title	Requirement — summarised from PER Guidelines	Relevant Chapter or Section of PER
5.9.3		Outline likely decommissioning and rehabilitation plans for the site, including timing.	6.3.3
5.10	Native title and cultural heritage		
5.10.1		Indigenous sites of archaeological, anthropological or other significance	9.5
5.10.2		Compliance with the *Aboriginal Heritage Act 1988*	9.5
5.10.3		Native Title issues	9.5
5.10.4		Heritage significance of any known heritage place, on or adjacent the site	9.5

2 Project need, benefits and alternatives

2.1 Introduction

This chapter discusses the need for the Transformation, the benefits that will be achieved and the alternatives that have been considered by Nyrstar.

2.2 Project objectives

The Transformation has the following objectives:

- deliver a step change reduction in air lead and sulphur dioxide emissions leading to a significant improvement in community health
- deliver a significant improvement in environmental performance and a reduced environmental footprint
- reduce carbon intensity
- continue to provide support for community based health and environmental initiatives that raise awareness and improve children's health
- continue to contribute to the economic development of Port Pirie and South Australia.

2.3 Project need

Nyrstar is a major employer in the Port Pirie region and a significant contributor to the South Australian and Australian economies and therefore plays a critical role in contributing to, and enhancing social outcomes within the Port Pirie community. The proposed Transformation will provide more certainty that Nyrstar's contributions in the region and State will be sustained.

The primary aim of the Transformation is to continue to reduce air emissions from the smelter. Nyrstar have worked closely with the Department of Health, the Environment Protection Authority (EPA) and the Port Pirie Regional Council over a number of years to reduce lead exposure in the surrounding community, continually working on upgrading smelter facilities, reducing emissions and implementing exposure reduction initiatives in the community. A recent example of Nyrstar's collaboration with the South Australian Government to reduce emissions impacts on the local community is the *tenforthem* program, described in **Chapter 3**.

2.3.1 Improving air quality

The smelter is the main contributor to reduced air quality in the area, particularly with respect to elevated lead and sulphur dioxide levels. The Transformation will result in significant reductions in air emissions from the smelter through implementation of the best available technology, thus improving air quality as described in **Chapter 7**.

South Australia has enacted the National Environment Protection (Ambient Air Quality) Measure or Air NEPM (NEPC 1998) as the required standard for six common pollutants: carbon monoxide, nitrogen dioxide, ozone, sulphur dioxide, lead and particulate matter as PM_{10}. The Air NEPM sets standards and goals for ambient air quality to protect human health and wellbeing, aesthetic values and local amenity.

The human health effects of lead exposure have been studied for many years (WHO 1995; Bascom *et al.* 1996; Needleman and Bellinger 1991). Lead is absorbed after being ingested or inhaled. It can result in a wide range of biological effects depending on the level and duration of exposure. The toxicity of lead can largely be explained by its interference with enzymes. It is for this reason that lead exposure may result in a range of adverse health effects. Effects at the subcellular level, as well as effects on the overall functioning of the body, range from inhibition of enzymes to the production of marked morphological changes at extreme exposures (WHO 1995).

Over the past 30 to 40 years, smelter owners have collaborated with the Department of Health, the EPA and the Port Pirie Regional Council to decrease lead exposure in the community. Particularly over the last 10 years, smelter upgrades and community exposure reduction initiatives have resulted in a decrease in the number of children with blood lead levels above 10 µg/dL (see **Chapter 8**).

It has been an ongoing priority for Nyrstar to reduce blood lead levels in children in the Port Pirie community. Measures implemented to date have reduced emissions from the facility and community exposure to contemporary and legacy lead. Reduction of blood lead levels has plateaued, and a step change in ongoing emissions from the smelter is required to facilitate the next phase of emission and blood lead reductions.

2.4 Project benefits

The Transformation will deliver significant benefits to the community, including:

- a step change reduction in air lead and sulphur dioxide emissions
- the opportunity for a significant improvement in community health
- improvement in overall environmental performance
- a reduced environmental footprint and lower carbon intensity
- ongoing community based health and environmental initiatives.

These benefits are discussed in detail in **Chapter 6**.

2.5 Collaborative approach

Nyrstar, the South Australian Government and the Commonwealth Government made an in-principle agreement to support the Transformation in December 2012. The support is dependent on completion of a final investment case, including detailed engineering studies, and development approval for the new technology to upgrade the smelter facility.

The development of the business case and investment sources for the Transformation is being managed by a joint South Australian Government-Nyrstar Port Pirie Transformation Steering Committee. Deloitte Access Economics was engaged to determine the likely impacts of the plant closure on the economy of Port Pirie and South Australia. Further information on the socio-economic impacts of the plant closure is provided in **Chapters 9 and 10**.

Nyrstar is committed to the provision of local, regional and state benefits from the Transformation.

2.6 Alternative to the Transformation

If the Transformation does not proceed the only alternative is the 'do nothing' option. Overall, the negative social, environmental and economic impacts to the local community, surrounding regions and South Australia as a whole of this option will be significant. Additionally, the EPA's Environmental Improvement Program (EIP) conditions are unlikely to be met in the long term. This could lead to breaches of the smelter's environmental licence that will necessitate substantial remediation or closure of the smelter, and will likely result in significant financial and operational penalties for Nyrstar which may affect future viability of the facility.

Closing the smelter will have significant negative social, environmental and economic impacts outcomes to the local community, surrounding regions and South Australia as a whole. These outcomes can be summarised as follows:

- loss of approximately AUD$150 million capital costs in private investment and the associated flow-on benefits
- loss of approximately 230 construction jobs and approximately 833 operational jobs
- loss of indirect employment for more than 3,250 people in South Australia
- loss of 50 employment opportunities per year over the next 10 to 15 years
- loss of State revenue from taxes and royalties, including tax generated of approximately AUD$103 million
- loss of Nyrstar's value-add contribution to South Australian Gross State Product (GSP) of approximately AUD$18 million p.a.
- loss of Nyrstar's AUD$1.6 billion contribution to the value of the South Australian economic output, including an average of AUD$755 million in exports per annum
- loss of flow-on economic benefits including:
    - operation of Port Pirie port facilities, which handled 629,375 tonnes of bulk and break bulk freight in 2012
    - investment in social infrastructure, including nine schools, a TAFE campus a hospital and other health care facilities
    - continued health implications to the community from air emissions.

Further information on the socio-economic impacts of the 'do nothing' option and plant closure is provided in **Chapters 9 and 10**.

3 Stakeholder and community engagement

3.1 Introduction

Public consultation for the project is to be consistent with that of a PER level assessment and will include a 30 business day public exhibition of the PER, during which at least one public forum for community feedback and discussion will be held. The following chapter highlights past, current and proposed future stakeholder and community engagement activities by Nyrstar regarding the Transformation.

Background

After 124 years of constant operation, the Nyrstar Port Pirie Smelter has a strong association with the Port Pirie community. The community is extremely supportive of the smelter, and it is not uncommon for generations of the same family to have worked at the smelter over its long and rich history.

Nyrstar is conscious of its social responsibilities to the community and plays a key role contributing to, and improving, social outcomes within Port Pirie. It recognises this responsibility by providing direct and indirect support to a wide range of programs and initiatives, and is proactive in its endeavours to support a broad cross-section of community events and groups that reflect the diversity of the community. Between 2007 and 2012 this support amounted to over AUD $4M.

Additionally Nyrstar has a strong reputation for open engagement and communication with the community and key stakeholders regardless of circumstance or issue. It is committed to building a sustainable future for the smelter by supporting positive engagement with respect to lead for both the community and company.

Specifically, Nyrstar is committed to improving the health of the people in the Port Pirie community and the environment in which it operates. This is particularly evident through its proactive approach to implementing high profile community initiatives such as the initial *tenby10* project (the Port Pirie community blood lead reduction program) which was launched in 2006.

Working in partnership with key South Australian government and regulatory stakeholders, the Port Pirie Regional Council and the local community, the aim of the initial *tenby10* project was to achieve the goal of at least 95% of all children 0 to 4 years of age having a blood lead level of less than 10 micrograms per deciliter (µg/dl). The *tenby10* project aimed to achieve this goal by the end of 2010, and while the original goal was not met, at the end of 2012, up to 77% of children tested had a blood lead level below 10 µg/dl. While improvements have been significant in recent years, the smelter now requires significant transformation to deliver a step change reduction in air lead emissions that will lead to further significant improvement in community health.

Community engagement and key stakeholder ownership of the Port Pirie blood lead reduction program has been the cornerstone of the *tenby10* program's success since its inception in 2006. Since then there have been three community blood lead engagement and awareness campaigns, "tenby10", "tenforthem" and the most recent "thumbs up for low

levels". All three programs have had a strategic methodology, the purpose of which was to assist the community accept and take stronger ownership of environmental health issues that could only be addressed through honesty, openness and a collective, cooperative approach by all stakeholders.

In the 6 years since the first program, there have been a number of positive changes within the community, none more significant than the community's and key stakeholders' acceptance of the issue. This is manifest in their support of and proactive approach to lowering children's blood lead levels in the community or home environment.

The Port Pirie community has embraced the engagement offered to them and it has empowered them to act. The momentum gained as an outcome of this will be a powerful tool in future community engagement programs.

3.2 Objectives

With the announcement in December 2012 that an in-principle agreement had been reached to transform the smelter, it remains critical that the already established community and key stakeholder engagement process is maintained.

During the Transformation, the community must remain proactive in relation to reducing community blood lead levels. Key stakeholders will be continually educated by Nyrstar regarding how the evolving blood lead reduction initiatives are managed. This will be rolled out over the course of the Transformation. Nyrstar will also seek to grow understanding, within the community and with key stakeholders, that in time the risk of exposure from historical lead disposition in the community will also be addressed.

To this end, a Communication and Community Education program is being developed focused on maintaining and, where necessary, raising awareness of the need to reduce children's blood lead levels. In addition, a Targeted Lead Abatement Program (TLAP) has been established to re-scope community blood lead reduction initiatives and consider what further measures would be beneficial beyond those currently implemented. Ongoing communication and engagement will remain a high priority for Nyrstar during the Development Assessment and Transformation process.

3.3 Stakeholder and community engagement plan

Nyrstar has actively engaged key stakeholders on a range of issues regarding its business for a number of years. This has nurtured a sound awareness of the Transformation, as well as the benefits to the smelter, the community and the wider region.

This process initially commenced with dialogue between senior Nyrstar Managers in London and Zurich as early as 2010 with the then SA Premier Mike Rann and other key SA Ministers. Since that time the engagement process has gained momentum, culminating in the establishment of the Port Pirie Steering Committee comprised of Nyrstar, State and Federal Government representatives who oversee the work required to achieve the Transformation.

In parallel with this, Nyrstar has continued to engage with and inform key stakeholders (see **Table 3–1**).

Table 3–1: Consultation summary; in-principle agreement

Date	Agency/Group	Purpose	Location
25/01/2012	SA Government Taskforce, Nyrstar (G. Poynter)	Meeting	Adelaide
31/01/2012	EPA, Nyrstar (G. Poynter)	Briefing	Adelaide
2/02/2012	Nyrstar site employees, R. Junck (Nyrstar CEO)	Briefing	Site (Port Pirie Smelter)
15/02/2012	Department Manufacturing Innovation Trade resources and Energy (DMITRE (L. Piro), Nyrstar (R. Thomas)	Briefing/ Site Tour	Site (Port Pirie Smelter)
21/02/2012	SA Government Taskforce, Nyrstar (G. Poynter)	Meeting	Adelaide
19/03/2012	Shadow Industry & Trade (S. Marshall), Nyrstar (G. Poynter)	Briefing	Adelaide
21/03/2012	SA Government Taskforce, Nyrstar (G. Poynter)	Meeting	Adelaide
3/05/2012	Local Opposition Federal Member Grey (R. Ramsay)	Briefing	Port Pirie
28/05/2012	SA Chamber of Mines and Energy (J. Kuchel)	Briefing	Port Pirie
29/05/2012	Port Pirie Regional Council (CEO, A. Johnson and Mayor B. Vanstone)	Briefing	Port Pirie
21/06/2012	SA Premier (J. Weatherill), Local Member (G. Brock)	Briefing/ Tour	Port Pirie
16/07/2012	Minister Koutsantonis, Minister For Manufacturing Innovation and Trade.	Briefing	Adelaide
17/07/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government Adviser N. Seils	Briefing	Adelaide
18/07/2012	Department Manufacturing Innovation Trade resources and Energy (DMITRE) (P. Heithersay)	Meeting	Adelaide
20/07/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government Adviser N. Seils	Briefing	Adelaide
20/07/2012	Senator (D. Farrell) (Parliamentary Secretary for Sustainability and Urban Water	Meeting	Adelaide
15/08/2012	Department Regional Australia, Local Government, Arts and Sport (DRALGAS)	Meeting	Canberra
15/08/2012	Senator (D. Farrell) Parliamentary Secretary for Sustainability and Urban Water	Meeting	Canberra
15/08/2012	Federal Ministerial Advisers	Meeting	Canberra
16/08/2012	Local Member for Frome (G. Brock)	Meeting	Port Pirie
16/08/2012	Port Pirie Regional Council (CEO, A. Johnson and Mayor B. Vanstone)	Meeting	Port Pirie
12/09/2012	Local Opposition Federal Member Grey (R. Ramsey)	Meeting	Canberra
12/09/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government Adviser N. Seils	Meeting	Canberra
13/09/2012	Department Education and Early Childhood Development (DEECD) (Dr X. Csar)	Meeting	Adelaide
18/09/2012	Minister Koutsantonis Minister For Manufacturing Innovation and Trade.	Meeting	Adelaide
5/10/2012	DMITRE (B. Carter and P. Heithersay)	Meeting	Adelaide

Date	Agency/Group	Purpose	Location
9/10/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government Adviser N. Seils & DEECD (Dr X. Csar)	Meeting	Canberra
25/10/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government and Export Finance Investment Commission (CEO A. Armour)	Meeting	Canberra
26/10/2012	SA Premier (J. Weatherill), and Minister Koutsantonis Minister For Manufacturing Innovation and Trade.	Meeting	Adelaide
6/11/2012	Minister Crean Minister for Regional Australia, Regional Development and Local Government Adviser N. Seils	Briefing	Adelaide
12/11/2012	Senator (D. Farrell) and Local SA Member Frome (G. Brock)	Briefing	Port Pirie
24/11/2012	Bruce Carter and Minister Koutsantonis	Meeting	Adelaide
4/12/2012	SA Premier (J. Weatherill), Minister Koutsantonis, Minister For Manufacturing Innovation and Trade. SA Local Member Frome (G. Brock), Port Pirie Mayor (B. Vanstone)	In Principle Announcement Port Pirie	Adelaide
12/12/2012	EPA & Nyrstar (G. Poynter)	Briefing	Adelaide
24/01/2013	SA Chambers Mines and Energy, Nyrstar (G. Poynter)	Briefing/ Site Tour	Site (Port Pirie Smelter)
24/01/2013	Port Pirie Regional Council (CEO, A. Johnson), Nyrstar (G. Poynter)	Briefing	Port Pirie
1/02/2013	SA/Federal Liberal Party (S. Marshall, M. Williams, V. Chapman, S. Griffiths, A. Pederick, M. Goldsworthy, I. Venning, R. Ramsay, R. Sanderson, K. Jackson, D. van Holst Pellekaan, S. Wade, T. Stephens, J. Lee)	Briefing/ Site Tour	Site (Port Pirie Smelter)
14/02/2013	Department Manufacturing Innovation Trade resources and Energy (DMITRE) and Nyrstar (G. Poynter)	Meeting	Adelaide
7/03/2013	EPA (C. Gemmell), Nyrstar (G. Poynter)	Meeting/ Briefing	Adelaide
19/03/2013	EPA (C. Gemmell), Nyrstar (G. Poynter)	Meeting/ Briefing	Adelaide
23/04/2013	Local Member Frome (G. Brock), R. Brokenshire, Member for Mawson and Nyrstar (G. Poynter)	Briefing	Port Pirie
3/06/2013	CANdo (Community Action Network delivering Outcomes), and Nyrstar (G. Poynter)	Briefing	Port Pirie

3.4 Engagement activities

A range of communication tools have been developed to foster ongoing communication and engagement with the community and key stakeholders. Some of these tools are already in place, while others are in the process of being developed.

Communication tools already developed include:

- Transformation brochure outlining the in-principle agreement, the reasons for the Transformation, basic technical aspects of the smelter redevelopment and positive implications for the smelter and the community
- Transformation website; www.portpirietransformation.com
- subject to the prefeasibility outcome, a Transformation DVD outlining a proposed technical solution for the smelter
- Employee and Community fact sheets, developed leading up to the in-principle agreement announcement in December 2012 to assist key stakeholders understand why the redevelopment of the smelter was critical to the community and Nyrstar
- billboards using images of Port Pirie residents, erected in the community using a key message tagline "for the future we all want"
- media advertisements (print/television)
- employee letters from General Manager, regular all-employee smelter updates regarding the Transformation status and milestones including press releases.

Planned communication and engagement activities include:

- two way engagement — visible presence in the community via shop front in public (high exposure) retail development during the community consultation period. The shop front will be in place between August and September to provide an opportunity for the community and other interested stakeholders to access information about the proposed Transformation
- media (print and television) advertisements promoting the shop front initiative and other community feedback mechanisms
- a scale model of the proposed Transformation will be on display in the community during the consultation period
- new media advertisements (print/television).

3.4.1 Meetings with State and Local Government

Meetings undertaken with the South Australian Government and Local Government post the in-principle agreement announcement are shown in **Table 3–2**.

Table 3–2: PER consultation summary

Date	Agency/Group	Purpose
31/05/2013	Department of Planning, Transport & Infrastructure	Obtain list of agency representatives
11/06/2013	Environment Protection Authority	Discuss PER timeline & summarise key issues
11/06/2013	Nyrstar, CSIRO, BlueSphere, COOE, Arup, CalibreGlobal	Risk Assessment Workshop
12/06/2013	Nyrstar, CSIRO, BlueSphere, COOE, Arup, CalibreGlobal, WQRA	Risk Assessment Workshop
13/06/2013	DEWNR	Discuss PER timeline & summarise key issues
13/06/2013	SA Health	Discuss PER timeline & summarise key issues
17/06/2013	Environment Protection Authority	Review relevant indicative noise levels

17/06/2013	DMITRE	Discuss PER timeline & summarise key issues
17/06/2013	DECD	Discuss PER timeline & summarise key issues
17/06/2013	DEFEEST	Discuss PER timeline & summarise key issues
18/06/2013	PIRSA	Discuss PER timeline & summarise key issues
19/06/2013	DPTI	Discuss PER timeline & summarise key issues
20/06/2013	Flinders Ports	Discuss PER timeline & summarise key issues

3.4.2 Summary of stakeholder issues and responses

Port Pirie community stakeholders have been positive and enthusiastic about the potential Transformation. There is a desire to know more about progress of work done to date and the potential positive impacts the Transformation will bring to the community.

3.5 Engagement following submission of this report

As per **Sections 3.2** and **3.3**, engagement with key stakeholders will be ongoing as the Transformation continues. Pending the development of the Transformation, communication strategy key messages will be developed for stakeholders along with various communication delivery tools and initiatives, in line with those already establish and described in the previous sections.

3.6 Conclusions

Nyrstar has a well-established stakeholder and community engagement program, as demonstrated by the ongoing programs, such as the *thumbs up for low levels* program for reducing blood lead levels in children. Leading up to and during the preparation of this PER the stakeholders including Nyrstar personnel, government staff and the Port Pirie Community have been engaged in the process.

Nyrstar intend to continue their engagement with the community and stakeholders, and will increase activities during the community consultation period to provide the community with a good understanding and an opportunity to comment on the Transformation.

4 Planning and environmental legislation and policies

4.1 Introduction

The proposed Transformation will be governed by a range of Commonwealth, State and local government environmental and health related legislation and policies.

4.2 Commonwealth legislation and policies

A range of Commonwealth environmental and health related legislation is relevant to Nyrstar Port Pirie. The following sections summarise those most relevant to the Transformation and its consistency with them.

4.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

On 19 March 2013 Nyrstar referred the Transformation proposal to the SEWPaC for determination as to whether the proposal was a "controlled action" pursuant to the *Environment and Protection Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act requires proponents proposing an action that may have a significant impact on a matter of national environmental significance (NES) to prepare a submission (known as a referral) to assist the Federal Environment Minister to determine whether the proposal needs to undergo a federal assessment process.

When an activity is referred to SEWPaC, the details of the proposal are reviewed to see whether or not it will have a significant impact on nationally protected matters. Nyrstar referred the Transformation to SEWPaC in early 2013, and after due consideration SEWPaC concluded on 18 April 2013 that the proposal was not a controlled action requiring further assessment and approval under the EPBC Act, as it was not likely to have a significant impact on matters of national environmental significance.

4.2.2 *National Environment Protection Council Act 1994*

The *National Environment Protection Council Act 1994* (NEPC Act) and complementary State and Territory legislation establishes the National Environment Protection Council (NEPC). The NEPC has two primary functions:

- to make National Environmental Protection Measures (NEPMs)
- to assess and report on the implementation and effectiveness of NEPMs in participating jurisdictions.

NEPMs are a set of national objectives designed to assist in protecting or managing particular aspects of the environment. The NEPMs particularly relevant to the operation of the smelter and the Transformation are the NEPM for Ambient Air Quality (Air NEPM) and the National Pollutant Inventory NEPM (NPI NEPM).

The Air NEPM sets national standards for the six key air pollutants to which most Australians are exposed: carbon monoxide, ozone, sulphur dioxide, nitrogen dioxide, lead and particles. All jurisdictions are required to report annually against the air quality standards.

The NPI NEPM provides the framework for the establishment of the NPI, an internet database providing publicly available information on types and quantities of certain substances emitted to air, land, and water.

The transitional provisions of South Australia's *Environment Protection (Miscellaneous) Amendment Act* 2005 implement the NEPMs as Environment Protection Policies (EPPs) in South Australia, administered by the South Australian EPA). Compliance with EPPs is mandated through environmental licences granted to individual industrial premises. Refer to **Section 4.2.1** for further information.

4.2.3 *National Health and Medical Research Council Act 1992*

The *National Health and Medical Research Council Act 1992* (NHMRC Act) establishes the National Health and Medical Research Council (NHMRC) whose activities are designed to:

- raise the standard of individual and public health throughout Australia
- foster the development of consistent health standards between the various States and Territories
- foster medical research and training and public health research and training throughout Australia
- foster consideration of ethical issues relating to health.

The NHMRC Act specifies a rigorous, evidence based approach to developing guidelines by teams of specialists. The guidelines become mandatory only if incorporated within legislation. In the health and medical fields, NHMRC guidelines provide information needed to achieve best practice.

In 2009 the NHMRC published a Public Statement on blood lead levels for Australians (NHMRC 2009a) and stated that:

'The research evidence on the effects of low-level lead exposure — particularly in children and pregnant women — gives no simple answer on what levels are 'safe' or 'of concern'.

In addition the NHMRC released an Information Paper (NHMRC 2009b) regarding lead exposure and health effects in Australia, recommending that:

- all Australians should have a blood lead level below 10 µg/dL
- all children's exposure to lead should be minimised
- all women are advised to minimise their exposure to lead both before and during pregnancy and also while breastfeeding.

Both the Information Paper and Public Statement are currently under review and the outcomes are expected to be made available publicly in late 2013 or early 2014. The recommendations made have not been incorporated in legislation. With respect to the Transformation, the NHMRC's recommendations are compatible with Nyrstar's continual improvement program to reduce blood lead in children and adults working and living in Port Pirie.

4.2.4 *National Greenhouse and Energy Reporting Act 2007*

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) is Commonwealth legislation that provides for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy production and energy consumption. It provides for a single national framework for corporations to report on greenhouse gas emissions, energy use and energy production. Corporations that meet a National Greenhouse and Energy Reporting (NGER) threshold must register and then report each year.

The Clean Energy Regulator administers the NGER Act and the Department of Climate Change and Energy Efficiency is responsible for NGER-related policy development and review. Nyrstar's energy consumption and greenhouse gas emissions for the 2011-12 reporting year are described in **Chapter 15** *Sustainability and Climate Change*. The Transformation will alter the facility's energy consumption and greenhouse gas emissions, and Nyrstar will continue to report in fulfilment of its obligations under the NGER Act.

4.3 South Australian legislation and policies

A range of South Australian legislation affects Nyrstar Port Pirie. Of particular importance is the *Environment Protection Act 1993* (EP Act) and associated policies. These and other legislation relevant to the Transformation are described in the following sections.

4.3.1 *Environment Protection Act 1993*

The EP Act aims to protect the environment, promote principles of ecologically sustainable development and ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment. The EP Act is administered by the EPA and provides for the licencing and control of activities under the EP Act and subordinate policies for noise, air and water quality.

Licencing

Nyrstar operates the smelter in accordance with EPA licence number 775 (Environmental Licence). The Environmental Licence authorises the following environmentally significant activities:

- chemical storage and warehousing facilities
- chemical works: inorganic
- scrap metal recovery
- ferrous and non-ferrous metal melting
- metallurgical works
- waste or recycling depot
- activities producing listed waste
- bulk shipping facility
- crushing, grinding or milling: rock, ores or minerals
- fuel burning: rate of heat release exceeding 5 megawatts
- discharges to marine or inland waters.

In 2008, the EPA integrated Nyrstar's environmental monitoring and reporting obligations, sourced from the conditions of its Environmental Licence, Environmental Improvement Program and a range of other legislative reporting obligations, into a consolidated Environmental Monitoring and Reporting Program (EMRP).

The EMRP requires reporting on the following four areas of anticipated impacts:

- lead (fugitive and process) emissions to air
- sulphur dioxide (process) emissions to air
- wastewater discharge of heavy metals to Spencer Gulf
- contamination of on-site soil and groundwater with heavy metals.

Following negotiations between Nyrstar and the EPA regarding Nyrstar's stated desire to proactively work to reduce TSP lead emissions, in July 2012 the EPA amended Nyrstar's Environmental Licence requiring new actions be implemented within specified timeframes to reduce TSP lead emissions in the near term, and to develop plans for longer term, transformational reductions in emissions. The Transformation represents Nyrstar's proposed plan for fulfilling its environmental obligations in the longer term.

In addition to satisfying its Environmental Licence conditions, the Transformation must meet criteria specified by the EP Act generally, the Air EPP, *Environment Protection (National Pollutant Inventory) Policy 2003*, Water Quality Policy, and the *Environment Protection (Noise) Policy 2007*.

Environment Protection (Air Quality) Policy 1994

The main objective of the Air EPP is to protect air quality and reduce air pollutant emissions. The Air EPP mirrors the emission standards introduced by the Air NEPM. The relevant aspects of the Air EPP are enforced through the Environmental Licence.

The smelter's air emissions are generated primarily from fuel burning and industrial plant operation. The relevant air quality standards relate to lead and sulphur dioxide emissions. The average one year standard for lead is 0.5 µg/m^3, and the average one hour, one day and one year standards for sulphur dioxide are 0.20 ppm, 0.08 ppm and 0.02 ppm respectively.

The SA EPA measures air lead and sulphur dioxide at a number of monitoring stations adjacent to the smelter and within the township of Port Pirie.

It is expected that the Transformation will reduce both air lead and sulphur dioxide emissions and significantly improve the smelter's capacity to meet air quality goals.

During the construction phase, works are required to conform to the air quality criteria specified in Schedule 1 of the Air EPP. Post-Transformation, the smelter will continue to be required to meet the air quality criteria specified in its Environmental Licence (775).

Environment Protection (National Pollutant Inventory) Policy 2003

Mirroring the NPI NEPM, the NPI EPP contains mandatory provisions requiring that businesses must report to the EPA in accordance with the NPI program. The

Transformation will not impact Nyrstar's current reporting obligations under the NPI program, and nor does it create additional obligations.

Environment Protection (Water Quality) Policy 2003

The main objective of the *Water Quality Policy* is to achieve sustainable management of waters by protecting or enhancing water quality while allowing social and economic development.

Water is currently extracted from the Port Pirie River for process cooling purposes. The current water intake is approximately 2 mega litres (ML) per hour and is discharged via the 1M flume to First Creek and Spencer Gulf at a combined rate of 2.62 ML/hr. This volume is likely to increase to facilitate the required smelter upgrade and service the needs of the proposed acid plant. An outfall pipe carrying the additional warm water will be required and may be located within the Port Pirie River or continue discharging to First Creek. Regardless of the location, Nyrstar aims to establish a mixing zone that complies with the *Water Quality Policy*. Criteria for water temperature will be used to guide the outfall pipe design. For the purposes of this development, the change in intake and discharge quantity and quality has been evaluated in **Chapter 12**.

Nyrstar is required to undertake representative daily monitoring of wastewater for metals from its facility at the point of discharge to First Creek (known as 1M Flume) located at the end of the sedimentation basin. The monitoring criteria are specified in the Environmental Licence and include target levels and reporting limits based on a seven day rolling average for arsenic, cadmium, copper, mercury, lead, nickel, selenium and zinc. This monitoring is ongoing and independent of the Transformation.

Environment Protection (Noise) Policy 2007

The *Environment Protection (Noise) Policy* 2007 (Noise EPP) provides a legal framework for the assessment of a wide range of complex noise issues. In general, guidance is provided on the starting point for action (the indicative noise level), and the factors to consider in determining action/s to take. Indicative noise factors during the construction phase of the Transformation and ongoing operation were determined by the EPA on 18 June 2013 and are outlined in **Section 9.3** and **Appendix A**.

4.3.2 *Coast Protection Act 1972*

The *Coast Protection Act 1972* (CP Act) provides for the conservation and protection of the beaches and coast of South Australia. It establishes the Coastal Protection Board (CPB) which manages beaches and the coast through the development and implementation of management plans, provision of funds for protection works and the undertaking of certain works. The Coast Protection Board is a key referral agency in the development assessment process for proposals likely to affect the coastal environment.

Coastline management in the vicinity of the Transformation with respect to the CP Act and CPB is described in **Section 15.5**.

4.3.3 *Harbors and Navigation Act 1993*

The *Harbors and Navigation Act 1993* provides measures for the administration, development and management of harbors and for safe navigation in South Australian waters.

A seabed licence will be required from the Minister for Transport, Planning and Infrastructure prior to the construction of a new caisson within the Port Pirie River. The caisson will provide seawater to cool the new acid production facility. Subject to approval, the caisson (see **Chapter 6**) will be of a similar design, and located adjacent, to the existing caisson.

4.3.4 *Marine Parks Act 2007*

The *Marine Parks Act 2007* (MP Act) establishes marine park boundaries, and seeks to protect and conserve marine biological diversity and marine habitats via management guidelines created for each marine park.

The South Australian Upper Spencer Gulf Marine Park occurs north of the coast adjacent to the smelter and encompasses an area from Port Jarrold and Cowleds Landing until Port Augusta with the exception of the ports of Port Pirie and Whyalla. Zones and activities, guidelines, and the management of day-to-day issues are contained within the *Upper Spencer Gulf Marine Park Management Plan* (2012) (see **Section 5.2.3**).

The Transformation is adjacent to the Special Purpose Area-2 Harbor of Port Pirie. A *special purpose area* is a zone within a marine park in which specified activities that would otherwise be prohibited or restricted under the zoning of the area are permitted under the management plan. The activities permitted in the special purpose areas are those related to maintaining or improving a harbor or port, undertaken by or on behalf of the Minister responsible for the administration of the *Harbors and Navigation Act 1993*, or a port operator.

The Transformation will be compatible with the activities allowed within Special Purpose Area-2 Harbor of Port Pirie. The potential for significant ecological impact from the Transformation to the Special Purpose Area-2 Harbor of Port Pirie with the Upper Spencer Gulf Marine Park is negligible. Ongoing consideration will be given to the relevant management strategies for the Upper Spencer Gulf Marine Park during the construction and operation phases of the project.

4.3.5 *Climate Change and Greenhouse Emissions Reduction Act 2007*

The *Climate Change and Greenhouse Emissions Reduction Act 2007* (CCGER Act) sets targets to reduce greenhouse gas emissions within the State with a view to achievement of a sustainable future. The CCGER encourages the use of renewable energy sources, promotes business and community understanding of climate change, and facilitates the early development of policies and programs to address climate change.

As described in **Chapter 15**, conservative estimates indicate the Transformation will reduce carbon intensity compared with current operations. If incorporated in the final design, recovery of energy from the smelting process through cogeneration will further reduce the facility's carbon footprint.

4.3.6 *Aboriginal Heritage Act 1988*

The Aboriginal Heritage Act 1998 (AB Act) provides protection for Aboriginal objects, remains and sites of spiritual, archaeological, anthropological and historical significance. The AH Act contains provisions for traditional owners to determine the significance of land or object to Aboriginal people.

Discovery of any Aboriginal objects or sites are to be reported to the Minister for Aboriginal Affairs and Reconciliation as soon as practicable. If destruction, disturbance or interference with a registered site is required, an application must be submitted to the Minister under the AH Act.

Prior to finalising its works program, Nyrstar will conduct searches of indigenous heritage registers, held by the Aboriginal Affairs and Reconciliation Division (AARD) of the Department of Premier and Cabinet, to enable the protection of recorded items of historical cultural heritage. Further details regarding Nyrstar's mitigation measures to protect and minimise any potential effects on cultural heritage are described in **Section 9.5**.

4.3.7 *Native Title (South Australia) Act 1994*

The *Native Title (South Australia) Act 1994* (NT Act) is complementary to that of the *Commonwealth Native Title Act 1993*. The NT Act recognises that some Indigenous people have rights and interests in their land that are based in their traditional laws and customs. It establishes a framework whereby Indigenous Australians can lodge claims for recognition of native title. A South Australian register of native title claims is held and the assessment process for the assessment of claims is established. The NT Act also validates past acts of government which may extinguish or impact upon the existence of native title.

The Transformation area is within the territory of the Nukunu People. The Nukunu People's land runs from north of the Hummocks in the south to the southern Flinders Ranges. The smelter falls within the area of the Nukunu People's Native Title Claim (SC96-5) which has been accepted for registration by the Native Title Tribunal, and which is yet to be determined by the Federal Court. The smelter is located on privately owned land and on which Native Title has been extinguished. Further details regarding native title and the Transformation are described in **Section 9.5**.

South Australia's Greenhouse Strategy

South Australia's Greenhouse Strategy, *Tackling Climate Change*, is a framework for South Australia's greenhouse targets and commitments. It outlines South Australia's planned response to climate change and includes six sectors: community; industry; energy; transport and planning; buildings; and natural resources.

For each of the six sectors, the Greenhouse Strategy describes three pathways for the future; reducing greenhouse emissions, adapting to climate change, and innovating in markets, technologies, institutions and the way South Australian's live.

The Greenhouse Strategy aims for South Australia's industry to be a leader in managing greenhouse gas emissions and tackling climate change. The goal for the Industry sector is to be a leader in managing greenhouse emissions and tackling climate change. Strategies

include managing business risks, reducing greenhouse gas emissions while driving and enhancing business competitiveness, targeting commercial opportunities and developing products and services of the future.

The Transformation will reduce greenhouse emissions per tonne of production via improved furnace design, sulphur dioxide capture and acid production, and potentially by installation of a cogeneration facility for heat recovery and electricity generation (if incorporated in final design).

Issues concerning sustainability and climate change are dealt with in **Chapter 15** and the management of hazards and risks, particularly from climate change, are described in **Chapter 16**.

4.3.8 *Development Act 1993*

The *Development Act 1993* (Development Act) and associated *Development Regulations 2008* (Development Regulations) set out the procedures by which different forms of development are assessed in South Australia. Part 4 of the Development Act lays out development assessment processes for major developments (Section 46 in particular).

On 26 February 2013 the Minister for Planning declared the Transformation to be a Major Development. The level of assessment required under Section 46 for the Transformation is a Public Environment Report (PER). Further details of the PER assessment and approval process are provided in **Chapter 1**.

On 28 February 2013 The South Australian Government Gazette published a Notice for the Transformation:

SCHEDULE 1
Specified Kinds of Development

Development associated with the upgrading and redevelopment of the existing Port Pirie Smelter Operations, including any or all of the following elements:

(a) upgrading and redevelopment of the current Sintering, Blast Furnace, Acid Making Operations and associated infrastructure and equipment, including construction and operation of:
    i. a new Stage 1 Enclosed Bath Smelting Facility (to replace the current Sinter Plant);
    ii. a new Stage 1 Oxygen Plant Facility;
    iii. a new Stage 2 Enclosed Bath Smelting Facility (to replace the existing Blast Furnace);
    iv. a new Sulphur Capture (Acid Plant) System (to replace the existing Acid Plant);
    v. the current 'intermediate materials storage area';
    vi. storage areas for mineral concentrate and raw materials;
    vii. an upgraded sea water intake cooling system; and
    viii. associated earthworks.

(b) all activities and works associated with the decommissioning or demolition of the existing Sintering Plant, Blast Furnace and Acid Making Operations and associated infrastructure and equipment;
(c) the undertaking of works for the purposes of, otherwise related to, railway lines, roads, parking, stormwater, water supply, power supply, telecommunications and effluent treatment in connection with any development whether undertaken within the site specified in Schedule 2 or on other adjoining or adjacent land;
(d) the excavation or filling, or the excavation and filling, of any land, or the formation of land for allotments;
(e) any related or ancillary development associated with development within the ambit of preceding paragraphs; and
(f) any change in the use of land associated with any development within the ambit of preceding paragraphs,

but excluding repairs or maintenance works in connection with the existing plant, facilities or machinery.

SCHEDULE 2
Specified Part of the State

The following part of the state is specified for the purposes of Schedule 1:

(a) section 637, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5689, Folio 260;
(b) section 638, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5689, Folio 260;
(c) section 1145, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5832, Folio 215;
(d) lot 1 in Deposited Plan 23903, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5372, Folio 307;
(e) lot 2 in Deposited Plan 23903, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5372, Folio 141;
(f) lot 10 in Deposited Plan 24051, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5133, Folio 522;
(g) lot 50 in Deposited Plan 12528, Hundred of Pirie, comprised in Certificate of Title Register Book Volume 5980, Folio 48;
(h) lot 93-96 in Filed Plan 213879, Hundred of Pirie, comprised in Certificate of Title Volume 5688, Folio 689;
(i) lot 201 in Deposited Plan 57808, Hundred of Pirie, comprised in Certificate of Title Volume 5689, Folio 260;
(j) lot 303 in Deposited Plan 67822, Hundred of Pirie, comprised in Certificate of Title Volume 5980, Folio 64;
(k) lot 307 in Deposited Plan 67822, Hundred of Pirie, comprised in Certificate of Title Volume 5980, Folio 64;
(l) section 1141, Hundred of Pirie, Crown Record comprised in Certificate of Title Volume 5769, Folio 760; and

(m) section 1069, Hundred of Pirie, Crown Lease comprised in Certificate of Title Volume 1611, Folio 88.

In addition to the legislative framework provided by the Development Act and Regulations, South Australia's land use planning and development system is informed by South Australia's Strategic Plan, the Strategic Infrastructure Plan for South Australia, and the South Australian Planning Strategy. Each of these components is described in the context of the Transformation in the following sections.

4.3.9 Port Pirie Smelting Facility (Lead-In-Air Concentrations) Bill 2013

The Port Pirie Smelting Facility (Lead-In-Air Concentrations) Bill 2013 was tabled in South Australia's parliament on 6 June 2013. It was created to provide regulatory certainty for Nyrstar and thus attract the investment necessary for the Transformation.

The focus of the Bill is on providing for a process to vary the lead-in-air condition contained in its EPA licence. For a period of 10 years following the date on which the EPA sets the maximum lead-in-air condition in the operating EPA licence for the completed project, the EPA may not vary that condition except in circumstances where the variation has been either approved by the Manufacturing Minister or where the company has consented to the variation. Outside of that 10 year period, the EPA can change the limits as it considers necessary.

If air lead limits are proposed to change, the Manufacturing Minister must consult the Environment Minister and consider written submissions, recent medical and scientific advances and international standards. The Manufacturing Minister must also consider the impacts of the proposed change on the Port Pirie community and on Nyrstar's operations.

4.3.10 South Australia's Strategic Plan

Overall, the Transformation will significantly reduce air emissions which aligns with one of the South Australian Premier's seven strategic priorities — 'every chance for every child' — which concentrates government efforts to improve health outcomes for children, particularly in the first five years of life.

South Australia's Strategic Plan recognises the importance of economic growth to the state. It identifies Nyrstar Port Pirie as being one of the principal industries in the region. The Plan also recognises the strategic capacity of Port Pirie's berthing facilities to handle grain, fertilizer, metal ores and concentrates and some containerised cargo. Nyrstar sub-leases the port for exclusive berth use from Flinders Ports Corporation. The Strategic Plan identifies Port Pirie as a regional centre undergoing growth in industrial development, which would require a proportional increase in housing availability.

The Transformation is a significant infrastructure development that contributes towards the State's objectives. The following describes the contribution the Transformation will make to targets established by South Australia's Strategic Plan.

- Target 35: Economic growth — Exceed the national economic growth rate over the period to 2020

Nyrstar is critically important to Port Pirie's economic landscape, and contributes significantly to the State's economy. Economic modelling indicates that in 2022, Nyrstar Port Pirie will be contributing $524 million or 0.46% to South Australia's Gross State Product (GSP). The smelter's contribution to GSP assists South Australia to meet this economic growth target.

- Target 37: Total Exports — Increase the value of South Australia's export income to $25 billion by 2020

  The current value of smelter production is estimated to be $1 billion. A significant proportion of Nyrstar's Port Pirie production, now and post-Transformation, is destined for international markets, supporting South Australia's export targets.

- Target 38: Business investment — Exceed Australia's ratio of business investment as a percentage of the economy by 2014 and maintain thereafter (baseline: 2002-03)

  Nyrstar's investment in the Transformation supports South Australia's business investment target, and secures long term viability for a regional industry and future investment.

- Target 45: Total population — Increase South Australia's population to 2 million by 2027 (baseline: 2003)

  Maintaining existing population levels within regional South Australian communities through the provision and encouragement of regional development can contribute to sustained population growth. The Transformation will support South Australia's population target by retaining a viable industry in a key regional centre, providing a local economy with the stability needed to support communities and perpetuate population growth.

- Target 46: Regional population levels — Increase regional populations outside of Greater Adelaide by 20,000 to 30,000 or more by 2020 (baseline: 2010)

  The Transformation will support South Australia's regional population targets by retaining an industry in a regional centre, assisting to mitigate negative population growth. Retention of viable industry provides the basis for further growth in the region through a stable local economy.

- Target 47: Jobs — Increase employment by 2% each year from 2010 to 2016 (baseline: 2010)

  The Transformed Port Pirie Smelter will employ a similar number of personnel to its current operations. This supports South Australia's employment targets by maintaining stable employment rates at the smelter. As the principal employer in the region, maintaining a stable workforce supports the community's economic and employment growth prospects.

- Target 56: Strategic infrastructure — Ensure the provision of key economic and social infrastructure accommodates population growth (baseline: 2010-11)

Provision of utilities, education and health services are determined by population size and stability. The Transformation will support a stable population size and local economy, justifying continued investment in social and economic infrastructure.

4.3.11 State Infrastructure Plan

The key purpose of the Strategic Infrastructure Plan (2005) is to guide new public and private sector infrastructure investment over the next five to ten years and improve the management and use of South Australia's existing assets. The South Australian government is currently updating the Strategic Investment Plan (2004/5 to 2015/15) to provide state-wide direction on investment priorities and integrate infrastructure planning and delivery by government and the private sector.

Port Pirie is addressed in the Strategic Infrastructure Plan (2004/5 to 2014/15) (the Strategic Infrastructure Plan) under the Upper Spencer Gulf and Outback Regional Overview. The Upper Spencer Gulf and Outback Regional Overview identifies the drivers for major infrastructure developments in the region to be related to mining and mineral processing through private sector investment.

The Transformation will consolidate Nyrstar Port Pirie's contribution toward the State Infrastructure Plan by directing private investment into infrastructure. This will have both direct and indirect impacts to the security and sustainability of investment into public infrastructure in the region. These economic impacts are further discussed in **Chapter 10** *Effects on the Economy*.

4.3.12 Planning Strategy for Mid North Region

Under Section 22 of the Development Act, the Minister for Urban Development and Planning is assigned responsibility for preparing the Planning Strategy on behalf of the State Government. The Planning Strategy is a non-statutory document that provides direction for the State Government on land use and development in South Australia in the medium term. The document is comprised of a number of volumes covering different geographic regions of the state.

The Mid North Region Plan (MNRP) guides future land use and development in one of seven regions defined by the South Australian Planning Strategy.

According to the MNRP, Port Pirie is recognised as being the major commercial and service centre of the region, containing 33% of the Mid North Region's population. Furthermore, it identifies the smelter as a significant contributor to Port Pirie and the regional economy.

The key goals of the MNRP include the retention of "a highly skilled and flexible workforce to ensure a strong economic base" for the region. The attraction of industry is also a key goal where the existing infrastructure, such as electricity, gas, roads, rail and shipping infrastructure, is sufficient to enable growth.

The MNRP provides an integrated vision for the region which includes industrial investment, specifically the corridor between Port Pirie and the inland community of Peterborough. A priority is to build on the industrial focus of Port Pirie and identify appropriate sites. Other

visions look to manage the region's population or strengthen towns with a focus on centres such as Port Pirie and Peterborough.

The MNRP recognises the seaport and associated bulk handling facilities at Port Pirie. Its *Policy 5.1* encourages industry clusters in strategic locations to maximise transport efficiencies and support industry development.

The Transformation is in line with the MNRP's objectives and direction to strengthen the regional economic base.

4.3.13 Port Pirie Regional Council Development Plan

The Port Pirie Regional Council Development Plan (PPRCDP) was consolidated 10 January 2013 having been first gazetted on 29 August 2002. As the primary regional planning scheme, this plan and its relationship to the Transformation are discussed in detail in **Chapter 5**, the overview of the existing smelter.

5 Overview of existing smelter and operations

5.1 Introduction

The smelter occupies approximately 180 hectares of land and is located 225 km north of Adelaide on the east coast of the Spencer Gulf (**Figure 5-1**). The smelter lies to the west of the Port Pirie River and within 1 km of Port Pirie city, which includes a range of retail, health, education, commercial and industrial activities.

The land immediately to the south and southwest of the smelter is a mixture of low-density housing, vacant public purpose land, and land used for commercial and industrial purposes. The major residential areas are on the southern and western side of the city centre, with the nearest residential property to the smelter approximately 200 m from the western boundary of the smelter. The smelter is surrounded to the north by low-lying samphire flats.

The Port Pirie Regional Council is the relevant local authority that governs the surrounding 178,281 hectares of land. Port Pirie currently has a population of approximately 14,000 people and the town's economy relies heavily on the smelter.

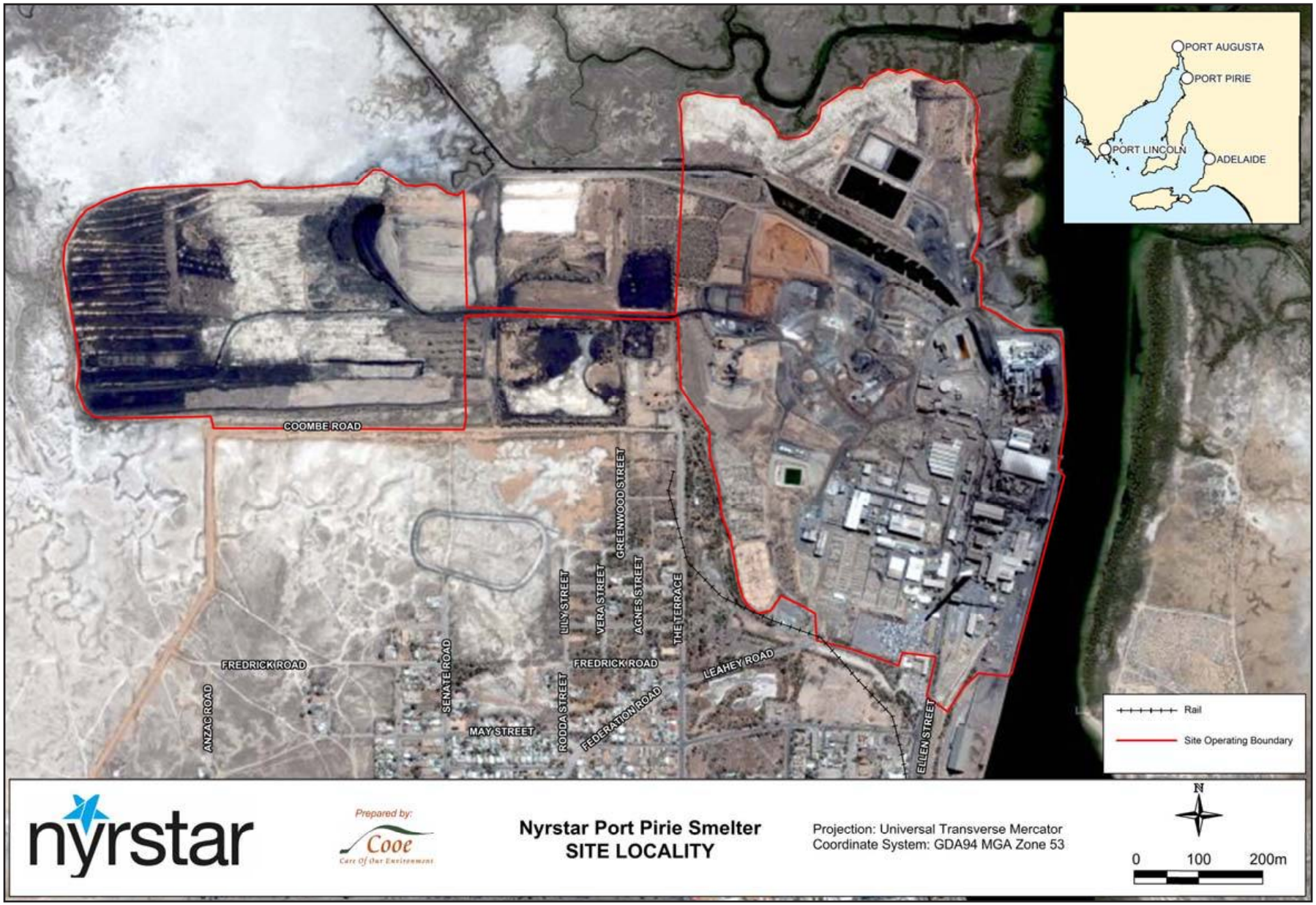

Figure 5-1: Smelter location

Overview

The smelter began operations in 1889, processing lead and zinc ore from mines in Broken Hill. The smelter has been in constant operation since, with plant infrastructure increasing over time to the current day, where it occupies approximately one third of the smelter.

The Nyrstar Port Pirie operation comprises a lead smelter and refinery, an acid plant, a precious metals refinery, a copper plant and a zinc plant. Other facilities on the smelter include administrative and hygiene facilities, workshops, open and enclosed storage areas, power plants, recycling facilities and rehabilitation areas, as well as car parking and recycling facilities. A dedicated port facility and wharf is located on the eastern boundary of the smelter in the Port Pirie River (**Figure 5-2**). A prominent feature of the smelter is 11.2 ha of land dedicated to the storage of sinter in open intermediate storage areas. The process of making sinter and intermediate materials and smelting is described in **Section 5.4**.

The existing updraft sinter machine was commissioned in 1956; however it is now considered to be past its operating efficiency and requires replacement. Updraft sintering involves a high temperature, pressure forced process, coupled with a suction of lead laden off-gases to gas cleaning and sulphur capture, and the tall stack baghouse system. The plant consists of numerous open conveyors and dry crushing rolls that give rise to substantial fugitive dust sources due to physical inability to draft all process stages.

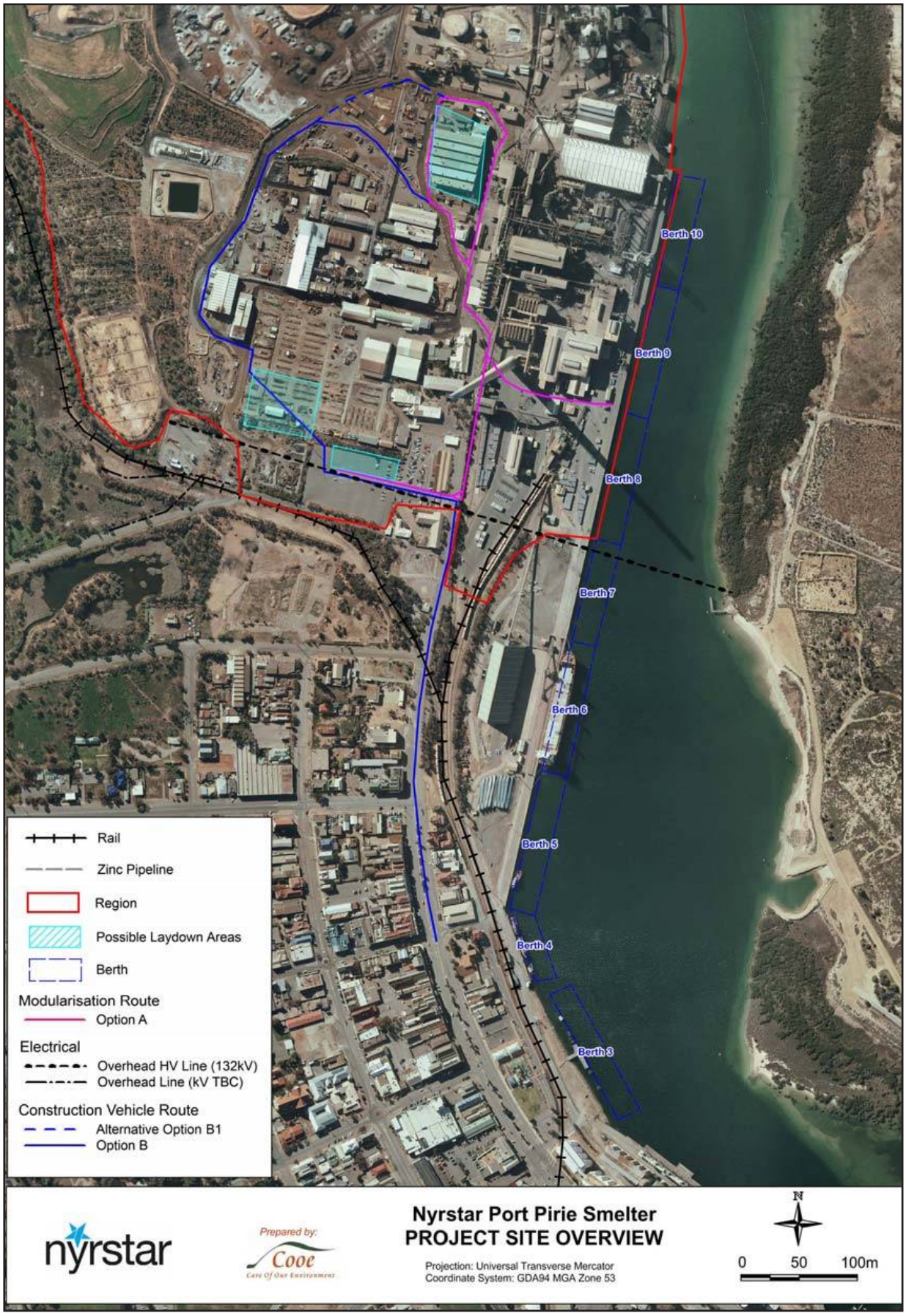

Figure 5-2: Smelter overview

5.2 Existing Environment

The following sections describe the physical and biogeographical features of the local environment within and adjacent to Nyrstar Port Pirie.

5.2.1 Climate

Port Pirie has a semi-arid climate characterised by hot summers and mild winters. Rainfall is relatively evenly distributed with slightly higher rainfall during the winter months.

Rainfall data from the Port Pirie Nyrstar Comparison Site (Bureau of Meteorology (BoM) site number 021043) and evaporation data from Whyalla (BoM site number 018120) have been used to establish the mean monthly rainfall, total annual rainfall, and excess of evaporation over rainfall for the region. Based on monthly rainfall from records between 1877 and May 2011, the mean total annual rainfall for the site is 345.7 mm, with annual rainfall over the last twenty years ranging from 207.6 mm (1994) and 617.1 mm (1992). Based on the mean monthly rainfall at the smelter, the wettest month of the year is June (rainfall average of 40.7 mm) and the driest month is February (rainfall average of 17.9 mm).

The highest mean monthly evaporation occurs in January (average of 347.2 mm) and the least mean monthly evaporation occurs during June and July (average of 93 mm).

5.2.2 Topography and geomorphology

The township of Port Pirie is located on the Port Pirie River estuary, a meandering tidal river system traversing a wide expanse of flat and low lying intertidal and supratidal flats comprised of geologically-recent alluvium.

The natural geomorphology of the smelter was relatively flat, low lying and intertidal in many places, traversed by rivulets and streams. These saline flats, which are still present to the north and west of the smelter, are generally referred to as samphire flats, owing to the dominant vegetation type that has colonised the hypersaline marine margin in the region.

Smelter topography has been highly modified by ongoing smelter activities. Fill material has been placed to various depths across the smelter and in parts of Port Pirie and adjacent industrial facilities. Parts of the western bank of Port Pirie River have been reclaimed in the past.

The eastern portion of the smelter, adjacent to the Port Pirie River, consists of a wharf and extensive operational areas underlain by a hard stand, and is therefore relatively flat, with an elevation of approximately 3.5 m Australian Height Datum (AHD).

To the west of the plant area, the smelter is dominated by the intermediate storage area, a large unsealed area used for storing a wide variety of in-process and waste materials. This area is founded on slag material and has a history of slag deposition and re-excavation, materials storage and rehabilitation. This portion of the smelter is considerably more undulating, with a total vertical relief of approximately 12 m, ranging from approximately 2 m AHD to 14 m AHD. Topographically, this portion of the smelter is dominated by the amphitheatre wall, an elevated area of residual poured slag (**Figure 5-3** and **Table 5–1**).

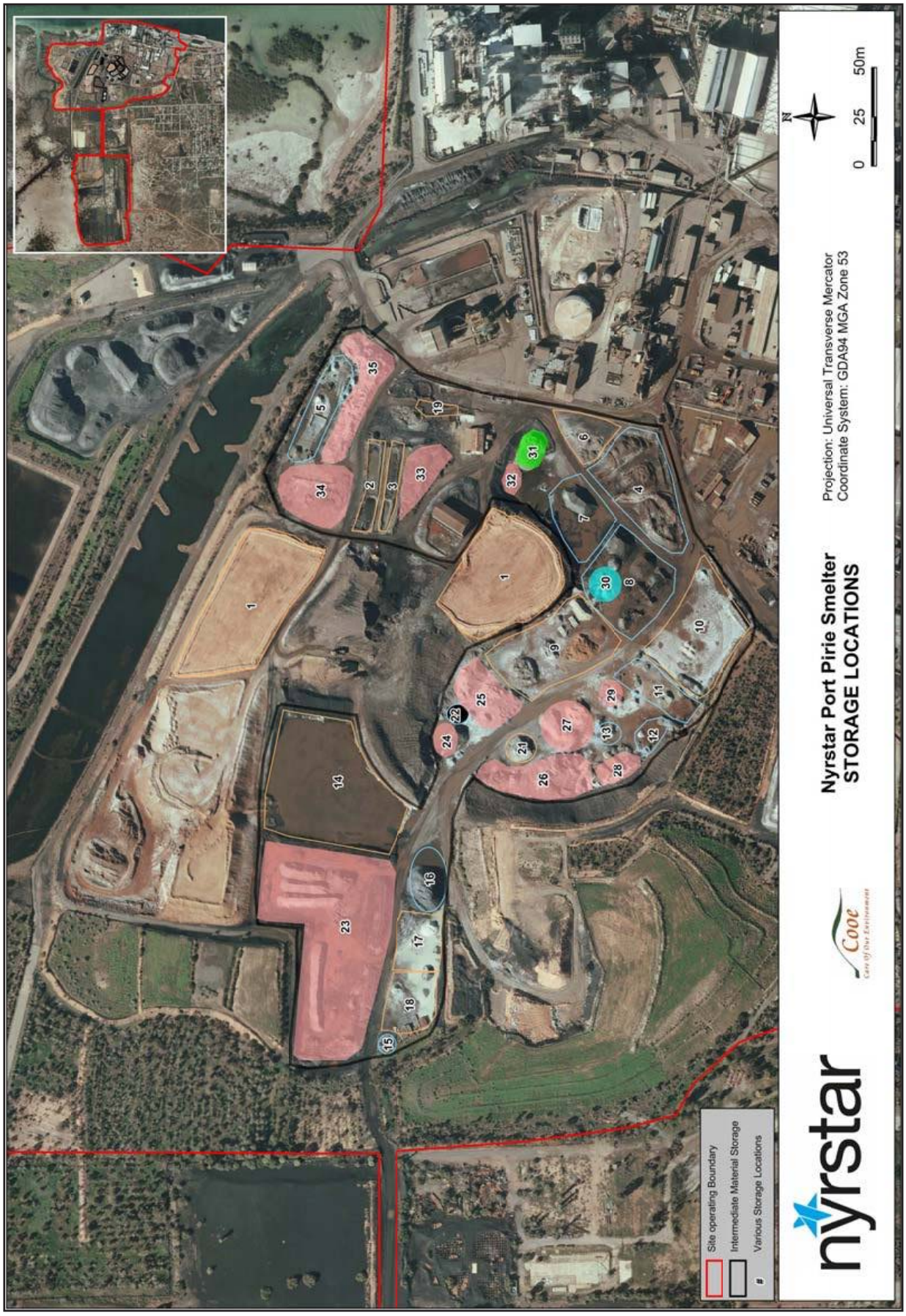

Figure 5-3: Intermediate materials and sinter storage location

Table 5–1: Legend intermediate storage area for Figure 5-3

Polygon #	Area ID
1	Revegetation area
2	Baghouse sludge stage 1
3	Baghouse sludge stage 2
4	EAF dust
5	Copper matte area
6	Softener slag
7	Saved slag & underflow
8	Rich slag mixing area
9	Residue mixing
10	Sinter pad
11	Zinc dross
12	Skull slag
13	Copper dross
14	Evaporation lake
15	Coke (high reactivity)
16	Coke & coal
17	Lime sand & grits
18	Wray
19	Truck wash residue
21	Williams ore
22	CDF slag
23	Low grade returns
24	PETS sludge
25	Andritz
26	Returns
27	Andritz
28	Refinery dross
29	Scrap lead
30	Boiler ash
31	Hobart brickbats
32	SRF slag
33	Baghouse sludge stage 3
34	Sludge drying & screening
35	SRF slag

To the north west of the smelter the topography is dominated by a broad rectangular deposit of granulated slag approximately 60 ha in aerial extent with a typical height above the natural samphire surface of approximately 3 to 4 m, extending to approximately 10 m high in the north east corner of this facility.

5.2.3 Coastal features and marine

Port Pirie is located approximately 8 km inland from Spencer Gulf on the Port Pirie River. The smelter is located to the north of the city of Port Pirie on the eastern shore of the Port Pirie River, a tidal saltwater inlet from Spencer Gulf.

The Port Pirie River estuary area, located to the north and east of the smelter is classed as a tidal flat or tidal creek. It is in an extensively modified condition and covers an area of 14.65 km². The Port Pirie region, including the Spencer Gulf and Port Pirie River, has a semi-diurnal tidal cycle (BoM 2011), such that there are two high tides and two low tides in a typical day and a relatively large diurnal inequality, where the two high tides (and two low tides) differ in height. The tidal range is moderate with an extreme spring tidal range of 3.44 m (AGSO 1998). A more typical maximum daily tidal range would be of the order of 2.5 m (BOM 2011), with a mean low tide of approximately -1.3 m AHD, and a mean high tide of approximately +1.2 m AHD. Port Pirie Chart Datum (0 m CD) is equivalent to -1.933 m AHD. This region experiences what is locally called a dodge tide, this occurs during a neap tide, with minimal rise and fall over the course of a day or two.

The South Australian Upper Spencer Gulf Marine Park is located adjacent to the coast to the west of the smelter, and encompasses an area from Jarrold Point to Cowleds Landing in the south to Port Augusta in the north. The port of Port Pirie is zoned within the marine park as Special Purpose Area-2 Harbor of Port Pirie. The potential for significant ecological change from the Transformation within the zone is negligible. **Figure 5-4** displays areas of marine and coastal protection proximate to the smelter.

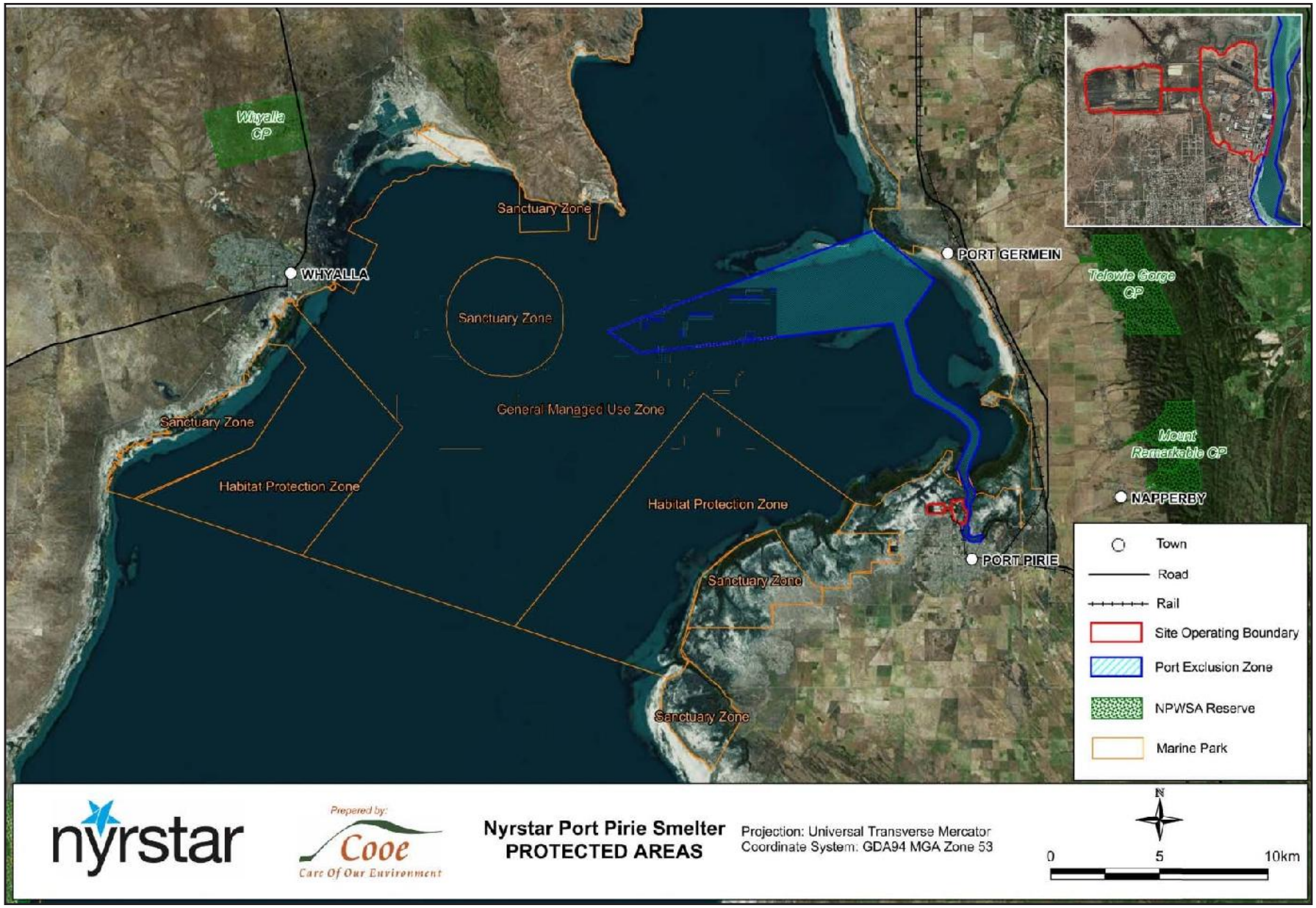

Figure 5-4: Protected areas within project vicinity

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5.2.4 Native vegetation and fauna

The Port Pirie River estuary consists of saltmarshes, mangroves, intertidal mudflats and seagrass communities. The dominant floral species include samphire (*Halosarcia pergranulata*), common sea-heath (*Frankenia pauciflora* var. *gunnii*), bindyi (*Sclerostegia* spp.) and saltbush (*Atriplex* spp.) species. In parts, the edges of the estuary are dominated by mangrove (*Avicennia marina* var. *resinifera*) communities (EBS 2004). It is an important site for seabirds and provides habitat for some commercial fish and crustacean species, such as King George whiting, Southern Sea garfish and Blue Swimmer crab (DEH 2007).

The smelter is located within the broader Hundred of Pirie that has been extensively cleared for farming and industrial purposes. There is approximately 5% of remnant vegetation within this Hundred (DEH 2002). The smelter itself is highly modified and there is no significant remnant vegetation. There are scattered amenity plantings and revegetation areas located within the smelter's boundary. However, these have no conservation significance (EBS 2004).

A Biological Databases of South Australia (BDSA) species search was undertaken within a 50 km buffer of the smelter (**Figure 5-5**). One flora species was previously recorded on the northern part of the project but, given its highly modified state is, unlikely to be present. It is Nyrstar's intention to remediate this area as part of the Transformation. The location of a Green Turtle in **Figure 5-5** reported by the biological data is highly unlikely because the Green Turtle (*Chelonia mydas*) is a marine species that lives in seagrass rich coral reefs in tropical and sub-tropical environments.

In addition to a consideration of state protected species, an EBPC Act Protected Matters search was conducted within a 10 km buffer of the smelter as part of the Development Application (Parsons Brinckerhoff, 2013). Twenty nine threatened species, one threatened ecological community and 39 migratory species were identified as potentially occurring within the search area. After due consideration by SEWPaC none were deemed to be impacted by the Transformation and the development did not require further consideration under the EPBC Act (**Section 4.1.1**).

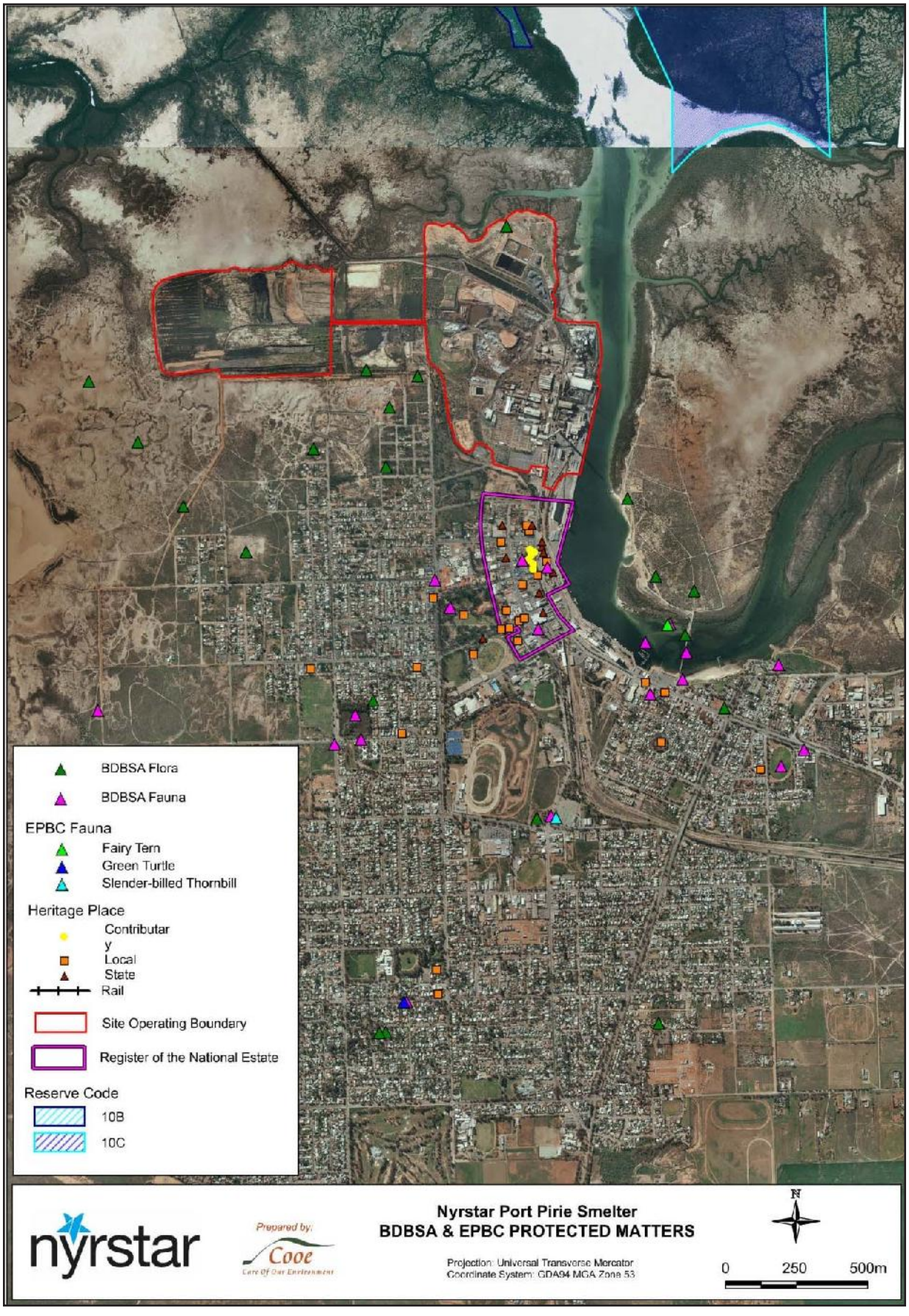


Figure 5-5: BDBSA & EPBC protected matters search

5.2.5 Soil, groundwater and surface water

The natural geomorphology of the smelter would have been a meandering tidal river system traversing a wide expanse of flat and low lying intertidal and supratidal samphire flats. It would have comprised of recent alluvium, traversed by rivulets and streams derived largely from groundwater discharge, and periodic tidal inundation and drainage.

Over time, slag has been deposited to various depths across the entire smelter, in parts of Port Pirie and on adjacent industrial facilities. Slag and other fill were used to reclaim parts of the western bank of the Port Pirie River.

The long history of industrial activity at the smelter has resulted in contamination of the subsurface environment.

The smelter is situated in a basin of sediments overlying basement rock. The basement geology is comprised of metasediments including feldspathic quartzites and shales, interbedded with dolomitic shales and limestone (Martin *et al.* 1998). The basement rocks outcrop in the eastern Mount Lofty and Flinders Ranges and are buried by more than 150 m of sediment in the vicinity of the smelter (Martin *et al.* 1998).

The Tertiary age geological sequence is reported to be composed largely of sands, sandy clays and clays (Geological Survey of South Australia 1964). The overlying Quaternary sequence is reported to contain a basal sequence comprised of sands, gravels and calcrete up to 20 m in thickness, which is overlain by a thick sequence (~80 m) of Hindmarsh Clay (Martin *et al.* 1998).

The Hindmarsh Clay is overlain in the Port Pirie region by Holocene-aged estuarine/coastal and aeolian derived clays, silts and sands mainly of the St Kilda Formation, the upper surface of which is composed of Samphire Clay flats and marshes (Geological Survey of South Australia 1964).

Generally, groundwater flows from the ranges to the sea where groundwater discharge occurs.

5.2.6 Air quality

Air quality in Port Pirie is influenced by the pattern of wind directions and the smelter located at the northern end of the town. Winds are predominantly (70% of the time) from directions that transport smelter emissions away from the town (**Figure 5-6**). For winds where the smelter is upwind from the town, the winds are principally from the NNW sector (15–20% of the time between N and NW) with a smaller fraction from the NE sector (10% of the time between N and E).

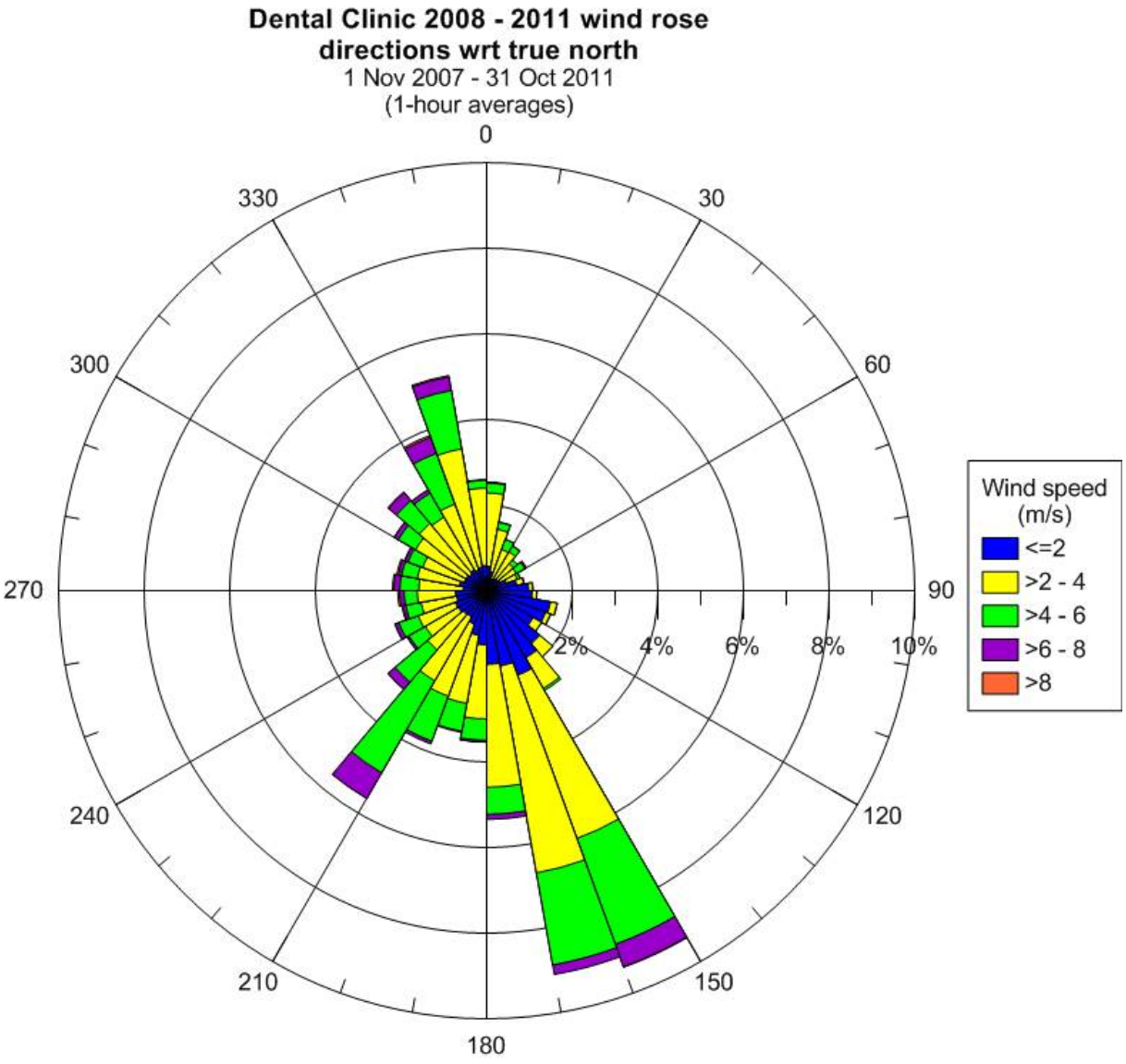


Figure 5-6: Port Pirie wind rose as measured at the Dental Clinic monitoring site from 2007–2011

This PER is limited to an examination of three key pollutants affected by the Transformation, namely sulphur dioxide (SO_2), lead and particles with a mean aerodynamic diameter less than 10 micrometres (PM_{10}). The health effects of these three substances are described in **Chapter 8**.

The longer term trend in annual average air lead concentrations illustrated by **Figure 5-7** (see **Chapter 7** for further information) shows significant reductions over the last 10 years at the licence monitoring sites at Pirie West Primary School and Oliver Street. Air lead levels have been below the 0.5 µg/m^3 NEPM standard at both monitoring sites since 2008. The significant reductions since 2005 are the results of emission and exposure reduction work undertaken as part of the 'Ten by 10' program.

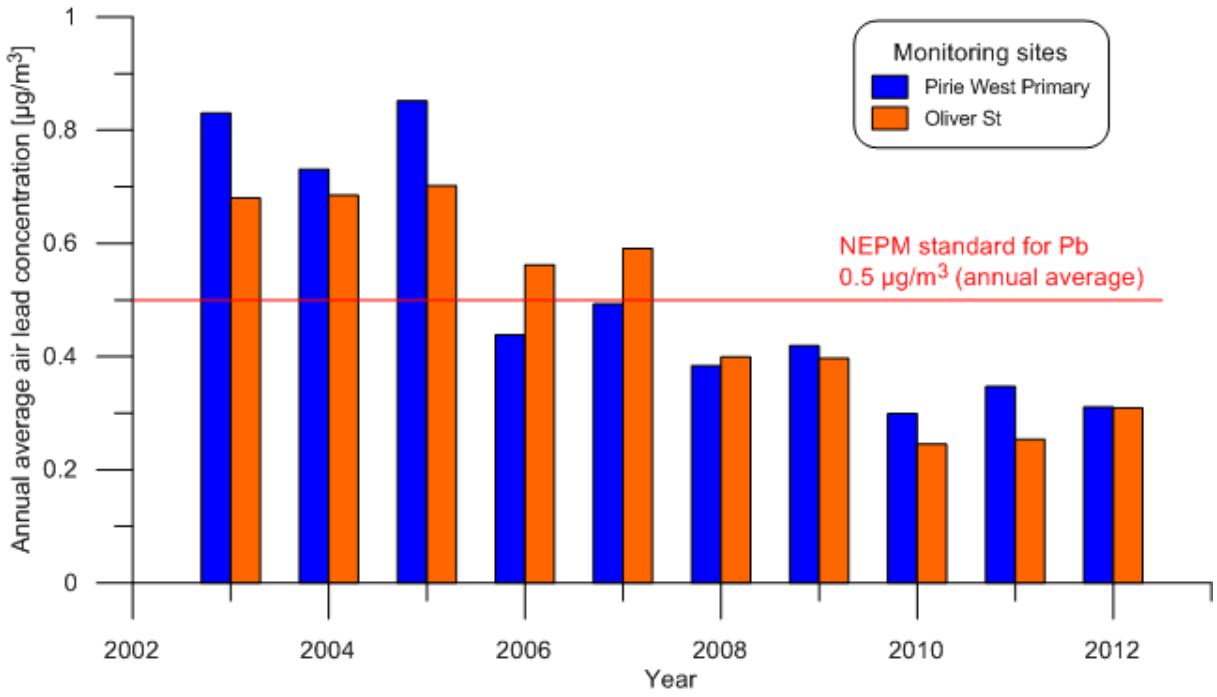


Figure 5-7: Annual average lead concentrations at the EPA Pirie West Primary School and Oliver Street monitoring sites for the last 10 years

The concentration of sulphur dioxide in air is currently measured continuously at the Oliver Street, John Pirie High School, Frank Green Park and the Boat Ramp (previously Golden North) monitoring sites. Measured sulphur dioxide levels in Port Pirie often exceed the 1-hour NEPM standard of 0.20 ppm (**Figure 5-8**).

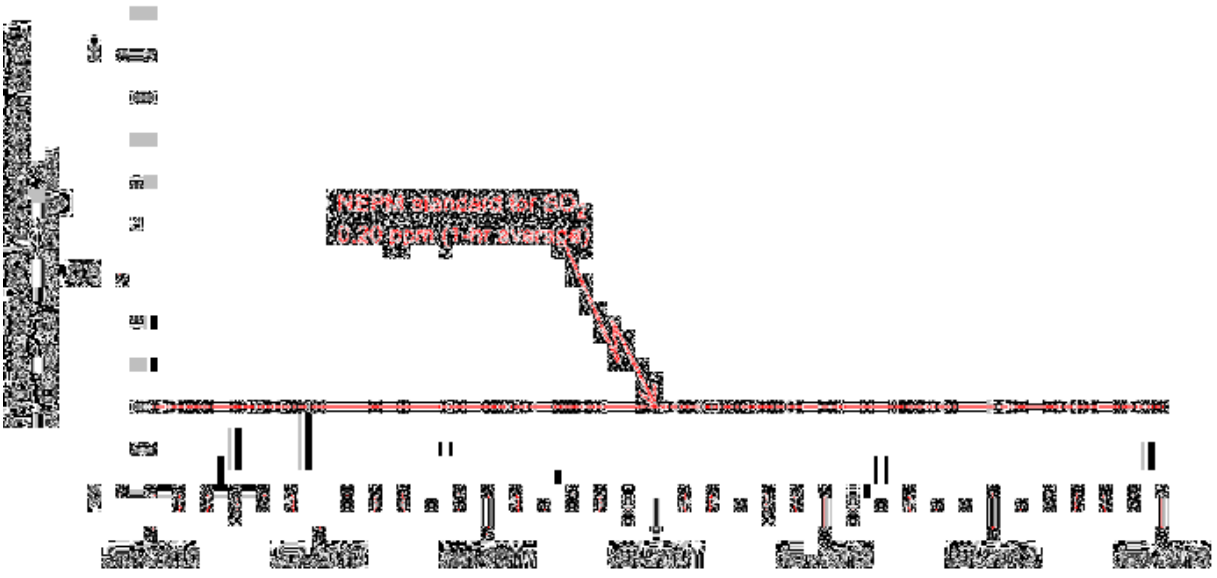


Figure 5-8: Time series of 1-hour average SO_2 concentrations at Oliver Street for the last 3 years (2010–2012)

The most recent data for PM_{10} is available from the TEOM (tapered element oscillating microbalance) operated by Nyrstar at the Boat Ramp site. **Figure 5-9** shows that average concentrations have reduced over the last few years with only one exceedance in 2011, four

in 2012 and none for the 4 months of available 2013 data. These PM_{10} concentrations meet the NEPM goal of not more than five exceedances per year.

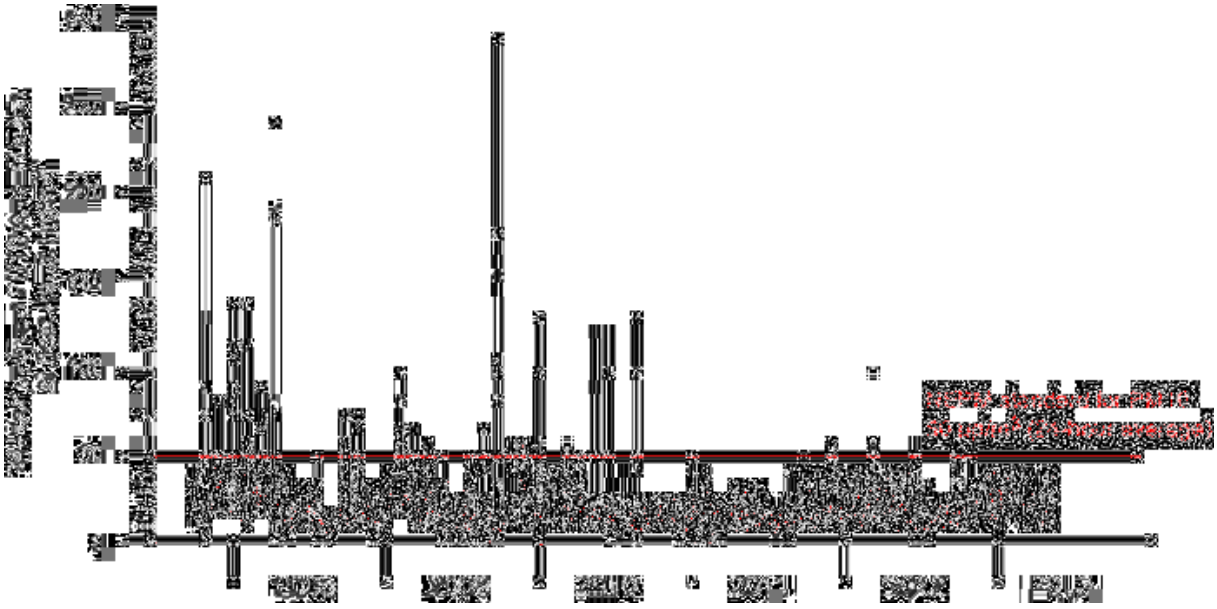


Figure 5-9: Average daily average PM_{10} concentrations at the Boat Ramp monitoring site for five years 2008–2013

5.2.7 Noise and vibration

Noise and vibration measurements were undertaken at the smelter and surrounding environment between 15 May and 22 May 2013. A detailed noise assessment is provided in **Appendix A**. All measurements were undertaken in accordance with the *Environmental Protection (Noise) Policy 2007* and used to determine the existing noise levels at and in the vicinity of the smelter.

Attended noise measurements of the smelter were undertaken with extraneous noise excluded from the measurement. Unattended noise monitoring was used to complement the attended noise measurement and to validate the measurements over a longer period; however they include localised noise events such as vehicle pass-by on nearby roads. Measurement locations are provided in **Figure 5-10.**

Figure 5-10: Noise measurement locations

For the purposed of describing the existing noise environment, a summary of the average measured night-time smelter noise is provided in **Table 5–2**. Subjectively, the noise from the existing smelter is audible at accessible boundary locations and at adjacent noise sensitive receivers. The measured noise levels are considered to be a typical representation of noise from the smelter under full operation. There is no significant vibration from the smelter outside its boundaries.

Table 5–2: Attended measured noise level at sensitive receivers

Location	Measured Noise Level, dBLAeq	Comments
A1. Corner Duffy Lane and the Terrace	43	General plant noise and some distant alarm and banging noise audible. Slag fuming steam noise can be identified.
A2. Corner Frederick St and the Terrace	46	General plant noise and some distant alarm noise audible.
A3. Corner George St and the Terrace	47	General plant noise and some distant alarm and banging noise audible.
A4. George Street West	48	General plant noise and some distant alarm and banging noise audible.
A5. George Street East	47	General plant noise and some distant alarm and banging noise audible.
A6. Ellen Street	47*	General plant noise and some distant alarm and banging noise audible at times where traffic is low. Smelter is inaudible at times of high traffic i.e. a shift change.

*Value has been determined as the average between the L_{eq} at 2200 hours and L_{90} at 0530 hours as a high level of road traffic at 0530 hours (likely shift change) affected the L_{eq} noise measurement at this time

5.3 Land use

The Port Pirie Regional Council Development Plan (PPRCDP) (DPTI 2013) zones the smelter as land designated for Industrial Development in *Policy Area 15* (Pasminco Metals Policy Area). Council objectives for land zoned Industrial Development are to provide an adequate supply of land to accommodate current and projected industrial activities. Existing industrial land and activities are to be protected from encroachment by incompatible land uses and any development at the border between industrial and/or commercial activities and sensitive uses needs to be compatible with surrounding activities (DPTI 2013).

Specific objectives outlined for Pasminco Metals Policy Area, as stated in the PPRCDP (DPTI 2013) are:

- a policy area accommodating major special industrial, commercial and storage activities and associated minor industrial activities and the handling of goods by transport by sea, road or rail
- no development prejudicial to the processing and storage of minerals
- the establishment and maintenance of a substantial visual and acoustic buffer between development and land in the adjacent Residential Zone, Rural Zone, Public Purposes Zone, Commercial Zone and the Port Pirie River.

Principles of Development Control (PDC) for Pasminco Metals Policy Area state that development should be principally major special industry, commercial and storage activities and associated minor industries. Additionally, any development should not impair the amenity of land in proximity to the Residential Zone, and treatment or depositing of

hazardous waste materials should not take place in proximity to the Residential Zone or the Public Purpose Zone (DPTI 2013).

5.3.1 Existing land use

An overview of smelter infrastructure and uses can be seen in **Figure 5-2**. The smelter has a range of on-site facilities which are approved under PPRCDP (**Section 4.2.12**). The existing policy (*Policy Area 15*-Pasminco Metals Policy Area) confirms these facilities are accepted forms of land use (DPTI 2013).

The Port Pirie port facility is operated by Flinders Ports, which has a 99 year lease and port operating licence (Flinders Ports 2013). Nyrstar has a lease arrangement with Flinders Ports for use of the port facilities and operates Berths 8 and 9 as a concentrate and residue unloading facility, as well as the finished metal product and acid loading facility.

5.3.2 Land tenure

The majority of land within the smelters boundaries is freehold land owned by Nyrstar, with the remainder consisting of coastal Crown land under the management of Department for Planning, Transport and Infrastructure (DPTI) for port activities and infrastructure.

Table 5–3 is a summary of the land currently used by Nyrstar, including volume and folio numbers, and title descriptions. This table also includes neighbouring land parcels, namely CR5628/894, CT5861/76, CT5133/521, and CT5980/64. **Figure 5-11** and **Figure 5-12** also summarises these land parcels.

Table 5–3: Current land use and title

Volume	Folio	Title description	Current Use
CT5689	260	Sections 637 and 638, Hundred of Pirie (updated ID: CT6114/4)	intermediate storage area amphitheatre
CT5689	260	Lot 201 in Deposited Plan 57808, Hundred of Pirie	intermediate storage area amphitheatre
CT5832	215	Section 1145, Hundred of Pirie	slag fumer and kilns
CT5372	307	Lot 1 in Deposited Plan 23903, Hundred of Pirie	north east corner of northern lines dams
CT5372	141	Lot 2 in Deposited Plan 23903, Hundred of Pirie	area north east of northern lined dams
CT5133	522	Lot 10 in Deposited Plan 24051, Hundred of Pirie (updated ID: CT6114/6)	sedimentation pond and northern lined dams
CT5980	48	Lot 50 in Deposited Plan 12528, Hundred of Pirie (updated ID: CT6114/2)	lead production, car park and old lined dam
CT5688	689	Lots 93–96 in Filed Plan 213879 (updated ID: CT6114/5)	zinc plant, administration, engineering and plant
CT5980	46	Lot 303 in Deposited Plan 67822, Hundreds of Burra, Whyalla, Pirie and Telowie	wharf area leased by Nyrstar from Flinders Ports

Volume	Folio	Title description	Current Use
CT5980	64	Lot comprising pieces of 307 and 308 in Deposited Plan 67822, Hundreds of Burra, Whyalla, Pirie and Telowie	north of the wharf and including wooden jetty, but excluding caisson
CR5769	760	Section 1141, Hundred of Pirie	north of the northern lined dams
CL1611	88	Section 1069, Hundred of Pirie	BSEA and salt flats beyond western fence
CR5628	894	Section 1072, Hundred 241000	Council owned parkland triangle, corner Leahey & the Terrace
CT5861	76	Allotment A2, Plan # F11452	SX Holdings (PIRSA)
CT5133	521	Allotment A1, Plan # F11452	SX Holdings (PIRSA)

Figure 5-11: Land parcels within the smelter operating boundary

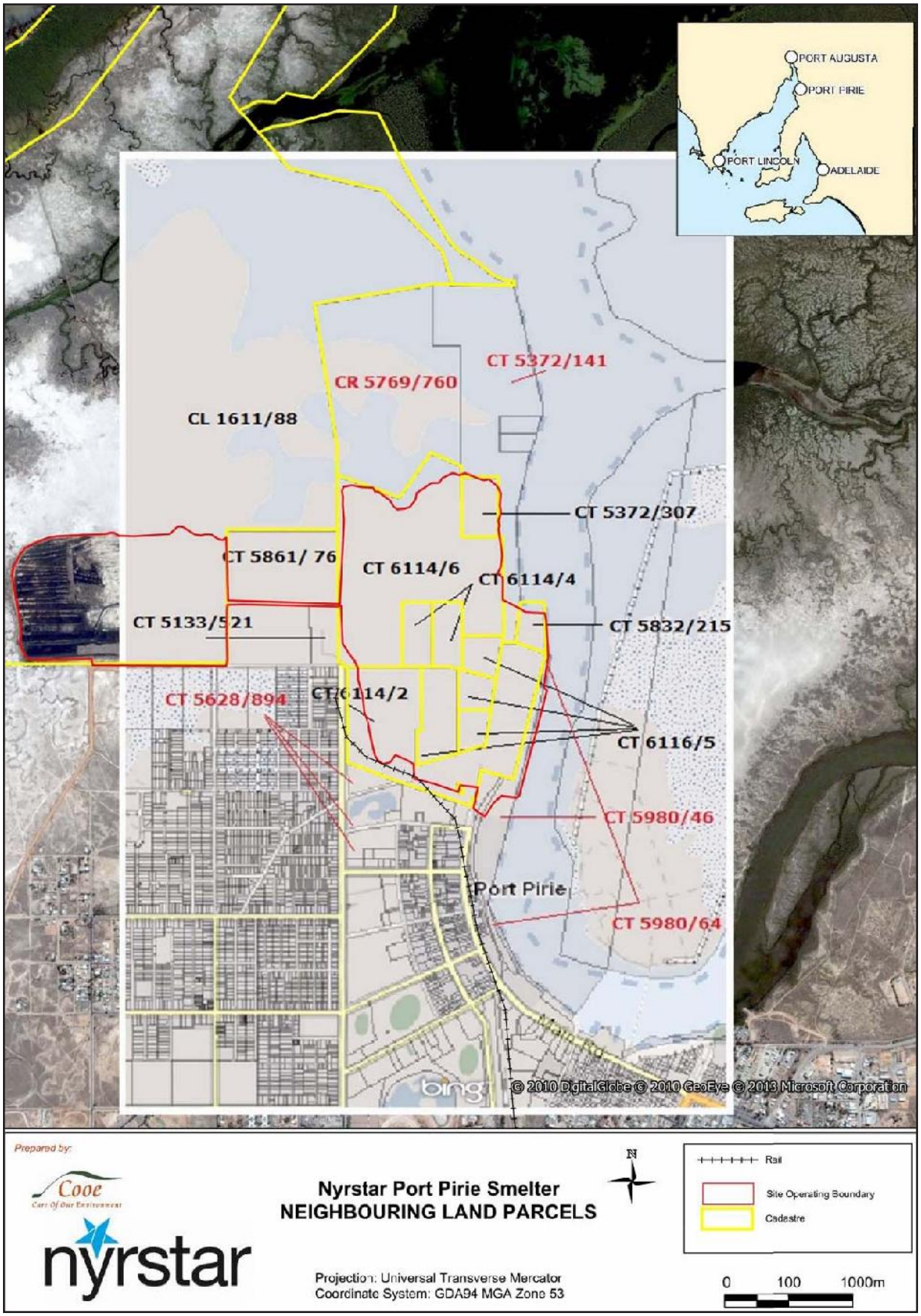


Figure 5-12: Land parcels neighbouring the smelter operating boundary

5.3.3 Smelter zoning

The existing smelter lies within the Industry Zone and *Policy Area 15*: Pasminco Metals Policy Area under the PPRCDP (DPTI 2013). In addition to the objectives and principles of development control (PDCs) that apply to the Industry Zone, on a whole the objectives of *Policy Area 15* specifically cater to the accommodation of major special industry, commercial and storage activities and associated minor industrial activities and the handling and transportation of goods by sea, road and rail. Furthermore, there must be no development within the Policy Area which is prejudicial to the processing and storage of minerals within the Policy Area, and substantial visual and acoustic buffers should be maintained between development within the Policy Area and any adjacent zones.

The PDCs indicate that further development is anticipated within the area and should be primarily major special industry, commercial and storage activities and associated minor industrial industries. However, development that is undertaken should not impact the amenity of the adjoining Residential Zone, nor should the treatment or deposition of hazardous waste materials be in proximity to the Residential or Public Purpose Zones.

This indicates that development in association with existing infrastructure is anticipated and encouraged so long as sufficient buffers are maintained between adjoining Residential and Public Purpose Zones. Similarly, development which aids the visual and acoustic amenity of adjoining zones will likely be viewed favourably and encouraged.

5.3.4 Adjacent land zones

The PPRCDP identifies five zones adjacent to the smelter (DPTI 2013):

- Residential Zone
    - *Policy Area 1 — Limited Development Area:* Designated as a vegetated buffer adjacent to the Policy to reduce the risk to health from high levels of lead contamination. It is located to the west of the smelter and is sparsely populated with approximately 12 dwellings that occupy large blocks. A parcel of land between the boundary fence of the smelter and The Terrace is vegetated, providing a buffer between the smelter and the Limited Development Area.
- Regional Centre Zone
    - *Policy Area 11 — Regional Centre Policy Area:* Dedicated to accommodation of institutional, educational, public health or recreational facilities. Parklands, gardens and areas of open space are also envisaged for the area with institutional and educational facilities buffered from the smelter by an area of open space, which is seasonally inundated, surrounded by native vegetation between Leahey Road and George Street.
- Commercial Zone
    - *Policy Area 13 — Commercial Policy Area 13*: In addition to the objectives and PDC listed for the overall Commercial Zone, *Policy Area 13* has the objective, due to its proximity to the Port Pirie River, of accommodating retail,

commercial servicing, storage and small scale industrial activities that are compatible or associated with the use of the waterfront or railway. The section of *Policy Area 13* that adjoins the smelter is primarily a vacant block (to the south of the smelter between Leahey Road and George Street), and also incorporates an industrial estate bordered by George Street, Gertrude Street, Little Gertrude Street and Florence Street.

- Industry Zone
  - *Policy Area 23 — Ports Policy Area*: This area is dedicated to the facilitation of port operations and associated industrial activities. The area is one of South Australia's major import, export and transhipment facilities, including functioning as the primary source of transfer for import of concentrates for the smelter (Nyrstar 2013). Objectives of development for the area, located to the south of the smelter, are to continue to support activities and infrastructure associated with ship movements, freight movements by rail and vehicles, large scale shedding associated with industrial storage and assembly, and small scale buildings associated with commercial uses.
- Rural Coastal Zone
  - *Rural Coastal Zone*: Identified as an area for the preservation and management of coastal land features, specifically sites of cultural, heritage, environmental, scientific or educational significance.

5.3.5 Land use development control principles

The PPRCDP designates the Nyrstar Port Pirie land for Industrial Development. Council objectives 48 and 49 explain the intention to ensure an adequate supply of land to accommodate current and projected industrial activity and that existing industrial land and activities should be protected from encroachment by incompatible land uses.

Relevant Principles of Development Control include PDC 172 which requires that industrial activity should effectively manage waste and emissions in an environmentally responsible manner and PDC 181, which directs industry adjoining non-industrial land users to not affect their level of noise amenity with respect to hours of operation and noise emitted. These environmental and industrial PDC are explained in further detail with respect to the existing smelter.

Environmental

Conservation and heritage is recognised within the PPRCDP through Council-wide Objective 57 which outlines the requirement for protection and management of the health of natural systems including areas of native vegetation, reserves, the coast, rivers, lakes, wetlands, floodplains and marine resources.

Objective 68 states that the development should minimise the creation of pollution relating to air, land and water. Amenity is addressed by PDC 308 and 309 which state that the appearance of land, objects and buildings should not impact upon the surrounding locality and that development should be located and designed to harmonize with conditions indicated by the objectives and PDC associated with the predominant character of other buildings in the locality.

The need for location-specific coastal development is recognised in conjunction with Objective 83 which seeks to protect the coast and adjacent marine areas from inappropriate development. The PPRCDP recognises that opportunities should be assessed prior to the introduction of zoning or policy which may prevent or inhibit development, such as mining development.

Minimisation of conflict due to development of the marine environment and land based uses including industrial development is encouraged as per Objective 99 (d) (viii). Principles of Development Control 325 states that development should not occur within environmentally delicate coastal features, such as sand dunes, wetlands or important remnants of native vegetation. No such features have been identified within or on the boundaries of the smelter.

Industrial

Provisions for industrial land use within the PPRCDP, specifically Objective 49, note that land designated for industrial purposes requires protection from encroachment from other incompatible land uses. Principles of Development Control 171 identifies that activities which have a potential for off-site environmental impacts should be appropriately located in relation to more sensitive land uses. The proposed smelter upgrade aims to manage activities with the potential for off-site environmental impact to mitigate risks as outlined in the draft Construction and Operations Environmental Management Plans (see **Chapter 18**).

Development on industrial land should take into account existing adjoining non-industrial land uses to prevent overshadowing and minimise the visual impact on neighbouring properties.

Furthermore the Industry Zone objectives look to establish visual and acoustic buffers between development and zone interfaces, an objective which is also specified within the *Policy Area 15*'s objectives.

Regional Plan Summary

The smelter contributes significantly to the local economy and has done so for 124 years. This is reflected in the provisions made for it in the PPRCDP. The current smelter plan adheres to the zoning policy developed to reflect the benefit provided to the communities economy through its ongoing operation.

The Transformation will improve smelter conditions by the introduction of new technology that will reduce emissions from the current sintering process. In particular, the upgrade enhances the facilities compliance with the PPRCDP's Objectives and PDC as follows:

- *Environmental Objective 62* — while not of historically significant value, the Transformation using new technology does not require the use of extra or new land to be developed.
- *Environmental Objective 68* — the Transformation will enable the smelting process to occur within an enclosed vessel which will significantly reduce fugitive emissions. Additional raw material or reagents will be stored under cover or contained within the negative pressure of the sealed vessel. This upgrade will see a significant

reduction of airborne emissions created by the current sintering process and materials disturbed by prevailing winds within the outdoor intermediate storage area.

- *Environmental Objective 70* — aside for some crushing and screening purposes, the outdoor intermediate storage area will no longer be required by the new process allowing redundant areas to be rehabilitated to an improved environmental value. However, the intermediate storage area will continue to be used for materials generated by other purposes on-site.
- *PDC 171* — reduction of the use of the outdoor intermediate storage area will lessen the likelihood of airborne emissions during windy days and thus the likelihood of off-site environmental impacts.
- *PDC 186 (a)* and *(b)* — setbacks between the adjoining land uses and the proposed development will remain adequate and minimise additional impacts to visual amenity or overshadowing issues when the smelter is upgraded.
- *Industry Zone 7* and *Policy Area 15 Objectives* — the existing visual and acoustic buffer will be maintained if not increased due to the rehabilitation works undertaken once the outdoor intermediate storage area is made redundant.

Modifications planned for the Transformation do not alter the smelter's compliance with the provisions of the PPRCDP. Some existing structures will be modified to accommodate the internalised furnace upgrade. Existing buffers will be maintained with a potential increase in visual amenity as use of outdoor intermediate storage area changes and becomes rehabilitated in the long term.

The Transformation provides the pathway to a sustainable future for the smelter, the community of Port Pirie and the wider region. Nyrstar is committed to supporting the goals of the PPRCDP.

5.3.6 Broader locality

The Port Pirie River runs along the eastern side of the smelter, while the area to the north and north west is dominated by low-lying samphire flats on Crown Land. The area to the south is the Port Pirie city and consists of a mixture of low-density housing, vacant public purpose land, and land used for commercial and industrial purposes.

5.4 Existing smelting process

The current smelter comprises of a lead smelter, refinery, an acid plant, a precious metals refinery, a copper plant and a zinc plant. The lead smelter operates using the sintering-blast furnace method, utilising an updraft sinter machine commissioned in 1956.

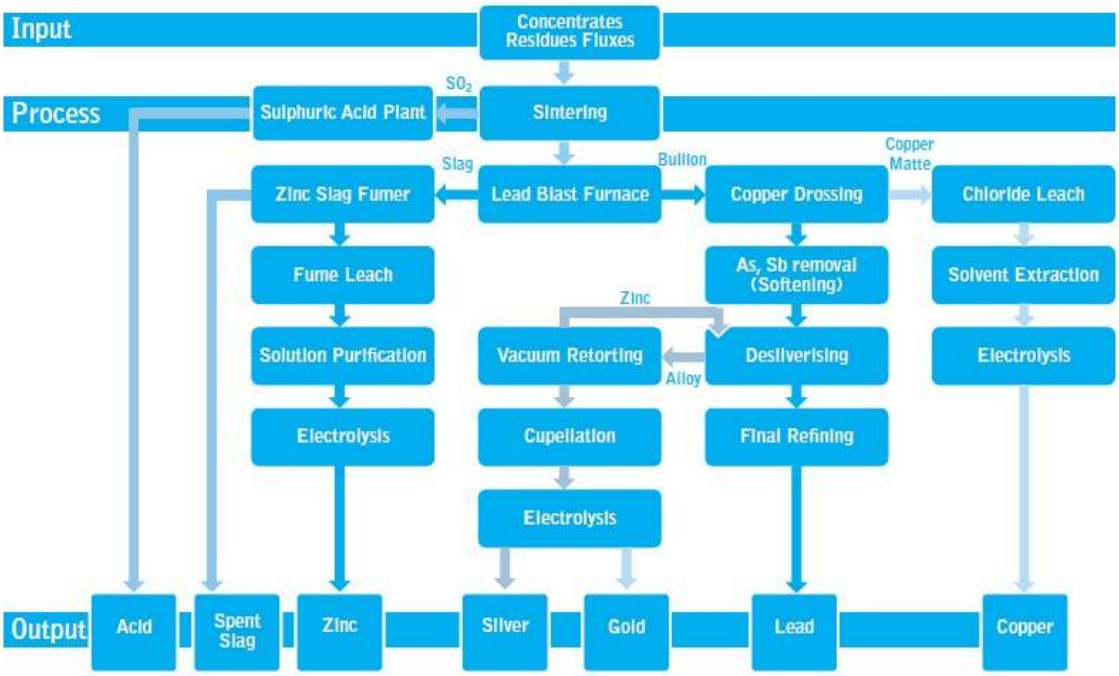


Figure 5-13: Production process at Port Pirie

The process starts by feeding lead ore concentrates and residues (fine metal bearing materials and fluxes) to the Sinter plant where they are roasted at high temperature to remove sulphur. Energy for the process is provided by the sulphides in the concentrates and coke. Sinter is fed to the blast furnace to produce a zinc rich slag for the zinc slag fumer and lead bullion that is processed to separate and refine lead, copper, silver and gold (**Figure 5-13**).

Updraft sintering involves a high temperature, pressure forced process, coupled with a suction of lead-laden off-gases to gas cleaning, sulphur capture and the tall stack via a baghouse system. The plant consists of numerous open conveyors and dry crushing rolls that give rise to substantial fugitive dust sources due to the physical inability to draft all process stages. The process itself uses approximately 50% recycled materials (predominately sinter), which is comprised chiefly of lead oxides. As a consequence, the handling of this dry material over a considerable footprint, combined with a high temperature process that is inherently difficult to control, lead to it being the largest source of air lead emissions from the smelter.

A secondary but important source of emissions arises from the blast furnace when treating off-grade or cold sinter. As sinter physically degrades with time and loses its mechanical properties, the blast furnace performance also erodes, which can result in characteristic emission events ('furnace blowholes'). These events are localised high intensity gas eruptions from the main furnace charge and are difficult to fully capture, despite the ventilation hood fitted over the furnace structure.

The sinter plant smelting process is now considered out-dated technology. This need to restrain the level of these emissions is the main driver behind replacing the existing process with modern EBS technology, complete with best available technology (BAT) fume handling and hygiene ventilation.

5.5 Conclusions

The smelter is located on a highly modified brownfield site that has been in constant industrial use for 124 years. Flora and fauna within the smelter's boundaries is limited and of low biodiversity value, with much of the native vegetation in surrounding areas previously cleared for residential, agricultural and industrial uses. Mangrove and seagrass habitats are found adjacent to the smelter however the Transformation is not expected to cause any additional impact.

Nyrstar either owns or leases all land parcels on which Transformation works will occur. Current land uses align with local and regional planning zones and uses. There are a small number of sensitive receptors located near the current and proposed production facilities, most of which are buffered from noise and air emissions by areas of vegetated land.

The existing and historical production processes have consistently emitted high quantities of lead-bearing dust and sulphur dioxide gas. Adjacent land has been impacted by airborne lead-bearing dust emissions during the operating life of the smelter, causing legacy contamination. Overall the Transformation will reduce these emissions and result in corresponding environmental improvements.

6 Description of the proposal

6.1 Introduction

Nyrstar proposes to update and upgrade the smelter to address air lead emissions and improve blood lead concentrations in the community. This chapter describes the nature of the proposed Transformation and its location, including a description of the principal processing plants and likely emissions. Management arrangements for the construction and operational phases are addressed, and a process flow diagram is provided for production processes to be used, showing inputs and outputs in the form of raw materials, products, wastes and emissions.

The proposed Transformation has been designed and developed with the EPA, SA Health and other key agencies requirements being considered, as well as site constraints and the potential impacts and benefits of the development. The level of detail presented in this chapter is considered sufficient for an assessment of potential project impacts for the purposes of a PER. Following approval, the project would undergo a detailed design phase during which specifications for the project would be defined. This process would take into account requirements identified by the PER process. Mitigation measures identified during the PER process relating to construction and operation controls would be applied via the preparation and implementation of environmental management plans, as outlined in **Chapter 18**.

6.2 The Transformation

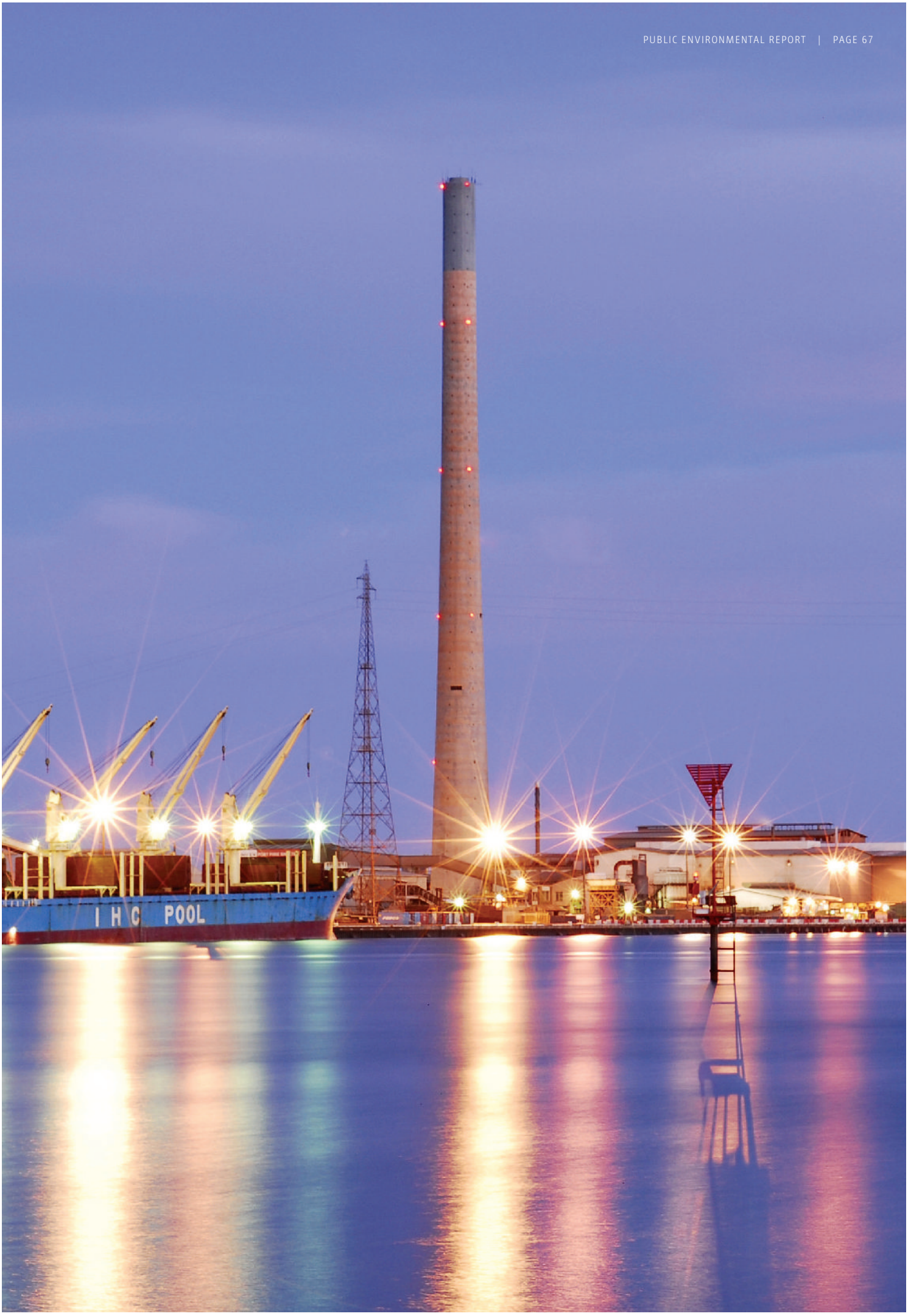
The Transformation is the first step in Nyrstar's strategy to upgrade the Port Pirie lead smelter into an advanced poly-metallic processing and recovery facility employing cleaner production techniques and best available technology.

The Transformation will replace the out-dated sintering technology in the lead smelting process with an oxygen-enriched, EBS oxidation furnace, coupled to a new sulphuric acid facility. The modern, proven technology will convert feed concentrates and residues (recycled internally or sourced from Nyrstar smelters and third parties) into primary lead bullion and slag precursors for the further recovery of lead and the recovery of copper, silver, gold, zinc and other minor metals.

The proposed development will also include the upgrade or replacement of associated environmental controls, acid production facilities and the installation of an electricity cogeneration facility.

Replacement of the existing blast furnace with a second EBS furnace is being considered and may be included in the final project scope.

Some ancillary equipment associated with the Transformation will be either refurbished to extend their operating lives, or upgraded to meet the changed operational demands of the new smelting assets.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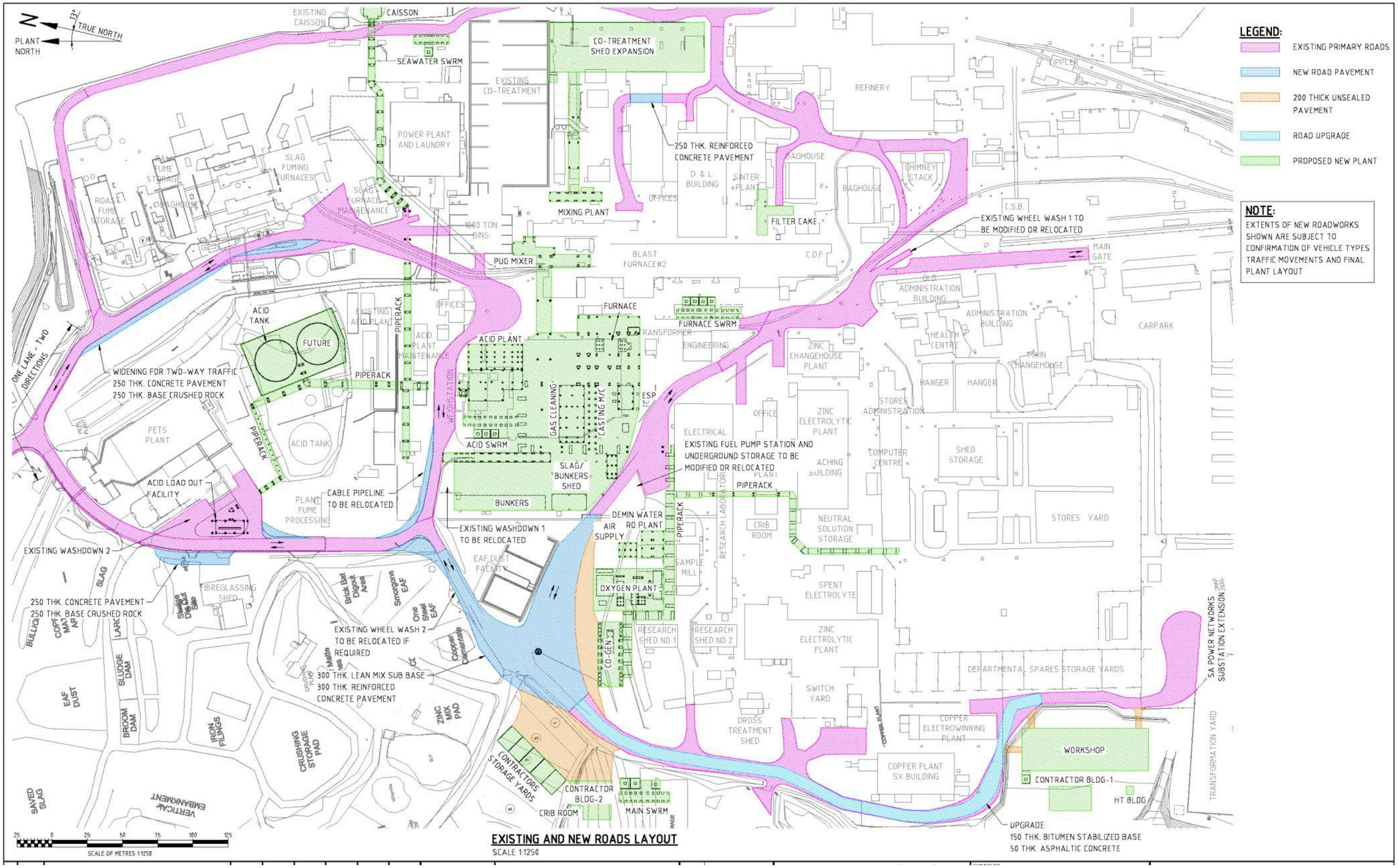

Figure 6-1: Transformation PFS proposed plant zones and areas existing and new roads layout

Figure 6-1 shows the Transformation as proposed at the pre-feasibility study (PFS) level. This chapter discusses the Transformation in the context of the following upgrades and considerations:

- sinter plant replacement with EBS oxidation furnace
- blast furnace replacement with EBS reduction furnace
- acid plant upgrade to modern acid production facility
- recovery of intermediate storage area materials
- concentrate handling improvements
- air hygiene improvements
- water systems
- design investigations
- construction details
- demolition
- decommissioning and transitional arrangements
- operation and maintenance.

No modifications are proposed for the slag fumer as part of the Transformation.

6.2.1 Community benefits of the Transformation

The Transformation will deliver a step change reduction in air lead and sulphur dioxide emissions and support a significant improvement in community health.

The Transformation will deliver a significant improvement in overall environmental performance and a reduced environmental footprint.

High temperature, oxygen-enriched EBS is acknowledged globally as the best available technology for integrated base metals production and has a range of features and benefits:

- Enclosed furnace design enables a step change reduction in airborne metal and dust emissions, assisting the smelter to meet and improve upon current environmental performance standards. All material transfer points are completely enclosed and drafted through a microfiltration baghouse.
- Capture of sulphur dioxide, and conversion to value added sulphuric acid, will minimise instances of nuisance sulphur dioxide gas within the city of Port Pirie and the surrounding environment. The final gas cleaning stage of the new acid facility will be for mercury removal and the management of the resultant product will be defined in the bankable feasibility study.
- A straight-through process means the avoidance of large tonnages of metal-bearing intermediate materials being handled, transported and stored on-site, thereby largely eliminating many sources of metal dusts from being mobilised on high wind days.
- Recovery of heat energy from the smelting process is feasible; the high temperatures generated in the EBS, and the ability to capture it, enables heat to be converted to steam, resulting in significant electricity cogeneration and consequent reduced load on the existing state electricity grid.
- Carbon footprint will increase, however EBS technology, coupled with improved sulphur dioxide capture and conversion to sulphuric acid, will reduce carbon

intensity. Carbon intensity is the carbon dioxide-equivalent (CO_2-e) emitted per unit of production.

While the Transformation will deliver significant environmental improvements, Nyrstar support will be ongoing for community based health and environmental initiatives that raise awareness and help continue to improve children's health, through lowering blood lead levels in the community of Port Pirie.

6.2.2 Process flow diagram

Figure 6-2 presents an overview of one option for the proposed production process: the replacement of the sinter plant with an EBS oxidation furnace, and modification of the blast furnace process. New processes and equipment are identified in dark green, and modified processes are presented in light green. The figure includes sequences, inputs and outputs, in the form of raw materials, products, wastes and emissions.

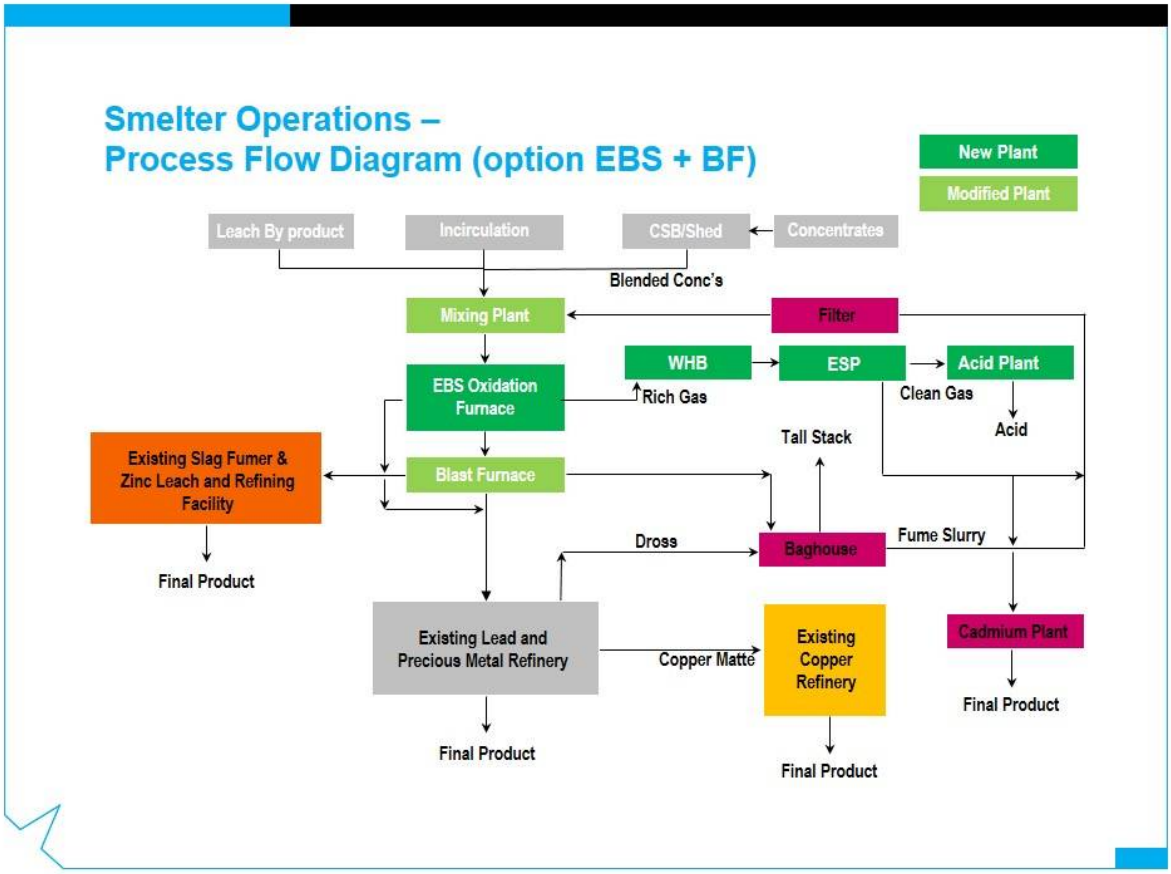

Figure 6-2: Smelter operations — Process flow diagram showing EBS plus blast furnace option, including inputs and outputs in the form of raw materials, products, wastes and emissions (EBS: enclosed bath smelter; ESP: electrostatic precipitator; WHB: waste heat boiler)

6.2.3 Sinter plant replacement

The key premise of the Transformation is to replace the aged sinter plant with modern oxygen-enriched EBS technology, thereby largely eliminating the major contributor of lead-based emissions to air (see **Chapter 7** for details of current emission sources).

Unlike the sinter plant, the modern EBS oxidation furnace will convert lead directly into bullion, reducing the volume and lead content of the process slag, which is the feedstock for the blast furnace. This will reduce the load on both the blast furnace and the baghouse, moderating their operational intensity, improving process stability and fume capture.

A move away from sinter to a uniform slag, consistent in physical and chemical properties, will translate into consistent blast furnace operating performance, further improving process stability, and reducing or eliminating localised high intensity gas eruptions from the main furnace charge (see 'blowhole events' in **Section 5.4**). Peaks in emissions of lead-based materials will be significantly lower than the existing plant as a result.

Other facilities to be installed as part of the sinter plant replacement includes:

- new waste heat boiler
- new cooling tower
- new cogeneration power facility
- new or increased capacity oxygen production facility
- new sulphuric acid facility
- new fuel coal preparation and conveying facility (includes fans and mill).

6.2.4 Enclosed bath smelting

In the EBS oxidation furnace process, the smelting reactions will be performed in the molten state within an enclosed vessel. Input and output ports of the vessel, required to enable addition of raw materials and reagents and removal of molten and gaseous products, are designed to minimise and control emissions. Maintaining negative pressure in the vessel enables the capture of dust, fumes and sulphur dioxide products for treatment, thus minimising their release to atmosphere.

Figure 6-3 provides an example of an EBS technology designed by SKS. This particular design, and this designer, may or may not be used in the Transformation.

The general sequence of improvements commences with replacing the sinter plant with a modern EBS oxidation furnace, complete with best available technology (BAT) fume handling and hygiene ventilation. A mix of concentrates and zinc smelter residues (mainly paragoethite from Hobart and lead sulphates from Nyrstar zinc smelters) will be processed in the EBS oxidation furnace to produce lead bullion and a slag phase.

The bullion will be tapped into ladles under controlled conditions and transferred to the existing lead refinery for purification and casting into finished products. The slag phase will be cast on a conventional straight line casting machine into 'bricks' for charging to the existing blast furnace, where it will be reduced to lead bullion and a zinc rich slag phase as is currently the case. Slag casting from the EBS oxidation furnace will be performed under a fume hood to capture any lead fume that is released while the slag is molten.

As the volume of slag from the EBS oxidation furnace will be significantly lower than the present sinter feed, upgrade and automation of the blast furnace feed system, including complete enclosure of conveyors, will be considered.

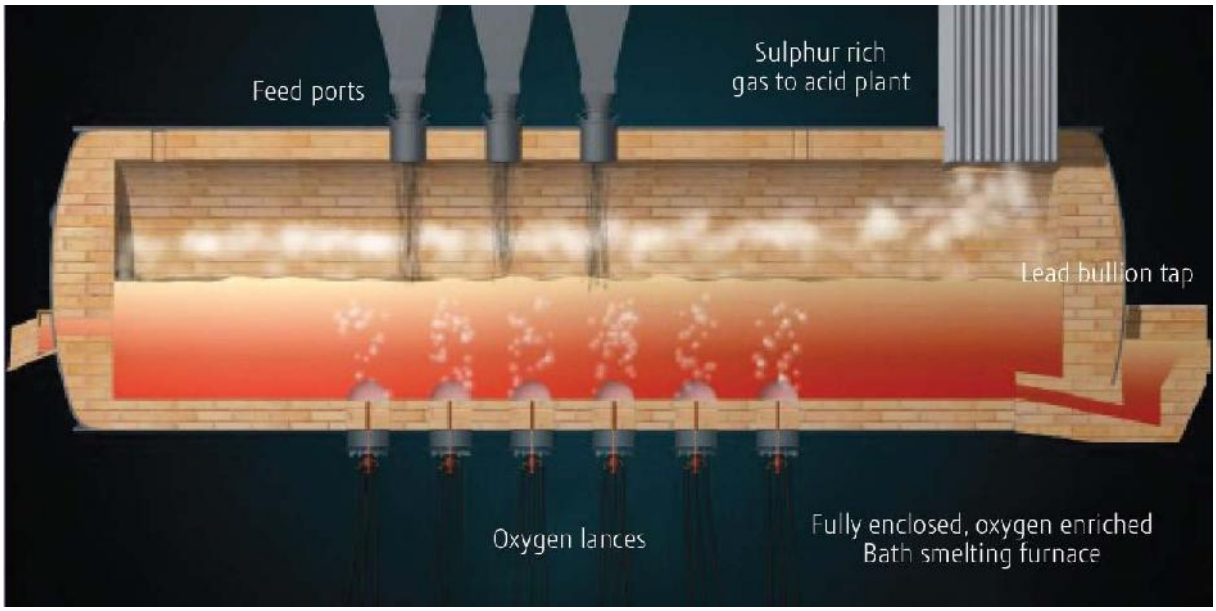

Figure 6-3: An example of EBS technology, as designed by SKS

The change to EBS technology benefits the community by:

- eliminating the sinter plant fugitive emissions
- reducing the production of intermediate lead-bearing materials
- reducing the associated dust emissions resulting from the transport, handling and recycling of these materials
- sulphur dioxide emissions from the tall stack reducing ten-fold
- substantially reducing blast furnace emissions through improved process performance and control.

6.2.5 Acid plant replacement

Off-gases from the EBS oxidation furnace will be captured and processed through a wet gas cleaning facility to cool the gas and remove dust, liquid droplets and excess water. The gas will then be further dried in a drying tower, and then heated. It will then pass through a converter, where sulphur dioxide is converted to sulphur trioxide. The sulphur trioxide will then be absorbed into 98% sulphuric acid. Of the sulphur dioxide captured, 99.8% will be converted into sulphuric acid. Product acid will be cooled and transferred to the acid storage tanks.

The existing 10,000 tonne acid tank will be retained and complemented with a new 10,000 tonne acid tank. The bund for the new tank will be sized to accommodate a second new 10,000 tonne acid tank if deemed required after draining and inspecting the existing tank. The new bunding will comply with current EPA bunding guidelines. The existing 400 tonne tank used to supply the zinc plant will be retained, and a new acid road loading station will be installed.

Benefits to the community resulting from these changes include:

- reduced sulphur dioxide emissions to air
- compliant bund reduces risk of emissions to ground or groundwater.

6.2.6 Blast furnace replacement with EBS reduction furnace

Replacement of the existing blast furnace with an EBS reduction furnace is being considered, and may be included in the final project scope. However, this will be a business driven decision, as environmental performance of the current blast furnace will be significantly improved by the Transformation, with improved feed consistency from the EBS technology, and better drafting due to reduced load.

6.2.7 Recovery of intermediate storage area materials

The sinter process requires feed material mixed to meet particular specifications. This requires a stockpile of a range of lead, zinc and copper based residues. Storage is presently in an 11.2 hectare open area, and dust management measures include sprays, fog cannons, proprietary dust suppressants, and high wind dust protocols. Wind mobilisation of dusts is an everyday problem. During wet periods, rainfall events, materials are also tracked via vehicle tyres around roadways, and when dried, present an expansive and persistent source of dust emissions.

The application of EBS technology allows the volumes of some intermediate storage area materials to be substantially reduced. As a consequence, some intermediate residues currently stored in the intermediate storage area, including all the lead oxide-bearing sinter material, will be completely consumed within the first 3–5 full operating years. The Environmental Improvement Program (EIP) will continue to investigate opportunities for recovery and reuse of the remaining intermediate storage area materials. Using a staged approach to reduce the intermediate storage area's footprint, its ultimate closure will enable land remediation to reduce wind mobilisation and vehicle tracking of lead-bearing materials.

Recovery of intermediate storage area materials through the change to EBS technology benefits the community by reducing the existing stockpiles of lead bearing materials (including lead, zinc and copper based plant residues), and the associated wind- and vehicle-mobilised dust emissions.

6.2.8 Concentrate handling improvements

Moving away from sinter technology removes the need for the intermediate materials, discussed in **Section 6.2.6** above, and also removes the requirement for many of the existing open conveyors. While concentrates are known to be a minor source of lead emissions on high wind days, the simplified plant layout of an EBS oxidation furnace process requires a fraction of the number of conveyors for feed transportation, significantly reducing the number of potential point sources for dust emissions.

These point sources will be further reduced by implementing simple but effective designs for enclosure with appropriate hygiene ventilation.

Feed blending is allowed for in the modernised plant design, such that all feed materials are either stored in covered bunkers or metered feed bins with appropriate dust capture. Enclosed storage will be provided for storage of some road-transported concentrates that are currently stored outside.

Improvements in concentrate handling benefits the community by reducing the number and nature of sources of lead emissions arising from concentrate handling and storage.

6.2.9 Air hygiene improvements

Removal of the sinter plant relieves a significant load from the existing lead baghouse system. The EBS oxidation furnace does not require as large a baghouse capacity, as the volume of air required to be hygienically drafted away from furnace feed ports, slag tapper and bullion hearth, is significantly smaller than required by the existing sinter plant. Surplus baghouse capacity will be available to capture fume and dust emissions from other parts of the facility. All new furnaces will have hygiene capture directed to the existing brick flue, baghouse and tall stack system.

Sulphur-rich off-gases from the EBS oxidation furnace will be treated via a wet gas cleaning facility and a new modern acid facility to capture the sulphur and produce sulphuric acid. The new process will result in a 90% reduction in sulphur dioxide emissions to the tall stack.

Improved hygiene in the proportioning plant will be achieved with chutes to the shuttle conveyors, an area vacuum clean up system in the shuttle floor area, skirts on the mixing facility bin feeders and dust collectors on the assigned coal storage bins and conveyor transfer points. New conveyors will be covered and new hoppers will be above ground to improve maintenance access and minimise confined space.

For the blast furnace feed preparation area, new bunkers for feed materials, metallurgical coke and fluxes will be located adjacent to the new bins for front end loader reclaiming, reducing transport distances and exposure duration, thus reducing dust generation. Lead rich slag will be handled within a shed to minimise wind mobilisation of lead-bearing dust.

The off-gas handling system will incorporate ventilation gas from conveyor transfer points, various process hoods, EBS oxidation furnace off-gas and hygiene, continuous sulphur drossing and copper drossing furnace process off-gas, rotary furnace process and hygiene off-gas, cadmium plant off-gas, part of the refinery off-gas and the blast or EBS reduction furnace off-gas. The hygiene gases will travel through a new flue to the existing baghouse and will be discharged as a clean gas to atmosphere via the tall stack.

The proposed hygiene improvements in the areas described above will provide benefit to the community and to the workforce by reducing fugitive sources of dust and off-gas emissions.

6.2.10 Water systems

In addition to potable water, five water systems are associated with the upgraded facility as follows:

- cooling water
- process water
- Process Effluent Treatment System (PETS) water
- demineralised water
- sewage treatment system.

A new seawater intake and discharge system will be constructed to complement the existing cooling system. Seawater within the cooling system will be single pass only and non-contact. There is no storage associated with this system with the exception of header tanks and water flowing through the system.

The existing process water systems will be retained with all process water from the new facility reporting to the process water system. The existing Process Effluent Treatment system (PETS) will be retained with a number of new inputs from the new facility. The PETS facility treats the water and has two sedimentation ponds (within the PETS facility area) used for settling prior to discharge.

The existing demineralised water facility (encompassing reverse osmosis and demineralised water facility) will meet the demands of the demineralised water uses within the new facility.

The existing sewerage system will be retained; this system includes the treatment ponds and other sewage treatment infrastructure. Recycled water from the sewerage system is used for irrigation purposes across the smelter.

6.2.11 Slag fuming and emissions improvements

In 2011, a major upgrade of the slag fuming baghouse stack fan and motor enabled the baghouse to be operated continuously under negative pressure. Data indicates that this has dramatically reduced emissions from this section of the facility.

The slag fumer will not be modified as part of the Transformation, but will continue to be subject to EIP continual improvement activities in the course of normal operations.

6.3 Construction phase

The construction phase of the Transformation will follow the:

- project implementation plan
- project charter
- construction management plan.

The project implementation plan will describe the implementation strategies, functional management outlines, stakeholder considerations and communication approaches that will be implemented during the project.

Objectives for the Transformation will be documented in the project charter, including the business needs of the project, and the high level requirements of implementation strategies and scope of the project.

The construction management plan will describe the construction management strategy, and will be developed as project design continues. The construction management plan will refer to the work breakdown structure for the key activity schedule.

Quality management will verify conformance, prevent deficiencies and non-conformances, and facilitate correction or acceptance of non-conformances. The project quality management plan (QMP) will specify organisational responsibilities and quality assurance

requirements for all work performed. Contractors will provide project-specific QMPs for their contracted work to ensure compliance with design requirements and prevailing health, safety and environmental regulations.

The following sections briefly discuss the various aspects of construction.

6.3.1 Construction

At this stage of the design process, construction of the Transformation is scheduled to take 24 months, from 2014 to 2016. Commissioning of the new facility will commence in 2016 (**Figure 6-4**). Staging details will be finalised as the bankable feasibility study is developed.

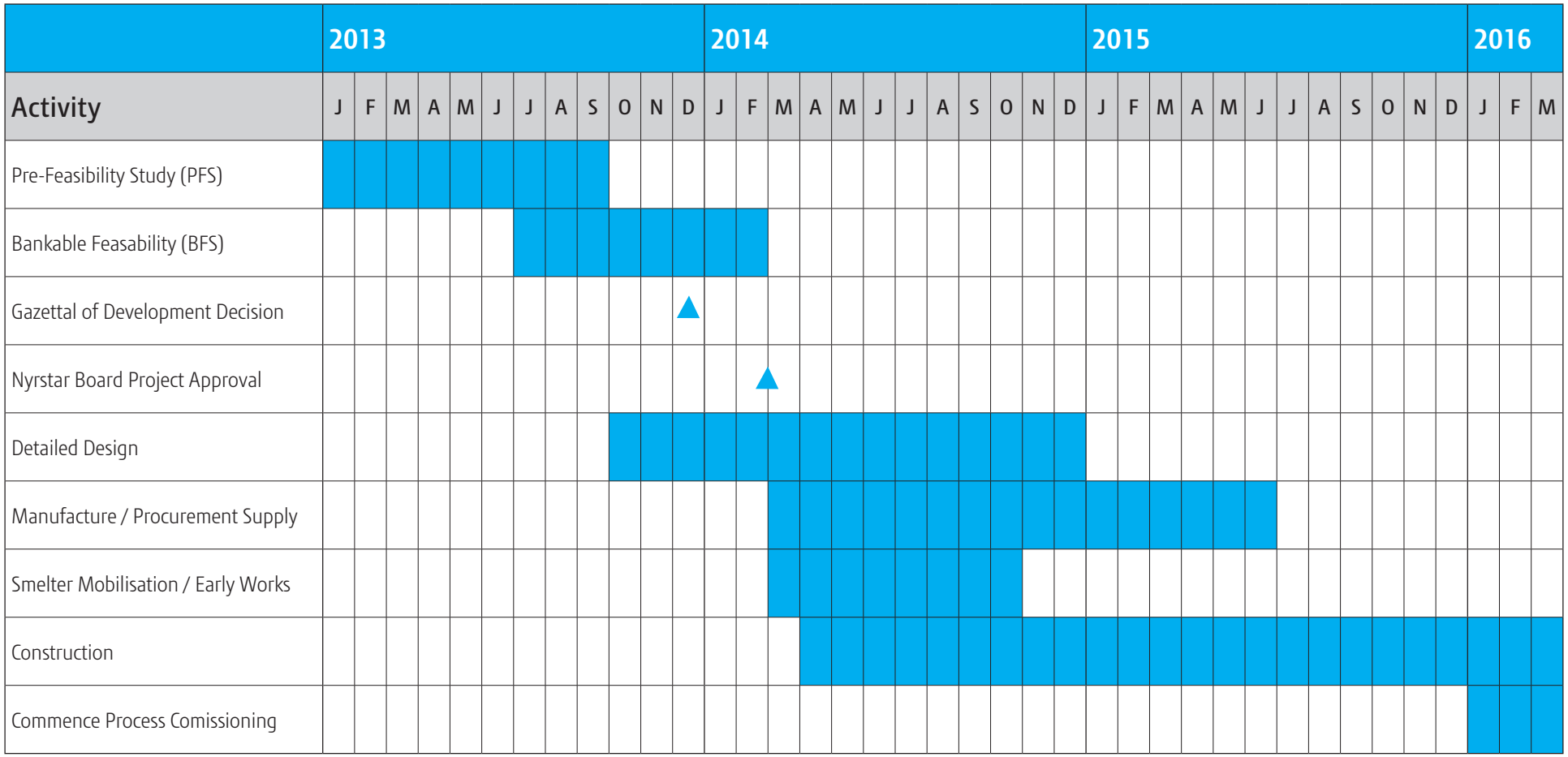

Figure 6-4: Proposed Transformation schedule

Construction of the replacement acid plant is targeted as a potential early works item due to the poor state of the existing facility.

Construction workforce

The current estimate indicates that the required construction workforce may peak between 250–400 personnel during the 24 month construction period. It is anticipated the workforce will be accommodated within a 250 person accommodation village, expandable to accommodate up to 400 individuals. Currently, shutdown accommodation supports between 170–230 personnel, albeit for shorter periods. Therefore it is expected that a mix of existing and new construction workforce accommodation will be needed to meet Transformation timelines. Approval for additional accommodation requirements will be sought from Port Pirie Regional Council using a local Development Application and approval process.

Overflow of management, company representatives, local employees and smelter visitors over and above the construction workers residing in the construction accommodation village, will allow benefit Port Pirie without causing accommodation shortfalls and creating a boom and bust economic cycle.

It is anticipated that the construction workforce will be sourced from Port Pirie and surrounding areas whenever appropriate.

Nyrstar follows a strict recruitment program that is based on merit and consistent with legal obligations including Equal Employment Opportunity (EEO) principles. The adoption of EEO principals dictate that Nyrstar decisions, in relation to employment, are not made on the basis of a particular characteristic or personal attribute held by an individual or group, but on merit and skill sets.

Smelter security

Through the construction phase, the smelter will continue to be secured under the existing security arrangements, in accordance with *Work Health and Safety Act 2012*. Existing security measures include boundary fencing, attended security gate/s, sign in/sign out procedures, personnel and visitor inductions and safe work method statements that consider risk to the public from construction activities will be utilised for the construction activities.

Design criteria

The works will comply with the requirements of the relevant Commonwealth, state and local, authority's acts, regulations and legislation, and Australian Standards. The most recent editions of the legislation and standards including any relevant amendments and addenda will be used unless specifically noted otherwise.

Where there is no applicable Australian Standard, the appropriate British or ISO or other approved standard will be used.

The statutory requirements of the acts and regulations shall apply in precedence over the requirements of the relevant standard. In the case of conflicting information the following precedent shall apply:

- Australian and South Australian Statutory regulations
- Australian Standards
- British Standards
- ISO Standards.

Other recognised codes may be used if specifically approved. Equivalence to Australian Standards must be demonstrated prior to approval.

Design will consider the existing and potential future environment. Protocols will be adopted to construct, operate and maintain buildings, structures and equipment to meet required performance standards.

Construction will take place under the supervision of a voluntarily appointed contaminated land auditor. Building footings will be designed to minimise impacts of contaminated soil on building integrity e.g. using bentonite sleeves. Any construction activities that may impact on groundwater quality or flow will be assessed by the auditor prior to commencement.

Smelter construction environmental management plan

A construction environmental management plan (CEMP) will be written to manage construction activities to minimise impacts on the local environment. A draft CEMP is appended to this PER, outlining strategies to minimise potential environmental impacts of construction. The CEMP will be monitored, reviewed, re-evaluated and communicated during the construction phase in accordance with the Nyrstar risk management framework (see **Chapter 16**).

Transport and storage of construction materials

Approximately 80% of construction materials required for the Transformation will be carried by sea. Current estimates of Transformation shipping volumes indicate that there will be minimal change from historical shipping traffic. SEWPaC has determined that the Transformation is not a controlled action. Biosecurity hazards relating to international shipping will be managed in accordance with Australian Quarantine and Inspection Service (AQIS) requirements.

The remaining 20% of construction material will be transported by road. Increases in traffic volumes will be managed under the CEMP and a traffic management plan. At this stage of the design process, no changes to wharf or road infrastructure are anticipated. The railway will not be used for the Transformation.

Storage of construction materials will be in temporary laydown areas within the existing smelter whenever possible. Construction materials planning will minimise impact to the Port Pirie community while facilitating efficient construction timelines. Construction modules will be unloaded at one of the smelter Berths then transported across from the wharf to the temporary laydown areas. No public roads or train lines will be crossed.

Refer to **Chapter 14** for further information about transport and storage of construction materials.

Construction emission management

Dust, sediment, litter, noise, vibration and construction wastes will be managed during the construction phase under the CEMP to be developed and approved prior to starting construction.

Refer to **Chapter 17** for detail about waste management. **Chapter 18** provides further information about environmental management during construction and operation.

Chemical and feedstock storage facilities

Existing process chemicals storage facilities and feedstock stockpiles will be retained for the new production process. Some process areas will be expanded to improve lead-bearing materials handling, including an augmented proportioning plant with new day bins installed to complement the existing proportioning plant.

Social and environmental impacts

Controls to minimise potential social and environmental impacts of the Transformation construction phase will be incorporated into, and managed under, the CEMP. Potential impacts may relate to employment opportunities, noise emissions, and emissions to air, water and soil.

Known adverse impacts of similar industrial plants

The outputs from the EBS technology are largely the same as those from the existing technology. However, EBS technology is enclosed, enabling capture and treatment of in excess of 95% of process off-gases and other emissions.

At some facilities, depending on process inputs and off-gas treatment, undesirable chemicals can form in the off-gases. The off-gas management technology that Nyrstar will install as part of the Transformation includes a quenching tower as a preventative measure, in case production feedstocks change in the future. The quenching tower is specifically designed to prevent formation of these chemicals. Should Nyrstar decide to change feedstock types in the future, this would require a Process Change Application to be approved by the EPA.

Existing operations during construction phase

Production will continue during the construction phase. Transformation activity areas will be identified and segregated from operations areas to enable construction activities to occur without risk to operations personnel, and without causing any significant impedance to operations. Access to Transformation activity areas and operations areas will be strictly controlled, with authorisation required to enter.

6.3.2 Demolition

Demolition of some existing infrastructure will be required as part of the Transformation.

Three sheds will be demolished near the sample mill, including their slabs at ground level, to enable construction of an oxygen facility and a cogeneration facility. A workshop and contractor's building will be constructed to the south of the copper electrowinning facility to replace those sheds before their demolition.

Various existing facilities will be demolished leaving the slabs for future use. Among these are redundant facilities including coke storage, a stack, a gantry crane and water storage tanks, to be demolished prior to installation of new facility. Infrastructure to be retained until new facility is operational or replacement facilities have been constructed includes a rigger shed, precipitator, machine workshop, pattern store, crib room and various other sheds.

Facilities that will become redundant and be demolished at a later stage include the rectifier house, the telpher area, the existing sinter plant and acid plant, the acid loading area and acid storage facilities.

6.3.3 Decommissioning and transitional arrangements

As production will continue during the Transformation, decommissioning of each existing process will not occur until its replacement equipment and infrastructure is installed and commissioned. Commissioning of project works will be conducted as each facility is completed and readied for service. Contingency planning will allow for existing facilities to remain operable until commissioned equipment has proven serviceable.

Assessment, management and removal of contaminated materials during decommissioning and transition will be managed in accordance with South Australian regulations and will be described in the CEMP. Remaining legacy contamination will be managed under the operations environmental management plan.

6.4 Operation and maintenance

Operational management of the transformed facility will be similar to the current production facility, although it will be more efficient, using modern technology, including the new EBS oxidation furnace and a new acid facility. Emissions and environmental and community impacts will be significantly lower.

The number of personnel employed to operate the transformed facility is not expected to change significantly from the current number of operational personnel.

6.4.1 Smelter operations environmental management plan

An operations environmental management plan (OEMP) will be written to manage operational activities to minimise impacts on the local environment. A draft OEMP is appended to this PER, outlining strategies to minimise potential environmental impacts of operation. A final OEMP will be developed prior to commissioning the Transformation facilities. The OEMP will be monitored, reviewed, re-evaluated and communicated during the operational phase in accordance with the Nyrstar risk management framework (see **Chapter 16**).

The proposed works will be constructed and operated on an existing brownfields smelter, in an area surrounded by operational industrial production facilities. Noise and vibration associated with the operation of the Transformation facilities are not anticipated to have any additional adverse impact on the environment or the community. Mitigation measures will be incorporated into the OEMP, and will include measures such as enclosure of facilities within buildings.

6.4.2 Operations emissions management

Dust, sediment, litter, noise, vibration and operations wastes will be managed during the operation phase under the OEMP.

The OEMP will also address chemical storage, plant feedstock stockpiles, materials handling, and management of storage bays, shed enclosures, bunding, drainage, and the handling and recovery of spills and emergencies.

During the operational phase of proposed development stockpiles are to be handled and stored in secured facilities and comply with Australian Codes & Standards and Occupational Health and Safety requirements. Aside from changes described previously, chemical storage areas and quantities will remain similar to the current operation.

Refer to **Chapter 17** for detail about waste management.

7 Effects on air quality

7.1 Introduction

The 2011-2012 National Pollutant Inventory report for Nyrstar Port Pirie lists 26 substances emitted to air. This report is limited to an examination of three key pollutants affected by the Transformation, namely sulphur dioxide (SO_2), lead and particles with a mean aerodynamic diameter less than 10 micrometres (PM_{10}). The health effects of these three substances are described in **Chapter 8**.

Impact assessments for these substances are reported and include the results of dispersion modelling for lead (**Appendix B**) and SO_2 (**Appendix C**) The impact of airborne emissions during Transformation construction and de-commissioning was not modelled due to the transitional nature of emission production at these times. Modelling was considered only at full production following Transformation.

Improvements in air quality due to the Transformation arise because of:

- replacement of the existing sinter plant with an EBS furnace and the associated reductions in material movements
- improved blast furnace drafting
- a new acid facility with increased capacity.

The Environment and Health Feasibility Study for the Smelter Transformation (EHWP 2013) estimated a 50% reduction in Port Pirie's air lead concentrations due to the Transformation with further reductions possible from continual improvement (**Figure 7-1**).

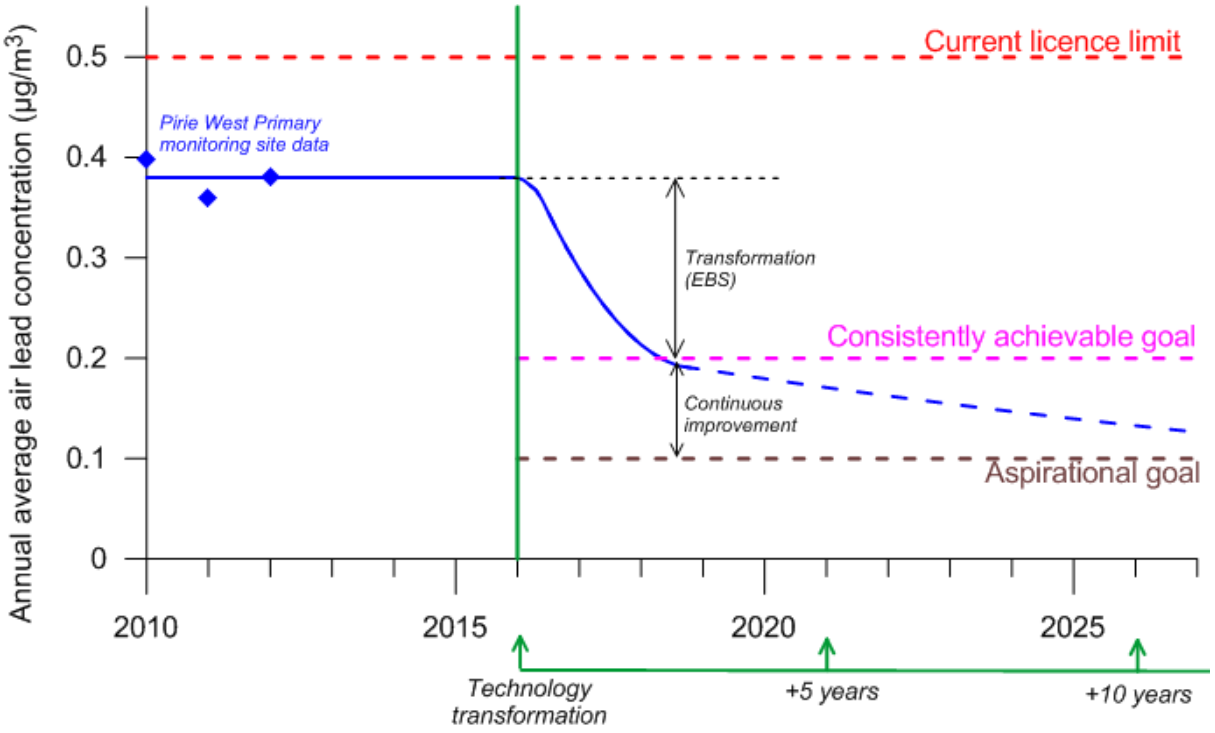

Figure 7-1: Schematic diagram (Appendix L) showing projected reductions in air lead concentrations at EPA licence monitoring sites following the Transformation in 2016 and implementation of a continual improvement program

Air quality in Port Pirie is influenced by the pattern of wind directions and the location of the smelter at the northern end of the town. Winds are predominantly (70% of the time) from directions that transport smelter emissions away from the town (**Figure 7-2**). For winds where the smelter is upwind from the town, the winds are principally from the NNW sector (15–20% of the time between N and NW) with a smaller fraction from the NE sector (10% of the time between N and E).

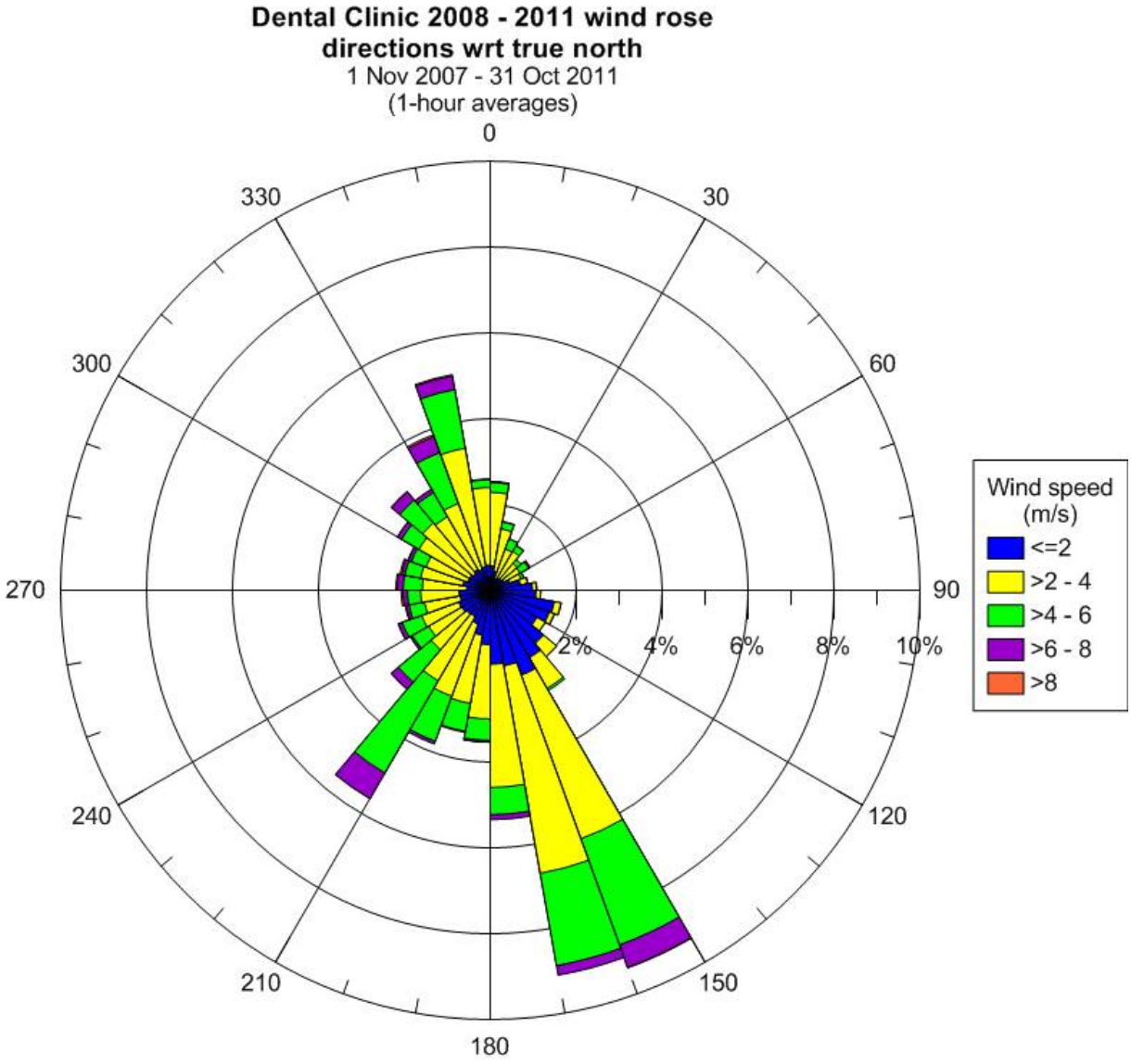

Figure 7-2: Port Pirie wind rose as measured at the Dental Clinic monitoring site from 2007–2011

7.2 Air quality criteria

The NEPM standards and supporting legislation are described in **Section 4.1.2**. The NEPM standard is used because they are nationally agreed standards for ambient air quality that allows for adequate protection of human health and well-being. **Table 7–1** lists the NEPM ambient air quality standards for the pollutants considered in this section.

Table 7–1: NEPM ambient air quality standards for sulphur dioxide, lead and particles

Pollutant	Averaging period	Maximum (ambient) concentration	Goal within 10 years (maximum number of exceedances)
Lead	1 year	0.50 µg/m^3	none
Sulphur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year None
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year

Air lead is a measure of the mass of lead particles in dust suspended in the air. Air lead standards vary between countries. For Australia, the NEPM air lead standard is an annual average of 0.5 µg/m^3. By comparison, the air lead standard (annual average) in Europe was reduced from 2.0 µg/m^3 to 0.5 µg/m^3 in January 2005. A transitionary value of 1.0 µg/m^3 was applied in the immediate vicinity of specific, notified industrial sources from January 2005 until January 2010, after which time the 0.5 µg/m^3 limit was also applied to these sources.

The US EPA introduced a new air quality lead standard in 2008 of 0.15 µg/m^3 as a rolling 3-month average. This replaced the 1978 lead standard of a quarterly average of 1.5 µg/m^3 (USEPA, 2008). A transitionary arrangement applied to smelters that did not meet the 1978 standard until implementation plans to attain or maintain the 2008 standard were approved. The new standard coincided with the closure (slated for the end of 2013) of the last lead smelter in the US (in Herculaneum, Missouri).

The international comparison of standards for sulphur dioxide is more complex because of the range of averaging times used. In Europe, the standards were reduced in 2005 to 0.12 ppm (350 µg/m^3) for 1-hour averages with 24 exceedances permitted each year and 0.04 ppm (125 µg/m^3) for 24-hour averages with 3 exceedances permitted each year.

In the USA, the SO_2 standards were tightened in 2010. For 1-hour averages, the standard is 0.075 ppm for the 99th percentile of the daily maximum of 1-hour averages over 3 years. Prior to this, there was a 24-hour standard of 0.14 ppm (not be exceeded more than once per year) and an annual average standard of 0.03 ppm.

For PM_{10} the current European standard is 50 µg/m^3 for 24-hour averages with 35 exceedances permitted each year, and 40 µg/m^3 for the annual average. In the USA, the national ambient air quality standard is 150 µg/m^3 for 24-hour averages, not to be exceeded more than once per year on average over 3 years.

7.3 Existing air quality

7.3.1 Air lead

Nyrstar currently operates 12 high-volume air quality monitors across Port Pirie, which collect 24-hour samples of total suspended particles (TSP). These are analysed for a range of metals including lead. **Figure 7-3** shows the locations of these monitoring sites as well

as the distribution of annual average concentrations across Port Pirie from the last five years of data (2008–2012), with fitted smoothed contours shown in yellow. The EPA and SA Health also operate TSP air lead sampling sites at Ellen Street, Frank Green Park, and Pirie West Primary School and a sampling site for both TSP air lead and PM_{10} air lead at Oliver Street.

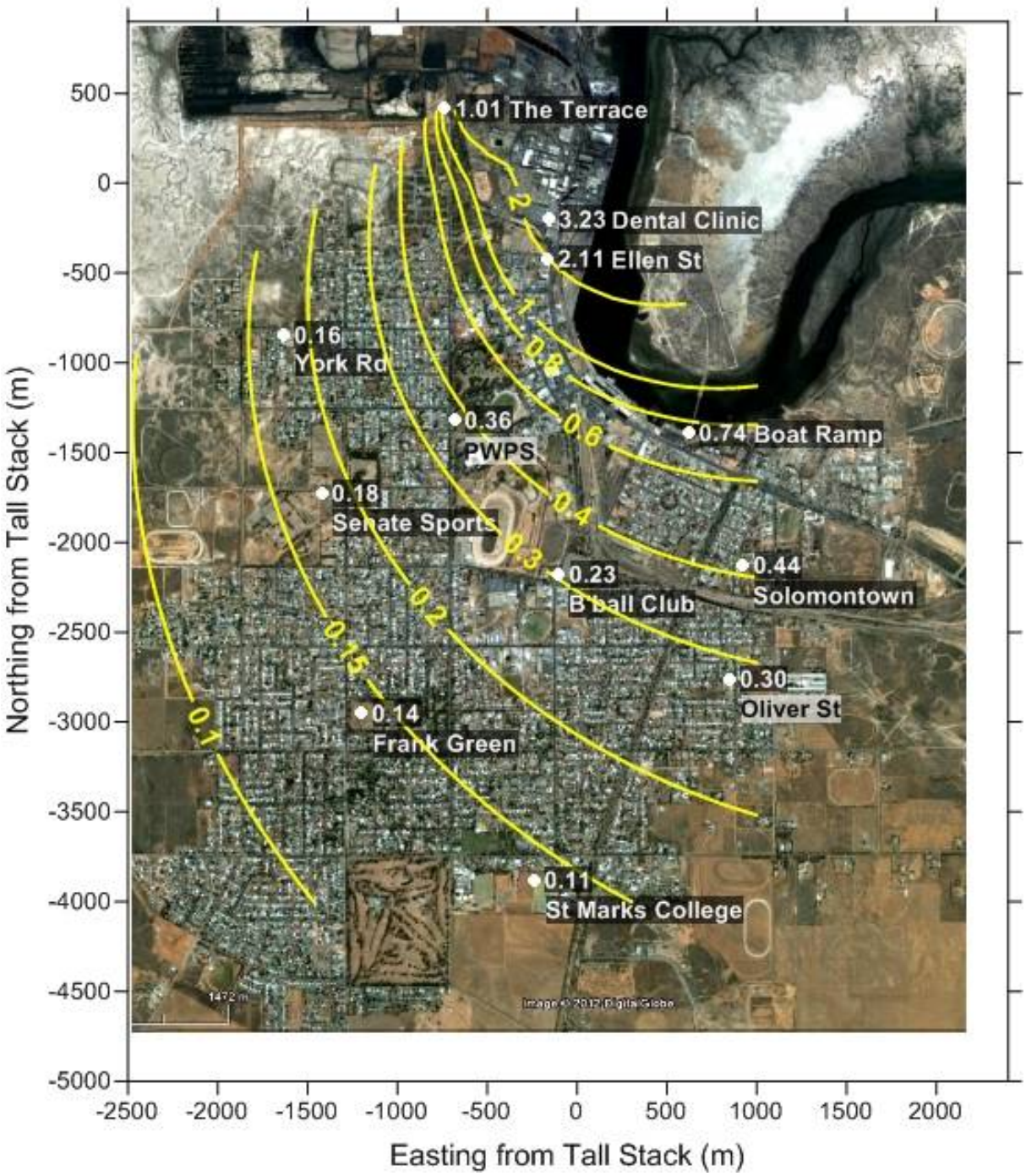

Figure 7-3: Five-year (2008-2012) average air lead concentrations (units of µg/m³) at the Port Pirie monitoring sites with fitted smoothed contours shown in yellow (Appendix L)

The shape of the contours is strongly influenced by the dominant wind directions shown in **Figure 7-3**, with the highest concentrations at a given distance from the smelter being to the southeast with lower concentrations to the south and southwest. The five-year average concentrations were used to smooth out the effects of year-to-year variability.

The most recent lead emissions study of the Nyrstar smelter (PAE Holmes, 2012) showed that in 2010/2011, background air lead concentrations at the licence monitoring sites (determined from days when the wind directions were not from the smelter) were less than 0.005 µg/m^3. This confirms that current smelter emissions rather than re-entrained dust from the region are the dominant source of air lead in Port Pirie.

The longer term trend in annual average air lead concentrations in **Figure 5-7** shows the significant reductions over the last 10 years at the licence monitoring sites at Pirie West Primary School and Oliver Street. Air lead levels are below the 0.5 µg/m^3 NEPM standard at both monitoring sites since 2008. The significant reductions since 2005 are the results of emission and exposure reduction work undertaken as part of the 'Ten by 10' program.

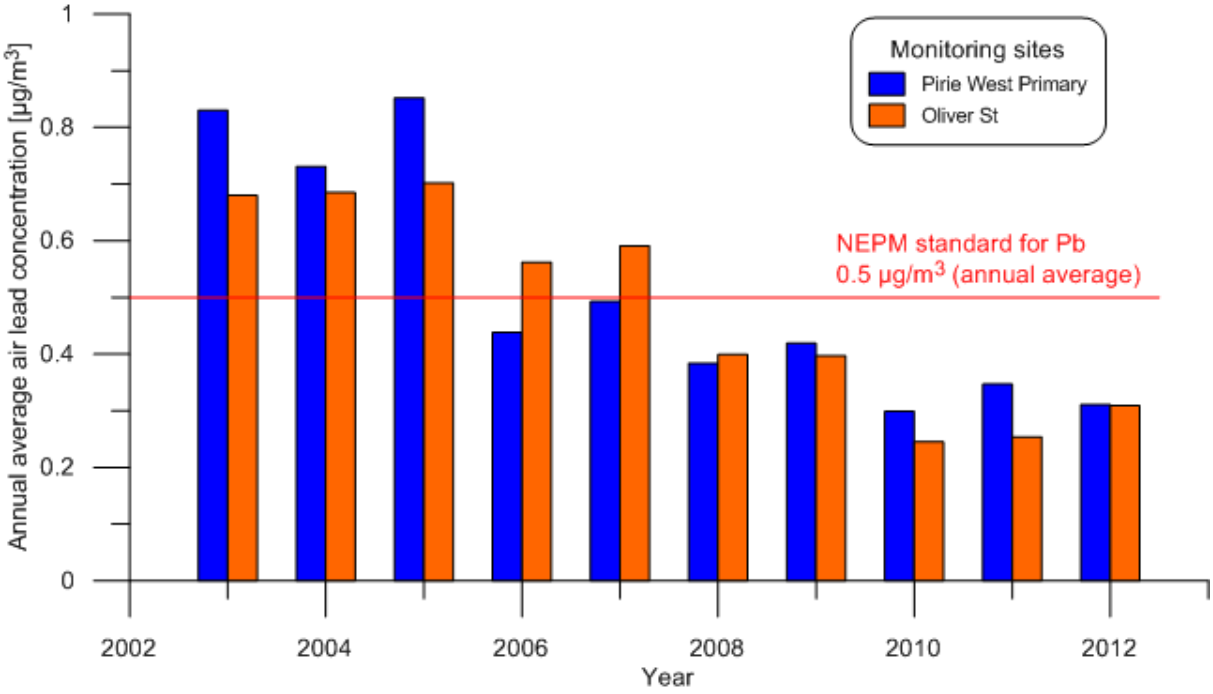

Figure 7-4: Annual average lead concentrations at the EPA Pirie West Primary School and Oliver Street monitoring sites for the last 10 years

7.3.2 Sulphur dioxide

The concentration of sulphur dioxide in air is currently measured continuously at the Oliver Street, John Pirie High School, Frank Green Park and the Boat Ramp (previously Golden North) monitoring sites (**Figure 7-8**). Measured sulphur dioxide levels in Port Pirie repeatedly exceed the 1-hour NEPM standard of 0.20 ppm (**Figure 7-5**). As discussed in **Section 7.5**, the highest concentrations occur due to convective mixing down of emissions from the smelter's tall stack. Over the last 9 years, there are between 30 and 40 days per year when the 1-hour NEPM standard is exceeded (**Figure 7-6**). For the last three years,

the NEPM standard has been exceeded on average 36 days per year. The NEPM goal is for not more than one exceedance per year of the 1-hour standard.

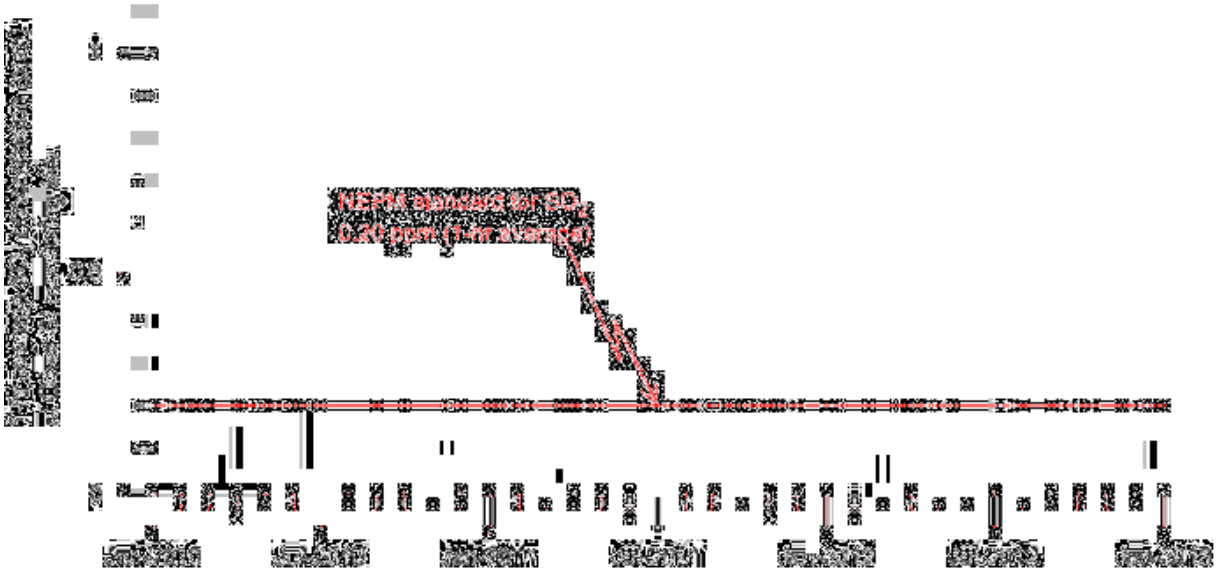

Figure 7-5: Time series of 1-hour average SO_2 concentrations at Oliver Street for the last 3 years (2010–2012)

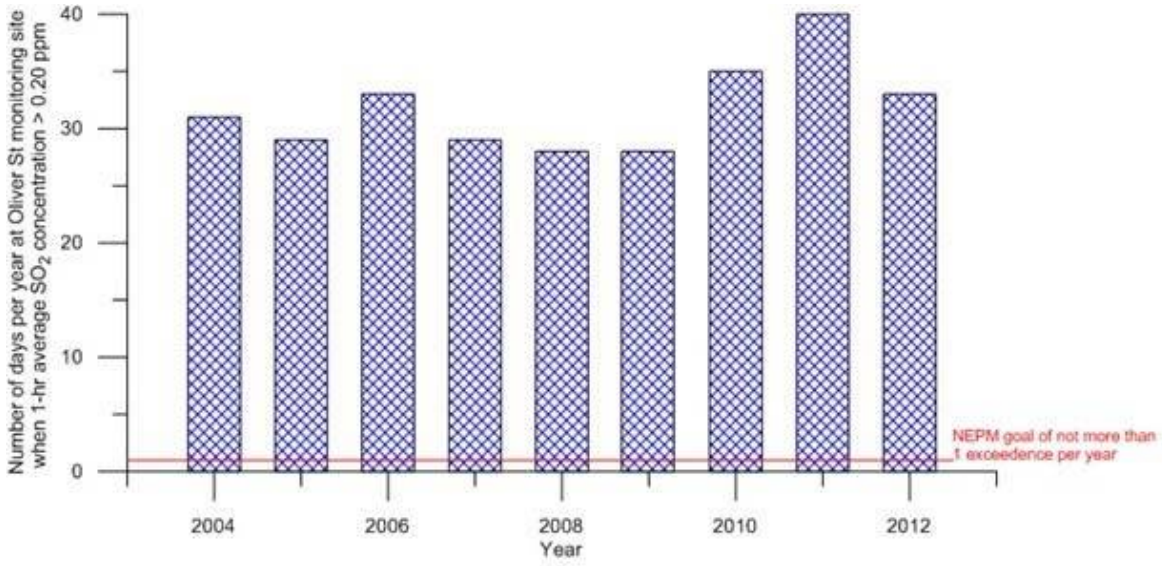

Figure 7-6: Number of days per year since 2004 at Oliver Street monitoring site when the 1-hour average SO_2 concentration exceeds 0.20 ppm

By contrast to the 1-hour averages, the majority of 1-day averages recorded are below the NEPM standard of 0.08 ppm, with the only exceedance over the last 9 years in 2012; a value of 0.091 ppm (**Figure 7-7**). Similarly, the annual averages of 0.007–0.009 ppm over this period are well below the NEPM standard of 0.02 ppm.

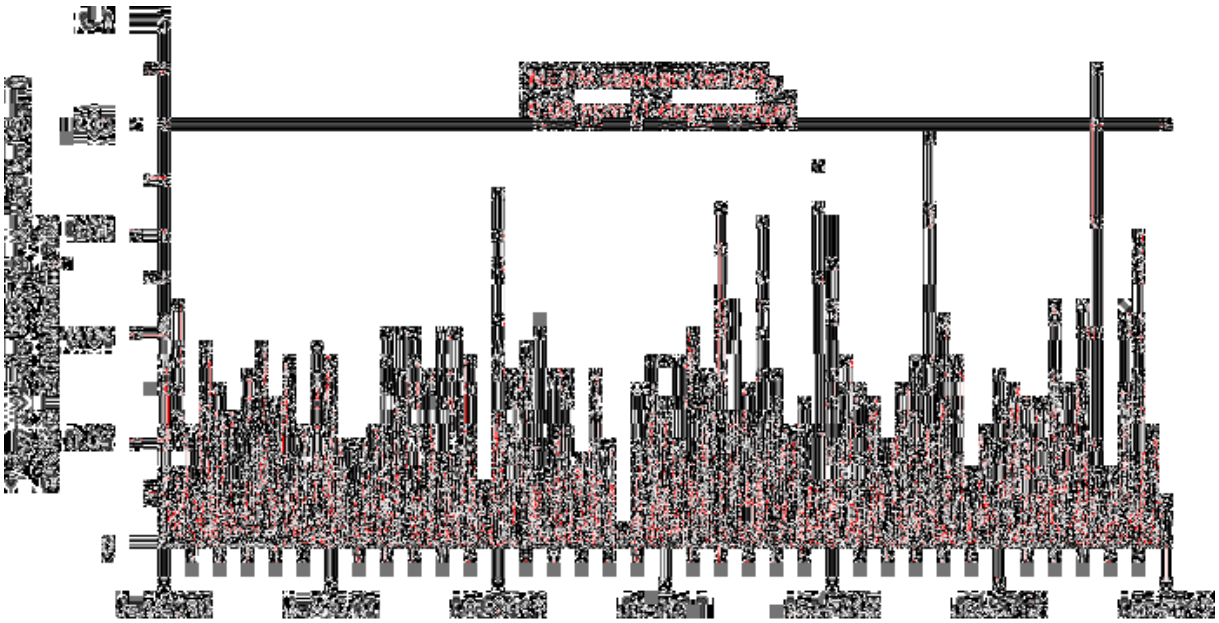

Figure 7-7: Time series of 1-day average SO_2 concentrations at Oliver Street for the last three years (2010–2012).

The distribution across Port Pirie of the number of days when 1-hr average SO_2 concentrations currently exceed 0.20 ppm is given in **Figure 7-8**. This shows the modelled contours for 2005-2006, along with observations from the four monitoring sites. The effect of the predominant southerly winds can be seen by the greater number of days with exceedances to the north of the smelter.

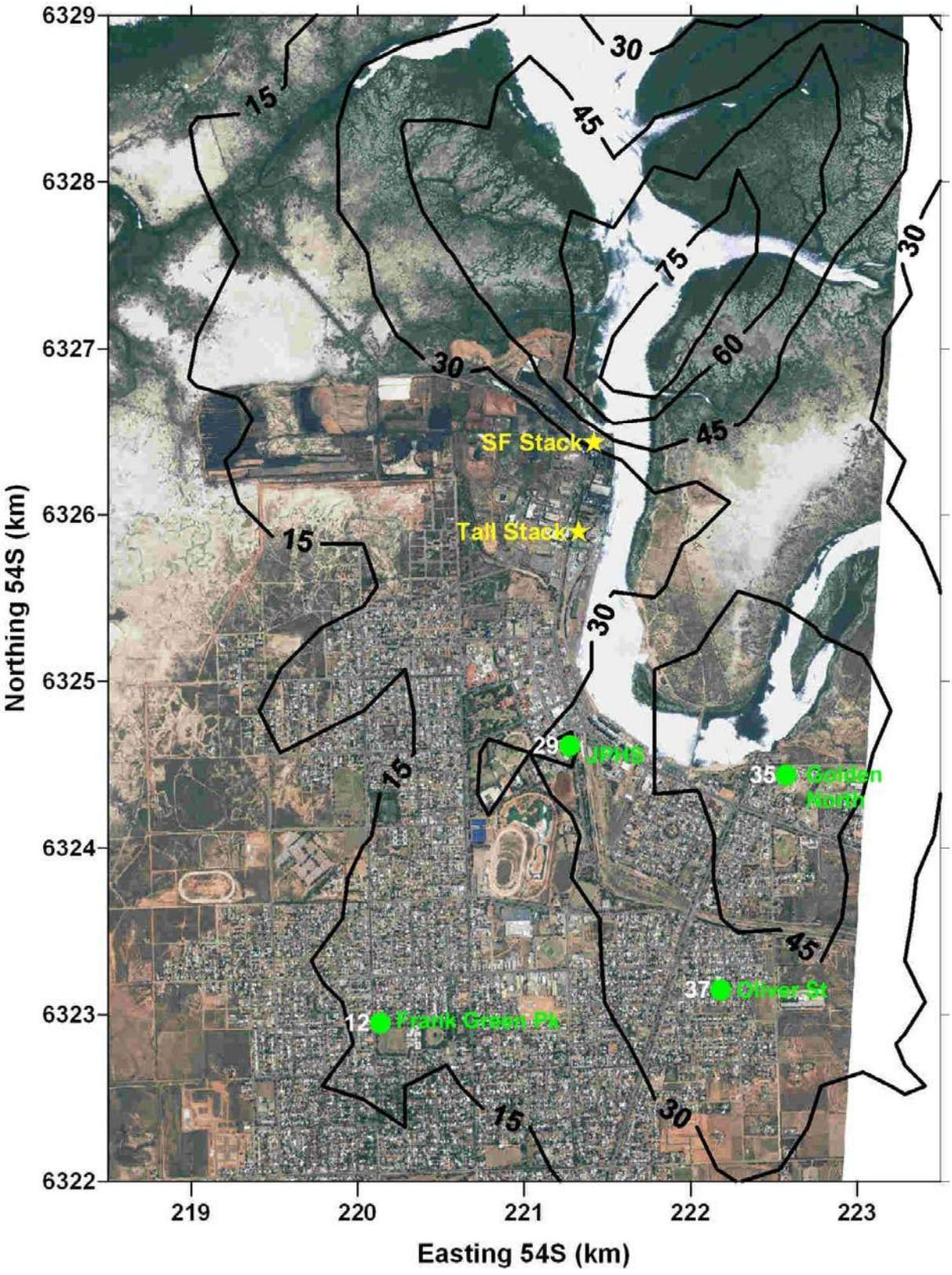

Figure 7-8: Modelled distribution of the number of days (labelled contours) when 1-hour average SO_2 concentrations exceeded 0.20 ppm in 2005-2006. The white numbers next to the green dots shows the actual number of days with exceedances at the four monitoring sites of John Pirie High School, Golden North, Frank Green Park and Oliver Street. NEMP standard allows no more than 1 day of exceedance.

7.3.3 PM_{10}

The most recent data for PM_{10} is available from the TEOM (tapered element oscillating microbalance) operated by Nyrstar at the Boat Ramp site. **Figure 7-9** shows that average concentrations have reduced over the last few years with only one exceedance in 2011, four in 2012 and none for the 4 months of available 2013 data. These PM_{10} concentrations meet the NEPM goal of not more than five exceedances per year.

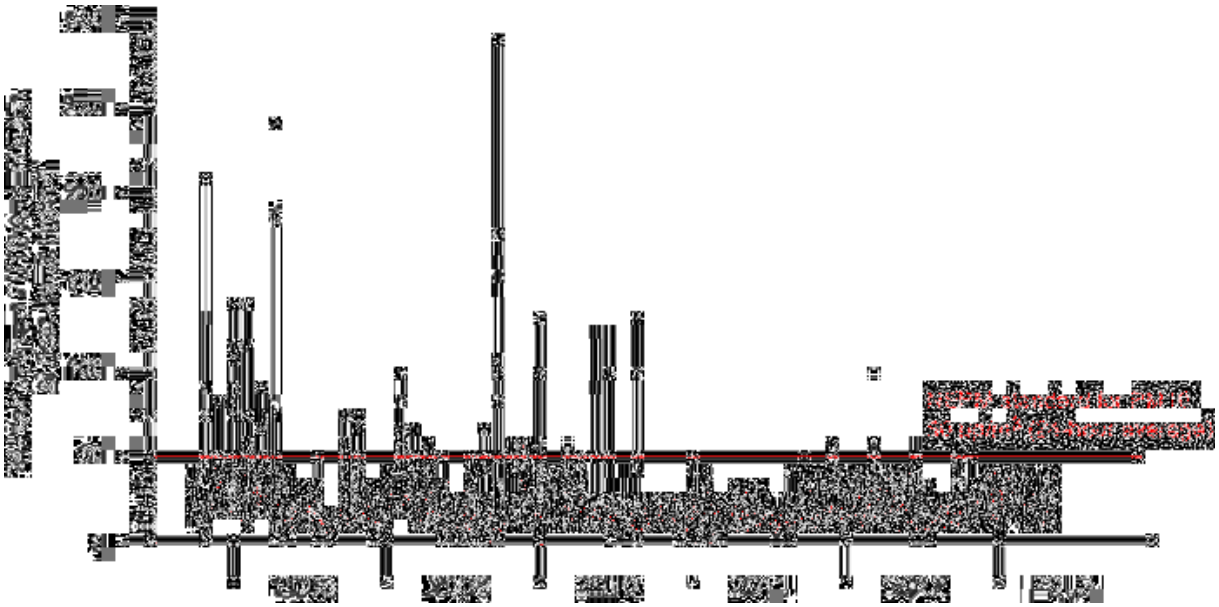

Figure 7-9: 24-hour average PM_{10} concentrations at the Boat Ramp monitoring site for five years 2008–2013.

7.4 Assessment methodology

Modelling of the impact of the proposed Transformation on air quality was undertaken in two separate assessments, one for air lead and one for sulphur dioxide (**Appendices C** and **D** respectively). Modelling of PM_{10} was not undertaken because current levels do not exceed the NEPM guidelines.

The sulphur dioxide modelling of SO_2 ground-level concentrations was undertaken using The Air Pollution Model (TAPM; version 4.05). The meteorological predictions of the model were validated against observations of winds at the Oliver Street monitoring station. The 12 months from July 2005 to June 2006 were selected for modelling because of the availability of a validated set of SO_2 measurements from four separate monitoring sites. The data in **Figure 7-4** indicates that there has been no significant change in SO_2 emissions since 2005/6, so modelling is assumed to be representative of current conditions.

The air lead modelling was carried out using CALPFF (version 6) software because of the importance of accurately modelling dispersion of the many surface and near-surface sources (e.g. stockpiles and the sinter plant) of air lead. Most of the sources of air-borne lead within the smelter are low level sources. The winds predicted by the model were validated against the Oliver Street data. The air lead emissions data used as input to the model was for the years 2010-11. The starting point for the air lead emission estimates was the work undertaken by PAE Holmes (2012), but was extended to improve estimates of emissions

from activity in the intermediate storage area. The predicted air lead concentrations for current operations were assessed against observed annual average air lead concentrations at the 12 monitoring sites for 2010 and 2011.

7.5 Post-Transformation model results

The following sections summarise two separate post-Transformation modelling results; air lead and sulphur dioxide. Additional information on each model is provided in Appendix B and Appendix C.

7.5.1 Air lead

Table 7–2 lists the sources of air lead emissions for both current and post-Transformation conditions. It shows that currently the main sources are the sinter process (27%), blast furnace (24%), slag fumer (29%) and the intermediate storage area (14%). The total air lead emissions of 62.2 tpa listed in **Table 7–2** is lower than the PAE Holmes (2012) inventory of 71.8 tpa for 2010-11, but higher than their adjusted estimate of 38.8 tpa, which was derived from a comparison of observed and predicted concentrations. This range of numbers reflects the considerable uncertainty in the actual emissions from many of the sources, which is due to uncertainty in emission factors, variability in the sources and dust control procedures etc.

Table 7–2 also lists the likely change in emissions from each source due to the Transformation, with total air lead emissions anticipated to reduce by 53% to 29.0 tpa. The major lead sources post-Transformation are seen to be the slag fumer (31%), blast furnace (15%) and point sources (12%). Thus the impact of the Transformation on ground-level concentrations of lead is assessed using the ratio of the predicted post-Transformation concentrations to the predicted current concentrations.

Figure 7-10 shows the predicted average air lead concentrations for current emissions. It agrees reasonable well with the contours in **Figure 7-3**, which were based on fitting the observed data. The average of the predicted concentrations agrees with the average observed concentration at the monitoring sites, with individual predictions all within a factor of two of the observations, which represents a solid basis for point-by-point model comparisons.

Table 7–2: Lead emissions for current smelter and post-Transformation

ID	Source	Current lead emissions as modelled		Predictions post-Transformation		
		kg/year	% of Total	Emissions as % of existing	kg/year	% of Total
SHIP	Ship unloading	2,051	3	100	2,051	7
PP	Proportioning facility (mixing plant)	1,701	3	50	850	3
Blast furnace sources						
BF	Blast furnace	14,518	23	30	4,363	15
TDO	Telpher drop off	421	1	0	0	0
Sub-total blast furnace sources		*14,938*	*24*		*4,363*	*15*
Sinter process sources						
SM	Sinter machine	7,341	12	0	0	0
SB	Sinter bins	751	1	0	0	0
BBDP	Battery bay & duck pond	236	0	0	0	0
EN	Eagles nest	3,464	6	0	0	0
DL	D&L building	5,240	8	0	0	0
NOF	EBS furnace	0	0		1,483	5
Sub-total sinter process sources		*17,033*	*27*		*1,483*	*5*
OPAVS	All other process area volume sources	1,561	3	100	1,561	5
APAPS	All process area point sources	3,588	6	100	3,588	12
Slag fuming process sources						
SF	Slag fumer	9,145	15	100	9,145	31
KDR	KDR System	3,013	5	100	3,013	10
Sub-total slag fuming process sources		*12,158*	*29*		*12,158*	*42*
p1-21	Paved roads	1,553	2	20	311	1
Intermediate storage area sources						
OPAS	Other intermediate storage area sources	1,430	2	100	1,430	5
u1-19	Unpaved roads	2,186	4	20	437	2
SRS	Sinter returns, sludge & residue mixes stockpiles	4,013	6	20	803	3
Sub-total intermediate storage area sources		*7,630*	*14*		*2,670*	*9*
TOTAL		62,213	100%		29,036	100%

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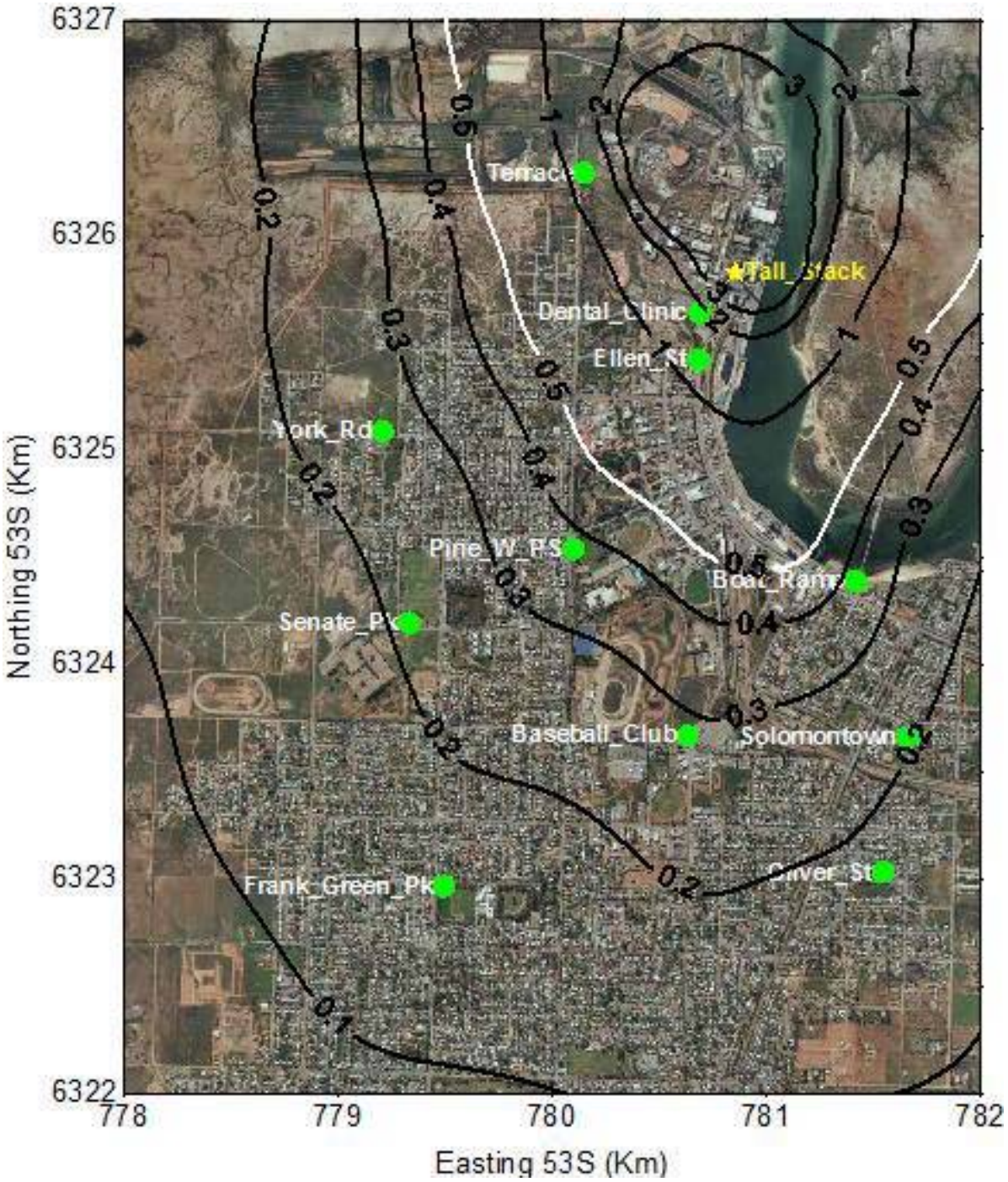

Figure 7-10: Predicted annual average air lead concentrations (µg/m^3) modelled using current emissions with monitoring sites shown as green dots. White contour is 0.5 µg/m^3 for reference to the NEPM Standard.

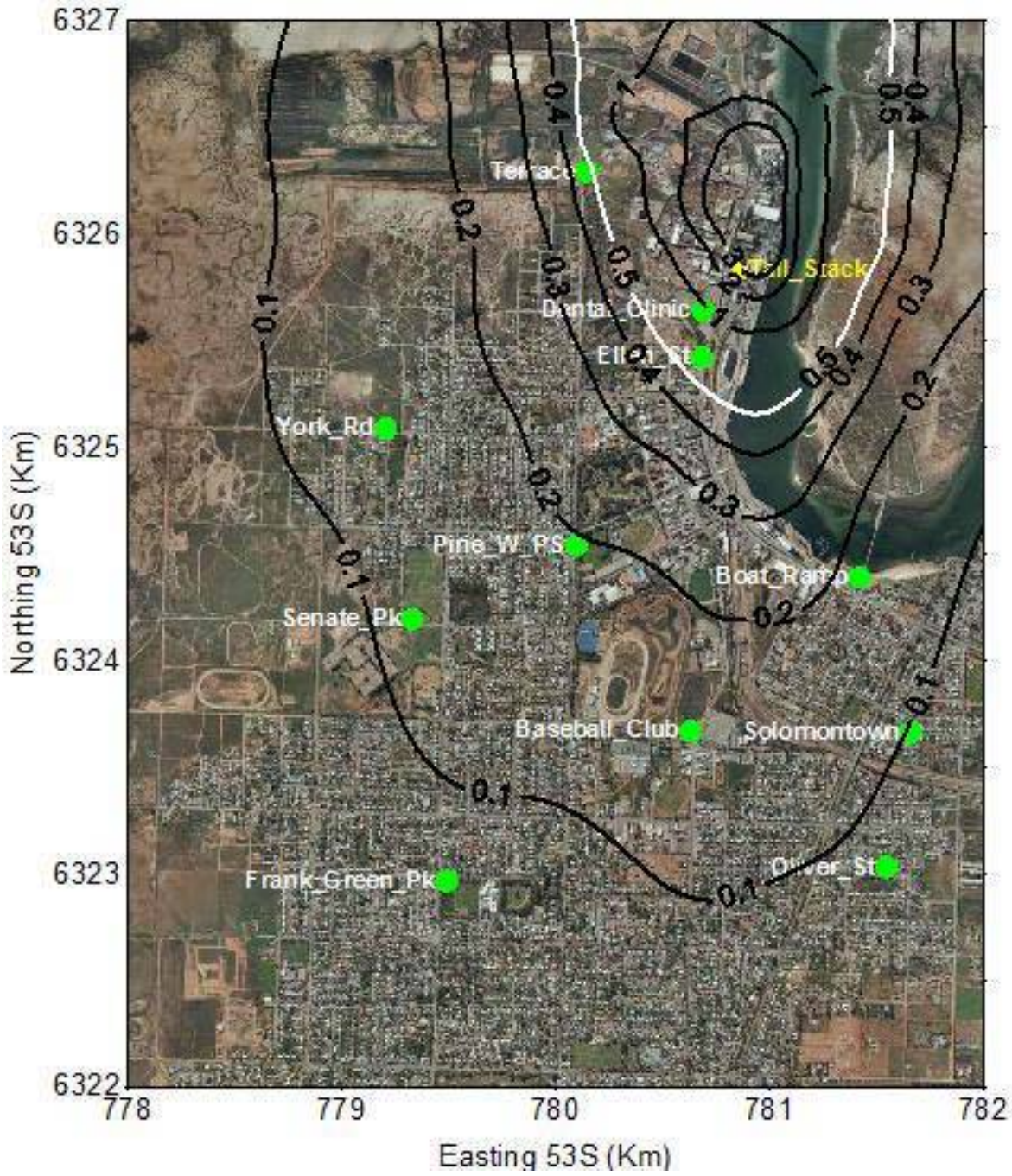

Figure 7-11: Predicted annual average Lead concentrations (µg/m^3) following Transformation with monitoring sites shown as green dots. White contour is 0.5 µg/m^3 for reference to the NEPM Standard.

Figure 7-11 shows the impact of the Transformation on the contours of annual average air lead concentrations across Port Pirie. Only a small area near the smelter exceeded the NEPM annual average standard of 0.5 µg/m^3. The annual average air lead concentrations are predicted to reduce to approximately 48 to 56% of current levels.

Table 7–3 lists the current observations at the monitoring sites, the predicted changes as a percentage, and the predicted post-Transformation annual average concentrations.

Table 7–3: Summary of current and predicted post-Transformation annual average air lead concentrations (µg/m^3) at the monitoring sites

Monitoring site	Observed annual average air lead concentrations 2010-2011 (µg/m^3)	Predicted post-Transformation as % of current values (%)	Predicted post-Transformation annual average air lead concentrations (µg/m^3)
York Road	0.19	52	0.10
Senate Sports Park	0.21	53	0.11
Frank Green Park	0.15	53	0.08
Terrace	1.00	39	0.39
Dental Clinic	3.33	49	1.64
Ellen Street	2.22	48	1.08
Port Pirie PS	0.39	51	0.19
Baseball Club	0.21	51	0.10
Boat Ramp	0.60	47	0.28
Solomontown	0.40	47	0.19
St Marks College	0.11	52	0.06
Oliver Street	0.27	49	0.13
Median	0.33	50	0.16

The modelling predicts that the current annual average air lead concentrations at the licensed EPA monitoring sites will fall from 0.39 µg/m^3 to 0.19 µg/m^3 at the Pirie West Primary monitoring site and from 0.27 µg/m^3 to 0.13 µg/m^3 at the Oliver Street monitoring site. The uncertainty in these numbers can be estimated from the annual variability of about ±10% in the annual averages over the last 3 years (**Figure 7-4**).

7.5.2 Sulphur dioxide

The major smelter sources of SO_2 are the four stacks listed in **Table 7–4**. The tall stack is currently the largest source of SO_2, accounting for approximately 95% of SO_2 emitted.

The Transformation includes the installation of a new acid plant. This change in infrastructure means that SO_2 emissions from the EBS oxidation furnace will be captured in the new acid plant. This will lead to a reduction of approximately 90% in the SO_2 emissions from the tall stack; this is seen in the change in the modelled median value in **Table 7–5**. The modelling also accounts for emissions during an acid plant shut down. During these events, the feed to the EBS oxidation furnace will initially stop, and the EBS oxidation furnace will be shut down unless the acid plant can be brought back on-line quickly. Therefore the EBS oxidation furnace will only continue to emit significant off-gases for approximately 15 minutes after the acid plant has stopped. These events mean that the maximum emission rate (**Table 7–5**) is reduced to only 18% of current values, rather than to 10%.

Table 7–4: Emission parameters for major SO_2 sources

Stack	Stack Height (m)	Median SO_2 Emission rate (g/s)	
		Current (2005/6)	Post-Transformation
Tall stack	205	1970	199
Slag fumer baghouse stack	44.2	56	56
KDR2 stack	36.5	27	27
Acid facility stack (new)	60	-	42
TOTAL		2081	324

Table 7–5: Changes in SO_2 emission rates for the smelter tall stack

Statistic	Current (2005/2006) SO_2 emission rate (g/s)	Post-Transformation SO_2 emission rate (g/s)	Post- Transformation as percentage of current emissions
Maximum	3315	613	18%
Median	1970	199	10%
Average	1836	202	11%

Figure 7-12 shows the contours of the predicted maximum 1-hour average SO_2 concentrations following Transformation. The concentrations are generally predicted to decrease to 50% of current values, so that the area over which the 1-hour NEPM standard of 0.20 ppm is exceeded contracts greatly following the Transformation. Greater reductions in concentrations occur at the more distant sites (Frank Green Park and Oliver Street) with the 1-hour maximum decreasing to less than 40% of current levels, whereas the reductions are less at monitors closer to the smelter, with values decreasing to between 48 and 64% of current levels e.g. Ellen Street and Pirie West Primary School. The reason for these differences is that closer to the smelter the modelling shows a greater proportion of the observed SO_2 is due to emissions from the shorter stacks, whose emissions do not change appreciably in the Transformation.

Compared to the current situation shown in **Figure 7-8**, the predicted number of days post-Transformation with exceedances of the 1-hour NEPM standard of 0.20 ppm is dramatically reduced (**Figure 7-13**). However there is still an area close to the smelter and along the river in which occasional exceedances may occur.

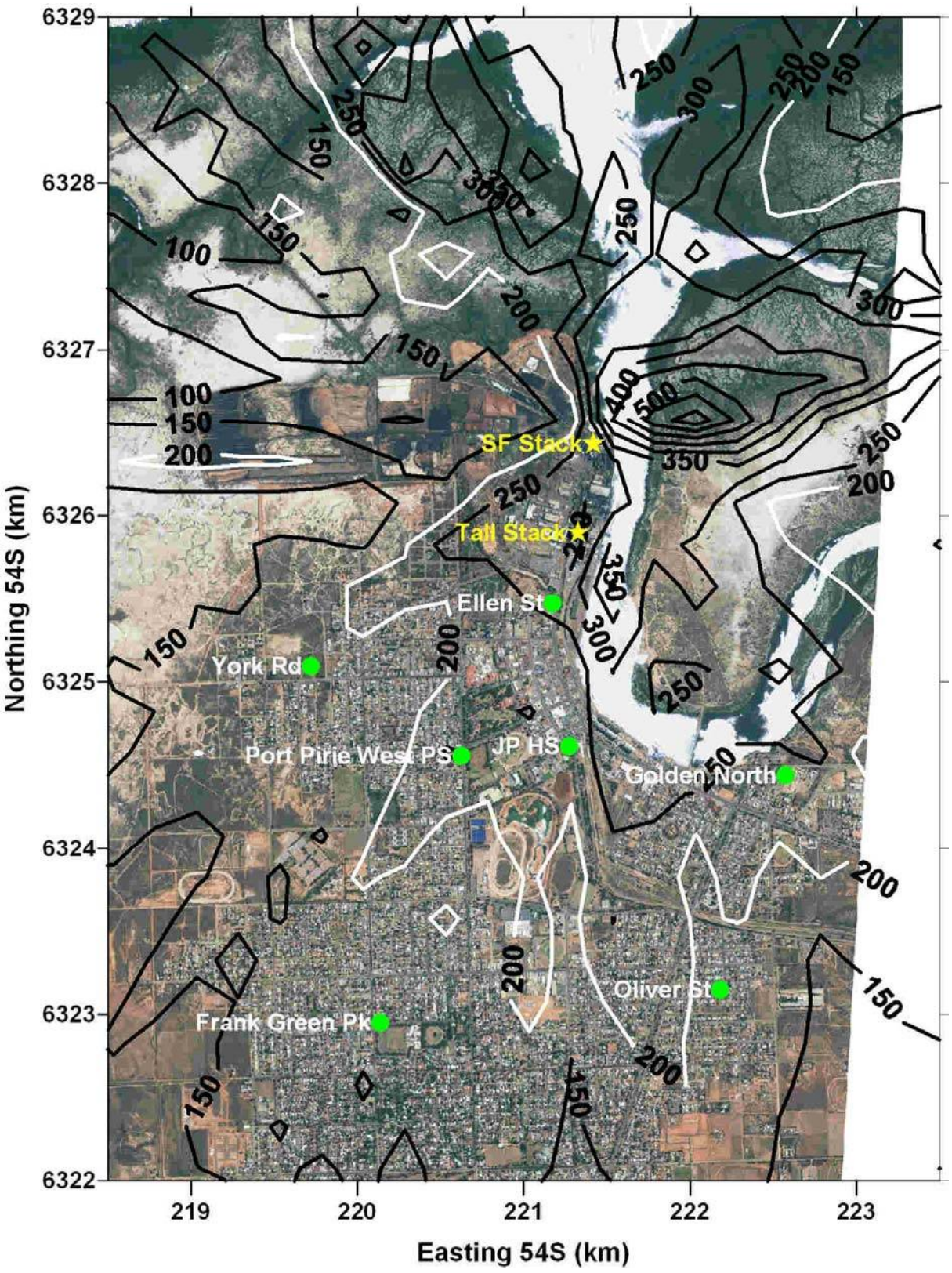

Figure 7-12: Predicted maximum 1-hour average SO_2 concentrations (ppb) following Transformation. The white contour is the 0.20 ppm NEPM standard

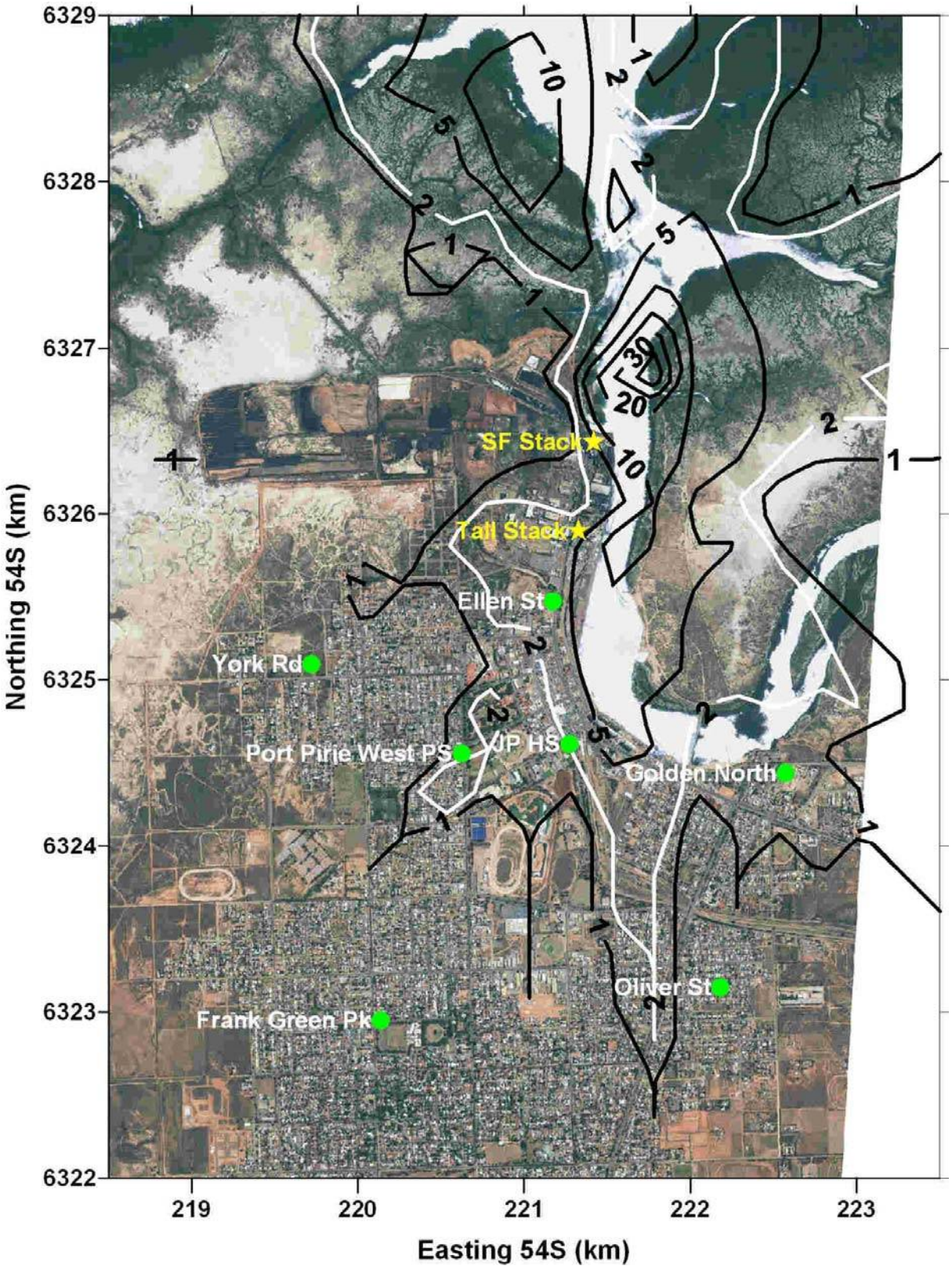

Figure 7-13: Predicted number of days when the 1-hour SO_2 NEPM of 0.20 ppm is exceeded following Transformation. White line for reference

7.6 Management

It is proposed that the current network of monitoring sites for both air lead and SO_2 remain in place during the Transformation and until all associated works and changes planned for the intermediate storage area materials and stockpiles are completed. This will enable ongoing assessment of the improvements in air quality in Port Pirie.

It is expected that following the significant reductions in emissions from the sinter plant/blast furnace region of the smelter, as well as major reductions in intermediate storage area emissions, it will be possible to undertake more targeted monitoring to confirm areas for ongoing improvements.

7.7 Conclusions

In summary, the Transformation will lead to major improvements in Port Pirie's air quality due to:

- replacement of the existing sinter plant with an EBS furnace and the associated reductions in material movements
- improved blast furnace drafting
- a new acid facility with increased capacity.

The annual average air lead concentrations are predicted to reduce to approximately 50% of current levels. It is predicted that following the Transformation, all except a small area near the smelter will be compliant with the NEPM standard of 0.5 $\mu g/m^3$ for annual average lead concentrations.

Sulphur dioxide concentrations are predicted to decrease on average to 50% of current values. It is predicted that post-Transformation it is likely that there will be no exceedances of the 1-hour NEPM standard of 0.20 ppm SO_2 at the Oliver Street monitoring site, compared to the current situation with exceedances averaging 36 days per year at this site over the last 3 years. However, it is predicted that there will still be occasional exceedances (less than 5 per year) in a small area along the river and close to the smelter.

8 Effects on health

8.1 Introduction

The most significant and studied effect on human health from the existing Nyrstar operations is lead. While the principal focus of this chapter is the effects of lead on human health, two other pollutants; sulphur dioxide (SO_2) and fine dust (PM_{10}) are also discussed.

Lead has been deposited from the smelter into the Port Pirie community for 124 years. The build-up of lead in soil and organisms is well understood and significant progress has been made by the community with support from government and Nyrstar to manage lead levels in blood, with a strong emphasis on children.

While contaminated soils are being managed using best available technology and strategies, the ongoing emissions of lead, SO_2 and PM_{10} from the smelter are known to have potential human health effects in Port Pirie.

A significant outcome of the Transformation is reduced lead, SO_2 and fine dust emissions. This will support the community efforts to achieve blood lead levels, particularly for children, which 0–4 years meet the following National Health and Medical Research Council (NHMRC) recommendation:

All Australians should have blood lead levels below 10 micrograms per decilitre (µg/dL) and that children's lead exposure should be minimised (NHMRC 2009).

The Transformation is projected to increase the proportion of Port Pirie children with blood lead levels below 10 µg/dL from 75% to between 85-90%. In conjunction with the Targeted Lead Abatement Program (TLAP) and further continual improvement, the proportion of children with blood lead levels below 10 µg/dL is projected to increase to 95% over the decade following the Transformation. **Figure 8-1** presents the increase in percentage of children with blood lead concentrations below 10 µg/dL over the next twenty years.

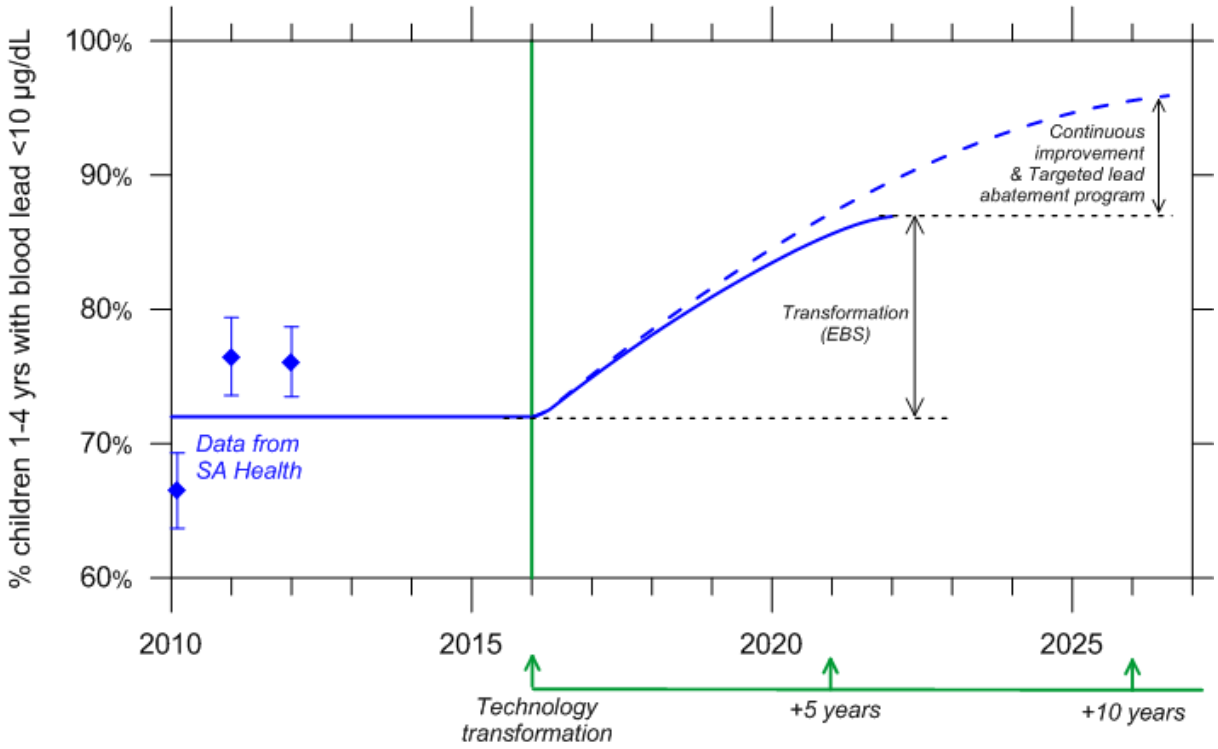

Figure 8-1: Projected increase in percentage of children with blood lead levels below 10 µg/dL following the Transformation in 2016 and with continued implementation of the TLAP

In addition, installation of EBS technology coupled to a new sulphuric acid facility will enable capture of 90% of generated SO_2; converting it into sulphuric acid, further benefitting community health.

8.2 Potential impact of reducing smelter emissions

Nyrstar recognises its responsibilities at the local, regional and state level with respect to the environment and human health. It is committed to initiatives that make a direct impact on reducing blood lead levels in the community (**Chapter 3**), and reducing sulphur dioxide emissions.

It has been demonstrated that the sintering process, and associated materials handling, is responsible for at least 50% of air lead emissions from the smelter. Replacement of the sinter plant with modern EBS technology will largely eliminate the main source of fugitive lead emissions and reduce the amount of lead-bearing dust emissions from the smelter. Air emissions projections provided in **Chapter 7** show an initial 50% reduction in annual average air lead concentrations due to the Transformation.

The enclosed nature of the EBS technology will also facilitate capture of almost all off-gas emissions from the smelting process, reducing SO_2 emissions to air by up to 90%.

Current annual average air lead concentrations are approximately 0.4 µg/m^3 at Port Pirie's licensed EPA monitoring sites. Estimates indicate that air lead will halve over the two years following EBS technology installation, reducing to 0.2 µg/m^3. Further reductions will occur during the decade which may intermittently produce values as low as 0.1 µg/m^3.

Reduction of annual average air lead concentrations to 0.2 µg/m^3 is projected to increase the percentage of children with blood lead levels below 10 µg/dL from the current 75% to an estimated 85-90%. **Figure 8-2** shows the projected changes in the blood lead distributions within the community as a result of the Transformation. It is likely that a large percentage of Port Pirie's population would have blood lead levels matching that of urban Sydney populations as measured in 2006.

Over the 10 years following the Transformation, ongoing continual improvement activities in conjunction with the TLAP are likely to achieve air lead reductions of 75% of current air lead values.

With air lead reduced by 75% as a result of these ongoing activities, the percentage of children below 10 µg/dL is projected to increase to 85-90% about 8 years after the Transformation, and 95% approximately a decade after the Transformation, with the assistance of TLAP. This translates to a decrease from around 200 children currently above the NHMRC guidelines to around 40 children 10 years after the Transformation.

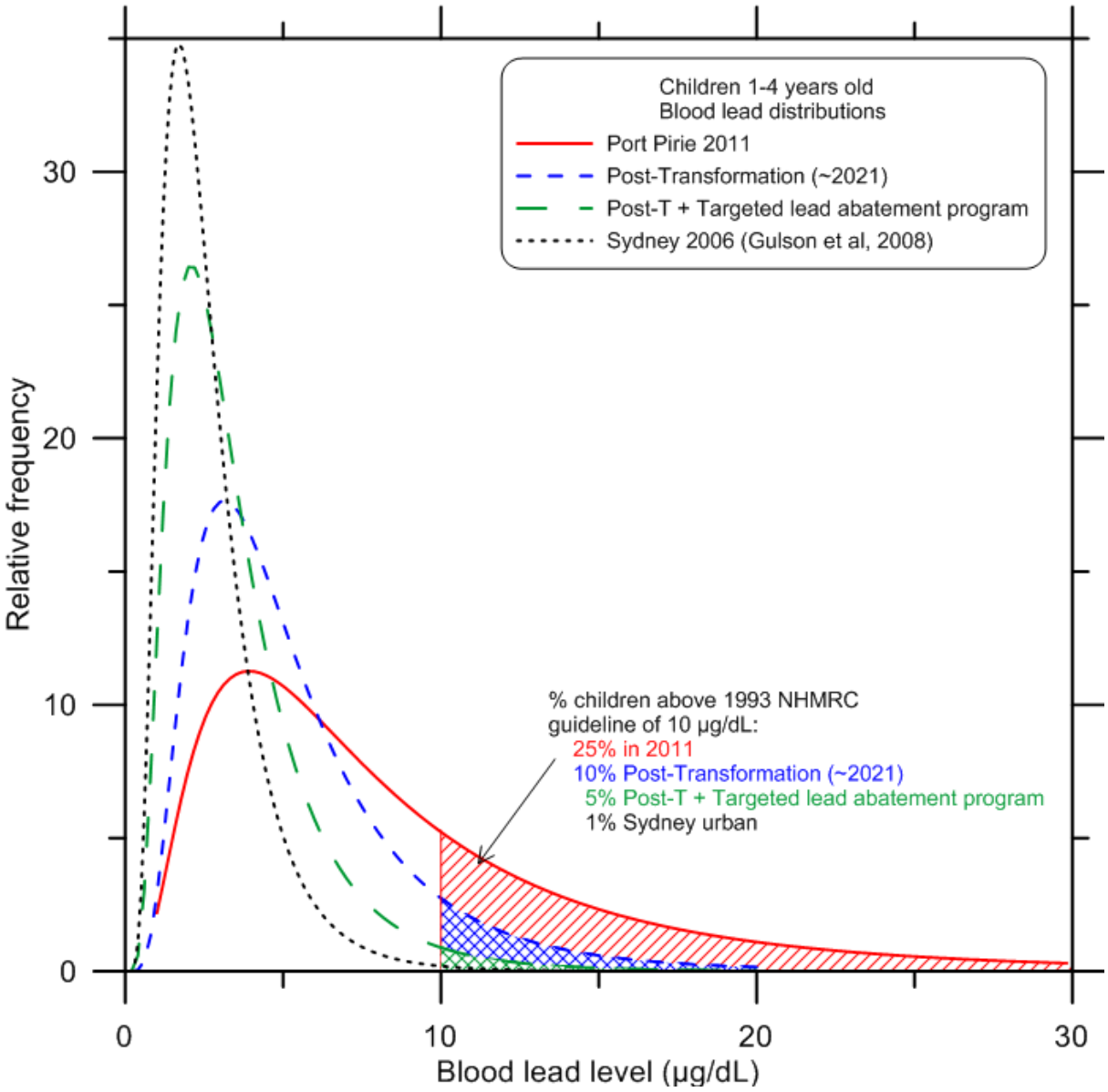

Figure 8-2: Current and projected blood lead distributions in Port Pirie compared with distribution among children in Sydney in 2006 (Gulson *et al.* 2008)

8.3 Existing health issues

Legacy emissions that pose the most significant risks to health in Port Pirie are lead and sulphur dioxide.

8.3.1 Lead emission sources

Elevated blood lead levels in children in the Port Pirie community have been a long standing issue. Installation of a blast furnace top enclosure and associated fume capture system has reduced blast furnace top emissions by approximately 75%. Since then it has been estimated that contributions to Port Pirie air lead are approximately 50% from the sinter plant and blast furnace, 30% from the slag fumer, and 20% from other point and area sources (see **Chapter 7)**.

8.3.2 Historical lead exposure in Port Pirie

Lead exposure and blood lead concentrations have been examined over many years in Port Pirie. The record from 1984 onwards (**Figure 8-3**) shows an upward trend in proportion of children aged 1–4 years with below 10 µg/dL blood lead concentrations. This is consistent with the continued attention to minimisation of exposure and mitigation of effects of exposure.

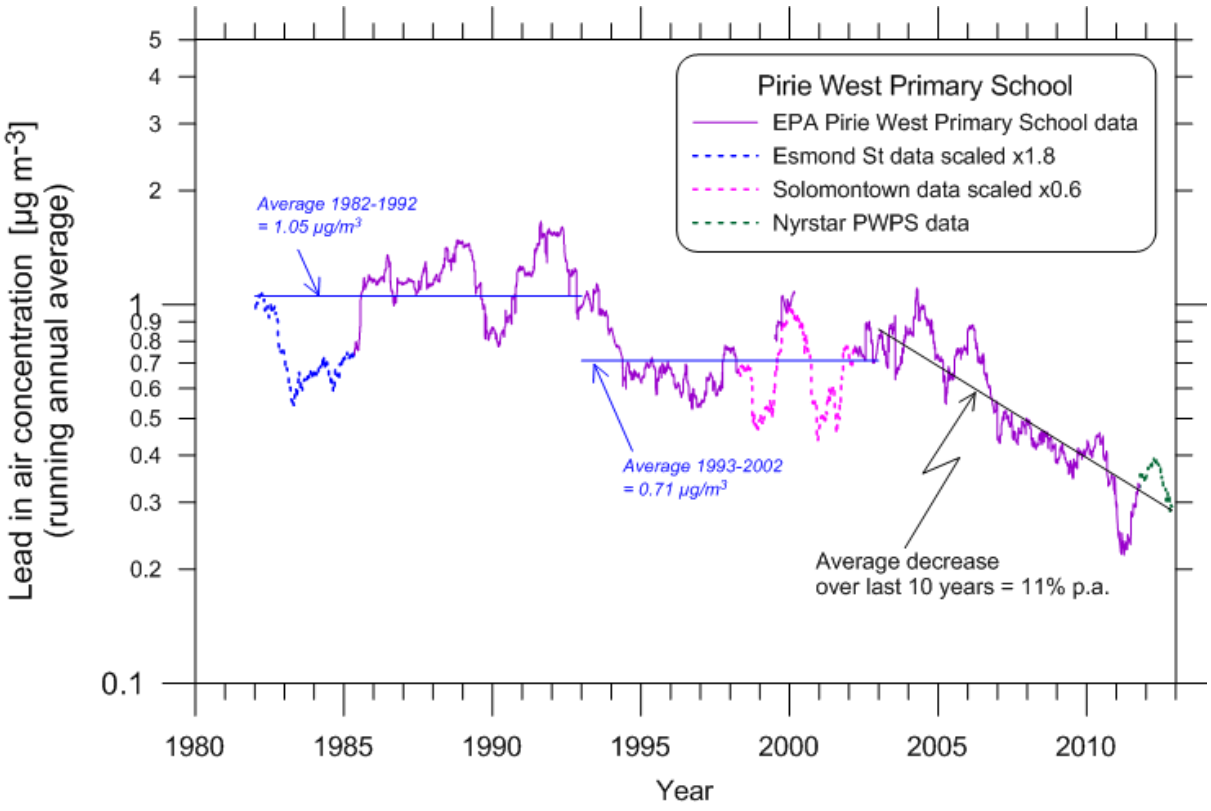

Figure 8-3: Running annual average lead concentrations at Pirie West Primary School over the last 30 years. Some gaps in the record at this monitoring site have been filled using data form other monitoring sites in Port Pirie (Appendix L)

The relative frequencies curves in **Figure 8-4** describe the distribution of blood lead concentrations in children between 1 and 4 years of age for:

- Port Pirie in 1984
- Port Pirie in 2011
- Port Pirie as projected after the introduction of new lead smelting technologies
- a population of infants in NSW described by Gulson *et al.* (2008).

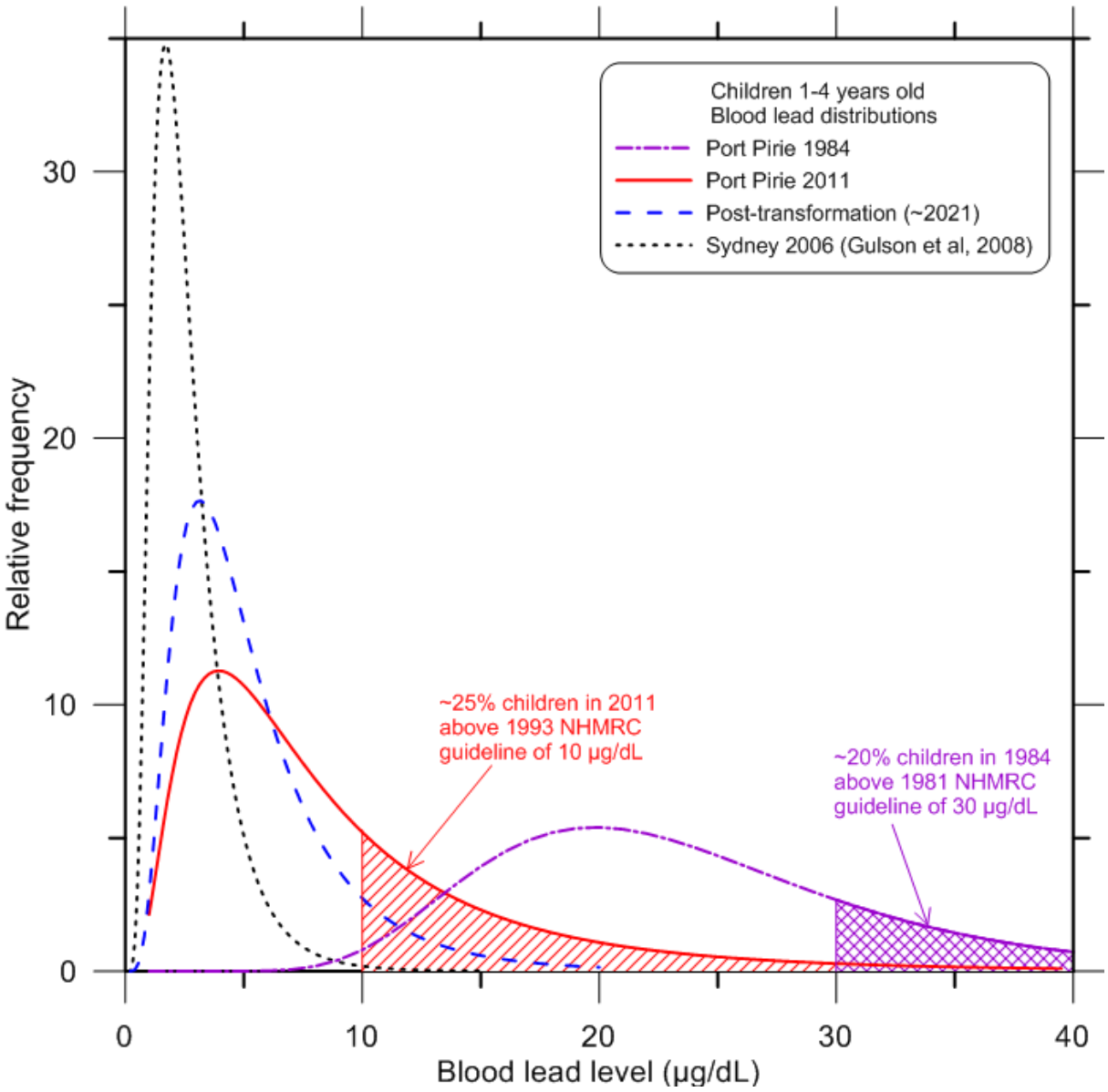

Figure 8-4: Blood lead distributions for Port Pirie in 1984, 2011 and projected Post-Transformation, compared with an urban Sydney population

Figure 8-4 demonstrates that in 1984, few of the children tested had blood lead concentrations below 10 µg/dL. At that time the guidance value was higher (30 µg/dL). The 2011 results indicate that 75% of the population had blood lead levels below 10 µg/dL. This is consistent with the process of continual improvement over the past 28 years.

The post-Transformation projections indicate that average blood lead concentrations would continue to reduce, although not all children would have concentrations below 10 µg/dL. This projection assumes that residual non-airborne lead exposure maintains blood lead levels of above 3 µg/dL (refer to **Section 8.3.3** regarding lead reservoirs). Further actions are expected to minimise these parallel routes i.e. respiratory and oral, of exposure resulting in further lowering of blood lead levels.

The data from the population of infants in suburban NSW shows that some children's blood levels exceeded 10 µg/dL.

Figure 8-5 shows the wide distribution of blood lead levels in Port Pirie in 2011, with 75% of the population having blood lead concentrations below 10 µg/dL. The data shows that in 2011 the greatest proportion of Port Pirie children had average blood lead concentrations of 5.72 µg/dL.

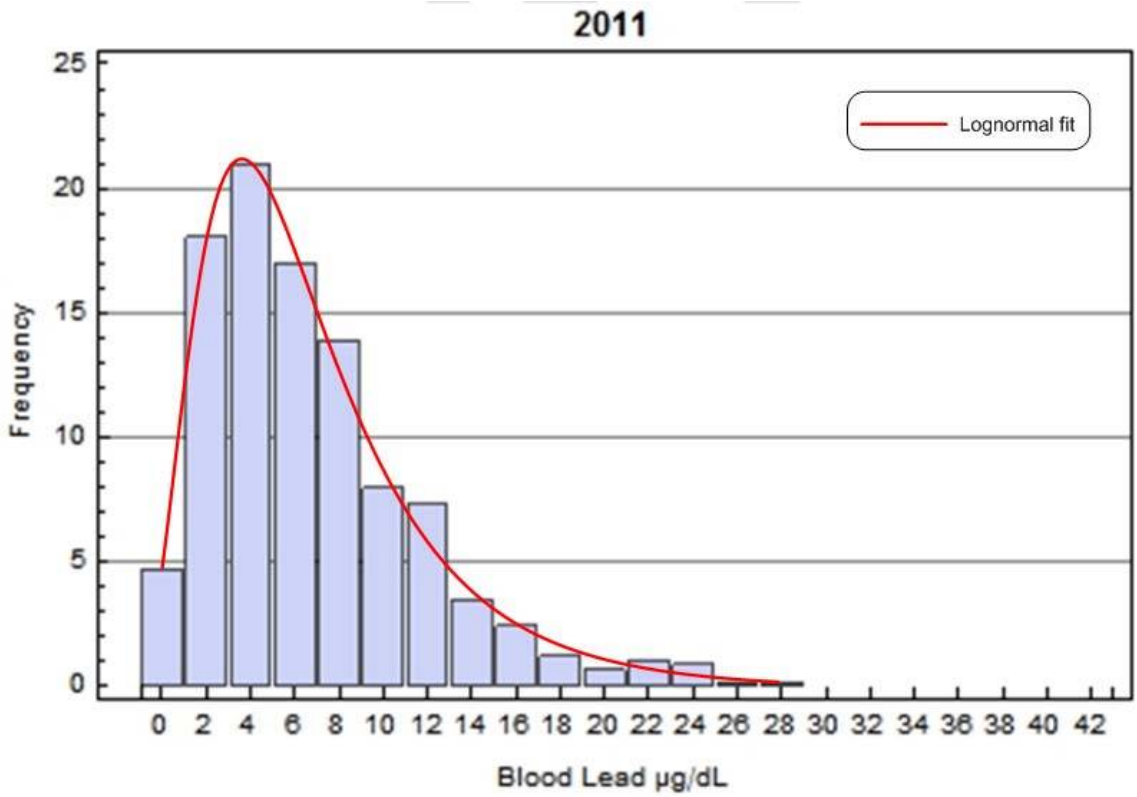

Figure 8-5: Frequency distribution of blood lead data from Port Pirie children tested in 2011 (the most recent result for children aged 0–4; Appendix L)

8.3.3 Relationship between air lead and children's blood lead levels

Although the relationship between air lead and blood lead is complex, it is accepted practice to use blood lead concentrations as a surrogate measure of health effect (see **Appendix L**).

Figure 8-6 shows the complexity of the relationship between smelter lead emissions and children's blood lead levels. The lead sources are shown in blue and the contributing factors are shown in orange. This complexity explains the difficulty in determining an exact air lead concentration that will ensure that the population of Port Pirie children will have blood lead levels below 10 µg/dL. Due to the various sources of lead within the home reservoir, if air lead is reduced to 0 µg/m^3, blood lead concentrations are likely to remain above 3 µg/dL (EHWP 2013).

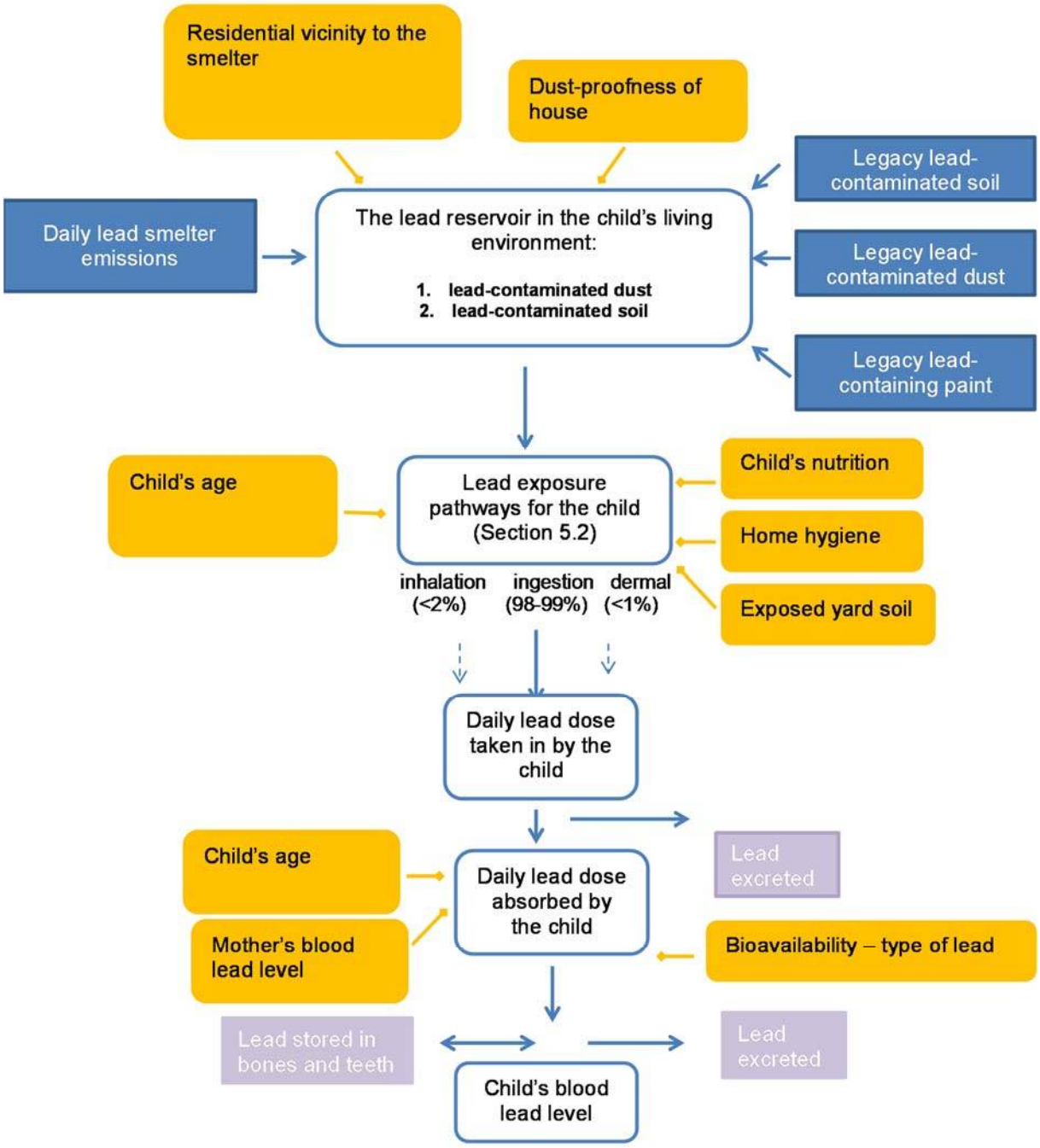

Figure 8-6: Lead exposure for children including lead sources (blue) and contributing factors (orange) that influence the child's exposure level (EHWP 2013)

8.3.4 Lead transfer pathways

Studies suggest that air lead concentrations explain less than 30% of the variation in children's blood lead levels. This remaining 70% may result from air lead concentrations and legacy lead contamination (dust and soil) in the child's living environment (**Appendix L**).

The source of lead exposure for Port Pirie children is usually smelter derived, rather than from lead paint and leaded fuel, which are now rare sources. Air lead emissions can deposit either directly or indirectly into homes.

Direct or contemporary contamination occurs via airborne lead particles. Contemporary lead emissions arise principally from fugitive emissions, from smelting processes, and on-site lead deposits, such as stockpiles of raw materials and deposits on roads, roofs, tarmacs, and bare soil. Stack emissions, which tend to have relatively low entrained lead, contribute very little to the air lead concentrations measured in Port Pirie (see **Chapter 7**).

Indirect or legacy contamination results from the transfer of dust and soil into homes via a number of routes (**Figure 8-7**).

Once transferred to the home, the lead particle may contaminate an object that the child will mouth such as a hand, a toy, a dummy or food. When the object is mouthed, lead enters the mouth, and if swallowed, some particles will be absorbed. Ingestion is the primary route for entry of lead into the body; while the respiratory route of exposure for a child makes an extremely small contribution to total exposure — less than 2%.

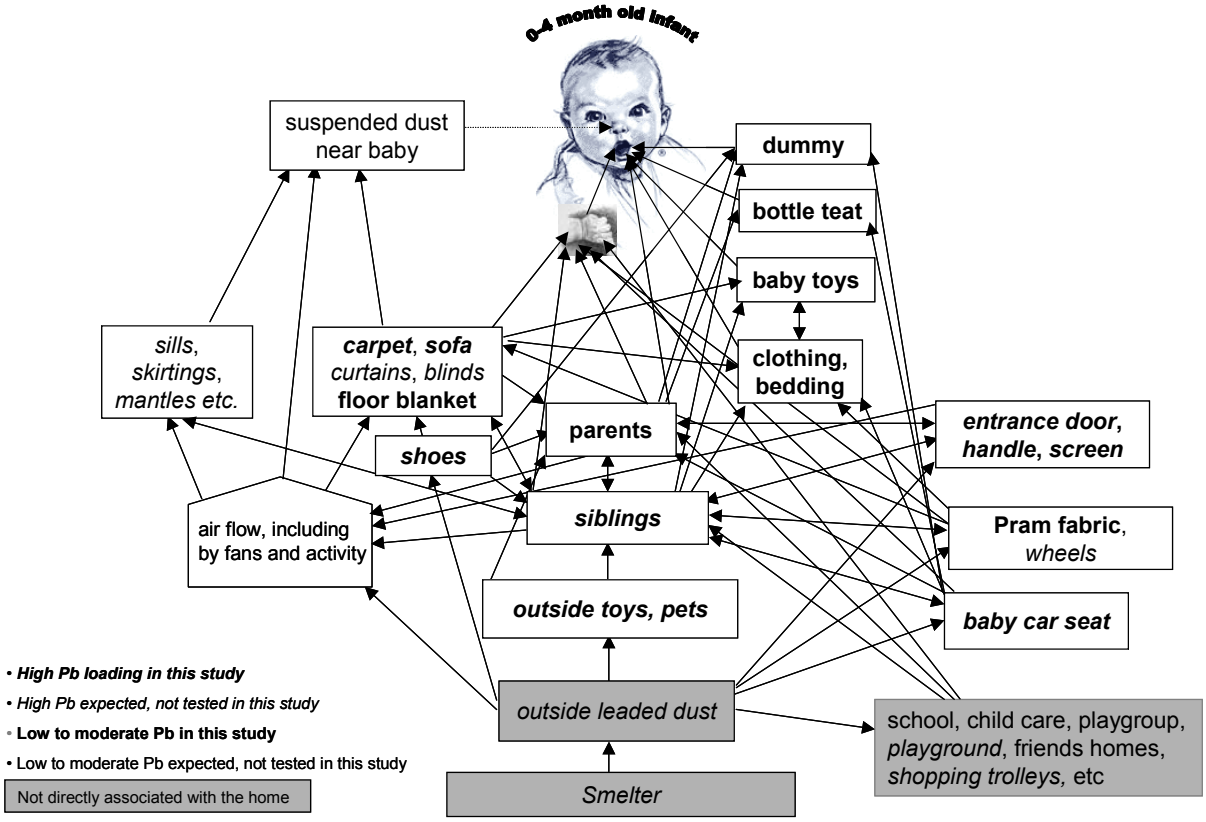

Figure 8-7: Schematic of the lead exposure pathways in the child's environment (Kranz 2004)

8.3.5 Other factors influencing exposure

Beyond transfer mechanics, other factors contribute to risk of exposure.

Influence of the child's age

The child's age is a primary factor in the lead exposure pathway. Newborn lead load is derived primarily from breast milk, as well as incidental lead contamination, such as re-entrained lead and lead on clothing or bed linen. Mouthing of surfaces begins around 5 weeks old, and once the child begins to crawl, the potential for lead exposure within the home increases further. As a child transitions from crawling to standing they will have reduced hand-lead contamination at each behavioural mile-stone (**Appendix L**).

Influence of socio-economic status

Socio-economic status (SES) influences housing condition, the lead reservoir and other aspects of lead exposure within the child's caring environment. These all contribute to increased risk of lead exposure. For example, lower SES is associated with:

- poorer nutrition, and associated increased metabolism of lead
- reduced focus on hand and house hygiene
- less resources available for cleaning and implementing barriers against lead reservoirs such as mattresses and high chairs
- educational disadvantage (especially care-givers), reducing the effectiveness of exposure-reduction education (EHWP 2013).

Legacy lead reservoirs

Houses are readily penetrated by airborne lead particles and are very effective in retention; the age of housing stock is a key feature that determines dust particle entry. Lead dust particles can also be mechanically transported, lodging onto objects such as clothes, shoes, animal fur, wheels of children's prams and strollers. These contaminated objects may then be directly handled and mouthed by the child. Alternatively, as these objects pass across the floors of homes, lead can accumulate as reservoirs (**Appendix L**).

Lead reservoirs, to varying extents, can feed into exposure pathways of children. Lead reservoirs in a child's living environment consist of lead-contaminated dust, soil inside or outside the child's house or a building or facility where the child spends significant time such as child or day-care centre, kindergarten, grandparent's house or playgrounds. Accumulation of lead in reservoirs may take days, months or years (**Appendix L**).

Inside the home or care facility, carpet, soft furnishings and ceiling spaces are the primary areas where lead accumulates. Outside, an undeveloped yard with exposed soil is the primary area for lead accumulation. The CSIRO has demonstrated that most carpet dust is located in the lower quarter of the carpet pile. This hinders removal regardless of cleaning methodology, such as by vacuum or steam cleaner. Walking on contaminated carpet moves lead particles vertically and some particles reach the surface. This is the most accessible lead in the home for children and for this reason children who are crawling are at most risk of lead exposure (EHWP 2013).

Location relative to the smelter and air control of the house envelope (leakiness) are primary factors influencing the amount of lead in the lead reservoirs. There is also a relationship between wind-speed and dust ingress, and home ventilation on hot or windy days.

Lead kinetics

Various factors influence the ability for lead to move into and within the body (bioavailability). The relationship between exposure and bioavailability is not linear; the greatest rate of change in blood lead is observed at the lowest levels of exposure. Transfer of lead into the blood by inhalation can only occur via the smallest of particles; large particles are evacuated from the lungs. Absorption of lead from ingested particles is dependent on the satiety of the individual; eating reduces acidity in the stomach, reducing lead solubilisation. Gender and age also drive bioavailability, with children and women in their childbearing years more likely to absorb more lead because of mineral insufficiency; especially iron (**Appendix L**).

8.3.6 Targeted Lead Abatement Program (TLAP)

To manage this 'residual exposure' risk, Nyrstar and the South Australian Government have established a working group to develop objectives and recommendations for the implementation of a new Targeted Lead Abatement Program (TLAP) in Port Pirie.

The TLAP working group will identify current and potential future community lead exposure reduction strategies and assess which are likely to have the greatest impact in reducing children's blood lead levels. A first milestone for the TLAP working group is to provide details of the proposed program and its implementation for consideration for implementation by the Port Pirie Transformation Steering Committee, the group overseeing the numerous work streams that need to be delivered by the end of 2013 to enable the project to proceed. Leading up to this milestone, numerous key stakeholders from a range of areas will be engaged to provide input into the development of TLAP. In this process, ongoing communication and community engagement regarding the TLAP process and implementation will be vital.

Nyrstar and the State Government have made a commitment to pursue the TLAP for a period of 10 years to achieve the long term objectives of the program. During this time the program will need to be constantly evaluated and modified to respond to changing environmental conditions in the community during and post-Transformation.

TLAP is expected to commence in 2014 in the lead up to the proposed construction and commissioning of the new technology in 2016. Strategies will continue post commissioning to minimise exposure to historical lead deposits and drive the Transformation's objectives.

The Environment and Health Feasibility Study (EHF) (2013) carried out by Nyrstar, SA Government, and CSIRO found that post-Transformation:

- it is expected air quality at the licenced EPA monitoring sites will improve by more than 50%
- the percentage of children with blood lead concentrations less than 10 µµg/dL will increase to around 85-90%, which equates to a reduction from around 200 children (aged 0–4 years) to around 80 children.
- the introduction of a targeted community lead abatement program would increase the percentage of children with blood lead concentrations below 10 µg/dL to 95% (**Figure 8-8**)

- continue with the ongoing improvement of smelter emissions, as well as community intervention.

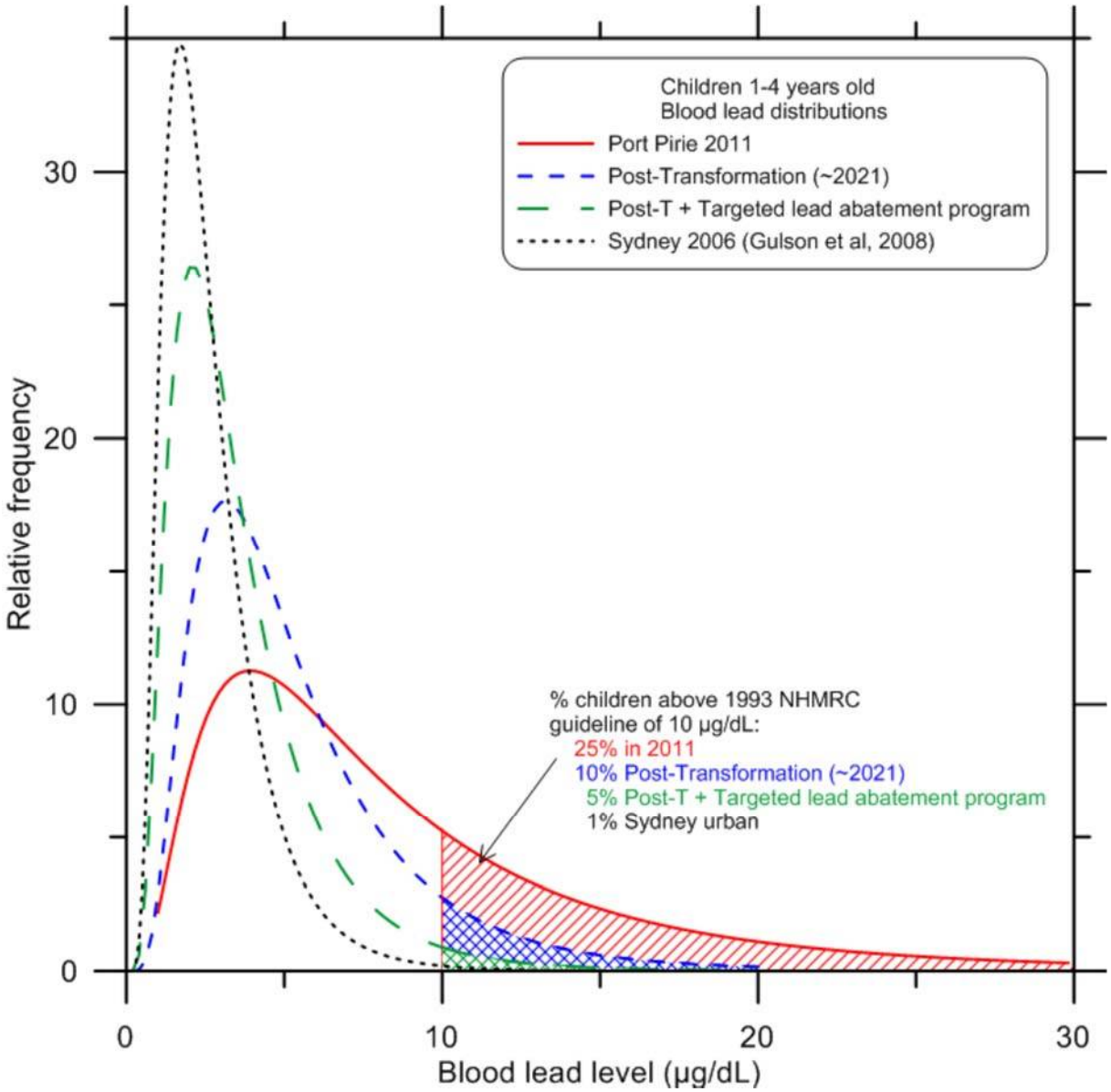

Figure 8-8: Current and projected blood lead distributions in Port Pirie compared with distribution among children in Sydney in 2006

As a result of these projections, Nyrstar and the South Australian Government have established a working group to develop objectives and recommendations for the implementation of a new Targeted Lead Abatement Program (TLAP) in Port Pirie.

The TLAP working group will identify current and potential future community lead exposure reduction strategies and assess which are likely to have the greatest impact in reducing children's blood lead levels. Specifically TLAP seeks to re-scope community blood lead reduction initiatives, and consider what additional measures would be beneficial beyond those currently existing that have proven to be successful in the past. Since the TLAP working group's establishment at the beginning of 2013, a number of strategies have been

identified, and work is underway to determine which measures will deliver the required positive impact for future improvements in community blood lead levels.

A first milestone for the TLAP working group is to provide details of the proposed program and its implementation for consideration by the Port Pirie Transformation Steering Committee. The Steering Committee oversees the numerous work streams that require delivery by the end of 2013 to enable the project to proceed. Leading up to this milestone, key stakeholders from a range of areas will provide input into the development of TLAP. In this process, ongoing communication and community engagement regarding the TLAP process and implementation is vital.

Community engagement and ownership of the Port Pirie blood lead reduction program has been the cornerstone of its success since 1984. Since 2006 there have been three community blood lead awareness campaigns, "tenby10", "tenforthem" and the most recent "thumbs up for low levels". The Port Pirie Targeted Lead Abatement Program is considered a natural progression of these previous programs and critical to the success of the Transformation and the subsequent reduction in community blood lead levels.

8.3.7 Australian and international blood lead standards

The current Australian air quality standard (NEPM) for air lead is 0.5 µg/m^3 (12 month average) and the current NHMRC recommendation (NHMRC 2009) is that all Australians should have blood lead levels below 10 µg/dL, and that all children's exposure to lead should be minimised.

The recommendation for blood lead concentrations below 10 µg/dL does not delineate a trigger point for health outcomes. A shift from 9 µg/dL to 11 µg/dL does not imply a sudden shift of health outcomes, merely a 2 µg/dL change in blood lead levels within a continuum of change.

International air lead and blood lead standards vary in levels and determination.

- In Europe, the air lead standard is 0.5 µg/m^3, while most of Europe adopted the 2005 US Centers for Disease Control and Prevention (CDC) recommended intervention level of 10 µg/dL (US CDC 2005).
- The US uses a rolling 3-month average air quality lead standard of 0.15 µg/m^3, and may adopt a reference value to be used to identify children with elevated blood lead levels, for whom public health actions should be initiated. Based on the 97.5th percentile of the blood lead levels of children 1–5 years old, currently 5 µg/dL. Currently there are at least 450,000 US children above this reference level.
- In Germany a reference value of the 95th percentile has been set, which is currently 3.5 µg/dL for children aged 3–14 years, 7 µg/dL for women and 9 µg/dL for men. Currently there are approximately 400,000 German children aged 3–14 years above this reference value (**Appendix L**).

8.3.8 Sulphur dioxide

Sulphur dioxide (SO_2) affects human health when it is breathed in. It irritates the nose, throat, and airways to cause coughing, wheezing, shortness of breath, or a tight feeling

around the chest. The effects of sulphur dioxide are felt very quickly and most people would feel the worst symptoms in 10 or 15 minutes after breathing in.

Those most at risk of developing problems if they are exposed to sulphur dioxide are people with asthma or similar conditions risk (Department of the Environment and Heritage 2005).

8.3.9 Sulphur dioxide transfer pathways

The highest concentrations of SO_2 occur due to convective mixing downward from the tall stack. Sulphur dioxide is mostly emitted through the tall stack at the smelter this usually is mixed with ambient air and significantly diluted by the time it reaches street level, that is its human targets.

The main pathway into the body is through inspiration leading to the symptoms of coughing and wheezing described in **Section 8.2.8**. Based on the average number of exceedances of the 1-hour NEPM standard in Port Pirie, these symptoms can be trigger between 30 and 40 times a year for very sensitive people.

Modelling of post-Transformation emissions (**Appendix C**) predicts that the 1-hour NEPM standard for SO_2 will be exceeded around 50% less frequently than the current situation. That is, asthmatics and others sensitive to SO_2 will potentially be exposed to levels that may trigger adverse symptoms on 20 fewer days a year.

8.3.10 Particulate matter (PM_{10})

PM_{10} is the indicator used for describing particulate matter relevant to human health. It refers to the mass concentration of particles with a diameter of less than 10 µm. The main constituents of particulate matter in emissions from Nyrstar include sulphates, nitrates, other inorganic ions such as ions of sodium, potassium, calcium, magnesium and chloride, organic and elemental carbon, elements (including arsenic, cadmium, chromium, copper, fluoride, lead, manganese, nickel, selenium and zinc) and polycyclic aromatic hydrocarbons (PAH) (National Pollutant Inventory [1] 2013).

Exposure to airborne particulates is dependent on wind strength and direction as discussed in **Chapter 7**. Short term (hours, days) and long term (months, years) exposure to particulate matter can cause lung irritation which may aggravate chronic lung diseases, such as asthma. Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable (WHO 2013).

The Australian NEPM and WHO standard for PM_{10} is 50 µg/m^3 with a target of not more than 5 exceedances per year. Nyrstar monitoring at the Boat Ramp site shows that the number of annual exceedance of the PM_{10} NEPM in 2011, 2012 and so far in 2013 have not exceeded the permissible target value of 5 per year (**Section 7.2**). Since the Transformation is expected to deliver further reduction in particulate emissions it is reasonable to assume that no health effects will arise from particulate matter.

8.4 Conclusions

It has been an ongoing priority for Nyrstar to reduce blood lead levels in children in the Port Pirie community. Numerous programs and upgrades implemented to date have reduced

emissions from the facility and community exposure to legacy lead. Reduction of blood lead levels has plateaued, and a step change in ongoing emissions from the smelter is required to drive emission and blood lead concentrations lower.

The proposed Transformation, including installation of EBS technology completed with the emissions capture and treatment technology, will reduce air lead, and hence reduce blood lead levels in young Port Pirie children. The facility is being designed to optimise health outcomes for the community.

Installation of best available technology economically achievable as part of the Transformation, and ongoing continual improvement of smelter emission controls, will minimise contemporary air lead. The TLAP will minimise community exposure to legacy lead contamination.

Projections indicate that the Transformation, in combination with the TLAP and ongoing continual improvement activities, will increase the percentage of children with blood lead levels within the guidelines to 95% over a decade.

9 Effects on the community

This chapter examines the key areas of potential impact on the community associated with the Transformation, including:

- land use
- noise amenity
- visual amenity
- native title and cultural heritage
- employment
- education.

It concludes that, when measured against the relevant guidelines and statutes, and taking into account the existence of smelter facilities at present, the Transformation will have an overall positive impact on the community as a result of significantly reduced emissions.

9.1 Introduction

Port Pirie is a town of approximately 14,000 residents. It is also home to one of the world's largest lead smelters. This smelter is thought to be the main cause of reduced air quality in the area, particularly in regards to lead and sulphur dioxide levels (Parsons Brinkerhoff 2013).

For the past three to four decades, the owners of the smelter (now Nyrstar) have been working with State Government agencies and the Port Pirie Regional Council to reduce lead exposure in the surrounding community. This work has resulted in upgraded smelter facilities and emission and exposure reduction initiatives in the community. While these programs have reduced the blood levels above 10 µg/dL from 60% to 28% of children over the past decade, improved facility technology is now required to further reduce emissions from the smelter and, accordingly, improve air quality (Parsons Brinkerhoff 2013).

Beyond a reduction in airborne and metal dust emissions, the upgrade to the facility may provide a number of benefits including:

- a reduction in the need to store large quantities of metal bearing intermediate materials on-site
- recovery of energy from the smelting process resulting in electricity cogeneration
- reduced carbon intensity from the improved furnace design coupled with modern acid production technology.

Subject to future approvals, the Transformation will also enable the facility to process a wider range of raw materials and recycle valuable metals that cannot currently be recovered in Australia (Parsons Brinkerhoff 2013).

Nyrstar and the South Australian Government have discussed the smelter's future since 2011 such that a new licensing agreement with the EPA would be required to satisfy more stringent environmental standards.

The Transformation proposed in this application will assist in meeting the required environmental standards. In addition to the significant health benefits that will result from the upgrading, the ongoing operation of the smelting facilities will continue to bring significant employment and other social benefits to Port Pirie and South Australia (Deloitte Access Economics 2012).

The town is located in the Port Augusta-Whyalla-Port Pirie priority employment area, one of the twenty such areas in Australia identified by the Department of Education, Employment and Workplace Relations (DEEWR) on the basis of labour market disadvantage, social economic vulnerability and industry weakness. Economic activity in Port Pirie is concentrated in the manufacturing sector, particularly the smelter currently operated by Nyrstar (Deloitte Access Economics 2012).

9.2 Land use

Detailed consideration of the appropriateness of the proposed land use is provided in **Appendix D**.

As described previously, the Transformation includes the upgrade and redevelopment of the current sintering, blast furnace and acid making operations and associated infrastructure and equipment, as well as the decommissioning and/or demolition of current infrastructure. In planning terms, the proposed land use at the smelter is not changing and is best described as a form of "special industry".

The Port Pirie (Regional Council) Development Plan is one of the key planning documents against which the Transformation is assessed. Nyrstar Port Pirie is located within *Policy Area 15*: Pasminco Metals Policy Area of the Industry Zone under the Port Pirie (Regional Council) Development Plan. "Special industry" is a land use that is expressly anticipated in *Policy Area 15*: Pasminco Metals Policy Area of the Industry Zone.

In summary, not only is the Transformation (otherwise referred to as "special industry") a land use already in existence at the smelter, it is also a land use that is clearly anticipated in the Policy Area and Zone that cover the smelter.

9.3 Noise amenity

Nyrstar undertook a detailed assessment of noise and vibration associated with the Transformation as provided in **Appendix A**. The key elements of this assessment are summarised below.

9.3.1 Noise from the existing smelter

The noise from the existing smelter operation is audible at boundary locations surrounding the smelter and at the nearest noise sensitive receivers to the West and South. However, the average measured noise levels from the smelter remains compliant and within the EPA's mandated noise limits at all sensitive receiver locations at all times (**Table 9–1**).

Table 9–1: Measured and predicted noise limits for the Transformation based on the *Environmental Protection (Noise) Policy 2007*

Location	Measured Noise Level of Existing Smelter , dBL_{Aeq}	Night-time Noise Limit, dBL_{Aeq}	Day Time Noise Limit, dBL_{Aeq}
Corner Duffy Lane and the Terrace	43	53	61
Corner Frederick Street and the Terrace	46	53	61
Corner George Street and the Terrace	47	53	61
George Street West	48	55–58	62–66
George Street East	47	55–58	62–66
Ellen Street	47	55–58	62–66

Some unusual smelter activities such as noisy equipment maintenance (banging) or mobile plant or equipment near the smelter's boundaries could exceed the noise limits from time to time. There is no significant vibration from the existing smelter operation beyond the boundary of the smelter.

9.3.2 Noise and vibration criteria

Operational noise limits have been determined in accordance with the *Environmental Protection (Noise) Policy 2007* and in consultation with the Environment Protection Authority. "Noise affected premises" may be located surrounding the smelter within the following Zones and Policy Areas as identified within the Port Pirie (Regional Council) Development Plan:

- Rural Coastal Zone
- Residential Zone and Limited Development Area *Policy Area 1*
- Public Purpose Zone
- Commercial Zone and Commercial *Policy Area 13*
- Regional Centre Zone and Regional Centre *Policy Area 11*
- Industry Zone and Port *Policy Area 23*.

Each of these Zones and Policy Areas has different noise limits according to the sensitivity of the primary land uses promoted within these Zones and Policy Areas.

9.3.3 Noise from the Transformation

An acoustic model was prepared for the Transformation which considered:

- the Transformation with only new or upgraded plant operating, including any significant mobile plant, alarms and site traffic that is associated with the transformation
- the Transformation with all plant operating including all mobile plant, alarms, site traffic and deliveries.

A summary of the predicted noise from the new and upgraded plant associated with the Transformation compared to the EPA Noise Policy guidelines and the existing smelter is provided in **Table 9–2**.

Table 9–2: Predicted noise from the Transformation for upgraded or new plant only versus noise limits

Location	Night-time Noise Limit, dBL_{Aeq}	Day Time Noise Limit, dBL_{Aeq}	Predicted Noise Level of Transformation (new and upgraded plant only), dB(A)
Residential Zone	45	52	45
Regional Centre Zone	50	57	44
Rural Costal Zone	50	59	47
Public Purposes Zone	53	61	47
Commercial Zone	53	61	46

A summary of the predicted noise from all plant operating after the Transformation is provided in **Table 9–3** to provide a description of the expected noise environment.

Table 9–3 Predicted noise from the Transformation from all plant versus noise limits

Location	Night-time Noise Limit, dBL_{Aeq}	Day Time Noise Limit, dBL_{Aeq}	Predicted Noise Level of Transformation, dB(A)
Residential Zone	53	61	53
Regional Centre Zone	55	62	55
Rural Costal Zone	55	64	54
Public Purposes Zone	58	66	56
Commercial Zone	58	66	56

The acoustic model has considered all significant noise sources operating at their maximum capacity, including any alarms or operational events (such as tippler operation). The noise level is expected to be continuous and additionally is expected to reflect the maximum noise level from the Smelter. On this basis, the 60dBLAmax criterion is also predicted to be met.

Even under adverse weather conditions, noise from the Transformation will be compliant and below the *Environmental Protection (Noise) Policy 2007* noise limits for surrounding noise sensitive receivers during the day-time and night-time period for both scenarios.

New and upgraded facility items are not expected to introduce any further or increased vibration sources into the smelter. On this basis, no specific mitigation requirements are necessary in association with the Transformation.

9.3.4 Noise during construction

Noise from construction activities (including clearing, demolition and building), are at times predicted to exceed 45 dB at the nearest noise sensitive receiver, which may have an impact on the amenity of those people residing or working in those areas.

To minimise this impact Nyrstar will take reasonable and practicable measures to minimise construction noise impact including, but not limited to:

- where an adverse impact is predicted, the construction will not occur on a Sunday or other public holiday and not occur on any other day except between 7am and 7pm
- scheduling construction activities such that the *Environment Protection (Noise) Policy 2007* noise emissions will be met during early morning, evening, weekends and public holidays
- early notice and ongoing liaison with potentially affected residents where noisier works, such as pile driving and use of vibratory rollers, are scheduled to occur
- maintain a register of and respond to any all noise complaints received, including investigation and response actions taken by Nyrstar
- locating construction-site buildings, access roads and plant such that minimum disturbance to the community where practical will be incurred
- maintaining all equipment to manufacturer's specifications
- fitting and maintaining appropriate mufflers on earth-moving and other equipment on-site
- turning machinery off when not in use.

The predicted vibration levels for construction will not be perceptible at receiver locations on the basis that blasting is not being used during construction and piling will occur at a minimum of 400 m from the nearest sensitive receiver.

9.3.5 Summary

Noise from the existing smelter is within the relevant noise limits for surrounding sensitive noise receivers. The Transformation operation is predicted to generate approximately 1 dB in additional noise which is considered to be unnoticeable at the nearest sensitive receivers. In some cases, there will be an overall decline in noise levels due to the new configuration and location of noise sources on the upgraded smelter. Even under adverse weather conditions, noise from the Transformation will not exceed the EPA's noise limits for surrounding noise sensitive receivers during the day-time and night-time period. New and upgraded facility and equipment are not expected to introduce any further or increased vibration sources to the smelter. On this basis, no specific mitigation requirements are necessary in association with the Transformation.

Noise from construction activities are expected to occasionally exceed 45 dB at the nearest noise sensitive receiver, which may have an impact on the amenity of people residing or working in those areas. To mitigate this, a range of measures will be taken to minimise construction noise impacts. The predicted vibration levels for construction are not considered to be perceptible at noise sensitive receiver locations.

9.4 Visual amenity

Detailed consideration of the impact on visual amenity by the Transformation is provided in **Appendix E**. In summary, the visual amenity of land and development surrounding the area of the Transformation will be appropriately protected given:

- The smelter is clearly identified in the PPRCDP as being appropriate for "major special industry", such as that proposed.
- The proposed buildings/plant/infrastructure replaces existing similar industrial development and, in particular, will not create any significant additional negative visual impact when viewed from the Port Pirie River.
- The proposed permanent buildings/plant/infrastructure will be located more than 350 m from the southern boundary of the smelter, where there is an interface with a largely vacant Commercial Zone and the Public Purpose Zone. This substantial distance is in addition to an expanse of trees and other vegetation which assist in partially screening the proposed development.
- The relatively small size of the proposed temporary buildings/areas, their location within the existing smelter, and the fact they are opposite the Commercial Zone and the Public Purpose Zone that are generally vacant, and their temporary nature i.e. relative to the overall life of this project.

9.5 Native title and cultural heritage

An assessment of both the indigenous and non-indigenous cultural heritage values for the Transformation area was undertaken, consisting of a study into the historical background of the area, a review of recent activities, search of relevant cultural heritage registers and consultation with relevant Aboriginal and historical heritage partners.

9.5.1 Native title

The Transformation area is within the territory of the Nukunu People. The Nukunu People's land runs from north of the Hummocks in the south to the southern Flinders Ranges. The Nukunu people now live in many places in South Australia including urban centres, with some still living in and around Port Pirie, Port Augusta and down to Port Lincoln. The smelter falls within the area of the Nukunu People's Native Title Claim (SC96-5) which has been accepted for registration by the Native Title Tribunal, and which is yet to be determined by the Federal Court. The *Native Title Act 1993* protects native title rights and interests that exist prior to a native title determination.

The smelter is located on privately owned land that has been utilised for industrial purposes for124 years and on which Native Title has been extinguished.

9.5.2 Cultural heritage

As part of its operations at Port Pirie, Nyrstar recognises the traditional custodians as stewards of the land on which the smelter operations are based. In acknowledging these groups, Nyrstar gives respect to the culture, history and relationship to lands which are integral to the past, present and future aspirations of the traditional custodians — keeping in line with Nyrstar's overarching principles to respect the human rights of individuals in the communities where they operate.

Given the use of the wider subject land for industrial purposes or smelting activities for 124 years, the land has been extensively filled 3–5 m above the natural mudflats or samphire surface. The main operational areas of the smelter, where the majority of the demolition and construction works are proposed, are already paved with concrete. Therefore it is not

expected that Aboriginal sites, objects or remains will be uncovered as part of the Transformation.

Given the smelter's proximity to the Port Pirie River, Nyrstar recognises the Nukunu People may have an interest in the proposed works and is committed to consulting with them as relevant and agreed through the life of the Transformation. Assisted by an Indigenous Cultural Heritage consultant, Nyrstar will develop a consultation program to allow for these activities.

The historical background of the Transformation area is limited, given its ongoing history as a smelting operation for over 120 years. Prior to finalising its works program, Nyrstar will conduct searches of the relevant indigenous heritage registers held by the Aboriginal Affairs and Reconciliation Division (AARD) of the Department of Premier and Cabinet to protect recorded items of historical cultural heritage. Prior to disturbance works, consultation with the Nukunu People will be undertaken, particularly with regard to protection of any items of indigenous heritage in impact areas such as the Port Pirie River.

Mitigation measures to protect and minimise any potential effects on cultural heritage include:

- the development of work programs and overall management of the development of the smelter in observance of due diligence protocols with regard to Aboriginal cultural heritage
- training and induction of construction workers regarding their obligations under the *Aboriginal Heritage Act 1988*
- construction workers will be briefed regarding compliance with, and legal ramifications to, the issues outlined in the Act
- all cessation of work if an Aboriginal site, object or remains are uncovered until directions from the Minister for Aboriginal Affairs and reconciliation are obtained
- consultation with the Nukunu people.

The Register of the National Estate was closed in 2007 and is no longer a statutory list. All references to the Register were removed from the Commonwealth EPBC Act and the Australian Heritage Council Act on 19 February 2012. A review of the National Heritage List and the Commonwealth Heritage List (both created under the EPBC Act), reveals there are no Indigenous places on either list within, or in the vicinity of, the Transformation.

9.5.3 Non-indigenous heritage

A search of the South Australian Heritage Places Database identified a number of State, Local and Contributory items in Port Pirie, none of which are on or adjacent to the smelter, or in such close proximity as to be likely affected by the proposed development.

The Database list was subsequently confirmed against the list of State Heritage Places (Table PtPi/3), Local Heritage Places (Table PtPi/4) and Contributory Places (Table PtPi/5) contained in the Port Pirie (Regional Council) Development Plan (Consolidated 10 January 2013). A number of places listed in the Database are contained within *Policy Area 21*: Port Pirie Historic (Conservation) Policy Area. This Policy Area is located more than 200 m to the

south of *Policy Area 15*: Pasminco Metals Policy Area, within which the smelter is located. Therefore, the Transformation will not impact on any places of heritage value within this separate Historic (Conservation) Policy Area.

In relation to Commonwealth legislation, review of the National Heritage List and the Commonwealth Heritage List reveals there is only one place within, or in the vicinity of, Port Pirie that is listed on the Commonwealth Heritage List. This is the Port Pirie Post Office in Ellen Street which will also not be affected by the Transformation.

9.6 Employment

Nyrstar is an integrated mining and metals business with mining and smelting operations located in Europe, the Americas and Australia. Nyrstar employs around 7,000 employees across 5 continents, 20% of Nyrstar's total personnel are employed in Europe, 62% in the Americas and 18% in Australia.

Nyrstar is the dominant employer in Port Pirie. It directly employs approximately 720 people and 133 full time equivalent contractors. This equates to approximately 18% of Port Pirie's total workforce and approximately 98% of the town's manufacturing workforce (Deloitte Access Economics 2012).

While the Transformation is not anticipated to result in an overall increase in employment numbers, the smelter's continued operation is expected to provide approximately 50 employment opportunities per year over the next 10 to 15 years. These employment opportunities will primarily arise from retirements and staff turn-over. DMITRE's population projections for Port Pirie indicate that 1,018 residents will be aged in the 20 to 24 age bracket by 2021. With the smelter's sustained operation in the region as a result of the Transformation, these figures indicate a strong alignment between employment opportunities and an emerging workforce in the Port Pirie district (DMITRE 2012).

Nyrstar follows a strict recruitment program that is consistent with the principles of Equal Employment Opportunity (EEO) principles). The EEO dictates Nyrstar's decisions in relation to employment, which are not made on the basis of a particular characteristic or personal attribute held by an individual or group, but on merit and skill sets.

A description of the construction workforce is provided in **Section 6.2**. It is anticipated that the construction workforce will be sourced from Port Pirie and surrounding areas whenever appropriate.

9.7 Education

Apart from during the construction period, employment numbers are expected to remain similar to current numbers. Consequently, it is not expected that any significant additional demands will be placed existing educational infrastructure in the region, other than those typically generated by an ageing workforce or retirees being replaced by younger workers.

More importantly, as the major employer in Port Pirie, there is a risk that the current level of educational infrastructure would not be maintained if the smelter were to close in Port Pirie.

Without the development of contemporary smelting technology, the Nyrstar facilities are at risk of closure (DMITRE 2012).

Port Pirie is home to nine government and non-government schools providing education and development opportunities for the youth of the town. In 2012, 704 children were enrolled in government secondary education institutions, and 1,296 were enrolled in government-provided primary, kindergarten and special education facilities (DMITRE 2012).

Further educational infrastructure includes the Port Pirie TAFE campus. Port Pirie TAFE has a focus on the development of skills across a broad range of sectors with the ability to service industry and society in Port Pirie and the region more generally. At August 2012, the Port Pirie TAFE had 1,249 enrolled (604 FTE) and employed 61 persons (53.72 FTE) (DMITRE 2012).

If Nyrstar closes its Port Pirie smelter, there may be a commensurate drop in demand for certain TAFE training which subsequently may undermine the viability of a number of TAFE courses. Reductions in delivery from the Port Pirie TAFE would reduce the already limited vocational education options in the town which may in turn negatively impact the ability of the town to develop new industries to compensate for the closure of Nyrstar.

9.8 Summary and conclusions

In terms of the key social impacts of the Transformation discussed in this section of the PER, the proposal:

- as a "special industry", is not only a land use that is already operating at the smelter, it is also a land use that is clearly anticipated in the Policy Area and Zone that cover the smelter
- will not create any significant increase in noise or vibration impact to nearby sensitive noise receivers such as houses when operating and satisfies all relevant EPA noise guidelines. There may be some noise impact on the nearest houses during construction, however Nyrstar will minimise this through measures such as scheduling noisier works e.g. pile driving and compacting, to avoid very early or evening time periods, and providing adequate warning of possible noise generating activities to residents of potentially affected locations.
- will not have appropriate significant impact on visual impacts in the direct vicinity given the smelter is clearly earmarked for major special industry, the proposed buildings/plant/infrastructure replaces existing similar industrial development and the operations will be located more than 350 m from the southern boundary of the smelter (other than some temporary components during construction), where there is an interface with a largely vacant Commercial Zone and the Public Purpose Zone. Vegetative relief will also be provided in areas surrounding the smelter.
- will not have any impact on known places of Indigenous or European heritage significance
- will have a positive impact on employment in the area during construction and will at least existing employment levels post-construction
- will provide a sustained economic base for Port Pirie that will assist in supporting existing schools and the Port Pirie TAFE campus.

When measured against the relevant Planning guidelines, and taking into account the existence of smelter facilities at the smelter at present, the Transformation will have negligible and acceptable impacts on the community beyond the positive impacts associated with reduced emissions.

10 Effects on the economy

10.1 Introduction

Economic activity in Port Pirie is concentrated in the manufacturing sector, which is dominated by the smelter currently operated by Nyrstar. The concentration of Port Pirie's economic activity in a single plant means the regional economy is sensitive to mineral prices and dependent on the smelter.

To comply with new environmental standards proposed by the SA EPA Nyrstar has two options at Port Pirie. Firstly, to undertake substantial re-investment to upgrade smelter technology (estimated at $350 million) or secondly, to cease operations. There are no other options. As a result, this chapter will deal only with these two scenarios and will not consider the economic impact of continuing current operations.

Nyrstar Port Pirie's economic impacts were explored by the Deloitte Access Economics (DAE, 2011). They identified seven themes demonstrating the smelter's importance to Port Pirie's socioeconomic viability and its contribution to State's strategic objectives.

The seven themes identified by DAE are:

1. Nyrstar's importance to underpinning Port Pirie's employment base
2. Nyrstar's critical role in the region's manufacturing sector
3. Nyrstar's role in maximising the use of major infrastructure
4. Nyrstar as a critical anchor against population drift
5. Nyrstar's role in maintaining community wealth (property values)
6. Nyrstar's role in maintaining community sustainability
7. Nyrstar's contribution to the South Australian Strategic Plan.

The impacts for each theme will be discussed within the existing economic environment context followed by the impact if the smelter ceases operations.

10.2 Assessment method

A standard approach to analysing economic impact is to use an input-output (I-O) model for the particular activity. This approach was not used for the Transformation because overall, there is little net difference between the smelter's current and post Transformation material consumption and production. In other words, the material inputs to and outputs from smelter will be similar and thus an I-O analysis would show little change from baseline economic conditions.

However, given the importance of the Transformation to Nyrstar's continued operation in Port Pirie, the 'go' or 'no go' scenario were used to give an indication of the likely economic impact of the Transformation.

In 2012 Deloitte Access Economics (Deloitte Access Economics, 2012) modelled the likely economic impact of the closure of Nyrstar Port Pirie over two years and analysed the prevailing economic conditions in Port Pirie.

Further economic effects that the construction and operation of the upgraded facility would have locally and regionally will be included in an Australian Industry Participation Plan (AIPP). The AIPP will be drafted as part of a two-stage process of the Enhanced Project By-Law Scheme (EPBS). The underlying premise of the EPBS is to give commitment (full, fair and reasonable opportunity) to Australian industry to enter the supply chain of the project's procurement program. The EPBS process is currently underway.

In addition, and as part of the South Australian Industry Participation Plan (SAIPP), Nyrstar will utilise Industry Capability Network South Australia to source lists of relevantly experienced local companies to be considered for pre-qualification by Nyrstar. No company shall be excluded from consideration for the packages of work. Construction work at Port Pirie will be tendered to local and Australia based companies. The full SAIPP shall be completed after the Pre-Feasibility Study stage when work packages are determined.

As well as providing the required technology upgrade to reduce lead emissions, the proposed Transformation provides Nyrstar with an opportunity to further diversify earnings by processing other metals. This opportunity requires additional economic assessment outside of the PER by Nyrstar. If realised it will further strengthen economic security and encourage local economic growth (**Figure 10-1**).

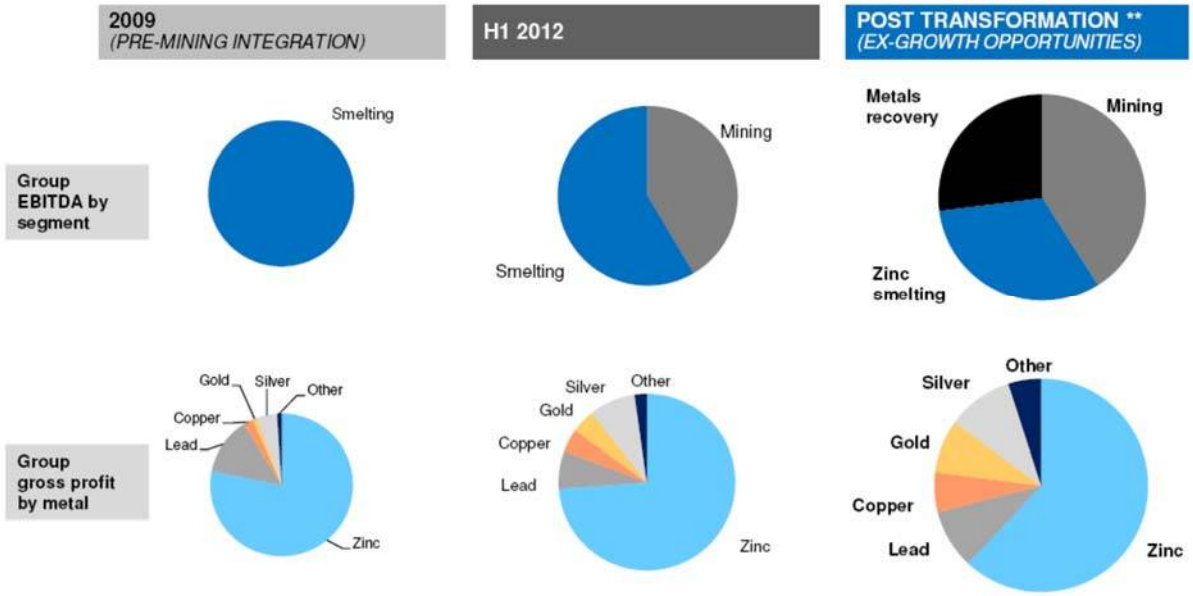

Figure 10-1: Illustrative impact of Transformation on Nyrstar's earnings

10.3 Existing economic environment

Nyrstar began operating as a zinc and lead smelting company in 2007. Since 2009, Nyrstar has expanded into mining, a strategy both to secure raw material supply and diversify and augment earnings. The proposed development builds on this strategy and will allow for a multi-metal processing facility that both drives Nyrstar's business requirement and meets the significant challenge of reducing lead emissions.

The existing economic environment has been examined with respect to the seven themes presented identified in **Section 10.1** that demonstrate Nyrstar's importance to Port Pirie's economic viability.

10.3.1 Employment

Within South Australia, Nyrstar's Port Pirie operation supports a total of 3,250 full time equivalent (FTE) positions.

Port Pirie's labour market is characterised by lower wage levels and higher unemployment than the South Australian average (ABS 2013). Nyrstar alleviates this already-strained labour market by engaging 18% of all employed persons in the Port Pirie area (DFEEST 2012) and providing above average wages. Nyrstar's workforce also benefits from training and career opportunities associated with a successful multinational corporation.

10.3.2 Manufacturing sector

Nyrstar has a critical role in the Port Pirie region's manufacturing sector. The company directly employs 720 people and 133 full time equivalent contractors in Port Pirie's manufacturing sector. This equates to 98% of the manufacturing sector's total employment.

In addition to being a major employer in Port Pirie, the manufacturing sector has a relatively high propensity to create full-time employment, as opposed to casual or part-time employment (89% of manufacturing workers are full time; ABS 2009-10). Steady incomes and job security associated with full time employment helps create a stable base to underpin broader economic activity in the town.

10.3.3 Investment in major infrastructure

The smelter's location in Port Pirie optimises the use of major infrastructure. This is expanded upon in **Section 14.2**.

Maintained by Flinders Ports, the port and wharf facilities are an important infrastructure instalment. Port Pirie Nyrstar contributes to the majority of port movements. In 2012, the port facilities handled 629,375 tonnes of bulk and break bulk freight.

Nyrstar's Port Pirie operations also support investment in major regional infrastructure assets, particularly electricity and gas supply. Nyrstar currently uses approximately 286,000 mWh of electricity and 1 petajoule of natural gas per annum. As well as being a major revenue source for suppliers, this consumption justifies investment in the region's supply infrastructure.

Port Pirie's population, supported by Nyrstar, justifies investment in social infrastructure, including nine schools, a Technical and Further Education (TAFE) campus, a hospital and other health care facilities.

10.3.4 Population

With approximately 14,000 residents, DMITRE projects Port Pirie's population will decline by 1.4% between 2011 and 2021. This compares to a projected population increase for the Yorke and Mid North Region of 1.61% (DFEEST 2010). It is possible that Nyrstar's presence in Port Pirie acts as an anchor against further population drift.

A major region-specific population trend is that males in their twenties and early thirties exhibit a strong tendency to migrate out of Port Pirie. Another significant trend emerging from the population projections is population aging. While fertility rates provide a steady stream of young people in the town, out-bound migration of those in their twenties and early thirties means the proportion of the population which is of working age is in decline. In the Yorke and Mid North Region, there is a projected decrease in the working aged population (15–64) of 6.71% (DFEEST 2010).The declining working age population is a concern for two reasons:

- declining working age population undermines ongoing economic activity in the town as employers are not able to secure access to sufficient numbers of workers with the appropriate skills
- an increasing dependency ratio of non-working age population to working age population jeopardises the community's economic viability as there are relatively fewer working people to provide goods and services to those who are not working.

With a tendency to employ young males and comparably high wages, Nyrstar's continued operation is likely to act as a population anchor, encouraging workers to remain in Port Pirie.

10.3.5 Property values

Nyrstar's employment of local workers and the associated flow-on economic benefits in likely to influence both residential and commercial property values. Therefore the continued operation of Nyrstar plays an important role in maintaining community wealth by boosting property values. Residential property values are supported by housing demand from town workers, and similarly, commercial property values by space demand from firms selling goods and services to Nyrstar and town residents.

10.3.6 Community sustainability

Nyrstar has an important role maintaining community sustainability. Port Pirie's enrolment rate in government social welfare programs is already higher than the State's average (DEWNR 2012). However, by employing a large proportion of Port Pirie's population, Nyrstar mitigates further escalation in welfare enrolment rates.

Nyrstar also contributes directly to State and Commonwealth Government revenue through taxes and other charges. Tax revenue generated by Nyrstar Port Pirie is estimated to be $103 million (Nyrstar 2013)

10.3.7 Contribution to the South Australian Strategic Plan

By facilitating the continued operation of the smelter, the Transformation will contribute to a number of the South Australian Strategic Plan (SASP) targets. The relevant contributions are summarised below with more detail provided in **Table 10-1**:

- Economic growth — significant contribution to and support of economic activity and growth in South Australia. Nyrstar's value-add contribution to the South Australian Gross State Product (GSP) is approximately $518 million (Nyrstar 2013).

- Total exports — exports contributed towards the target to increase total exports from South Australia to $25 billion. Nyrstar contributes $1.6 billion (Nyrstar 2013) to economic outputs, including $755 million of exports per annum.
- Business investment — the smelter is a major business investment and confidence signal in the State which may encourage further business investment.
- Minerals production and processing — one of South Australia's largest minerals processing facilities.
- Regional population levels — creates socioeconomic opportunities that encourages population stability in regional areas.
- Jobs — contributes to the State's employment growth targets.

10.4 Impact assessment of the 'Do Nothing' alternative

Deloitte Access Economics' (DAE) modelling indicates the South Australian and Australian economies would be adversely affected by the closure of Nyrstar's operations in Port Pirie. **Table 10-1** quantifies the likely economic effects over 10 years to GSP and employment for the local, state and national economies. The closure would impact workers directly employed by Nyrstar as well as cause flow-on impacts to household incomes and expenditure. This would have broader implications for other sectors, in retail, trades, hospitality, transport, health, education and services.

Given the weak economic linkages between Port Pirie and other regional towns e.g. Port Augusta, DAE expects the greatest impact of Nyrstar closing to be observed in Port Pirie. However, a proportion of the total economic impact is expected to occur outside Port Pirie and Port Augusta. This is a result of fewer purchases of intermediate inputs to final production or consumption in Port Pirie. Given the narrow economic base of Port Pirie and Port Augusta, this region is heavily reliant on inputs from the rest of South Australia.

Table 10–1: Economics effects of closure[1] of Nyrstar Port Pirie operations (Deloitte Access Economics 2012)

Scale	Economic Statistic	Effect (Levels derived from the reference case[2])		
		Year 1	Year 2	Year 10
Port Pirie and Port Augusta Local Government Area	GSP ($ millions)	-132	-161	-372
	Employment (FTE)	-965	-974	-1,153
South Australia	GSP ($ millions)	-304	-321	-524
	Employment (FTE)	-2,508	-2,064	-1,136
Australia	GDP ($ millions)	-311	-416	-777
	Employment (FTE)	-2,437	-2,696	-1,001

[1]Model assumed Nyrstar's progressive closure over a two year period in 2012–2013 (Year 1 and 2)

[2]reference case represents an economic scenario whereby the current economic conditions remain in place (Nyrstar continues business as usual) for the projected ten year period (2012 to 2022)

10.4.1 Employment

The unique circumstances of a relatively small population base (approximately 14,000 residents) and a single dominant employer leave Port Pirie's unemployment rate at risk if Nyrstar Port Pirie were to close. If that were the case then the loss of employment for approximately 18% of the working population of Port Pirie would severely impact on employment rates that are already below the state average.

Approximately 25% of Nyrstar's workforce is aged 51 or over (Department for Manufacturing, Innovation, Trade, Resources and Energy, 2011). These workers are likely to retire in the next 10 to 15 years, creating approximately 190 new job opportunities. Combining these job opportunities with a 5% staff turn-over rate, there will be approximately 50 vacancies per year at Nyrstar. This is a significant number of employment opportunities if the development proceeds and operations are ongoing. In addition, it is expected that the proposed development would create additional employment during the construction phase. While the specific type and quantity of employment opportunities will be finalised pending approval of the Transformation, it is expected that approximately 250 to 400 personnel will be needed during construction.

10.4.2 Manufacturing sector

Employment in Port Pirie is highly dependent on the manufacturing industry, providing work for 18% of the employed population (ABS 2009-10). Nyrstar contributes to 98% of manufacturing jobs within the township, most of which are full-time positions. Nyrstar's closure would significantly impact Port Pirie's manufacturing sector.

10.4.3 Investment in social and physical infrastructure

Nyrstar Port Pirie's level of economic activity creates direct and indirect opportunities for viable transport, utility, education and health infrastructure. Investment in Port Pirie to develop and maintain productive infrastructure is justified by the smelter's location. While much of Port Pirie's key infrastructure has been developed to directly service Nyrstar or associated industry's needs, there are spill-over benefits to unrelated industries. If Nyrstar were to cease operations, it is likely the level of investment in productive infrastructure would not be maintained.

Nyrstar is critical to the operation of Port Pirie port facilities, contributing to over 50% of port movements. The port has been configured to meet Nyrstar's requirements and lacks the capability to handle significant quantities of containerised freight. This limits the range of goods which can be transported through the port. Nyrstar's closure would have a major impact on the port's commercial viability.

Nyrstar's smelter already hosts a reverse osmosis water purification facility to produce approximately 350 ML of water per year, 100 ML of which will be provided to the Port Pirie Council. In addition, the facility produces water for dust suppression, cleaning and revegetation. These activities improve the amenity for Port Pirie's residents.

In addition to physical infrastructure, Nyrstar's operations in Port Pirie support significant social infrastructure. There are nine government and non-government schools in Port Pirie servicing the region's educational needs.

Further educational infrastructure includes the Port Pirie TAFE campus. Port Pirie TAFE focuses on the development of skills across a broad range of sectors (24 career areas) with the ability to service industry and society in Port Pirie and the region more generally.

If Nyrstar closes in Port Pirie, there may be a drop in demand for TAFE training sectors which may undermine the viability of a number of TAFE courses. Reductions in delivery from the Port Pirie TAFE would reduce the already limited vocational education options in the town which may in turn lessen the town's ability to develop new industries to compensate for the closure of Nyrstar.

In addition to educational infrastructure, Port Pirie's population warrants a community health centre and 95-bed hospital which includes acute care facilities. If Nyrstar were to close and Port Pirie's population decline, the nature of health services and assets could also change markedly.

10.4.4 Population

The population projections described earlier were based on the continued operation of Nyrstar Port Pirie and did not consider significant migration that could result from closure.

Without Nyrstar Port Pirie anchoring or encouraging young people, particularly males, to stay in the area, migration and population shift may reduce the working age population and stress the town's economic viability.

DMITRE (2011) forecast that between 1,500 and 3,000 people may leave Port Pirie in 2013 in the event of Nyrstar's closure. The forecast migration out of Port Pirie represents between approximately 10.3 and 20.7% of the total population and a reduction of approximately 10% in the number of wage and salary earners. Based on these forecasts, Port Pirie's unemployment rates would rise along with an increase in the number of families that have sole or no income earners.

10.4.5 Property values

As described earlier, property values in Port Pirie are reliant on the economic activity and associated demand generated by Nyrstar.

Residential

The South Australian Valuer-General provided 2012/2013 data detailing the current value of residential and commercial property in Port Pirie. The total housing stock was valued at $1.2 billion. Given the potential for a significant number of workers and families moving out of the area within two years in the event of Nyrstar's closure, the combination of more properties for sale and fewer buyers would lead to a reduction in the value of residential property. These factors place the accumulated value of $1.2 billion of housing stock in Port Pirie at risk in the event of closure.

Commercial

Commercial property derives its fundamental value from the income a tenant or owner is likely to earn using the property to sell goods and services to customers. This income is in turn dependent on the level of economic activity driving spending by potential customers.

Data provided by the Valuer-General (for 2012/2013) indicated the total value of commercial property in Port Pirie is $188 m (Department for Manufacturing, Innovation, Trade, Resources and Energy, 2011). The value of these properties would be placed at risk if Nyrstar closes.

DAE's modelling forecasts economic activity in the Port Pirie and Port Augusta region will be reduced as a result of Nyrstar ceasing operations in Port Pirie (**Table 10-1**). While it is likely some of the reduced activity would be in Port Augusta, the bulk of the diminished economic activity is expected to be localised in Port Pirie (Deloitte Access Economics, 2012).

This reduction in economic activity would undoubtedly negatively impact the value of commercial property in Port Pirie and the likely incomes tenants or owners can expect to earn from commercial activities would be reduced.

Community sustainability

Nyrstar contributes to community sustainability through economic activity and employment. DAE's economic modelling found the closure of the smelter may lead to a net reduction in approximately 2,696 FTE's (**Table 10-1**). This would impose additional costs on the Commonwealth Government in the form of welfare payments to the unemployed.

While there are a range of Commonwealth Government funded payments to the unemployed, an examination of the Newstart Allowance and Rent Assistance payments can provide an indication of likely welfare costs to government.

If the 2,696 FTE's forecast by DAE become unemployed and receive the lowest Newstart Allowance benefit and one third of these (assuming a consistent proportion of population were renting) receive the lowest Rent Assistance benefit, then the additional value of Commonwealth welfare payments would be $36.1 million (current prices) per year in 2013 (Department for Manufacturing, Innovation, Trade, Resources and Energy, 2011). This excludes the cost to the Commonwealth Government of administering these payments.

In some previous examples of major employers ceasing operations, structural adjustment or other regional assistance funds have been established. Typically these funds are financed by both State and Commonwealth Government and typically, the total cost historically of these funds is in the order of $10 to $30 million (based on similar potential job losses in recent South Australian and interstate cases).

10.5 State economy

Nyrstar is already a significant contributor to the South Australian economy. The proposed Transformation is likely to enhance the state's economic growth and industry capability.

As the aim of the Transformation is to make Nyrstar Port Pirie a multi-metal facility, the additional metals proposed to be extracted would create more economic growth.

Additionally, the innovative technology used for the development will expand the knowledge, understanding and capabilities of local industry and small and medium enterprises (SME's).

Local SME's are regularly employed at Nyrstar Port Pirie, many with ongoing contracts. The Transformation will give competitive SME's fair and reasonable opportunity to be considered for major work being undertaken in South Australia by the public and private sectors. As described in **Section 10.1**, Nyrstar is preparing a South Australian Industry Participation Plan which addresses this commitment.

10.5.1 Impact to the SASP

Deloitte Access Economics (2012) identified six ways in which Nyrstar makes a significant contribution to the targets of the South Australian Strategic Plan (the Strategic Plan).

The Strategic Plan reflects the input of South Australian communities and their aspirations for how South Australia can best continue to grow and prosper. It aims to show how the State can most effectively balance its economic, social and environmental aspirations in a way that improves overall wellbeing and creates even greater opportunities.

The Strategic Plan targets and measures against which these targets are assessed and for which Nyrstar makes a significant contribution are discussed in **Table 10-2**.

Table 10-2: An assessment of Nyrstar's contribution to specific targets of the South Australian Strategic Plan

Target	Measure	Assessment
Target 35: *Economic growth*	Exceed the national economic growth rate over the period to 2020	Nyrstar's closure would inhibit the ability of South Australia to meet its economic growth target. Economic modelling undertaken by DAE forecasts that in the event of Nyrstar's closure, South Australia's GSP would be $524 million or 0.46% lower than would otherwise be the case in 2022.
Target 37: *Total exports*	Increase the value of South Australia's export income to $25 billion by 2020	The magnitude of the reduction in South Australia's exports in the event of Nyrstar's closure was estimated to be approximately $1 billion in current prices. The closure of Nyrstar's Port Pirie facility would hinder the ability of South Australia to meet the export targets detailed in the Strategic Plan.
Target 36: *Business investment*	Exceed Australia's ratio of business investment as a percentage of the economy by 2014 and maintain thereafter	DAE's economic modelling of the impact of Nyrstar closing its Port Pirie and Hobart smelters forecasts business investment in South Australia would be 1.09% lower in 2022 than would otherwise be the case. Given the fall in business investment is forecast to be greater than the fall in economic activity resulting from the smelter closures, the ratio target of the Strategic Plan would be made more difficult to achieve.
Target 42: *Minerals production and processing*	Increase the value of minerals production and processing to $10 billion by 2020	DAE estimated the value of output of Nyrstar Port Pirie is $1 billion at current prices. The closure of Nyrstar's Port Pirie smelter would significantly and negatively impact the level of minerals processing undertaken in South Australia and potentially damage perceptions in relation to future investment in the South Australian minerals processing sector.
Target 46: *Regional population levels*	Increase regional populations, outside of Greater Adelaide, by 20,000 to 320,000 or more by 2020	Economic modelling undertaken by DAE suggests the closure of Nyrstar's Port Pirie smelter would likely lead to a reduction of employment in the region of 1,153 jobs by 2022. In the face of significantly reduced economic opportunities in Port Pirie, it has been estimated that between 1,500 and 3,000 people may leave Port Pirie.
Target 47: *Jobs*	Increase employment by 2% each year from 2010 to 2016	Economic modelling undertaken by DAE forecasts South Australian employment would be reduced by 1,136 jobs (0.14%) in 2022 if Nyrstar closes its smelter in Port Pirie. This would make it more difficult for South Australia to continue to create employment growth for its citizens. Coupled with a forecast reduction in wages, the closure of Nyrstar's Port Pirie smelter is not only expected to reduce the number of jobs in South Australia, but the quality of employment opportunities as well.

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10.6 Conclusions

The options facing Nyrstar Port Pirie are either to undertake substantial re-investment to upgrade technology or to cease operations. Economic analysis by DAE has demonstrated that Nyrstar is critical and local, regional and state economic scales. If operations were to cease, there would be reductions in economic output and employment each of these levels.

11 Effects on soil, surface water and groundwater

This chapter describes the effects of the Transformation on soil, surface water and groundwater and identifies mitigation and management measures to address any potentially adverse impacts.

11.1 Introduction

The Transformation affects the main operational area of Nyrstar Port Pirie (the smelter) as defined in **Chapter 6**. The black sands emplacement area and intervening land parcels to the west are hydraulically isolated from the main operational area of the smelter and have been excluded from this discussion.

Assessment of surface water and subsurface environments at the smelter has been the subject of many studies over more than 15 years. Investigation has been relatively intensive in the last 2–3 years with Nyrstar adopting a formal SA EPA regulatory approach to risk management; including the voluntary appointment of a SA EPA accredited Contamination Auditor (the Auditor) (appointed December 2011) to oversee the process. This chapter relies mainly on the technical report presented in **Appendix I**.

Nyrstar is not only well prepared to assess the effects of the Transformation; its understanding of these environments is being proactively entrained in Transformation design to avoid future impacts.

11.2 Existing environment

The following sections summarise current understanding of the surface water, geology, and hydrogeology and associated contamination of Nyrstar Port Pirie. Additional information is provided in **Appendix I**.

11.2.1 Surface water

The main operational area sits within the Port Pirie River catchment, with much of the natural drainage reporting to the River. The smelter as a whole (including the black sands emplacement area) straddles a drainage divide, with parts of the westernmost portion of the smelter naturally draining to the Spencer Gulf.

The Port Pirie River is an estuary which drains north to the Spencer Gulf, with the river mouth located approximately 4 km north of the smelter. The Spencer Gulf and Port Pirie River are both tidal. The tidal range is moderate with an extreme spring tidal range of 3.44 m (AGSO 1998).

The majority of the Transformation demolition and construction works will occur in areas paved with concrete. Surface water (dust suppression water and rainfall) from the majority of this area is collected in a stormwater drainage system that reports to the smelter sedimentation pond and then discharges via First Creek to the Spencer Gulf. Discharges from the sedimentation pond are subject to an EPA Licence condition and are continuously monitored for compliance. Some the key smelter features, including the sedimentation pond and First Creek are shown in **Appendix I**.

Rainfall in the western unpaved areas of the main operational area of the smelter (including the intermediate storage area) tends to infiltrate though the generally permeable surface recharging a shallow aquifer system (see geology and hydrogeology).

11.2.2 Geology and hydrogeology

The smelter is situated in a regional-scale basin of sediments overlying basement rock. Groundwater systems (aquifers) exist in the rock and sediments, and generally flow from the Mt Lofty and Flinders Ranges in the east to the Spencer Gulf in the west where groundwater discharge occurs. A generalised conceptual cross-section showing the setting of the smelter from the Mt Lofty Ranges in the east through to the Spencer Gulf in the west is presented in **Figure 11-1**.

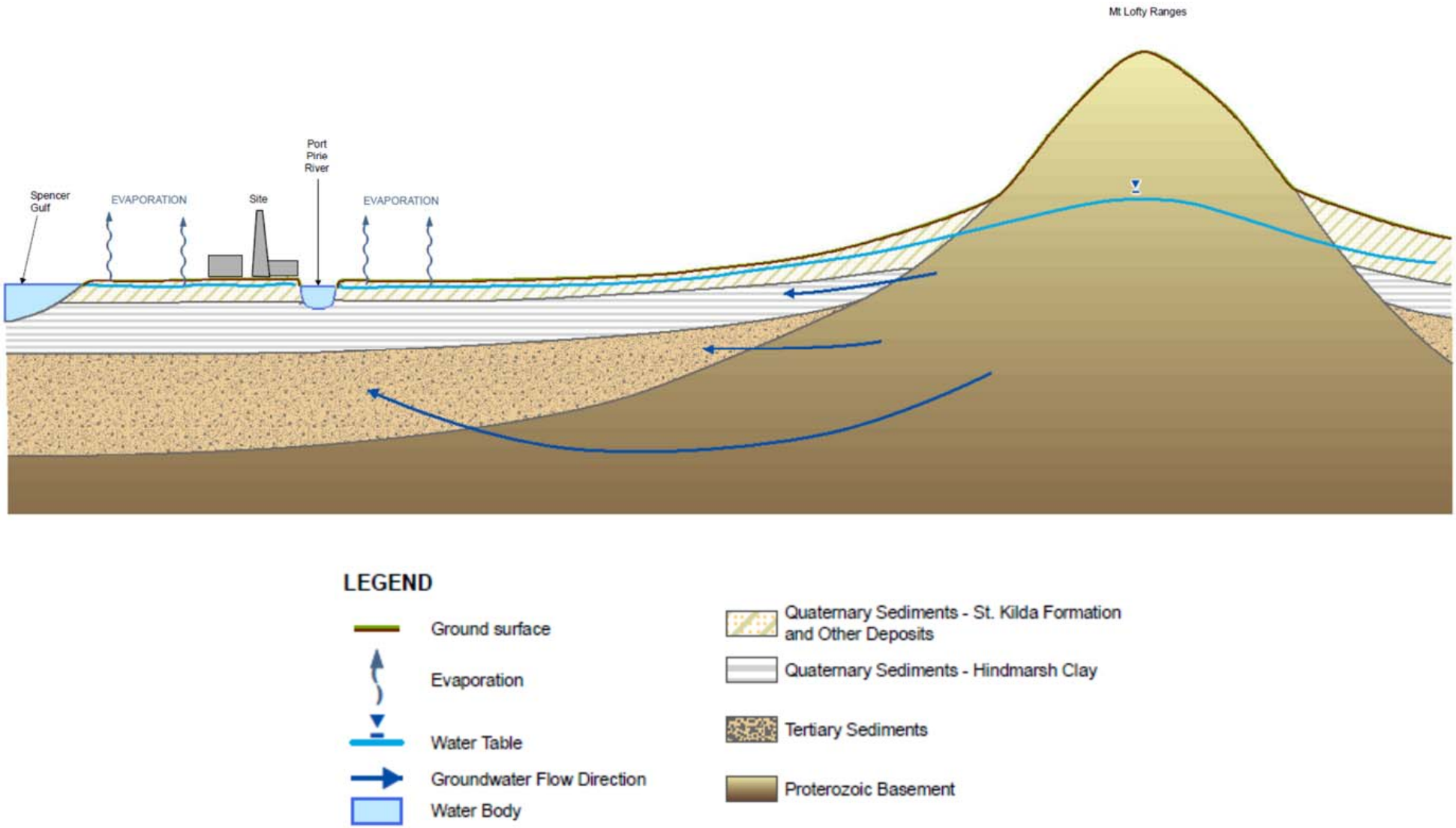

Figure 11-1 Regional conceptual hydrogeological cross-section

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The shallow basin sediments at the smelter generally comprises a sequence of natural clays and sandy clays overlain by a variable thickness of anthropogenic slag and other fill used to raise the low lying ground surface. The upper sequence of the natural formations is known to contain acid sulphate soil (CSIRO 2013).

The understanding of the local, shallow sedimentary sequence of the smelter is based on extensive drilling (see **Appendix I**) and can be summarised, chronologically from the surface, as follows:

- Slag (with intermittent fill of other type) to depths of approximately 4 to 5 m.
- Clays of the St Kilda Formation, with typical thicknesses between 2 and 3 m.
- Silty and sandy clays of the St Kilda Formation, with typical thicknesses of approximately 4 m.
- Mottled clays of the Hindmarsh Clay, including inter bedded sandy horizons (≥50 m).

The slag and other fill, the silty and sandy clays of the St Kilda Formation and the sandy portions of the Hindmarsh Clay all contain groundwater and are considered to be aquifers. These aquifers have been named the Fill Aquifer, Upper Natural Aquifer (UNA) and the Hindmarsh Clay Aquifer, respectively; the upper clay sequence of the St Kilda Formation (the 'Samphire Clay') forms an aquitard (restricts groundwater movement). These shallow aquifers and aquitard are of potential significance to Transformation.

The UNA and Hindmarsh Aquifers contain hyper saline groundwater which is consistently greater salinity than that of seawater, making it unsuitable for many uses. Groundwater salinity in the Fill Aquifer is much more variable, ranging from approximately 5,000 mg/L to >40,000 mg/L total dissolved solids (i.e. brackish to saline).

There are a number of natural and anthropogenic features that are considered important to the smelter's hydrogeology due to the likely controlling influence they have on groundwater flow and contaminant movement. These are compiled, discussed and presented in **Appendix I**.

11.2.3 Existing contamination

For more than 120 years, smelter activities have resulted in contamination of the subsurface environment. Smelter site assessment and remediation to date has followed a regulatory process as defined by the SA EPA. Recently Nyrstar voluntarily appointed a Contamination Auditor accredited by the SA EPA to oversee the regulatory process.

As part of this regulatory process, a detailed site history has identified activities that may have resulted in subsurface contamination (BlueSphere 2012). This work underpins the impact assessment that Transformation may have on existing soil, groundwater and surface water quality.

Subsurface contamination is consistent with the historic use of the smelter, including a range of metals/metalloids (lead, zinc, cadmium, manganese, copper, silver and arsenic), acids and some hydrocarbons associated with fuel use and storage. **Appendix I** shows a summary of potential contamination sources across the smelter. The plans give an indication of the potential contaminants of concern that may be encountered during the Transformation.

The widespread deposition of slag and aerial deposition of site-derived dusts and other emissions has resulted in local background concentrations of primarily zinc and lead in the subsurface.

The Fill Aquifer is the main aquifer requiring consideration during Transformation. Contaminants in Fill Aquifer, including cadmium, lead, manganese and zinc, are generally most concentrated near the Zinc Plant, Lead Production Area, the Cadmium Plant and the existing sludge dewatering dams. From these areas, groundwater contamination extends down hydraulic gradient and in some cases underlies areas where Transformation works are planned.

These areas are the focus of remedial efforts by Nyrstar, which are being conducted as part of the overall Groundwater Management Plan. Transformation-related changes are being entrained into remedial planning and design to prevent compromise of remedial efforts by Transformation activities.

It is expected that the net result of the Transformation will be a positive impact on the current status of the smelter with respect to soil, groundwater and surface water.

11.2.4 Acid sulphate soils

Potential Acid Sulphate Soils associated with the St Kilda Formation have been defined by mapping in the area (CSIRO 2013). This formation has been substantially covered by slag and other fill beneath the main operational area, consequently most of the Transformation works will not disturb these sediments. However, north of the smelter and along the Port Pirie River margin, these natural sediments are either exposed or are close to ground surface during relatively low tides, and as such may be encountered during Transformation related activities. The risk and management measures associated with this issue are further discussed in **Section 11.3.2** and **Section 11.4**.

11.3 Assessment methods

The assessment and remediation of the subsurface conditions has been conducted in accordance with industry standards and a defined regulatory (SA EPA) process. More recently Nyrstar have voluntarily appointed an SA EPA accredited Contamination Auditor to oversee all activities and assessment of the groundwater and subsurface of the smelter, inclusive of those activities related to the Transformation. Details of this process, including the relevant guidelines, assessment criteria and beneficial use assessment is provided in **Appendix I**.

11.3.1 Impact assessment

The Transformation is expected to deliver a net environmental benefit with respect to the soil, groundwater and on-site surface water environments. While some risks exist during the design, construction and operational phases of Transformation, these can be readily eliminated, mitigated or managed by adopting established environmental protocols.

11.3.2 Risks identified

The following tables identify the potential impacts to soil, groundwater (**Table 11–1**) and surface water (

Table 11–2) associated with the design, construction and operational phases of Transformation. Further details of the risks identified and management measures are discussed in **Appendix I**.

These risks have been entrained in the overall risk assessment and control measures reported in **Chapter 16** and the construction and operations environmental management plans in **Chapter 18**.

Table 11–1: Risks to soil and groundwater

Activity	Task	Potential Groundwater Impact	Assessment/Mitigation Measures
Decommissioning and Demolition of Existing Plant			
Demolition	Stockpiling of building rubble/waste materials	Stored materials may be contaminated and form a groundwater contamination source	• Environmental Management Plan (EMP) (including stockpile management procedures)
		Excessive dust generation may lead to increased entrainment of metals and other contaminants in recharging groundwater	• EMP (including dust management)
	Creation of open sealed and/or unsealed space	Increased runoff of potentially contaminated water could enter aquifers through unsealed surfaces or degraded drainage infrastructure increasing contaminant loads and/or hydraulic head in the groundwater system.	• EMP
Construction of New Facility			
Feasibility Investigations	Geotechnical Drilling and Test Pitting	Potential breach of aquitard could lead to cross contamination of aquifers	• EMP (including management of geotechnical Scopes of Work)
Excavation	Excavation	Potential breach of aquitard could lead to cross contamination of aquifers	• EMP (including excavation procedures)
	Stockpiling and disposal of contaminated spoil	Stored materials may be contaminated and form a groundwater contamination source	• EMP (including stockpile management procedures)
		Excavated spoil, particularly natural materials may be acid	• EMP (including Acid Sulphate Soils

Activity	Task	Potential Groundwater Impact	Assessment/Mitigation Measures
		generating under oxidising conditions (i.e. Acid Sulphate Soils)	management procedures)
	Dewatering	Could temporarily alter groundwater and contaminant flow paths	• EMP
		Stored water could form a groundwater contaminant source if not appropriately managed	• EMP
	Emplacement of underground cooling water pipeline	Pipeline could interfere with contaminated groundwater flow paths, modifying the location or concentrations of discharge to boundaries	• EMP • Modelling
Piling	Drilling	Potential breach of aquitard could lead to cross contamination of aquifers	• EMP (including management of geotechnical Scopes of Work and specific piling design)
	Stockpiling/storage and disposal of contaminated spoil and water	Stored materials may be contaminated and form a groundwater contamination source	• EMP
	Piling Emplacement	Piles may reduce aquifer transmissivity and alter groundwater and contaminant flow paths	• Modelling • Groundwater Monitoring and Management Plan (GMMP) • Piling design
Caisson and Diffuser emplacement and associated pipelines	Excavation	See previous	• EMP
	Caisson, Diffuser and Pipelines Emplacement	Caisson may affect aquifer transmissivity and alter groundwater and contaminant flow paths locally	• EMP • GMMP
Ongoing Operation			
Increased Cooling Water Disposal	Additional water input to Sedimentation Pond and/or First Creek Drain	Increased head in the Sedimentation Pond and/or First Creek Drain could alter groundwater and contaminant flow paths and lead to flooding of low lying areas of the smelter through groundwater level increases	• Modelling • GMMP
Rationalisation of Intermediate	Possible disposal of unused feedstocks	Stored materials may form a groundwater contamination source	• EMP (including waste management)

Activity	Task	Potential Groundwater Impact	Assessment/Mitigation Measures
Materials	Creation of open unsealed space	Increases in evaporation from the shallow water table may alter water balance and groundwater/contaminant flow paths	• Modelling • GMMP
Storage of New Feedstocks	Storage of new, potentially contaminant-bearing feedstocks	Stored materials may form a groundwater contamination source	• Nyrstar Operating Procedure • GMMP
Acid Management	Monitoring and prevention of acid ingress from historical releases entering the Transformation site	Groundwater barriers may alter groundwater and contaminant flow paths	• Modelling • GMMP
		Groundwater barriers may fail or be circumvented requiring contingency measures to be implemented	• GMMP

Table 11–2: Risks to surface water

Activity	Task	Potential Surface Water Impact	Assessment / Mitigation Measures
Decommissioning and Demolition of Existing Plant			
Demolition	Stockpiling/Disposal of building rubble/waste materials	Stockpiles may leach contamination and run-off into surface or water systems, including the Port Pirie River.	• EMP (including stockpile management procedures)
	Creation of open sealed and/or unsealed space	Increased runoff of potentially contaminated water could enter stormwater or surface water systems, including the Port Pirie River.	• EMP
Construction of New Facility			
Feasibility Investigations	Geotechnical Drilling and Test Pitting	See Excavation Tasks below	
Excavation	Stockpiling and disposal of contaminated spoil	Stockpiled spoil may leach contamination and run-off into stormwater or surface water systems, including the Port Pirie River.	• EMP(including stockpile management procedures)
		Excavated spoil, particularly natural materials may be acid generating under oxidising conditions (i.e. Acid Sulphate Soils) and may leach acid and metals into adjacent	• EMP (including Acid Sulphate Soil Management)

Activity	Task	Potential Surface Water Impact	Assessment / Mitigation Measures
		stormwater or surface water systems.	
	Dewatering	Stored water could form a stormwater and/or surface water contaminant source if not appropriately managed.	• EMP
Piling	Stockpiling/storage and disposal of contaminated spoil and water	Stored materials may be contaminated and form a stormwater/ surface water contamination source	• EMP
	Piling Emplacement	Piles may alter groundwater flow paths thereby potentially modifying the discharges of groundwater and contaminants to contiguous surface water systems such as the No.1 Drain, Sedimentation Pond and the Port Pirie River	• Modelling • GMMP • Pile Design
Caisson and Diffuser emplacement and associated pipelines	Excavation	See Excavation Impacts above	
		Excavation at the river margin and/or within the intertidal/subtidal zones may lead to sediment mobilisation and unacceptable turbidity and visual impacts	• EMP (including silt management procedures)
	Caisson, Diffuser and Pipeline Emplacement	Caisson may affect aquifer transmissivity, altering groundwater and contaminant flow paths locally thus potentially altering the flux of contaminants to the Port Pirie River	• Modelling • GMMP
Ongoing Operation			
Increased Cooling Water Disposal	Additional water discharges to the Sedimentation Pond, First Creek Drain and/or the Port Pirie River	Increased flow in the Sedimentation Pond and/or First Creek Drain could increase hydraulic heads in these systems, restricting groundwater drainage and potentially alter dissolved and particulate contaminant loads reporting to the Spencer Gulf	• Hydrological Modelling conducted by others • Nyrstar Operating Procedure
		The volume, temperature and other physical properties of discharging cooling water	• Hydrodynamic Modelling conducted by others

Activity	Task	Potential Surface Water Impact	Assessment / Mitigation Measures
		may alter the physical environment of the receiving water potentially impacting aquatic flora and fauna	
Rationalisation of Intermediate Materials	Possible movement and/or disposal of unused feedstocks	Stored materials may generate leachate or particulate-bearing run-off to stormwater and/or surface water systems	• EMP (including waste management as appropriate)
Storage of New Feedstocks	Storage of new, potentially contaminant-bearing feedstocks	Stored materials may generate leachate or particulate-bearing run-off to stormwater and/or surface water systems	• Nyrstar Operating Procedure • GMMP
Acid Management	Monitoring and prevention of acid ingress from historical releases entering the Transformation site	Groundwater barriers may alter rates of discharges of groundwater, acid and/or contaminants to contiguous surface water systems such as the No.1 Drain and Sedimentation Pond, altering contaminant loads at compliance points	• Modelling • GMMP

* GMMP = groundwater monitoring and management plan.

11.3.3 Potential benefits and opportunities

With the current SA EPA accredited Contamination Audit process and Nyrstar's continual improvement strategy it is expected that the Transformation will provide substantial environmental benefits to the soil, groundwater and surface water systems. This will be facilitated by the:

- reduction of metal-bearing airborne and dust emissions
- discontinuation of the use of the sludge dewatering dams and the subsequent recovery of metals-bearing materials
- decommissioning and demolition of the existing acid facility
- reduction in storage of metal-bearing intermediate materials in the intermediate storage area.

The likely significance of these changes for the local groundwater and surface water systems are detailed in **Appendix I**.

11.4 Mitigation and management measures

The risk identification process highlights some potential direct and indirect, impacts on soil, groundwater and surface water. Human health and environmental risks associated with these aspects of the environment have been assessed to the level of available information (**Chapter 16**) and will be re-evaluated through numerical modelling prior to construction.

The mitigation and management measures proposed in this report will be updated prior to construction to address any unexpected outcomes of the numerical models.

The mitigation and management measures for soil, groundwater and surface water will be documented in the Construction and Operations Environmental Management Plans (CEMP and OEMP) and the Groundwater Management and Monitoring Plan (GMMP). All of these measures will be independently reviewed and approved by the SA EPA accredited Contamination Auditor to confirm adherence to appropriate protocols and protections.

11.4.1 Management system and approach

Groundwater is currently managed in accordance with the current GMMP. This plan covers both the ongoing assessment and remedial programs and also strategic and operational risks based on Australian Standard risk ranking methodologies (AS/NZS 4260:2004).

Currently, the GMMP is subject to review and approval by the SA EPA accredited Contamination Auditor to confirm compliance with the relevant legislation and protocols. There is also regular interaction between Nyrstar and EPA representatives on groundwater matters.

Groundwater monitoring wells have been progressively installed at the smelter between 1994 and 2012, predominantly within the Fill Aquifer, but also in the UNA and Hindmarsh Clay. These have focused on the smelter boundary to characterise potential off-site discharges and associated risks and also to form a sentinel well network for ongoing compliance monitoring. Selected source zone characterisation has also been undertaken during these programs.

The smelter well network currently comprises 101 monitoring wells, more details and locations of these wells are presented in **Appendix I**. Transformation activities will be incorporated to this existing and extensive management system in consultation with the SA EPA accredited Contamination Auditor.

11.4.2 Decommissioning and demolition of existing plant

All identified soil, groundwater and surface water risks associated with the decommissioning and demolition phases of Transformation will be managed in accordance with the CEMP. The final CEMP will address the:

- background and smelter summary information including site identification, scope of the proposed activity and Contaminants of Potential Concern (CoPC)
- roles and responsibilities
- health and safety requirements including management options and controls to mitigate occupational health and safety hazards
- regulatory, licensing and legislative requirements
- identification of potential environmental impacts associated with each activity, including dust, noise, vapour, soil contamination, groundwater contamination, surface water runoff, soil runoff and waste generation
- relevant environmental management quality control measures to minimise potential impacts associated with the each activity including operational objectives
- performance criteria, management strategies, monitoring, reporting and corrective actions

- emergency procedures and environmental incident response.

The CEMP will be subject to review and approval by the appointed SA EPA accredited Contamination Auditor with respect to soil, surface water and groundwater.

The key risks associated with this phase of the Transformation include the stockpiling and management of potentially contaminated waste materials and the creation of open sealed or unsealed space increasing runoff of potentially contaminated water and possibly aquifer recharge, respectively. In both cases the relevant CEMP will specify management protocols such as limiting the removal of pavements and detailing stockpile management procedures which will effectively manage these risks.

11.4.3 Design and construction of new plant

All identified soil, groundwater and surface water risks associated with the design and construction phases of Transformation will be assessed and/or managed using modelling, CEMPs and/or GMMPs.

Modelling will be utilised during the options assessment phase or following the determination of final design criteria. Current modelling scenarios related to Transformation are expected to include the following:

- the effects of the distribution of new piles during the Transformation
- the effects of the distribution of any foundations or other sub-surface infrastructure expected to be constructed below the water table
- the effects of any remedial measures such as groundwater interception or infrastructure management related to acid risk mitigation and management
- the effects of Caisson emplacement on the local groundwater system
- the effects of removing intermediate materials stockpiles from areas of shallow water table
- the effects of any additional evaporative lakes proposed in redundant areas of the intermediate storage area amphitheatre.

Due to the relative scale of the smelter compared to the anticipated subsurface features, the impacts to groundwater flow and contaminant fate are expected to be minimal. Where a potential risk is identified by the modelling, a risk assessment will be undertaken to determine appropriate elimination, mitigation or management approaches.

In addition to modelling and as part of the smelter-wide assessment program, a Groundwater Management and Monitoring Plan (GMMP) will be developed to monitor temporal and spatial changes in groundwater quality and to evaluate the impacts of Transformation activities at the smelter and verify the effectiveness of remedial or control measures.

The likely content of the GMMP is described in **Appendix I**, and summarised:

- definition of groundwater quality management objectives
- definition of roles and responsibilities
- identification of groundwater CoPC
- identification of relevant groundwater beneficial uses and permitted groundwater beneficial uses at and surrounding the smelter

- summary of groundwater management approach including health and safety protocols
- groundwater monitoring requirements including the rationale for groundwater sampling, location of groundwater wells to be sampled, groundwater sampling methodology and frequency of groundwater sampling
- definition of contaminant trigger levels to assess if relevant groundwater quality management objectives have been met
- contingency actions to be implemented where trigger levels are exceeded

The GMMP will be subject to review and approval by the SA EPA accredited Contamination Auditor.

The key risks associated with this phase of Transformation include the geotechnical testing and pile installations which may modify groundwater flow patterns and contaminant distributions and potentially interconnecting aquifers of differing quality. Some subsurface infrastructure, such as the proposed cooling water pipeline, may also alter groundwater flow paths and contaminant distributions.

These risks will be effectively managed by the CEMP and OEMP, which will specify drilling methodologies and pile design. Monitoring within the GMMP will verify the modelling used to assess the impact to groundwater flow path.

11.4.4 Ongoing operation

Soil, groundwater and surface water associated with the ongoing operation of the smelter after the Transformation will be assessed and managed using the OEMPs and the modelling verified by GMMP. Further information on these processes and protocols are provided in **Appendix I**.

The key risks associated with the operational phase of the Transformation with respect to soil and water include:

- increased cooling water disposal potentially altering groundwater and surface water interactions
- the management of new and possibly existing smelting feedstocks
- acid management infrastructure.

These risks will be effectively managed by a combination of the OEMP and the GMMP to monitor and changing conditions and document contingency actions if required.

11.5 Conclusions

The Transformation will have no net negative impacts on the surface water, soil or groundwater conditions, provided the identified risks are managed in accordance with the established protocols and standards.

The reduction in emissions and the removal of potentially contaminating materials from the intermediate storage area and the old sludge dewatering dams will reduce soil, groundwater and surface water contamination potential. Potential impacts associated with sub-surface acid will be reduced by replacing the existing acid plant, improved management and bunding design and appropriate foundation design, supported by strategic groundwater monitoring and contingency plans.

The removal of the intermediate process materials from the intermediate storage area is likely to provide a larger surface area for groundwater evaporation. This in turn will lower the groundwater levels reducing the potential for groundwater contamination.

The primary potential impacts identified from the Transformation and associated activities are:

- *Geotechnical testing and piling activities*

  This has the potential to interconnect aquifers and mobilise contaminants, particularly from the Fill Aquifer to underlying aquifers. This will be managed by dedicated pile design that will hydraulically isolate the aquifers and appropriate drilling methodologies. This has been successfully completed on the smelter to the satisfaction of the SA EPA accredited Contamination Auditor. Impedance of groundwater flow by piles can be assessed and managed based on results from a numerical groundwater model.

- *Pavements*

  Removing pavements will increase the rate of recharge and the risk of further groundwater contamination. Where required, pavement improvement will be designed to reduce the potential for groundwater recharge and contaminant migration.

- *Contaminated materials*

  Handling potentially contaminated materials, including acid sulphate soils and waste construction materials can have an impact on soil, groundwater and surface water. The CEMP and OEMP will outline strategies and procedures for handling contaminated materials. The SA EPA accredited Contamination Auditor will review and approve the CEMP and the OEMP.

- *Cooling water pipeline*

  The cooling water pipeline may alter groundwater flow potentially impacting groundwater quality. The cooling water pipeline will be designed with the aid of numerical modelling to avoid further contamination. The pipeline construction is being assessed as a potential opportunity to assist with groundwater contamination management.

In summary, the Transformation presents net benefits to soil, groundwater and surface water management on smelter. These benefits will be principally realised through the removal of some existing sources of contamination which currently impact these aspects of the environment. The risk of negative impacts will be managed by the implementation of a CEMP and an OEMP supplemented by other environmental management procedures approved by the SA EPA accredited Contamination Auditor.

12 Effects on coastal and marine communities

12.1 Introduction

This chapter assesses the effects the Transformation will have on the marine communities inhabiting First Creek, the Port Pirie River and Spencer Gulf. Specifically, the assessment focuses on effects associated with:

- the increased volume of cooling water being discharged
- increased shipping traffic during construction.

The specific issues addressed include:

- increased temperature effects of cooling water
- sediment erosion by cooling water flows and shipping traffic
- sediment re–suspension by cooling water flows and shipping traffic, and bio–availability of contaminants
- turbidity effects associated with winnowing of sediments by ships
- introduction of exotic species by ships.

12.2 Existing environment

The Nyrstar smelter is located on the Port Pirie River, which is a tidal estuary on the eastern shore of Spencer Gulf. Spencer Gulf is termed an 'inverse estuary' as, unlike most estuaries, its salinity increases with distance from the open ocean.

The sheltered and shallow conditions in Upper Spencer Gulf result in relatively warm seawater temperatures during much of the year and conditions that support many species with tropical or sub–tropical affinities.

The dominant coastal and marine habitats in the Port Pirie region are extensive mangrove woodlands, samphire shrubland and tidal creeks in the intertidal area, and extensive seagrass meadows to a depth of about 10 m, and deep water channels in the deeper areas.

With the exception of the ports of Port Pirie and Whyalla, the South Australian Upper Spencer Gulf Marine Park encompasses most of northern Spencer Gulf from Port Jarrold and Cowleds Landing in the south to Port Augusta (see **Chapter 4**).

This section discusses the existing environment in the Port Pirie region at a range of scales, including Spencer Gulf and Upper Spencer Gulf (north of Jarrold Point), Germein Bay (bounded by Ward Spit at the north and extending southwards to Fisherman's Creek), and the potential cooling water intake and discharge sites in Port Pirie River and First Creek.

12.2.1 Oceanography

Tides and currents

The narrowing and shallowing of Spencer Gulf towards the north results in tidal ranges that are unusually high for southern Australia, being up to 4.3 m at Port Augusta and 3.4 m at

Port Pirie (compared with less than 1.8 m at Port Lincoln near the mouth of the Gulf). Storm surges can increase this range by more than 1 m (Noye 1984).

Currents in the vicinity of Port Pirie are driven mainly by the tides, with a maximum speed of around 0.5 m/s adjacent to Ward Spit and 1 m/s near the entrance to Germein Bay, although tidal flows within the bay itself are expected to be much less than this. Wind–driven currents and thermohaline (density) currents created by stratification in the northern reaches of the Gulf also contribute to water movement (Noye 1984; Nunes and Lennon 1986; Nunes Vas *et al.* 1990; Harris and O'Brien 1998).

Temperature

The seasonal temperature range of Spencer Gulf is typically 12–24°C (Nunes and Lennon 1986; Nunes Vaz *et al.* 1990).

Seawater temperatures in Spencer Gulf, however, can also vary markedly on a temporal scale of hours to days and a spatial scale of metres to kilometres, as the extensive areas of shallow water on the tidal flats of Upper Spencer Gulf respond much more rapidly to the prevailing air temperature than deeper off–shore waters.

On hot summer days the shallow water on the tidal flats can reach temperatures above 30°C, compared with offshore water temperatures of 23–24°C. For example, it is reported that the water in Port Paterson, which is a shallow embayment in Upper Spencer Gulf, reaches temperatures up to 33.5°C in summer (Ainslie *et al.* 1989).

Similarly, during cold winter nights, the water on the tidal flats can cool to approximately 8–10°C compared with the offshore water temperatures of about 12–13°C (D Wiltshire, personal observation, 10 June 2012).

During ebb tides when water drains from the shallow tidal flats, water masses of different temperatures often mix, sometimes resulting in temperature stratification and thermoclines developing in the deeper offshore areas (D Wiltshire, personal observation 9 July 2012).

Salinity

The warm to hot climate and high net evaporation in Spencer Gulf result in the formation of an inverse estuary with progressive increases in salinity and seasonal salinity range from south to north. Specifically, salinity increases from typical oceanic salinities of 35–36 g/L at Port Lincoln in the south to 43–48 g/L at Port Augusta in the north. Offshore from Port Pirie, the annual depth–averaged salinity range is about 40–42 g/L with the peak in autumn (Nunes 1985). In Port Pirie River, Johnston (1981) recorded salinities in the range 40–47 g/L, again probably influenced by water seeping from shallow tidal flats where much higher salinities have been recorded (Nunes and Lennon 1986).

Turbidity

Johnston (1981) made a series of 28 measurements of water clarity in Port Pirie River over a period of four years in the 1970s. On all except four occasions, the secchi disk depth exceeded 2 m, which equates to the EPA (1993) water quality guidelines threshold of 10 NTU for marine ecosystems (Coleman and Cook 2007). Although the EPA has undertaken a

small amount of turbidity monitoring in the region in recent years, the data is yet to published (S Gaylard, EPA, pers. comm., 20 June 2013).

12.2.2 Marine habitats and biota

Principal marine habitats

The eastern shorelines of Upper Spencer Gulf are characterised by wide intertidal flats frequently colonised by seagrass, mangroves and samphire, and interspersed with tidal creeks (**Figure 12-1**). The mangrove and samphire communities of Upper Spencer Gulf are the most extensive in South Australia.

Communities of the southern mangrove *Avicennia marina* occur at Port Germein and from Weeroona Island to Fisherman Creek, backed by samphire communities extending inland by up to five kilometres (**Figure 12-2**). There are numerous tidal creeks between Port Pirie River and Fisherman Creek, and in Germein Bay. Intertidal sand flats extend 1–2 km offshore, often covered by the seagrass *Zostera mucronata* (particularly on the sand flats adjacent to mangroves southwest of Port Pirie). Ward Spit extends 8 km into Spencer Gulf, and Cockle Spit (4 km long) lies in the middle of Germein Bay. Ward Spit supports intertidal seagrass communities.

Offshore, the shallow, sheltered waters of Germein Bay support extensive communities of the seagrasses *Posidonia australis, P. sinuosa* and *Amphibolis antarctica,* with areas of unvegetated sand (**Figure 12-2**).

Associated communities

The marine habitats occurring in the Port Pirie region form a productive, detritus–based ecosystem which provides feeding, nursery and/or breeding habitat for a variety of fish and crustacean species (McDonald 2008, Bryars 2003). Species important to fisheries include the Western King Prawn *Melicertus latisulcatus* (King 1979), Blue Swimmer Crab *Portunus armatus*, King George Whiting *Sillaginodes punctatus*, Yellowfin Whiting *Sillago schomburgkii* (Jones 1979) and the razorfish *Pinna bicolor*. Razorfish are a dominant but patchily distributed benthic species (McLaren and Wiltshire 1984; Corbin and Wade 2004), which provide substrate for a variety of molluscs, bryozoans, soft corals, ascidians and sponges (Ward *et al.* 1982). The seagrass and sand habitats support an infauna community of moderate diversity but low density in comparison with other temperate regions (Hutchings *et al.* 1993). These communities comprise mainly polychaete worms, molluscs and crustaceans, and are most dense within intertidal seagrass habitat.

Upper Spencer Gulf supports numerous species with tropical or subtropical affinities (Baker 2004), including the brown macroalga *Hormophysa cunieformis,* the soft coral *Carijoa multiflora*, the Sponge Crab *Schzophrys aspera*, the sea pen *Virgularia gustaviana*, the goby *Bathygobius kreffti* (BHP Billiton 2009) and the Horseshoe Worms *Phoronis albomaculata* and *P. psammophila* known from Germein Bay (Emig and Roldan 1992). The turfing macroalga *Vaucheria conifera*, considered vulnerable by Cheshire *et al.* (2000) due to its narrow range (<500 km), has been recorded on the north bank of Port Pirie River, opposite Fishermans Jetty.

The tidal flats and mangrove woodlands provide nesting and feeding habitat for many species of waterbird, particularly at Ward Spit (Baker 2004; BHP Billiton 2009).

Biological surveys

Biological surveys were undertaken to provide more detail on habitats within Port Pirie River and First Creek near potential intake and/or discharge sites. The vertical face of the wharf in Port Pirie River was dominated by the encrusting mussel *Trichomya hirsuta* and filamentous red algae, with ascidians, orange finger sponges and fan worms also present. Several Sea Sweep *Scorpis aequipinnis* and Snapper *Chrysophrys auratus* were observed. The seafloor adjacent to the wharf consisted of mud with a sparse cover of dead *Posidonia australis* leaves and other organic debris. North of the wharf, the relatively shallow sandy area (<2 m depth) between the shore and the shipping channel supported patches of *Zostera*, drift macroalgae including *Caulocycstis cephalornithos*, calcareous tube worms and microphytobenthos inhabited by isopods. No living biota was observed on the floor of the shipping channel.

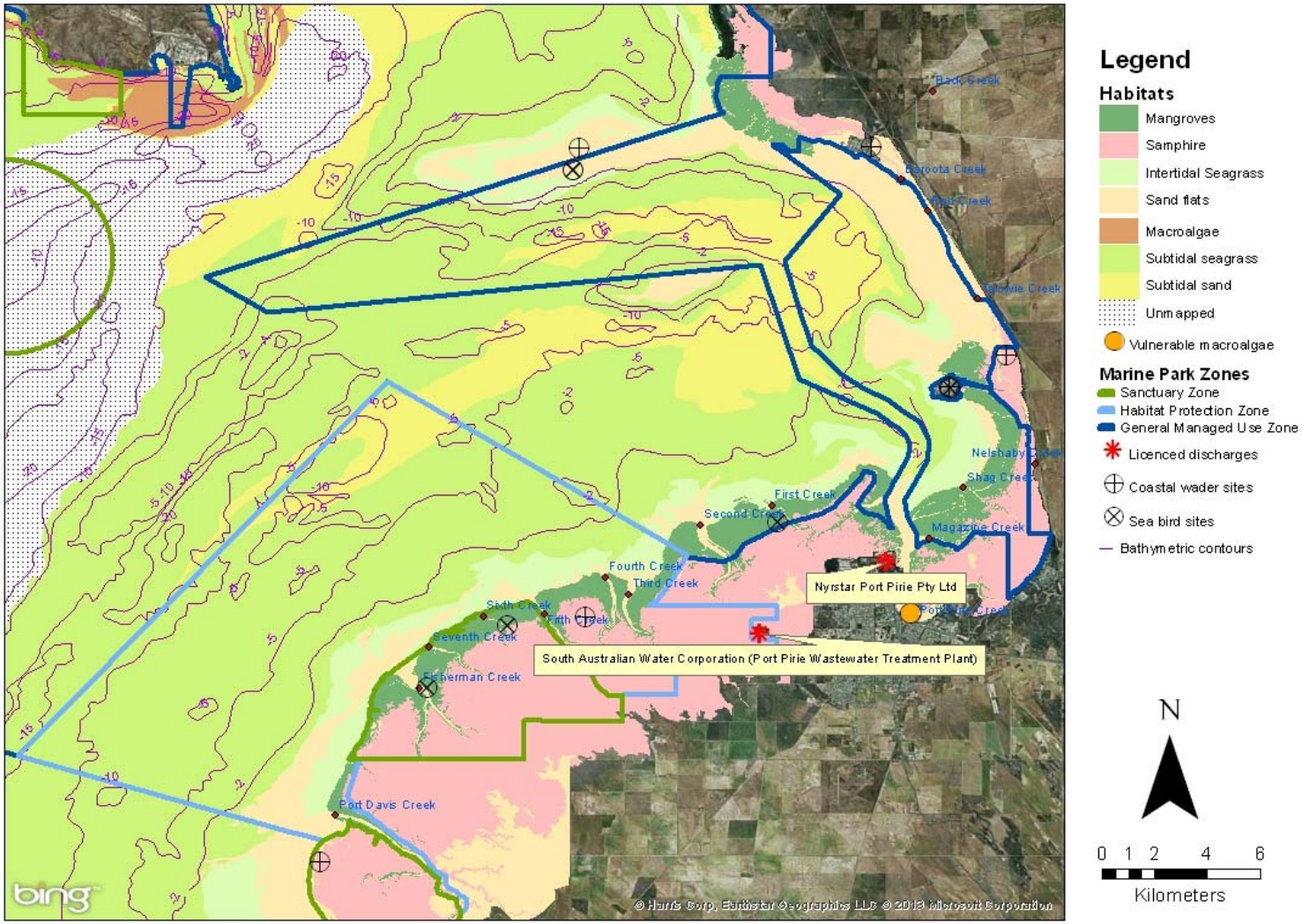

Figure 12-1: Overview of the regional coastal and marine habitats and sites of ecological importance (data source: DEWNR)

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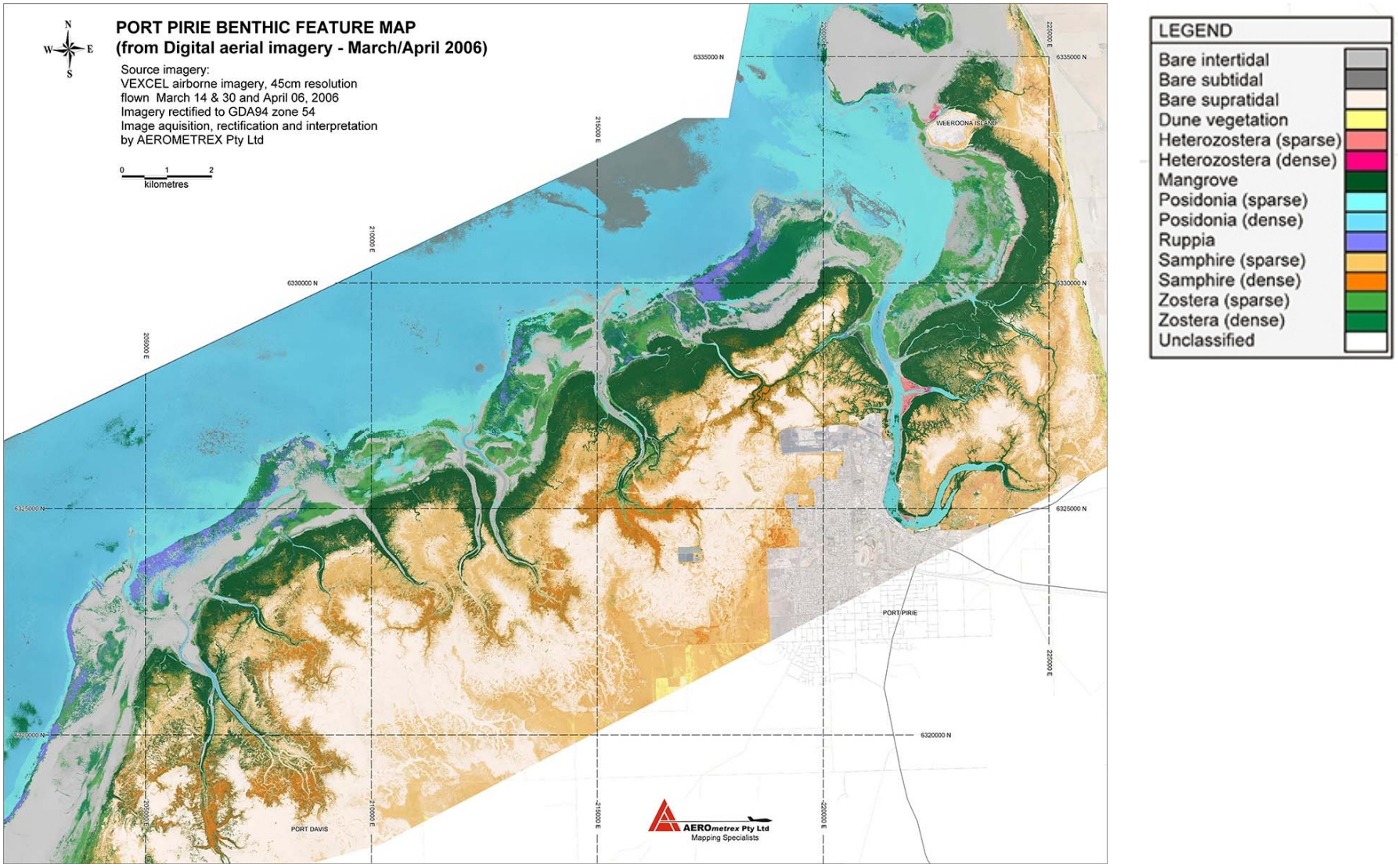


Figure 12-2: Coastal and marine communities near Port Pirie based on aerial photography interpretation

First Creek was surveyed for approximately half its length beginning approximately 1 km downstream of the existing cooling water discharge point at the 1M flume (i.e. the most easterly point accessible by boat). The muddy banks were lined by mangroves and a dense cover of aerial roots. Other than one yellow–eye mullet, no macrobiota were observed within the habitat provided by the aerial roots. The sediments varied between mud, sand and coarse shell fragments, and there were sections with a dense cover of filamentous turfing algae. Other than the Southern Longfin Goby *Favonigobius lateralis*, which was abundant in the sandy sediments, no biota was observed in the creek bed.

12.2.3 Significant or sensitive species

An EPBC Protected Matters search of a 10 km zone around the smelter (and supplementary searches) were undertaken and identified 58 species of national significance including 34 threatened species and 41 migratory species (with some overlap). Many of these species were also Listed Marine Species or Cetaceans under the EPBC Act. An additional 30 Listed Marine Species (including 24 pipefish and 3 cetaceans) were identified using the search. Many of the species were also listed as threatened or rare under the South Australian *National Parks and Wildlife Act 1972* (including one species not protected under the EPBC Act), or protected under the *Fisheries Management Act 2007*.

A search of DEWNR's Biological Databases of South Australia (BDBSA) was also undertaken to determine the likely occurrence of listed flora and fauna within a 50 km radius of the smelter. Other key sources included Carpenter and Langdon (2013) and BHP Billiton (2009).

The listed species and their likelihood of occurrence are summarised in **Appendix F**. The listed species include:

- five coastal seabirds
- three terrestrial birds
- 14 waders
- six marine mammals
- the seagrass *Zostera mucronata*
- the Great White Shark *Carcharadon carcharias*
- 17 pipefish.

12.2.4 Fisheries and aquaculture

Upper Spencer Gulf supports important commercial and recreational fisheries. The zone between Whyalla and Port Pirie is particularly productive, with over 6,000 tonnes of seafood caught annually (Knight *et al.* 2005).

The principal species caught in Upper Spencer Gulf are the Australian Herring (or Tommy Ruff) *Arripis georgianus*, Australian Salmon *Arripis truttacea*, Blue Swimmer Crab *Portunus armatus,* Garfish *Hyporhamphus melanochir*, King George (or Spotted) Whiting *Sillaginodes punctatus*, Western King Prawn *Melicertus latisulcatus*, Snapper *Chrysophrys auratus,* Snook *Sphyraena novaehollandiae,* Southern Calamary *Sepioteuthis australis*, Yellow–eye Mullet *Aldrichetta forsteri* and Yellowfin Whiting *Sillago schomburgkii* (BHP Billiton 2009).

These species depend on a variety of habitats for at least part of their life cycle, including seagrass and unvegetated sand, intertidal flats, tidal creeks and mangroves (Bryars 2003). Most of them are caught within or near the seagrass meadows, which they use as feeding and refuge habitat. Two important species, the Western King Prawn and Snapper, are caught in the deep water channels of Upper Spencer Gulf.

Historically more than half of the South Australian recreational and commercial catch of Blue Swimmer Crab, Western King Prawn (commercial only), Yellowfin Whiting and Snapper has typically come from Upper Spencer Gulf (BHP Billiton 2009).

No aquaculture is permitted within Germein Bay. There is a production facility for the alga *Dunaliella salina* in False Bay near Whyalla, and limited aquaculture near the Port Augusta power station. There is currently no farming activity within the finfish zones in Fitzgerald Bay where kingfish aquaculture has occurred over the past decade.

12.2.5 Marine and coastal protected areas

The Upper Spencer Gulf Marine Park extends from Port Jarrold and Cowleds Landing in the south to Port Augusta in the north. The ports of Whyalla and Port Pirie are excluded from the park (**Figure 12-1**).

The park consists of a series of nested zones, including a Sanctuary Zone and a Habitat Protection Zone near Port Pirie (DEWNR 2012).

A Sanctuary Zone extends along the coast from Fifth Creek to 2 km north of Port Davis and inland over about 5 km of mangrove and samphire habitat. Sanctuary Zones protect habitats and biodiversity by prohibiting the removal of, or harm to, plants, animals or marine products. Specific provisions include the prohibition of water extraction and discharges that might otherwise be allowable under the *Environment Protection Act 1993*.

The Sanctuary Zone is buffered by a Habitat Protection Zone extending along the coast from just west of Second Creek to the park boundary and offshore by about 8 km. Habitat Protection Zones allow activities and uses that do not harm habitats or the functioning of ecosystems. Discharges in such zones will be managed in accordance with the *Environment Protection (Water Quality) Policy 2003*, taking reasonable and practicable measures to prevent harm.

A General Managed Use Zone that surrounds the Habitat Protection Zone and the port area aims to protect habitats and biodiversity whilst allowing ecologically sustainable development and use.

A Special Purpose Area has been overlaid over the entire park to provide for harbor, transport and the development of marine based infrastructure.

The mangrove, tidal flats and tidal creek habitats in the vicinity of Port Pirie also form part of the Northern Spencer Gulf Wetland which has been included in the Directory of Important Wetlands in Australia.

12.2.6 Existing levels of disturbance

Effluent has been discharged to the marine environment adjacent to the smelter via Port Pirie River and First Creek since 1889.

Metal–rich effluent has been discharged into First Creek since 1939 (and into Port Pirie River for fifty years prior to that). Other pathways for metals into the marine environment include spillage and fugitive dust emissions at the wharf during ship loading, direct atmospheric deposition to marine waters, and indirect deposition via contaminated groundwater flows and storm water runoff, which drain largely into Port Pirie River (Gaylard 2013).

Effluent volume and toxicity reached a peak in the mid–eighties and gradually decreased during the 1990s as effluent treatment and environmental controls initiated by the smelter owner and operator improved. Since the early 1990s, following the introduction of the Environmental Improvement Plan and environmental management systems, the concentrations of metals in the water discharged from the smelter were reduced significantly. In particular, the PETS facility, commissioned in 2002 to treat effluent being discharge to First Creek, has significantly reduced the load of metals entering the marine environment.

Since 1988 upgrades to operational procedures and systems have also significantly reduced airborne emission and spillage during loading. Consequently, the content of lead and zinc discharged has reduced by an order of magnitude over the past twenty years to about 6 and 23 t respectively for 2011/12 (NPI 2013).

Key studies

The environmental effects of smelting operations at Port Pirie have been studied since the early 1970s.

The first comprehensive assessment of the effects of the smelter discharges on the marine environment of Spencer Gulf was undertaken by CSIRO in the1970s and early 1980s (Ward *et al.* 1982, Ward *et al.* 1984).

A 5 year marine monitoring program from 2002 to 2007 was undertaken to provide Nyrstar with information on the health of key environmental indicators (COOE 2008). This program targeted indictors that addressed issues of environmental significance and public concern, including metals and the health of marine organisms.

In recent years the EPA has undertaken assessments of metal contamination of biota in the Upper Spencer Gulf (Corbin and Wade 2004), and within the Port Pirie River (Gaylard *et al.* 2011).

Heavy metals

The initial CSIRO study during the early 1980s showed that the concentrations in marine sediments of the metals lead, zinc, cadmium, and to a lesser degree arsenic, copper, manganese and antimony, in exceeded background levels over 600 km^2 of Germein Bay and

Spencer Gulf. The highest concentrations occurred off First Creek where 25 km^2 of sediment was found to be contaminated by metals from 200 to 1,000 times background levels. The concentrations decreased to background levels about 10 km from the First Creek outfall (Ward *et al.* 1982, Ward *et al.* 1984).

The studies by COOE (2008) showed that metals in sediments had decreased to some degree over the five year monitoring period post commissioning of the PETS. Elevated metals were measurable 4–5 km offshore from First Creek, and elevated levels of cadmium and zinc extended 10–15 km along the coast southwest of First Creek.

Recent work in the Port Pirie River by the EPA has shown that the Port Pirie River continues to have a relatively high level of metal contamination. The lead, cadmium and zinc concentrations in the water were higher than those measured by Ferguson (1983) near the effluent discharge site in First Creek.

The EPA results have demonstrated that significant concentrations of metals remain biologically available in the estuary and that the harbour area may have shifted from being a metal sink to a source of metals in the adjacent marine waters. Metal concentrations in ambient seawater from the estuary were found to be toxic to sea urchin larvae (EPA, unpublished data).

Unpublished studies by the EPA (cited by Gaylard *et al.* 2011) show that the concentration of bioavailable metals in Port Pirie River is higher than historical levels in First Creek, with up to 98% of metals in the water column being bioavailable (dissolved). It is likely that the local estuarine ecosystem is adversely affected, with metals transported through the deep water shipping channel into Germein Bay.

The EPA's assessments of metal levels in shellfish in the estuary have shown that the applicable food standard within the prohibition area is still exceeded for razorfish (Corbin and Wade 2004) and mussels (Gaylard *et al.* 2011). Furthermore, the lead concentrations in translocated mussels in the Port Pirie River were some of the highest recorded in the literature (Gaylard *et al.* 2011).

Temperature, salinity and turbidity

Four years of continuous water quality monitoring in and around First Creek (2003–2007) shows that seawater temperature and salinity offshore from First Creek is not significantly affected by warm saline water being discharged from the smelter (COOE 2008).

The approximately 15 GL of cooling water discharged per year to First Creek was 10°C above ambient in winter and less than 2°C in summer. Downstream monitoring found that water temperatures had returned to background levels by the creek mouth (COOE 2008), but recent observations indicate distinct thermoclines persisting to the mouth.

Although warm water plumes were measured in First Creek they rarely extended beyond its middle reaches. Water was warmer in winter than summer in First Creek (COOE 2008).

In general, salinity levels were higher in summer than winter, and creek salinity levels were higher than those recorded at offshore sites (COOE 2008).

Turbidity was generally higher near the mouth of First Creek and near the shipping channel compared with control sites (COOE 2008).

Nutrients

Southern Australian waters receive few nutrients via natural run–off from the land or oceanographic currents, and are therefore nutrient poor. With the Spencer Gulf ecosystem having evolved in response to low nutrient levels, it is highly susceptible to impacts associated with anthropogenic inputs.

The Port Pirie waste water treatment facility discharges 15 tonnes of nitrogen annually into Second Creek, resulting in frequent localized phytoplankton blooms (Gaylard 2013). This discharge is an order of magnitude lower than nutrient outputs from the Whyalla Steelworks and two orders of magnitude lower than the combined input from finfish aquaculture in southern Spencer Gulf (Gaylard 2013).

Existing effects on marine communities

A study by CSIRO in the early 1980s found clear evidence of metal accumulation in fish, molluscs and seagrasses, particularly lead, zinc, cadmium and manganese. Compared with control sites, lower abundance of some animal species from seagrass habitats, and of epifauna communities colonizing razorfish, were found at sites adjacent to the mouth of First Creek. Metals appeared to reduce or eliminate 20 of the most common species (mainly fish). Effects on fauna were detectable over 100 km^2 of seagrass meadows and a similar area of unvegetated sediments. Effects of metals on seagrass communities appeared to be minimal (Ward *et al.* 1982; Ward *et al.* 1984).

More recent studies focussing on the communities of organisms colonising artificial substrates deployed at the mouth of First Creek and at numerous sites radiating from First Creek found subtle evidence of ecological effects on biota at sites up to 10 km from First Creek. The effects were most pronounced at the site at the mouth of First Creek. It is suggested that some of these effects may be related to re–suspension of metals in the sediments related to historic discharges rather than ongoing discharges (COOE 2008).

These studies also found that the seagrass community at most sites in Germein Bay were as healthy as the control site at Port Broughton. The exceptions were a site just offshore from the mouth of First Creek where heavy metal levels were elevated in the sediments and seston, and in the shipping channel, where turbidity associated with shipping was higher than other sites (COOE 2008).

Other disturbances to seagrass in Germein Bay include impacts of boat propellers around Mangrove Point, and the loss of seagrass west of Second Creek, possibly associated with the nutrients in waste water discharge (COOE 2008).

Introduced species

Introduced marine pests found in Upper Spencer Gulf include the European Fan Worm *Sabella spallanzanii,* the Pearl Oyster *Pinctada albina sugillata* and the cryptogenic Slime Featherduster Worm *Myxicola infundibulum* (Wiltshire *et al.* 2010). No introduced species were noted in the Port Pirie River or First Creek during the biological survey.

12.3 Cooling water requirements and characteristics

The current process includes a cooling water intake point located within the Port Pirie River and a discharge point located in First Creek adjacent to the site. The current cooling water intake is approximately 2 ML/hr (or 0.56 m^3/s). The cooling water is currently discharged to a sediment basin, where it mixes with other treated process effluent and is discharged via the 1M flume to First Creek and Spencer Gulf at a combined rate of 2.62 ML/hr (or 0.73 m^3/s) and at a temperature approximately 9°C higher than the intake water.

The Transformation will require an increased cooling water flow of approximately 5.8 ML/hr (or 1.62 m^3/s), which will result in a total cooling water requirement of 7.8 ML/hr (or 2.18 m^3/s). The discharge site for the Transformation's cooling water has not yet been determined. Water will be discharged either directly into the Port Pirie River or into First Creek, downstream from the 1M flume. The proposed temperature increase of the cooling water above ambient will be 10°C for the Port Pirie River disposal option, and <10°C for the First Creek disposal option. The reason for the lower cooling water temperature for the First Creek option is that there is a much smaller volume of water in First Creek than Port Pirie River, resulting in poorer mixing and dispersion of the cooling water. A cooling tower would be used to achieve the lower cooling water temperature prior to disposal.

12.4 Modelling of cooling water dispersion

Modelling of the cooling water dispersion is presented in **Appendix H**. The new cooling water intake (PP01) and the potential cooling water outfall sites (PP02 in First Creek, and PP03, PP04 and PP05 in Port Pirie River) are shown in **Figure 12-14**.

12.4.1 Water quality guidelines

The modelling outcomes are assessed against appropriate water quality guidelines.

The existing *Environment Protection (Water Quality) Policy* 2003 does not have a specific guideline for temperature effects. Instead, the EPA negotiates appropriate guidelines on a case by case basis. Based on precedents in South Australia, the EPA is likely to require that temperatures resulting from the disposal of cooling water into the Port Pirie River are no greater than 2°C above the ambient temperature 20 m from the outfall (S Gaylard, EPA, pers. comm. 24 May 2013).

It is also relevant that a draft *Environment Protection (Water Quality) Policy* 2012, based on the ANZECC/ARMCANZ 2000 Water Quality Guidelines, is likely to replace the existing policy in 2014. The new policy requires that the resultant median water temperature does not exceed the 80th percentile of the ambient water temperature at the edge of the agreed mixing zone.

12.4.2 First Creek option

For the First Creek discharge option, the additional cooling water would be discharged directly to First Creek via the channel below the 1M flume. The existing discharge into First Creek via the 1M flume would be maintained. A diffuser would not be used as there is insufficient depth of seawater immediately below the 1M flume to enable a diffuser to operate. Instead the cooling water would flow along the earth channel for approximately 1.5

km before entering First Creek. Field measurements indicate that the temperature of the cooling water reduces by approximately 1°C before entering First Creek (A Gilbert, pers. comm. 28 June 2013).

BMT WBM used the TUFLOW-FV model to simulate dispersion of the cooling water in First Creek and the adjacent Spencer Gulf. TUFLOW-FV is a modern and extensively validated finite volume 3D hydrodynamic modelling package that has been successfully used in floodplain, estuarine, coastal and ocean environments both in Australia and overseas (see **Appendix H**).

BMT WBM deployed an Acoustic Doppler Current Profiler (ADCP) and three Conductivity-Temperature-Depth probes (CTD) off First Creek from 4 April to 8 May 2013 to collect oceanographic data for use in calibrating the model.

The following scenarios were modelled for one month in autumn and one month in summer:

- the existing discharge of cooling water to First Creek (i.e. impacted baseline)
- existing discharge + additional discharge at 10°C above ambient
- existing discharge + additional discharge at 5°C above ambient
- existing discharge + additional discharge at 2°C above ambient (see **Appendix H**).

The outputs for each cell within the model domain were provided as temperature exceedances expressed as percentiles (i.e. 0^{th}, 10^{th}, 20^{th} and 50^{th} percentiles). Subsequent post-processing of the model results provided the temperature changes in each cell relative to the existing temperature regime.

The results of each scenario for the autumn simulations are presented as absolute temperatures in **Figure 12-3**, **Figure 12-4**, **Figure 12-5**, and **Figure 12-6**, and as temperature changes from the existing regime in **Figure 12-7**, **Figure 12-8** and **Figure 12-9**. To simplify the presentation the results have been summarized using only the 10^{th} percentile outcomes, as these are relatively representative of the overall trends and are close to least optimistic outcomes.

For the discharge scenario with the cooling water at 10°C above ambient the 10^{th} percentile comparisons revealed that:

- the temperature of First Creek would increase above the existing regime by 3 to 4°C for most of its length
- the temperature of First Creek would increase to 4–8°C above ambient for most of its length
- the section of First Creek where water temperatures would exceed the + 2°C over ambient guideline would extend several hundred metres beyond the mouth of First Creek (see **Figure 12-4** and **Figure 12-7**).

For the discharge scenario with the cooling water at 5°C above ambient the 10^{th} percentile comparisons revealed that:

- the temperature of First Creek would decrease below the existing regime by approximately 1°C in its upper reaches, and increase by 1–2°C in its lower reaches and 200 m beyond its mouth
- the temperature of First Creek would decrease to 3–4°C above ambient in its upper reaches, and increase to 2–3°C above ambient in its lower reaches
- the section of First Creek where water temperatures would exceed the + 2°C over ambient guideline would extend slightly beyond the mouth of First Creek (see **Figure 12-5** and **Figure 12-8**).

For the discharge scenario with the cooling water at 2°C above ambient, the 10th percentile comparisons revealed that:

- the temperature of seawater in First Creek would decrease by up to 3°C in its upper reaches and remain unchanged in its lower reaches
- the temperature of First Creek would decrease to 1–2°C above ambient for most of its length
- the section of First Creek where water temperatures would exceed the + 2°C over ambient guideline would decrease to just its upper reaches (see **Figure 12-6** and **Figure 12-9**).

It is concluded that the average temperature regime within First Creek would be:

- significantly higher with the discharge of additional cooling water at 10°C above ambient
- generally slightly higher with the discharge of additional cooling water at 5°C above ambient
- generally lower with the discharge of additional cooling water at 2°C above ambient.

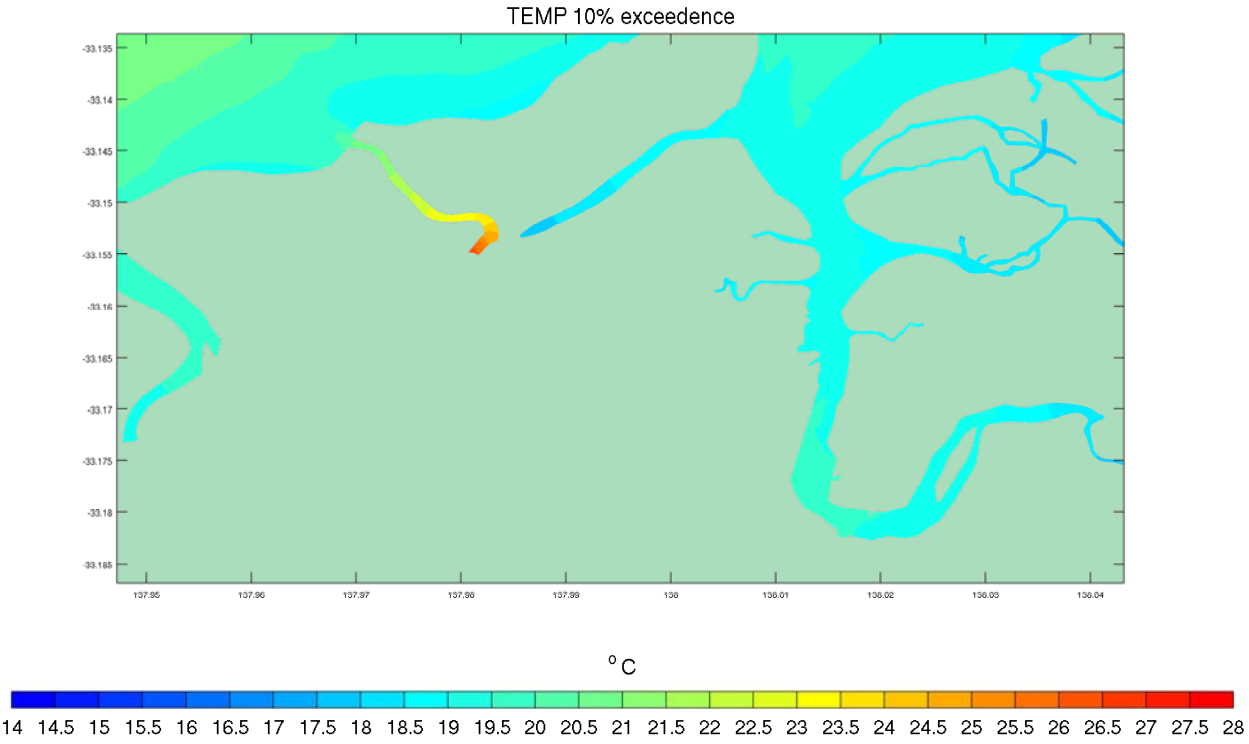


Figure 12-3: Existing temperature in First Creek (10th percentile)

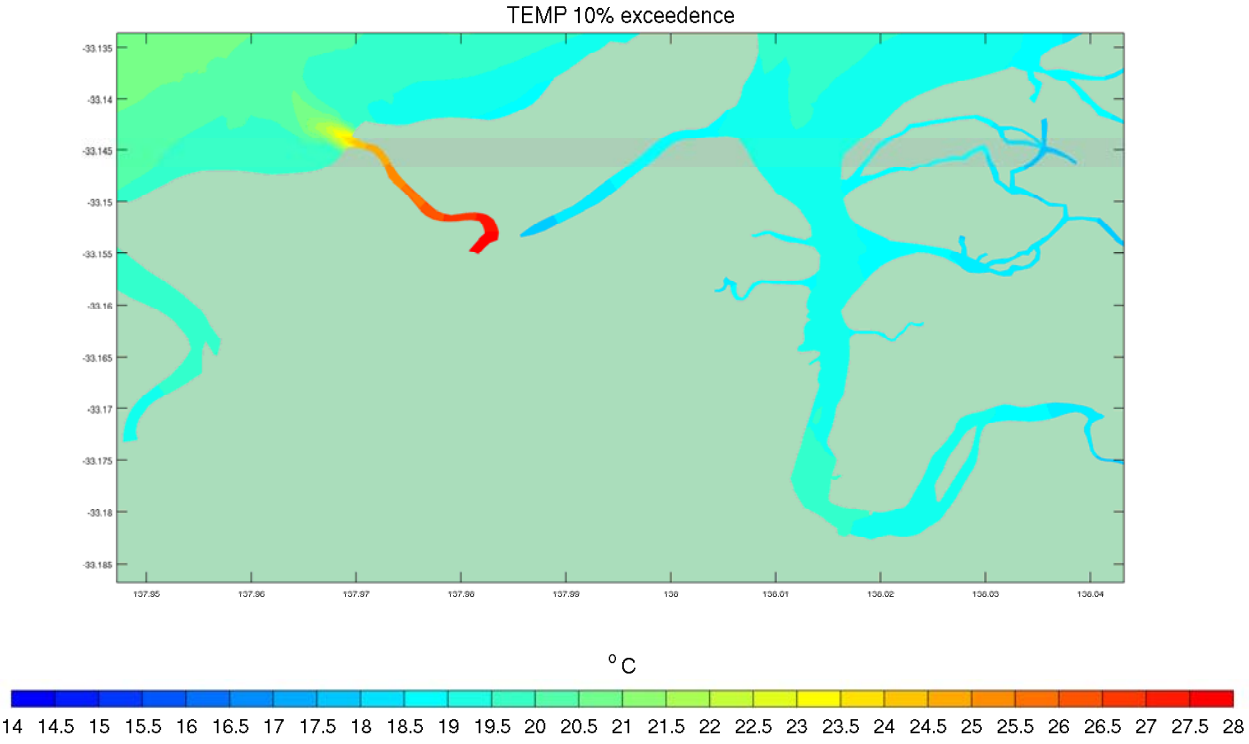


Figure 12-4: Resultant temperature in First Creek with additional discharge at 10°C above ambient (10th percentile)

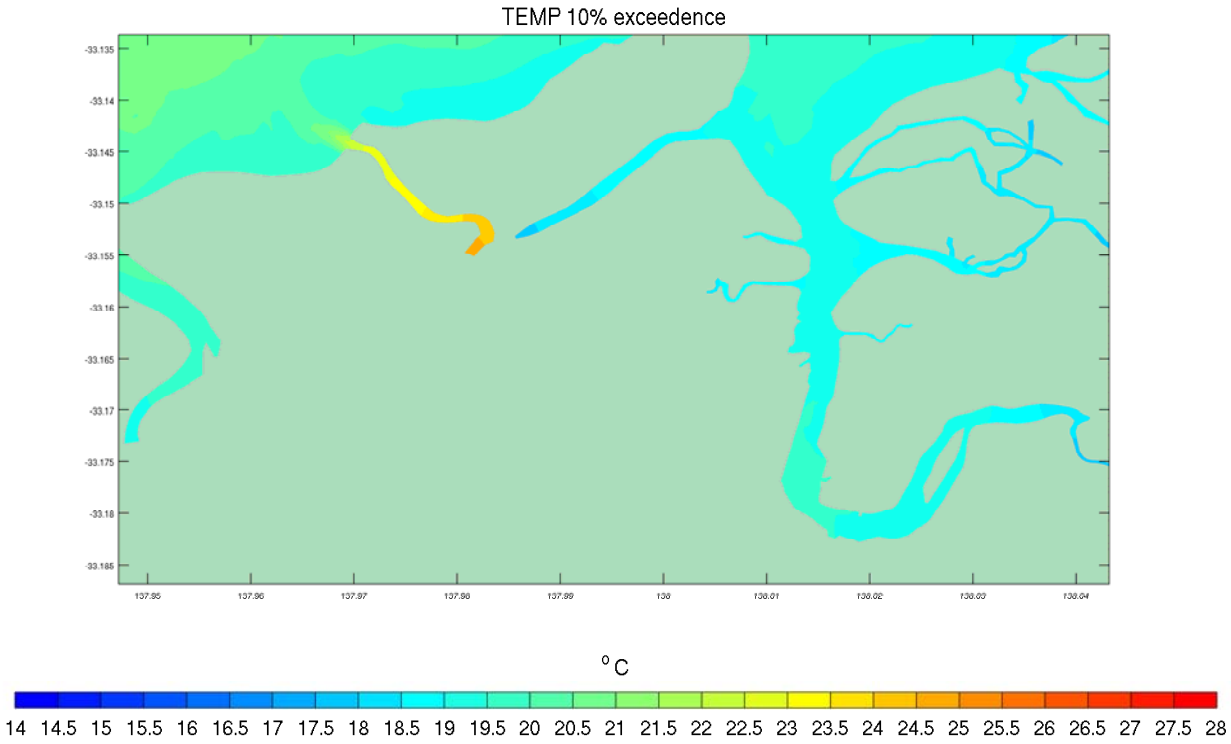


Figure 12-5: Resultant temperature in First Creek with additional discharge at 5°C above ambient (10th percentile)

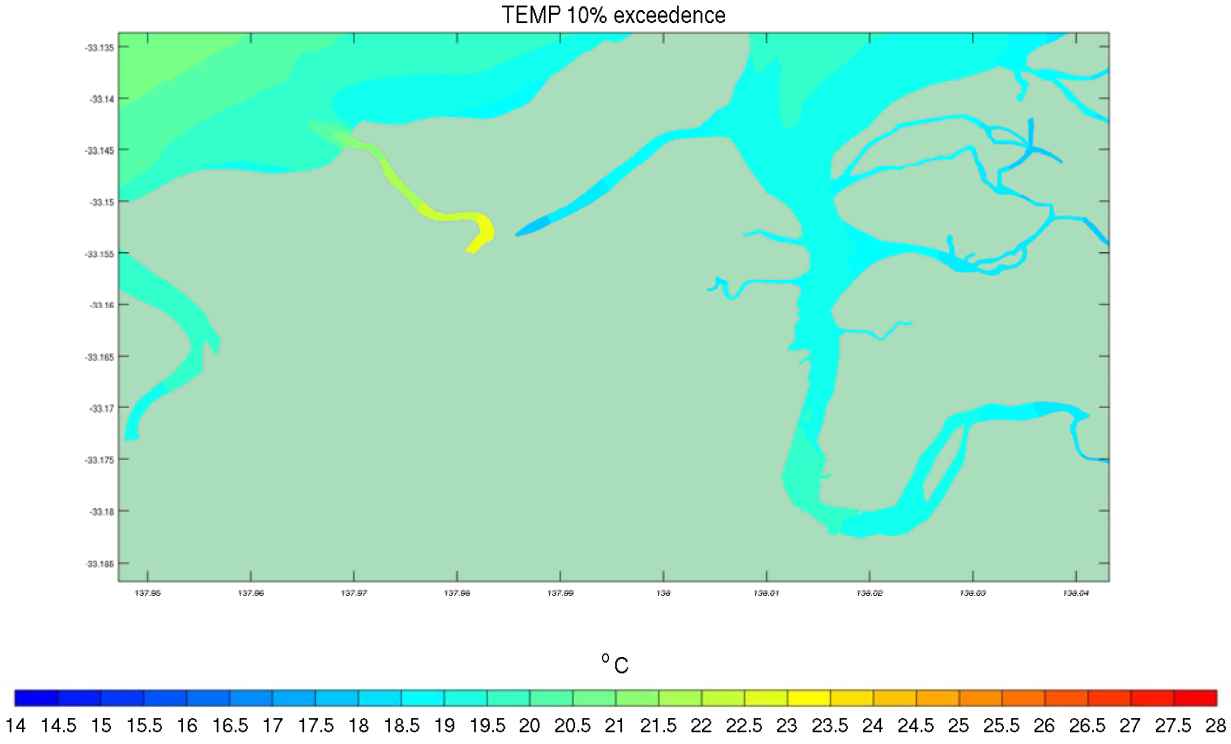


Figure 12-6: Resultant temperature in First Creek with additional discharge at 2°C above ambient (10th percentile)

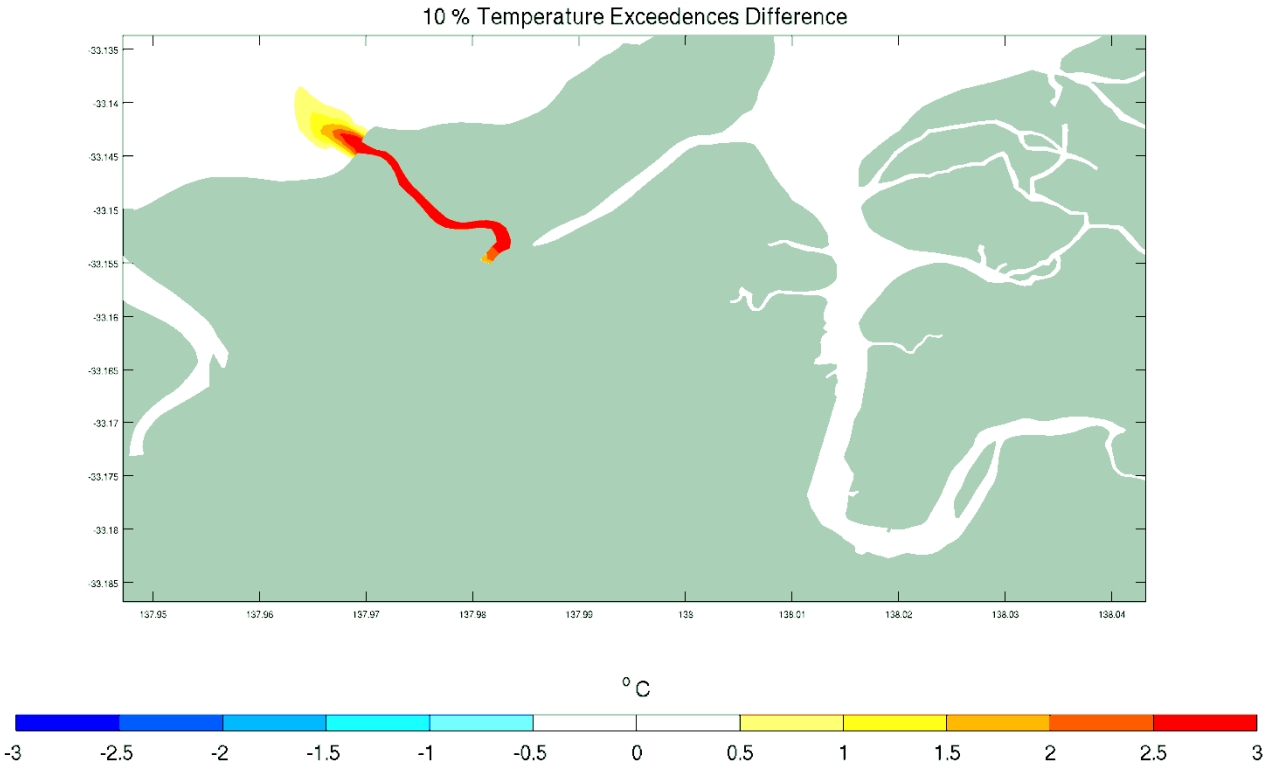


Figure 12-7: Temperature increase in First Creek with additional discharge at 10°C above ambient (10th percentile)

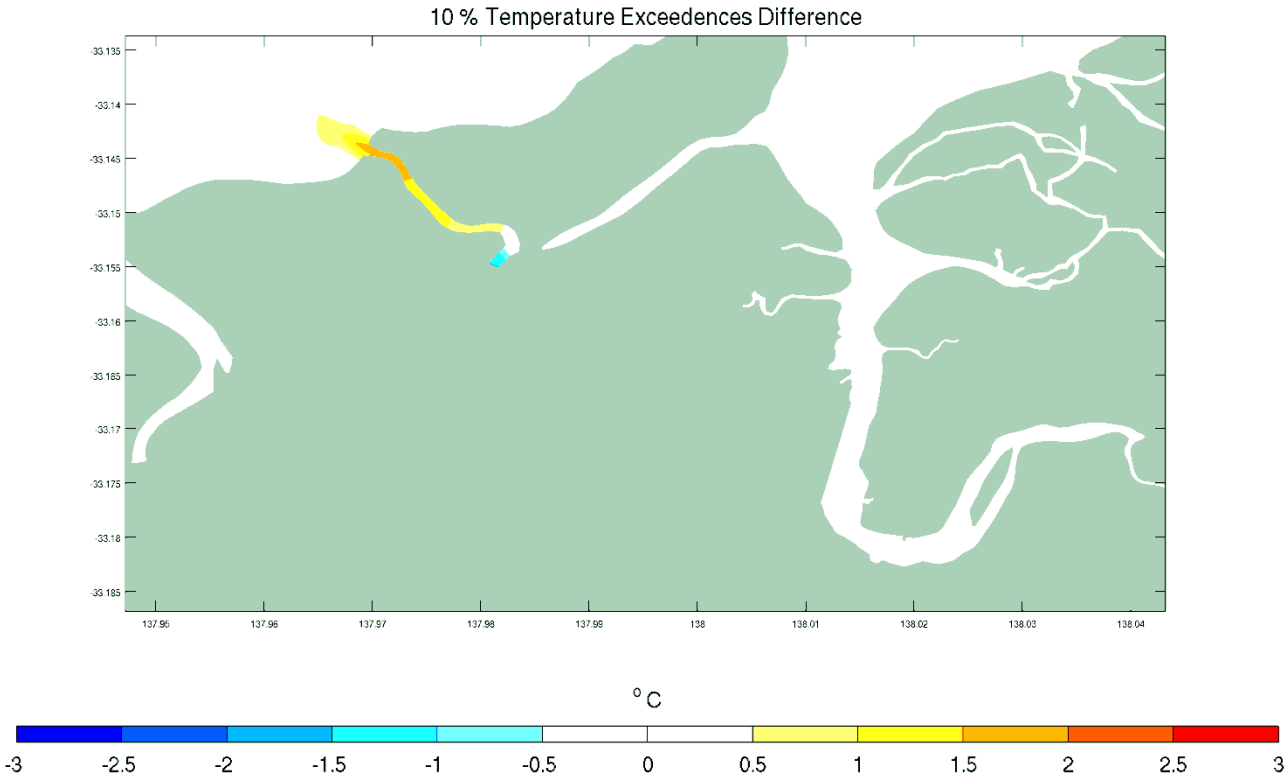


Figure 12-8: Temperature change in First Creek with additional discharge at 5°C above ambient (10th percentile)

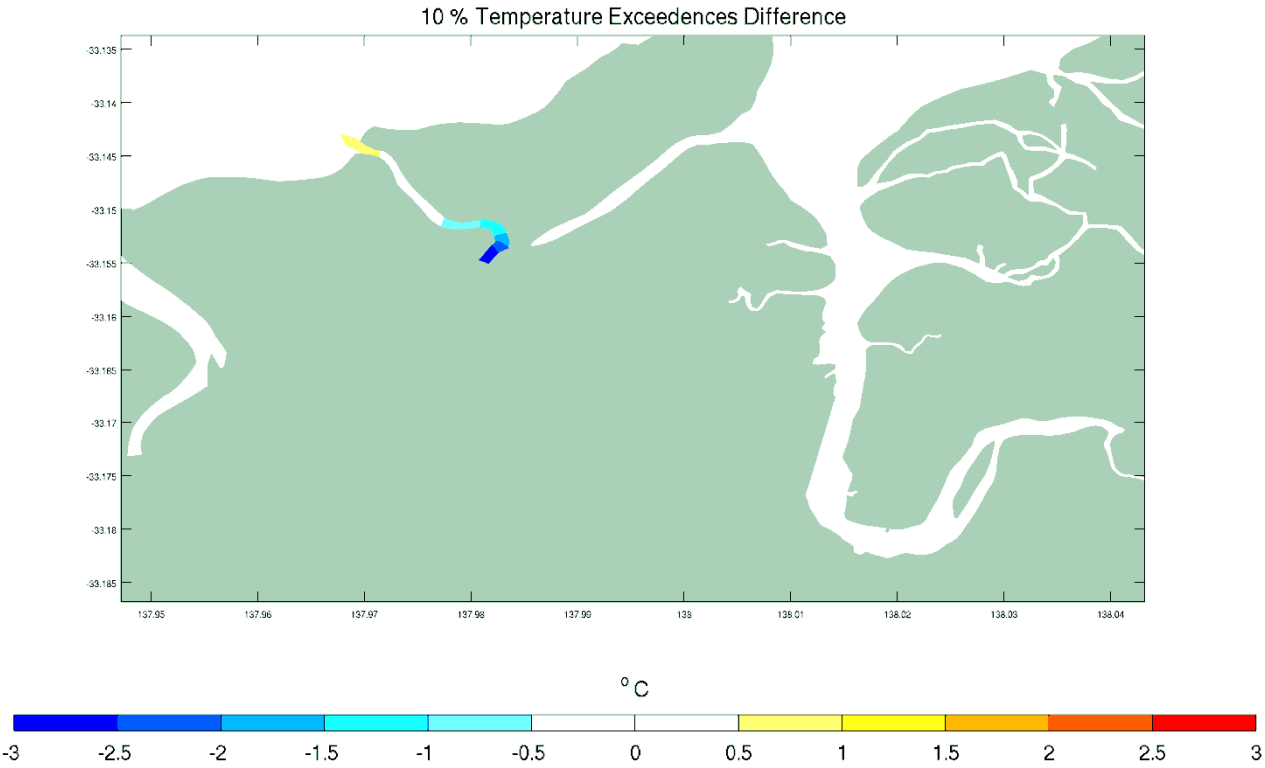


Figure 12-9: Temperature change in First Creek with additional discharge at 2°C above ambient (10th percentile)

12.4.3 Port Pirie River option

For the Port Pirie River disposal option, the additional cooling water would be discharged to the Port Pirie River via a linear diffuser installed on the channel floor at a depth of approximately 8 m. Upon discharge from the diffuser the warm, less dense cooling water plumes would rise to the surface, entraining and mixing with ambient seawater.

BMT WBM undertook both nearfield and farfield modelling of dispersion of the cooling water plume in the Port Pirie River. BMT WBM used two empirical models (CORMIX and Visual Plumes) to simulate the nearfield dispersion, and a three dimensional model (TUFLOW-FV) to simulate farfield dispersion (see **Appendix H**).

BMT WBM deployed an Acoustic Doppler Current Profiler (ADCP) and two Conductivity-Temperature-Depth probes (CTD) in Port Pirie River from 4 April to 8 May 2013 to collect oceanographic data for use in the models.

Nearfield modelling

The CORMIX and Visual Plumes models are recommended by the United States EPA and used to design diffuser outfalls in Australia and internationally. The models provide 'look-up tables' that describe output temperatures, dilutions and plume geometrical characteristics at various distances from the diffuser for numerous combinations of diffuser designs such as lengths, port numbers and port diameters, and ambient seawater characteristics, such as temperature and current speeds.

The model outcomes are summarized in **Figure 12-10:** Predicted temperatures 20 m from the diffuser for a 12 port diffuser for a range of current speeds

and **Figure 12-11**.

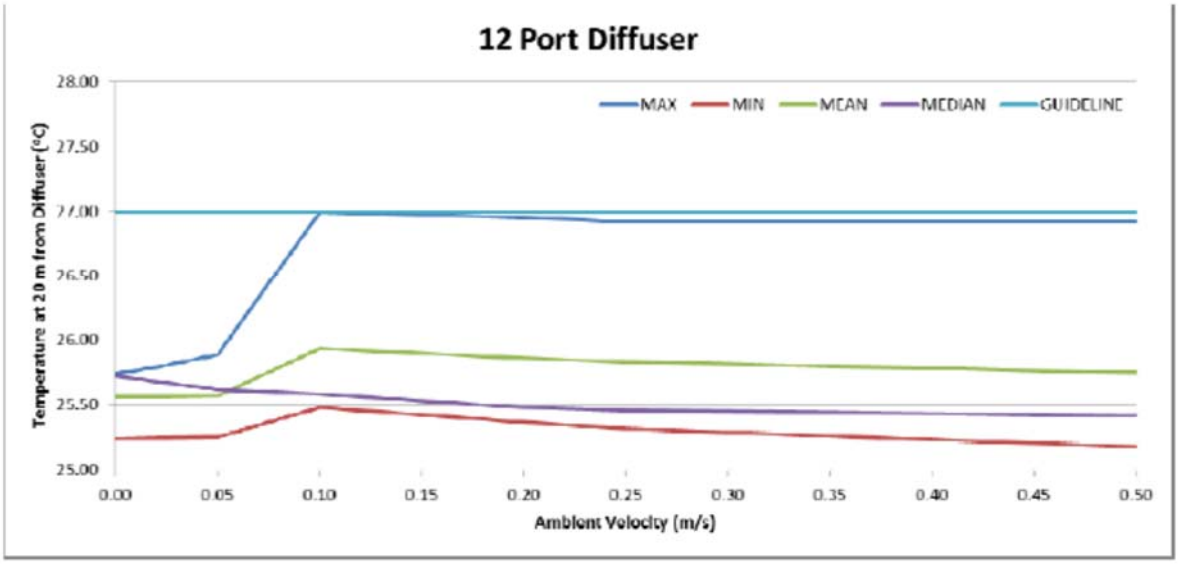


Figure 12-10: Predicted temperatures 20 m from the diffuser for a 12 port diffuser for a range of current speeds

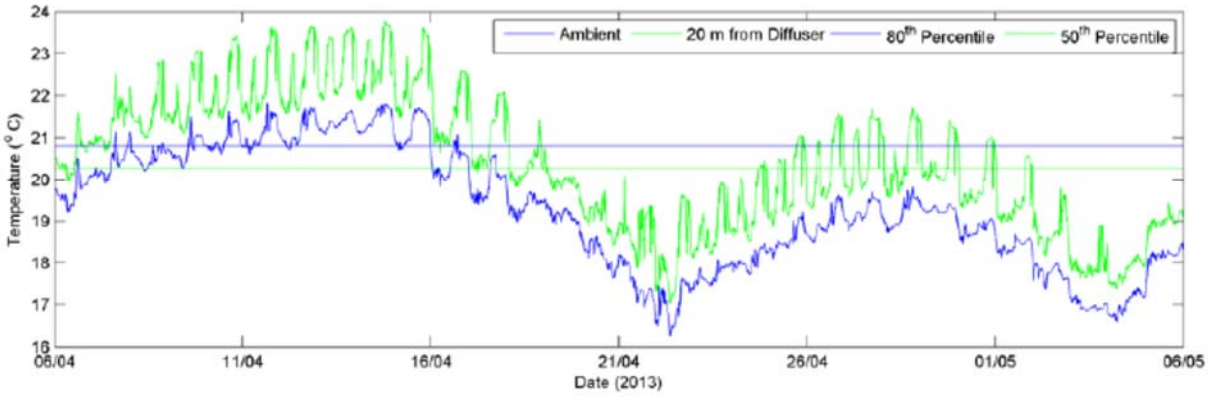


Figure 12-11: Comparison of ambient temperatures (blue) with modelled temperatures (green) 20 m from the diffuser over four weeks (12 port diffuser). The blue straight line is the 80th percentile of ambient temperatures, and the green straight line is the 50th percentile of modelled temperatures

The model runs show that for the diffuser configurations considered and the ambient conditions encountered in the Port Pirie River in April/May 2013, it is possible to design a diffuser that would meet the EPA's suggested temperature guideline, and the draft *Water Quality Guidelines* 2012. The results indicate that a design with cooling water exit velocity of 7.7 m/s from a 48 m long diffuser with 12 ports of 15 cm diameter is likely to result in compliance with the guidelines at all times.

BMT WBM cautions that the near field modelling is preliminary and should not be used to design the diffuser as numerous other diffuser configurations and exit velocities are also

likely to be suitable. They recommend that Computational Fluid Dynamics (CFD) be used to design and optimise the performance of the diffuser (see **Appendix H**).

Farfield modelling

The TUFLOW-FV model outcomes for discharges in the Port Pirie River are presented in **Appendix H**. The 10th percentile (i.e. least optimistic) outcomes for one of the potential outfall locations (PP05) are summarized in **Figure 12-12** and **Figure 12-13**.

It should be noted that the farfield modelling does not take into account the use of a diffuser to provide initial mixing and dispersion of the cooling water plume. Consequently, the farfield model outcomes are too high within approximately 100–200 m of the diffuser and should not be relied upon.

The farfield modelling indicates that the dispersion of cooling water in Port Pirie River is considerably better than in the First Creek, despite a much larger volume of water being discharged to the Port Pirie River (Figure 12-12). It is clear that the deeper and wider Port Pirie River has a greater capacity to dilute the cooling water than First Creek.

A temperature increase of 0.5–1.5°C over ambient extends approximately 1.5 km north and 3 km south of the outfall, which indicates that flushing in the upper reaches of the estuary is relatively poor.

The modelling also shows that there is potential for re-circulation of cooling water if the inlet and outlets are too close together. During design of the cooling water infrastructure, careful consideration will need to be given to providing sufficient separation of the inlet and outlet and positioning the intake as close as feasible to the floor of the estuary where the water is cooler. Additional modelling will be required to determine the optimal locations for the inlet and outlet to minimize re-circulation.

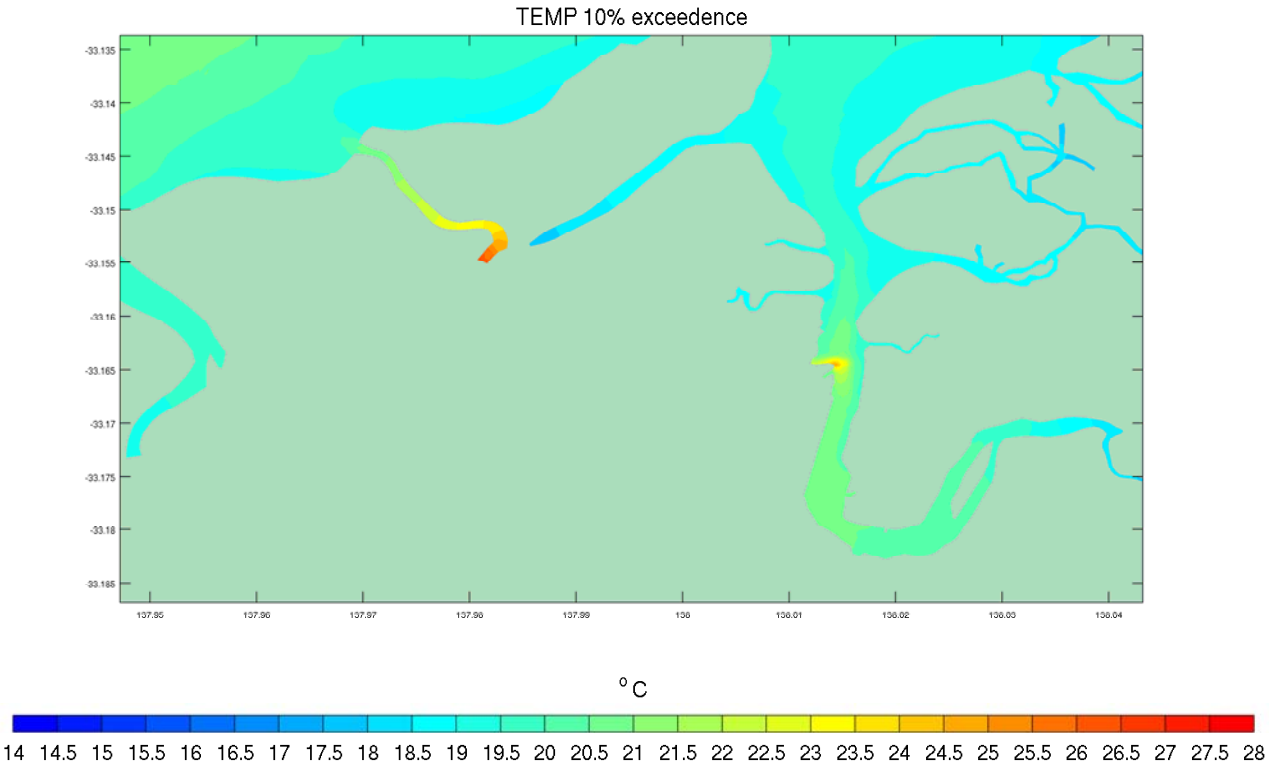


Figure 12-12: Resultant temperatures in Port Pirie River with the new discharge at 10°C above ambient (10th percentile). Note ongoing First Creek discharge

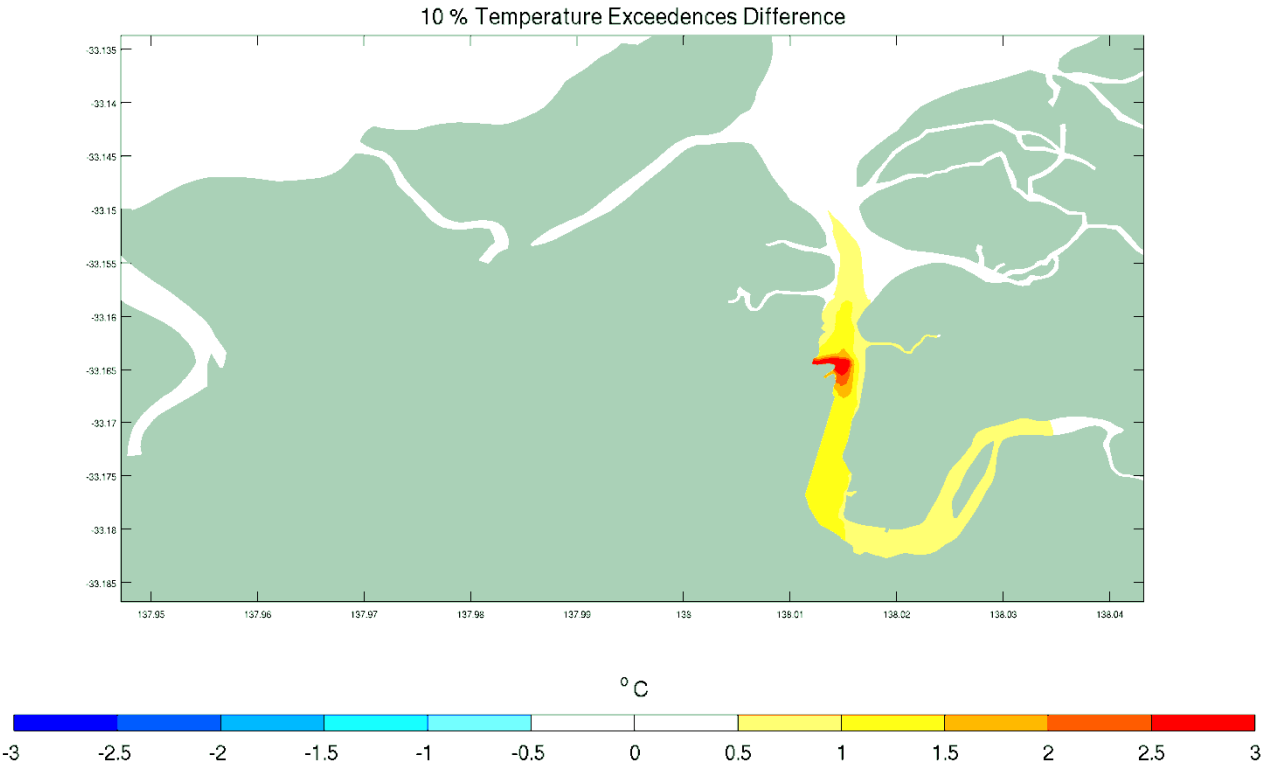


Figure 12-13: Temperature change with the new discharge at 10°C above ambient (10th percentile) to Port Pirie River

Figure 12-14: Cooling water inlet and outfall sites

12.5 Impact assessment and management

An impact assessment and recommended management has been completed for the potential environmental effects of thermal effluent, cooling water quality, potential sediment erosion by cooling water as well as other discharges to the marine environment. Additionally, entrainment and impingement of species at the cooling water intake is assessed, as well as the biosecurity and relevant invasive species. Effects from climate change and seagrass offsets are also considered.

12.5.1 Thermal effects

Potential environmental effects associated with the discharge of thermal effluent from the Nyrstar smelter may be predicted to some degree by examining impacts associated with operation of the Northern and Playford Power Stations at Port Augusta.

The relative size of the Nyrstar cooling water discharge is considerably smaller than the discharges associated with Northern and Playford Power Stations at Port Augusta (**Table 12–1**). Temperature increase at Nyrstar, however, is higher.

12.5.2 Cooling water quality

Seawater will be extracted from Port Pirie River, pumped through the cooling water system, and discharged back into Port Pirie River or into First Creek. Cooling water does not come into contact with any process waters and therefore physical water quality parameters other than temperature will remain the same.

12.5.3 Erosion of sediments by cooling water

The following sections describe the likely effects of erosion on sediments depending on whether cooling water is discharged via Port Pirie River or First Creek.

Port Pirie River option

Discharge of cooling water into the Port Pirie River would occur via a diffuser with numerous vertically oriented ports. The cooling water would be discharged under pressure vertically into the water column. The buoyant plume would rise to the surface and only interact with bottom sediments after initial mixing had occurred and the exit velocity of the plume had dissipated.

Discharge of cooling water into the Port Pirie River via a diffuser would therefore have no effect on the bottom sediments of the harbour and would therefore not result in the mobilization of heavy metals associated with sediments. Impacts from cooling water discharge are likely to be negligible given the distance of the diffuser from the nearby Upper Spencer Gulf Marine Park.

First Creek option

Discharge of almost 4 times more cooling water into First Creek will result in the velocity of cooling water in the confined sections of the earth channel and the upper reaches of First Creek increasing by about 3–4 times (from about 0.5 m/s to 2 m/s).

Contaminated sediments will be mobilized and moved down the earth channel and into the upper reaches of First Creek. As First Creek becomes wider and deeper approximately 1.5 km from its mouth, however, the velocity of the cooling water will quickly reduce back to ambient tidal flows and much of the entrained sediment will drop out. It is very unlikely that the increased cooling water flow would have any measurable effect on the velocity of tidal flows in the wider and deeper sections of First Creek.

It is concluded therefore that the increased cooling water flow will result in some movement of contaminated sediments along the upper reaches of First Creek, but that there would be little or no additional movement of sediments in the lower reaches of the creek. First Creek flows into Special Purpose Area-2 Harbor of Port Pirie within the Upper Spencer Gulf Marine Park and it is expected that the zone's environmental, social and economic values will be maintained as per the Upper Spencer Gulf Marine Park Management Plan 2012 requirements.

If erosion occurs, the upper reaches of the earth channel immediately below the 1M flume can be protected by lining the channel with either concrete or rock.

12.5.4 Other discharges to the marine environment

The increased cooling water discharge will be dosed with the surfactant Mexel 432, which is currently used to dose the existing discharge. Rather than being toxic to fouling organisms, the non-toxic surfactant prevents the organisms from attaching to infrastructure.

The Mexel 432 technology is biodegradable and is non-toxic to mammals, bacteria, algae, crustaceans, molluscs and fish, and complies with international standards including the

Australian Pesticides and Veterinary Medicines Authority (Mexel Industries SAS, 2012). This would be less toxic than commonly used anti–fouling chemicals such as chlorine.

The Transformation will be planned and implemented so groundwater movement beneath the smelter is not adversely impacted. Consequently the change in discharge of contaminated groundwater to the Port Pirie River is expected to be negligible.

During demolition and construction operations there will be an increased risk of surface run–off becoming contaminated by sediments and metals and discharging into the marine environment. As with existing stormwater, run–off from demolition and construction will be controlled and directed as required to the sedimentary basin prior to discharge into First Creek. The details of how stormwater will be controlled will be described in the CEMP.

Similarly, during demolition and construction operations there will be an increased risk of contaminated dust blown into the marine environment. At these times, measures will be taken where necessary to minimise dust mobilisation from potentially dusty sites. The CEMP will provide more details of how dust will be controlled (**Appendix J**).

During the operational phase of the Transformation it is expected that airborne metal bearing dust and SO_2 emissions will be reduced due to the elimination or significant reduction of intermediate product produced and better SO_2 capture from the EBS oxidation furnace through the new acid facility. These design and operational strategies will significantly reduce contaminated airborne emissions from entering the marine environment.

12.5.5 Entrainment and impingement

Marine organisms with little or no ability to move actively, such as phytoplankton and zooplankton, including earlier stages of larval fish, may be impinged upon filter screens or entrained into the cooling water intake.

A review of studies assessing power station intakes in NSW found low rates of impingement of fish and crustaceans with relatively few species of socio–economic importance affected. It was suggested that impingement or entrainment would be minimised with an intake velocity of <0.6 m/s (The Ecology Lab 2005). The proposed intake would therefore be designed to achieve an intake velocity of velocity of <0.6 m/s.

Hodgson (1979) found that zooplankton suffered 50% mortality after exposure to temperatures of 35°C for one hour. With the output temperature of the cooling water varying seasonally from 20–35°C, and seasonal larval concentrations being highest during summer, the highest naturally occurring larval mortalities are likely to occur during summer.

The ecological significance of the loss of phytoplankton, zooplankton and larvae may be placed in perspective by considering the size of existing cooling water intakes in Spencer Gulf, the percentage of organisms lost and the breeding strategies of the organisms.

The volume of the proposed cooling water intake is at most one tenth of the intakes for the Northern and Playford Power Stations near Port Augusta (see **Table 12–1**).

The annual cooling water intake for the Nyrstar smelter would be about 0.01% of the volume Spencer Gulf, or 0.4% of the volume of Upper Spencer Gulf.

A larvae survey conducted over four different seasons off the coast from Point Lowly for a proposed desalination facility on the western coast of the upper Spencer Gulf found that the larval fish assemblage was dominated by grubfish (*Parapercis* spp.) and bluespot goby (*Pseudogobius olorum*) during spring and by anchovy (*Engraulis australis*) and bluespot goby during summer. Larvae of other fishes, including some of commercial fish species, were caught in very small numbers, such as early juveniles of southern calamary (*Sepioteuthis australis*) and the western king prawn (*Melicertus latisulcatus*) (BHP Billiton 2011).

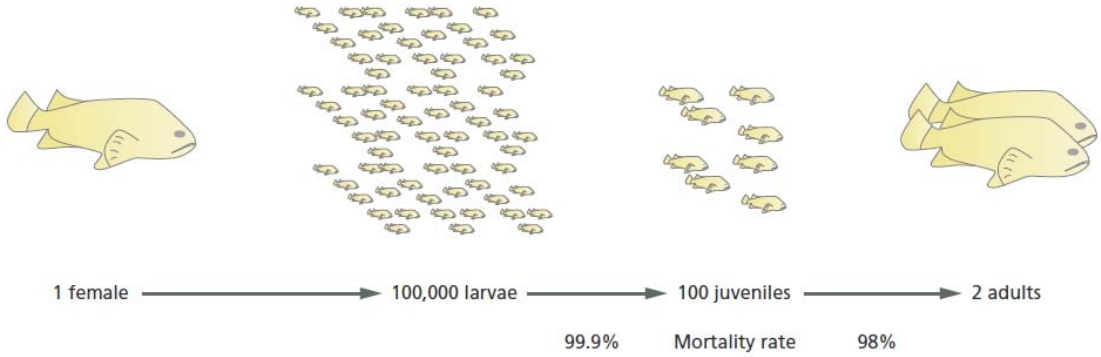
The ecological significance of the loss of phytoplankton and zooplankton resulting from entrainment is considered to be low due to their high abundances, wide distribution and short generation times. It is expected that plankton lost by entrainment would be replaced within days to weeks (Steinbeck *et al.* 2007; CEE Consultants 2008). For example, no evidence of even a local reduction in zooplankton abundance was found near a power station intake in California with 75 times the proposed intake rate, despite up to 1,200 tonnes being entrained annually (Ambrose *et al.* 1996).

Reductions in larvae do not generally translate into a reduction in the adult population as few larvae naturally survive to adulthood (CEE Consultants 2008; Steinbeck *et al.* 2007). The natural daily mortality of larvae ranges from 1–50%, and commonly exceeds 10% (Houde and Bartsch 2009; Houde 2002; Houde 1989). The high natural mortality rate of larvae results in only 0.0001–1% becoming adults (i.e. cumulative mortality is 99–99.9999%), which is sufficient to sustain adult populations (DSE 2008, CEE Consultants 2008, Raimondi 2008) (**Figure 12-15**). Natural mortality is typically even higher for eggs (Houde and Bartsch 2009; Houde 2002).

Assuming 0.4% of the larvae in Upper Spencer Gulf are entrained, it is estimated that from about one in 25,000 to one in 250,000,000 adult fish or crustaceans (depending on the species) may be lost each year from Upper Spencer Gulf as a result of entrainment.

Based on the volume of water entrained, the daily mortality of larvae in Upper Spencer Gulf resulting from entrainment would be about 0.001%. The increase in mortality arising from the proposed intake would therefore be 1,000 to 50,000 times less than natural mortality in Upper Spencer Gulf.

The impact of entrainment in the proposed cooling water intake on natural populations in Upper Spencer Gulf would not be measurable.



Source: Raimondi 2008

Figure 12-15: The natural losses of larvae and juveniles are far greater than potential losses due to entrainment

12.5.6 Construction impacts

Depending on the option chosen, First Creek or Port Pirie River, a small amount of dredging of the Port Pirie River banks may be required to install the new cooling water inlet caisson and outlet pipeline. The scale of the dredging is likely to be of the order of 10 m x 10 m x 8 m for the inlet caisson (adjacent to the existing caisson), and 50 m x 5 m x 3 m for the outlet pipeline across the tidal flat adjacent to the north east corner of the smelter.

Construction of the outlet pipeline through a 10 m wide section of tidal flats is likely to result in the loss of some Eelgrass *Zostera* sp. (potentially 100 m^2 or 0.1 ha). Installation of the diffuser on the channel floor or against the wharf would not result in the loss of any seagrass.

The impact of silt plumes generated in the Port Pirie River during the dredging process and can be minimised using silt curtains. Sediment deposition from the construction plumes would occur mainly within about 200 m of the construction activities. Water turbidity would temporarily increase during dredging for probably up to a kilometre from the construction sites. Heavy metals in the surface sediments would inevitably be re–mobilized during dredging operations. The effects, however, would only occur for the duration of the dredging program (i.e. approximately 1–2 weeks), after which the sediments would fall out of suspension.

Effects of turbidity and sedimentation on the seagrass (*Zostera* sp.) communities would be minor as its extent near the construction sites is limited. Furthermore, *Zostera* sp. is an opportunistic seagrass that has the potential to recover rapidly. The mangrove communities would not be affected by dredging operations. Measures to mitigate impacts associated with dredging will be developed in the CEMP (**Appendix J**).

Increases in noise and vibration associated with construction of the new cooling water inlet caisson and outfall in Port Pirie River would be slight in the context of the ongoing operation of ships and other vessels, smelting operations and unloading and loading operations in the area. Short term aversion effects on some marine species such as dolphins may occur. However, the effects would be temporary and of negligible ecological consequences. The

potential to impact Special Purpose Area-2 Harbor or Port Pirie with the Upper Spencer Gulf Marine Park is considered negligible.

12.5.7 Increased shipping

During construction there will be an estimated 24 additional shipping movements in the Port Pirie River per year. This number is within the normal operating range for the port over the last 20 years. Additional shipping movements are expected to cease once the Transformation is complete.

The effect of the temporary increase in shipping operations during construction on the ecology of the Port Pirie River would be negligible as the slight increase in shipping traffic is unlikely to cause a significant short term or long term increase in turbidity, siltation or smothering of benthic communities within the estuary.

Heavy metals in the surface sediments would inevitably be re–mobilized during shipping movements. The effects, however, would be similar to those resulting from existing operations. The effects would be of short duration, with the sediments and associated metals probably falling out of suspension within hours.

The likelihood of whales and other threatened or protected species being impacted by shipping movements is expected to remain very low.

The operational phase following the Transformation would result in no additional impacts to the ecology of the Port Pirie River as production rates, storage, loading and shipping operations are expected to remain unchanged from existing operations.

12.5.8 Effects on significant species or protected areas

None of the listed species potentially occurring in the project area are at risk of being adversely affected by the Transformation for the following reasons.

- None of the listed species are likely to utilise the smelter for habitat, although some of the listed birds may fly over the smelter.
- None of the habitat potentially used by listed species will be cleared or adversely affected by the Transformation.
- The substantial reductions in emitted SO_2 may improve the quality of the coastal vegetation and habitat.
- The greater cooling water discharge will not result in an increase in the temperature of seawater in First Creek beyond existing levels. The sea birds known to use the habitat at the mouth of First Creek would not be affected. Similarly, listed marine species potentially using gulf waters off First Creek would not be affected.
- Discharge of cooling water into Port Pirie River via a diffuser would result in a temperature increase over ambient of less than 2°C within 20 m of the diffuser. Ecological effects are unlikely to be measurable beyond 20 m from the diffuser. Adverse effects on listed species potentially occurring in Port Pirie River would not occur. The vulnerable turfing macroalga *Vaucheria conifera* recorded in the Port Pirie River is not likely to be affected.

As discussed above the construction and operational impacts on marine flora and fauna would in general not be measurable. Consequently it is considered that there would be no adverse effects on the Upper Spencer Gulf Marine Park resulting from the Transformation project.

12.5.9 Biosecurity and invasive species

The risk of introducing invasive marine species would be minimised through adoption of the national ballast water management requirements (AQIS 2008) developed to meet Australia's commitment to International Convention for the Control and Management of Ships' Ballast Water and Sediments (IMO 2008).

Consistent with current procedures, Nyrstar would require that ships delivering materials during construction possess ballast water management plans that comply with international, Australian and local (Flinders Ports) requirements.

Consequently, ballast water would be managed according to the recognised guidelines.

12.5.10 Climate change

Changes in the distribution and abundance of marine species and the timing of biological processes in response to temperature changes are well known (e.g. Brierley and Kingsford 2009; Hobday *et al.* 2006). There is also evidence that acidification associated with climate change can affect the ability of animals such as molluscs to produce shells and plates from calcium carbonate (Secretariat CBD 2009; Brierley and Kingsford 2009; The Royal Society 2005; Hobday *et al.* 2006; Kleypas *et al.* 2006). Additive or synergistic effects resulting from the cumulative impact of increases in salinity, temperature and acidity associated with climate change are also possible (Hobday *et al.* 2006; Brierley and Kingsford 2005).

There have been a number of predictions concerning increased air and water temperatures in Spencer Gulf. In particular:

- Suppiah *et al.* (2006) predicted air temperature changes of 1.6°C by 2030 and 4.7°C by 2070, with corresponding increases in water temperature being approximately half the air temperature rises.
- Bothelo *et al.* (2013) modelled climate change in Upper Spencer Gulf, and predicted an annual mean seawater temperate increase of about 0.9°C by 2030 and 2.8°C by 2070.

There have also been more general predictions for Australian sea waters, including:

- a sea surface temperature rise of 1–2°C by 2070 (Hobday *et al.* 2006)
- a decrease in pH (i.e. increase in acidity) of 0.14 by 2030 and 0.24 by 2070 (Hobday *et al.* 2006).

The temperature increase associated with the cooling water discharge into the Port Pirie River would be confined to no more than 2°C within 20 m of the diffuser. Should the discharge occur into First Creek, there would be no increase in seawater temperature (over that associated with the existing discharge) as a cooling tower would be used to cool the water prior to discharge. This may result in a decrease in temperature effects in First Creek.

Temperature effects associated with the proposed increased cooling water discharge would be negligible compared with potential increases in ambient temperatures predicted under climate change scenarios. Similarly, the contribution of the increased cooling water discharge to possible synergistic effects associated with climate change would be negligible.

12.5.11 Seagrass clearance off–sets

To offset the potential loss of seagrass associated with the Port Pirie River option for cooling water disposal, Nyrstar will consider monetary payment to the Native Vegetation Fund, to achieve a Significant Environmental Benefit (SEB) and compliance with the *Native Vegetation Act 1991*.

12.5.12 Marine Users

There will be no impact from the Transformation on marine users such as aquaculture or commercial and recreational fishers.

Table 12–1: Nyrstar cooling water use compared with Northern and Playford Power Stations

	Flow rate (m^3/s)	Temperature increase (°C)
Nyrstar (existing and proposed)	2.18	10
Northern Power Station[1]	47	7
Playford A[2]	7.5	5.8
Playford B[2]	14.5	6.6

[1] Source: Kinhill (1982)

[2] Source: McLaren and Wiltshire (1984)

The two power stations near Port Augusta increase the temperature of more than 800 GL of cooling water annually (5% of the volume of Upper Spencer Gulf) by 4–5°C. The cooling water from the power stations is discharged into a relatively shallow and enclosed part of Spencer Gulf and does not use a diffuser.

Extensive marine monitoring programs were undertaken in the late 1970's and 1980s to determine the effects of the cooling water discharge from the power stations on adjacent marine communities. These studies revealed the following:

- Operation of the Playford Power Station had not affected seagrass or mangroves to a degree that could be observed qualitatively (E.R.A. 1973).
- The marine communities on six transects across the gulf did not appear to be greatly affected by the cooling water discharge (Johnson 1976).
- Subtidal communities near the power station were similar to those further south near Redcliff Point (Johnson 1976).
- Normal assemblages of marine communities, including infauna, inhabit the near vicinity of the power station. However, some species such as razorfish and sponges may be more abundant near the power station (ETSA 1977).
- Occasional incursions of warm water into the intertidal zone had no measurable impact on intertidal communities (Ainslie *et al.* 1989).

- Seagrass communities near the power station appear to tolerate occasional incursions of seawater at 28°C. However, there was some evidence that 28°C is the threshold at which some reduction in total standing biomass, reduced leaf length and increased shoot production occurs (Ainslie *et al.* 1989).

Seagrass communities in Port Paterson, which is a large shallow embayment in northern Spencer Gulf, are subjected to natural temperatures up to 33.5°C in summer. The seagrass communities in Port Paterson appear to tolerate the occasional extreme temperatures. They are, however, characteristically stunted. It was concluded that the natural thermal stress in Port Paterson was considerably greater than the thermal stress near the power station and covered a much greater area (Ainslie *et al.* 1989).

Further south near Port Broughton, dieback of approximately 11,000 ha of intertidal and shallow subtidal seagrass was reported in 1993, probably due to heat stress associated with a hot El Nino summer (Seddon *et al.* 2000).

These studies indicate that existing cooling water discharges into Upper Spencer Gulf have had negligible effects on adjacent marine communities and that potential effects associated with the discharge of cooling water are minor compared with natural heat stress.

Effects on mangrove and seagrass communities

The hydrodynamic modelling of the cooling water discharge into the Port Pirie River via an appropriately designed diffuser (see **Section 12.4**) demonstrates that dispersion of the effluent plume will result in no more than a 2°C increase over ambient water temperature 20 m from the diffuser. The modelling indicates that the temperature increase (above the existing regime) would be less than 2°C at the nearest mangrove and seagrass communities. Studies of the effects of thermal effluent on mangroves at Torrens Island (De Guia 1982) and seagrasses near Port Augusta (Ainslie *et al.* 1989) suggest that neither community would be adversely affected by the possible 1–2°C temperature increases they may sometimes be exposed to.

Effects on marine communities

The hydrodynamic modelling of the additional cooling water discharge to First Creek demonstrates that, with the use of a cooling tower to provide an appropriate level of cooling prior to discharge, the average seawater temperature in First Creek will either be the same as at present, or decrease to some degree. Consequently, should the First Creek disposal option be chosen, the Transformation is likely to have no adverse effects on the marine communities inhabiting First Creek (including recreational and commercial species), and may result in some degree of improvement, depending on the level of pre-cooling prior to discharge that occurs.

Similarly, the hydrodynamic modelling of the cooling water discharge into the Port Pirie River via an appropriately designed diffuser demonstrates that dispersion of the effluent plume is likely result in no more than a 2°C increase over ambient water temperatures approximately 20 m from the diffuser, which will satisfy the appropriate water quality guidelines.

The modelling indicates that the temperature increase would be less than 2°C at the nearest mangrove and seagrass communities in the Port Pirie River. Studies of the effects of thermal effluent on mangroves at Torrens Island (De Guia 1982) and seagrasses near Port Augusta (Ainslie *et al*. 1989) suggest that neither community would be adversely affected by the possible 1–2°C temperature increases to which they may sometimes be exposed.

Similarly, the relatively small temperature increases in the Port Pirie River are unlikely to result in measurable effects on marine communities more than 20 m from the outfall. The fauna living on the estuary floor and in the sediment next to the diffuser are unlikely to be exposed to temperature increases greater than 2°C as the buoyant plume will rise to the surface on discharge.

The warm water plume near the diffuser is likely to attract some fish species (including recreational and commercial species). Being highly mobile, they would have the ability to avoid the thermal plume if it exceeds their thermal tolerances. Adverse effects on fish are therefore unlikely.

12.6 Conclusions

The following conclusions may be drawn concerning impacts on coastal and marine communities.

Thermal effects

- The much larger cooling water discharges at the Northern and Playford Power Stations near Port Augusta have had negligible impact on adjacent marine communities.
- Port Augusta seagrass communities near the power station appear to tolerate water temperatures of 28°C, which is considerably higher than seagrass communities near Port Pirie would be exposed.
- Seagrass communities in Port Paterson near Port Augusta tolerate natural temperatures up to 33.5°C in summer.
- Potential effects associated with the discharge of cooling water at Port Pirie are likely to be very minor compared with natural heat stress in Upper Spencer Gulf.
- Studies on the effects of thermal effluent on mangroves at Torrens Island and seagrasses near Port Augusta suggest that seagrass communities will not be adversely affected by the possible 2°C temperature increase above ambient levels in the Port Pirie River.

First Creek

- The average temperature regime in First Creek would be significantly higher with the discharge of additional cooling water at 10°C above ambient
- However, the temperature regime would be only slightly higher with the discharge of additional cooling water at 5°C above ambient, and lower with the discharge of additional cooling water at 2°C above ambient.

Port Pirie River

- Nearfield modelling indicated that it is possible to design a diffuser that would meet the EPA's suggested temperature guideline, and the draft *Water Quality Guidelines* 2012.
- The results indicate that, with a 48 m long diffuser with 12 ports of diameter 15 cm, a cooling water exit velocity of about 7 m/s is likely to result in a temperature increase of no greater than 2°C 20 m from the diffuser.
- Farfield modelling indicates that a temperature increase of 0.5–1.5°C over ambient would extend approximately 1.5 km north and 3 km south of the outfall, which indicates that flushing in the upper reaches of the estuary is relatively poor.
- The modelling also shows that there is potential for re-circulation of cooling water if the inlet and outlets are too close together. The positioning of the inlet on the floor of the estuary is likely to minimise re-circulation.

Marine communities

- With the use of a cooling tower to provide pre-discharge cooling to approximately 5°C above ambient, the Transformation is unlikely to result in further adverse effects on the marine communities inhabiting First Creek.
- Similarly, with the use of an appropriately designed diffuser in Port Pirie River, the relatively small temperature increases (<2°C) in the Port Pirie River 20 m from the diffuser are unlikely to result in measurable effects on marine communities adjacent to the outfall.

Cooling water quality

- Cooling water does not come into contact with any process waters and therefore physical water quality parameters other than temperature will remain the same.

Erosion of sediments by cooling water

- Discharge of cooling water into the Port Pirie River via a diffuser would have no effect on contaminated sediments on the floor of the estuary.
- The increased flow of cooling water in the confined upper reaches of First Creek may initially mobilise and move contaminated sediments down First Creek. However, the sediments would be re–deposited in the less confined middle reaches of First Creek as the velocity of cooling water decreased to ambient tidal levels.

Other discharges to the marine environment

- The increased cooling water discharge will be dosed with a non-toxic surfactant to prevent fouling organisms from attaching to infrastructure, rather than the more toxic, conventional anti–fouling chemicals.
- The movement of contaminated groundwater beneath the smelter will not change. Consequently, there will be no change in the discharge of contaminated groundwater to the Port Pirie River.
- Run–off from demolition and construction sites will be controlled and directed to the existing sedimentation basin prior to discharge to the marine environment.
- During demolition and construction, measures will be taken to minimise dust emissions to the marine environment from potentially dusty sites.

Entrainment and impingement

- The increase in mortality of larvae arising from entrainment would be 1,000 to 50,000 times less than natural mortality of larvae in Upper Spencer Gulf.
- It is estimated that from about one in 25,000 to one in 250,000,000 adult fish or crustaceans may be lost each year from Upper Spencer Gulf as a result of entrainment.
- The impact of entrainment in the proposed cooling water intake on natural populations of marine biota in Upper Spencer Gulf would not be measurable.

Construction impacts

- Limited dredging associated with the construction of new cooling water caisson and the outlet pipeline would result in a short term increase in turbidity in the Port Pirie River.
- Turbidity and sedimentation effects on the *Zostera* sp. seagrass communities in Port Pirie River would be minor as its extent near the construction sites is limited and recovery of *Zostera* sp. is likely to be good as it is an opportunistic species.
- Increases in noise and vibration associated with construction of the new cooling water inlet caisson and outfall in Port Pirie River would be slight in the context of the ongoing smelting and port operations. Effects would be temporary and ecologically negligible.
- Potential construction of the cooling water outfall pipeline through the 100 m wide tidal flats adjacent to the smelter would result in the loss of up 100 m^2 of Eelgrass *Zostera* sp. Loss of the seagrass may require an SEB offset payment to be made to the Native Vegetation Council.

Increased shipping

- During construction there will be an estimated 24 additional shipping movements in the Port Pirie River per year. Annual shipping movements will return to current levels after construction.
- The slight increase in shipping traffic will result in minor short term increases in the mobilization of contaminated sediments, turbidity and siltation in Port Pirie River. However, effects on marine communities would be negligible.

Effects on listed species

- The risk of listed marine or coastal species being adversely affected by the Transformation is considered to be negligible.
- None of the listed species are likely to utilise the smelter for habitat, and none of the habitat potentially used by listed species will be cleared or adversely affected by the Transformation.

Invasive species

- The risk of introduction of invasive marine species would be minimised by strict adherence to the national ballast water management guidelines by all shipping.

Climate change

- Temperature effects associated with the proposed increased cooling water discharge would be negligible compared with potential increases in ambient temperatures predicted under climate change scenarios.

13 Effects on native vegetation and fauna

13.1 Introduction

This chapter assesses the effects the Transformation may have on terrestrial vegetation, habitat and fauna in the vicinity of the smelter.

The specific issues addressed include:

- clearance of native vegetation during construction
- the effect of air emissions (particularly SO_2) on vegetation
- the effects of additional noise and light during construction on fauna.

13.2 Existing environment

13.2.1 Vegetation communities, habitats and fauna

The Transformation is located within an existing industrial site that was mostly cleared of natural vegetation in 1885 and sections likely to have been cleared earlier for shipping, fishing and agricultural activities. The smelter supports none of its original native vegetation and habitat. Prior to clearance the native vegetation at the smelter would probably have been similar to the tidally influenced communities adjacent to the smelter.

The intertidal and supratidal environment adjacent to the smelter support relatively intact mangrove and samphire communities that extend several kilometres inland along the eastern shore of Spencer Gulf. The mangrove and samphire communities near Port Pirie are some of the most extensive in southern Australia (Dittmann and Baggalley 2013).

The Port Pirie River estuary covers an area of approximately 15 km^2 and is part of the Northern Spencer Gulf Wetland which is included in the Directory of Important Wetlands in South Australia (ANCA 1996). They provide important habitat for native fauna, particularly waterbirds.

The distribution of mangroves and samphire on the tidal flats is influenced largely by micro-topography that may only vary by 0.6 m, but produces significant spatial variation in drainage and tidal flooding and therefore physical complexity (Fotheringham and Coleman 2008).

The Port Pirie River and First Creek support extensive Grey Mangrove *Avicennia marina* var. *resinifera* woodland that progressively becomes less dense and confined to the main tidal channels in their upper reaches. The supratidal zone adjacent to Port Pirie River and First Creek supports extensive samphire shrubland consisting of Grey Samphire *Halosarcia halocnemoides*, *Sclerostegia* spp., *Sarcocornia* spp. and Shrubby Glasswort *Tecticornia arbuscula*. Large areas of bare sand and clay flats occur within the samphire communities.

The coastal wetlands of Upper Spencer Gulf provides important habitat for waterbirds with significant populations of several species, including the migratory waders Red-necked Stint *Calidris ruficollis*, Red Knot *Calidris canutus*, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper *Calidris ferruginea*, Banded Stilts *Cladorhynchus leucocephalus* and Red-capped Plovers *Charadrius ruficapillus* (Carpenter and Langdon 2013).

Upper Spencer Gulf also supports significant nesting colonies of some species, including the Crested Tern *Thalasseus bergii*, Caspian Tern *Hydroprogne caspia* and Fairy Tern *Sternula nereis*. Their main nesting site near Port Pirie is on Ward Spit. The Great Egret *Ardea alba* is reported to nest with Pied Cormorants *Phalacrocorax varius* in mangroves at Port Pirie and near Redcliffe Point north of Port Pirie (Carpenter and Langdon 2013).

13.2.2 Existing levels of disturbance

The Port Pirie region has been extensively cleared since European settlement for agriculture, housing and industry and now supports only remnant patches of native vegetation. The Port Pirie Environmental Association and Hundred of Pirie have only 3% and 4.6%, respectively, of their native vegetation remaining, which are considered to be very low.

More than 75% of the catchments of First, Second and Third Creeks have been cleared. Similarly, the catchments of Fisherman Creek and Port Pirie River have been substantially cleared. Each of these catchments is classified as severely modified (Barnett 2001).

The most intact communities of native vegetation in the region are the mangrove woodland and samphire shrubland in the intertidal and supratidal zones. Although the native vegetation and habitat adjacent to the western and northern boundaries of the smelter are largely intact, they have been degraded to some extent by recreational vehicles creating a network of tracks, effluent discharges into First and Second Creeks and the deposition of air pollutants, including SO_2 and heavy metals.

Similarly, the eastern side of the Port Pirie River is easily accessed from Port Pirie and as a consequence is heavily impacted by cars, fishers and walkers. Car tracks, rubbish and erosion are common in the area.

A revegetation program at the smelter commenced in 1993, and by 2000, approximately 200,000 plants were planted on the smelter to reduce fugitive dust emissions. Revegetation has predominantly involved the use of shrubs and grasses, such as Bluebush *Maireana sedifolia*, Old Man Saltbush *Atriplex nummularia* and speargrass *Austrostipa* sp.

13.3 Impact assessment and management

An impact assessment and recommended management has been completed for the clearance of vegetation and habitat, the effects of sulphur dioxide emissions on vegetation, effects on fauna and effects on listed species and communities.

13.3.1 Clearance of vegetation and habitat

Other than the possible clearance of 0.1 ha of the Eelgrass *Zostera* sp., should an outlet pipe for cooling water be constructed (see **Section 12.5.6**), no terrestrial vegetation or habitat clearance will be required for the Transformation.

13.3.2 Effects of sulphur dioxide emissions on vegetation

Sulphur dioxide emissions have the potential to damage vegetation through foliar injury and disruption of metabolic or physiological processes (O'Connor *et al.* 1974). The tall stack emissions are the main source of SO_2 emanating from the smelter. Although there is

currently no clear evidence of air emissions having had adverse effects on vegetation around the smelter, subtle effects are likely to have occurred.

The Transformation will reduce the tall stack emissions of SO_2 by 90% (see **Chapter 7**). Consequently, the vegetation in the vicinity of the smelter will be exposed to significantly lower concentrations of SO_2 than at present. It is expected therefore that the condition of vegetation adjacent to the smelter will improve to some degree as a direct consequence of the Transformation.

13.3.3 Effects on fauna

The potential effects from the Transformation on fauna from noise and light are described in the following sections.

Noise

Increased noise can lower the value of habitat by disrupting the behaviour of fauna (e.g. Habib *et al.* 2007). Noise levels associated with the Transformation may increase to some degree during the construction phase, but would be similar to existing noise levels when construction is complete (**Chapter 9**). Noise emissions during construction may temporarily adversely affect fauna and reduce the value of habitat immediately adjacent to the smelter.

The effects of noise during construction on fauna are unlikely to result in a long-term reduction in habitat value near the smelter, particularly given the modified nature of the environment within and adjacent to the smelter. Noise modelling suggests that levels would be significantly attenuated within 500 m of the source.

The temporary reduction in habitat value immediately adjacent to the smelter resulting from construction noise would have negligible effect on the viability of fauna in the area.

Light

Artificial light at night can affect the foraging behaviour, predator prey interactions, reproduction, migration and social interactions of fauna (Rich and Longcore 2006). The amount of artificial lighting associated with the Transformation may temporarily increase during the construction phase, but would be similar to existing light emissions when construction is complete.

Depending on the types of lights used, the lights may attract large numbers of insects that would in turn provide foraging opportunities for bats, some birds and ground dwelling fauna. The effects, however, would be similar to existing light effects at the smelter are unlikely to result in a long-term reduction in habitat value near the smelter. Light spillage would be mitigated to some degree by using screens and directional lighting where appropriate.

The temporary reduction in habitat value immediately adjacent to the smelter resulting from light spill would have negligible effect on the viability of fauna in the area.

13.3.4 Effects on listed species and communities

Potential effects on listed terrestrial species are discussed collectively with marine and coastal species in **Section 12.5.8** and **Appendix F**. There is negligible risk of listed terrestrial species being adversely affected by the project.

13.4 Conclusions

The following conclusions may be drawn concerning impacts on terrestrial flora and fauna communities.

- no vegetation or habitat removal will be required for the construction phase of the Transformation
- the Transformation will reduce the tall stack emissions of SO_2 by around 90%, and consequently, the health of the vegetation in the vicinity of the smelter may improve
- the temporary reduction in habitat value immediately adjacent to the smelter resulting from construction noise and light would have negligible effect on the viability of fauna in the area
- the risk of listed terrestrial species or communities being adversely affected by the Transformation is negligible.

14 Effects on transport and infrastructure

14.1 Introduction

The following section addresses the effects of the Transformation on transport and infrastructure, particularly those external to the smelter. Consideration has been given to the construction and operational phases of the Transformation.

14.2 Traffic and transport

Nyrstar Port Pirie can be accessed directly by road, rail and sea (**Figure 14-1**).

Road access, including heavy vehicle traffic, is from the Princess Highway to the Spencer Highway, Main Road and Ellen Street, with internal smelter roads from Ellen Street taking road traffic to the various parts of the smelter.

Rail access is via a rail line owned and operated by Genesee & Wyoming Australia Inc.

Sea access is via the Spencer Gulf with a shipping channel servicing the wharf facility. The shipping channel is 6.4 m deep, 90 m wide. The Port Pirie wharf facility is operated by Flinders Ports, which has a 99 year lease and port operating licence. Nyrstar currently subleases and operates Berths 8 and 9 to service the smelting operations.

Traffic and transport implications have been considered for the construction and operational phases of the Transformation.

14.2.1 Construction phase

Approximately 80% of the Transformation's transport requirements during construction will be met using vessels carrying prefabricated modules by sea. The remaining 20% of equipment, materials and resources will be transported by road. Rail transport is not expected to be used for the construction phase of the Transformation.

Sea

The majority of material required for construction will be transported as modules by sea. Tug and barge combinations or self-propelled module carriers will be used to make scheduled deliveries over the course of the construction phase. They are capable of docking at the existing Port Pirie wharf facility at Berth 9. No wharf infrastructure changes are expected because of the Transformation.

Modules of varying size and configuration will be fabricated, fitted-out, tested and dry commissioned off-site. They will be transported complete with all equipment, cabling, instrumentation and piping.

Vessels berthing at the Port Pirie wharf facility range between 55 and 106 per year over the last ten years. Approximately 42 modules will be delivered in stages, with current project scheduling calling for two vessels per month carrying up to six modules each. Based on 2012 data the additional two vessels per month is within the historical range of shipping traffic to Port Pirie and is therefore unlikely to impact on the existing port operations.

Figure 14-1: Smelter access

Once the modules have been received at the wharf they will be transported directly to their final location or to a temporary laydown yard within the smelter using self-propelled hydraulic mobile trailers or similar transportation. The mobile trailers will travel via the wharf and internal smelter roads **(Figure 14-2**). Public roads will not be used for this process. Traffic impacts will not occur on public roads as a result of the on-shore module transport.

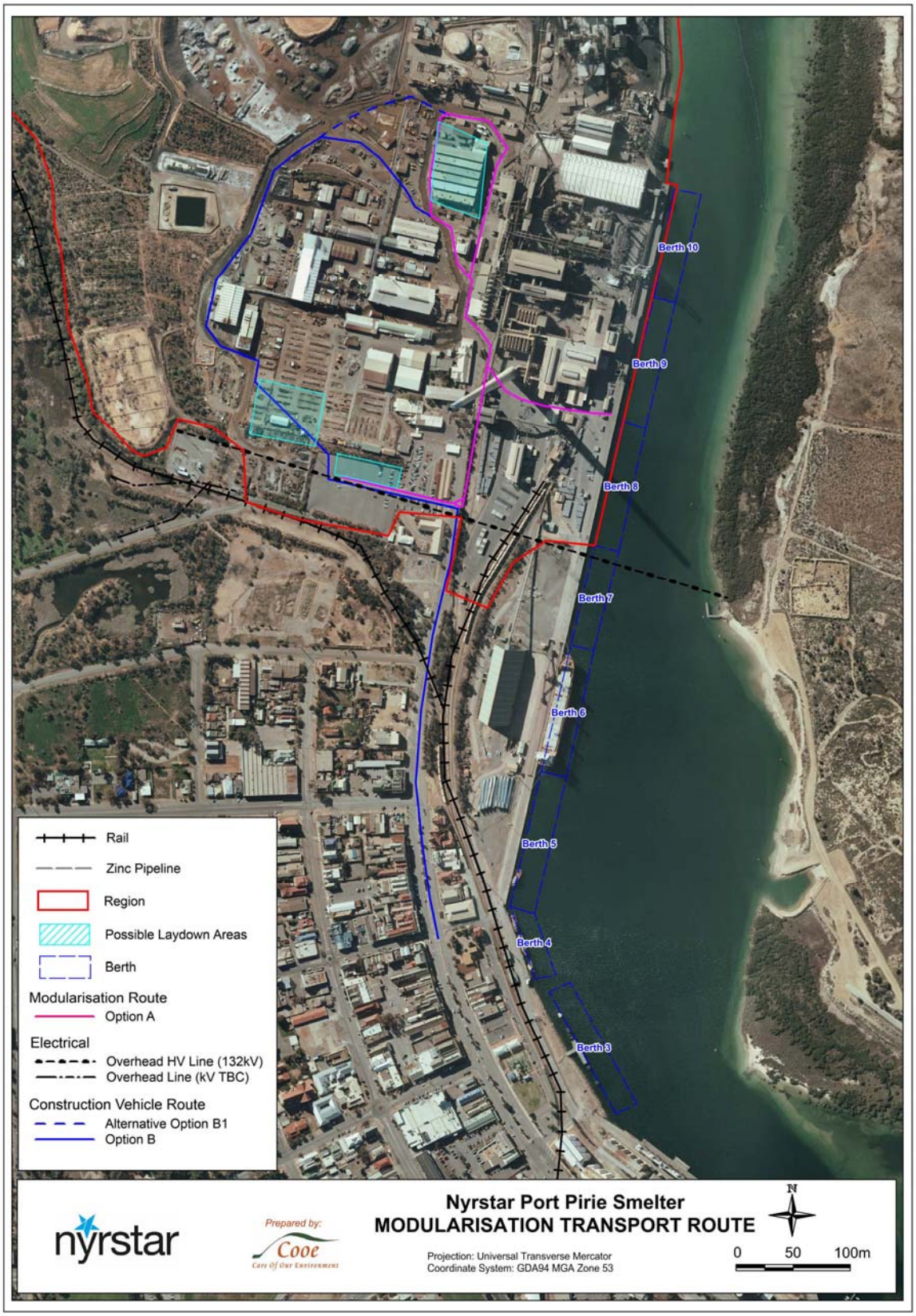


Figure 14-2: Module transport route from wharf to laydown yard

Road

Road transport will deliver equipment for demolition and construction purposes, minor construction materials including steel and concrete, and additional materials for module connection. Fuel for equipment will be delivered as required by mobile refuelling vehicles. Oversized loads are not anticipated, although road registered mobile cranes may be required for the positioning of the modules, and would access the smelter by road. These vehicles have no special requirements in terms of traffic management or infrastructure upgrades.

Nyrstar anticipates that buses will be used to transport construction personnel between their accommodation and the smelter, minimising traffic on public roads. This method has been used successfully during previous regular shutdowns.

Increased road traffic during the construction phase of the Transformation is likely to have intermittent and localised impacts in Port Pirie. It is estimated that construction phase road transport will increase road traffic by 20–40%. Impacts on public roads are expected to be negligible, particularly Main Road in Port Pirie. All parking requirements will be provided within the smelter. An appropriate traffic management plan will be developed prior to the construction phase to mitigate potential impacts. No modification to public traffic infrastructure will be required.

Car parking provisions

All car parking requirements for the construction and operational phases of the Transformation will be provided on-site. The construction workforce will be transported to the smelter by bus, minimising on-site car parking requirements.

Rail

Rail transport is not expected to be required for the construction phase of the Transformation. No impact on rail traffic is expected, and no rail infrastructure improvements will be required.

The type and volume of road traffic associated with the Transformation is not expected to impact the level crossings at or near Port Pirie.

14.2.2 Operational traffic

Operational traffic, via sea, road and rail will be similar to current traffic volumes.

Transport of product

No change to the transport of final product is anticipated. Product will continue to be transported by sea via the existing wharf facilities, which are suitable for the operational phase of the Transformation.

14.2.3 Transport infrastructure improvement requirements

At this stage of design and planning, no off-site transport infrastructure improvements are required to enable the construction or operational phases of the Transformation.

Construction modules, equipment and materials will be delivered by sea or road. The existing road transport infrastructure is suitable to service the types and volume of road traffic required for the construction and operational phases of the Transformation. In particular, the level crossings within Port Pirie are appropriate for the size, type and volume of traffic associated with the project and therefore do not require upgrading.

The temporary increase in traffic volume during the construction phase will be addressed through schedule management, with localised impacts addressed by a traffic management plan.

Vessels that are capable of entering and docking at the existing wharf facility will be used for module delivery during construction, and operational shipping will continue in the current manner. Therefore, no change to the current wharf facility will be required as a result of the Transformation.

It is not proposed to use rail transport for the construction phase of the project. No modification to existing rail infrastructure is required for the operational phase of the Transformation.

Some smelter roads and intersections will be upgraded as part of the Transformation to enable traffic movement of on-site and off-site visiting vehicles, including B-Double vehicles. Two lanes, with bi-directional vehicle access, are being considered for all new facilities.

14.3 Effects on infrastructure

Nyrstar Port Pirie is currently serviced by electricity, gas and water utilities and the smelter has sewerage infrastructure including a sewerage treatment facility.

14.3.1 Water

Potable water requirements for the facility are supplied from Port Pirie mains water via an existing potable water ring main. The smelter currently uses approximately 5,167 kL per day.

In addition to the existing plant, the main uses of potable water will include the steam cogeneration facility and various facilities within the smelting process. Over the long term, the Transformation is expected to achieve a decrease in potable water requirements.

There may be a minimal increase in potable water required at the smelter for the construction phase of the Transformation, mainly associated with smelter's ablution blocks. At this stage of design, the existing potable water infrastructure can deliver an adequate supply for the construction and operational phases of the Transformation. This is unlikely to be any different to the current shutdown demand intensity.

14.3.2 Gas

Natural gas mains supply to the Nyrstar Port Pirie Lead Smelter is provided at 700 kPa. The smelter currently consumes approximately 2,025,986 Nm^3 per month. The construction phase of the Transformation is not expected to impact on current gas demand.

During operations following the Transformation, gas demand will be higher than current use. New facilities consuming gas will include the cogeneration steam superheater, the EBS oxidation furnace standby burners, various burners for launder, taphole and ladle heating, and the acid facility pre-heater. If installed, an EBS reduction furnace and its standby burners will also consume additional gas.

Current estimates indicate that the existing gas infrastructure servicing the smelter is adequate to meet the increased demand for gas following the Transformation.

14.3.3 Electricity

Electricity is supplied to the smelter by SA Power Networks via the Allendale electricity substation. The smelter currently consumes approximately 300 MWh annually when operating at capacity.

Electricity demand during the construction phase of the project will be addressed through the use of generators. Following the Transformation, approximately 20 MW of additional electricity will be required, primarily for the EBS oxidation furnace and associated equipment and processes.

The pre-feasibility study has determined that the Allendale electricity substation is operating at capacity. Therefore new substation infrastructure and upstream augmentation will be required to meet the increased energy demands from the Transformation.

It is anticipated that a proportion of the additional electricity will be provided by a new cogeneration facility to be installed during the Transformation. The cogeneration facility will recover waste heat from EBS oxidation furnace and reduction furnace off-gas to produce electricity. High pressure steam, generated from the furnace waste heat boilers, will be superheated using a natural gas superheater. The superheated steam will then be converted to electricity by a condensing steam turbine and generator set. The cogeneration facility is expected to have a net operating electricity output of between 4.8 and 8.1 MW dependent on the configuration of the new equipment.

14.3.4 Sewage

The smelter is serviced by an on-site sewage treatment facility, where sewage is treated and used for irrigation purposes. There will be a temporary increase in sewage generation as a result of increased personnel involved with construction. The existing sewage system and sewage treatment facility is sufficient to meet this increased demand. No significant change in sewage volumes is expected as a result of operations following the Transformation.

14.3.5 Stormwater

All existing stormwater systems will remain functional during the construction and operational phases of the Transformation. Temporary stormwater control measures will be implemented during the construction phase of the project in accordance with the construction environmental management plan (CEMP).

Stormwater is discharged via the sedimentation pond through the 1M flume which is the licenced discharge point. The volume of stormwater generated as a result of the upgrade is

not expected to increase. Some changes will be made to stormwater infrastructure on-site during the Transformation. The new stormwater drains will connect into the existing infrastructure. The quantity of stormwater managed during and after the Transformation is not expected to vary significantly from typical seasonal volumes, which the existing system is designed to manage.

14.3.6 Communications

Communication systems which service the smelter are adequate to cope with the construction and operational phases of the Transformation and are not expected to be impacted or require upgrading.

14.3.7 Emergency services

During and following the Transformation, emergency services will continue in their current form. The smelter's medical centre will be continuously staffed by a first aid attendant. The centre will continue to attend to minor incidents involving basic first aid, such as cuts, bruises and sprains etc. Incidents requiring first aid will be coordinated through the medical centre.

Serious incidents would be referred, through the medical centre, to the Port Pirie Regional Health Centre (Port Pirie Hospital). If required, an ambulance with paramedic staff can arrive at the smelter within approximately four minutes to transfer patients to the Port Pirie Hospital. Should the extent of injuries exceed the Hospital's capability then patients would be flown to Adelaide for further treatment. If an incident involved fire or rescue, the Port Pirie Metropolitan Fire Service (MFS) would be engaged.

More serious incidents would be referred to an on-site Crisis Management Team that will also be continuously staffed. The Crisis Management Team will coordinate the response to serious incidents, such as serious injury, fire or infrastructure collapse.

During construction, the Transformation is not expected to require any additional personnel or resources with respect to emergency services. Following the Transformation, emergency response plans will be updated and additional hazard and risk analyses undertaken.

15 Sustainability and climate change

15.1 Introduction

The Transformation is focused on delivering an innovative and sustainable solution to the current environmental and technical challenges facing the smelter. This chapter discusses sustainability aspects of the Transformation.

Overview

The smelter has been in continuous operation since 1889, with many of the core production assets having been in service for up to sixty years. These assets are increasingly less capable of meeting the environmental and operational standards expected of a modern base metals facility.

The Transformation will involve the permanent decommissioning of a portion of the key infrastructure. Specifically the Transformation will replace the sinter plant with an EBS oxidation furnace, coupled to a heat recovery and electricity cogeneration facility and a modern sulphuric acid production facility. The project will facilitate recovery of materials from the intermediate storage area, improve concentrate storage handling, and introduce significant air hygiene improvements to the production process. Replacement of the blast furnace with an EBS reduction furnace is being considered: this

Sustainability, community health and environmental benefits and features of the Transformation include:

- significantly reducing airborne metal and dust emissions
- enclosing material transfer points and drafting emissions through a microfiltration baghouse
- substantially increasing capture of sulphur dioxide and conversion to useable sulphuric acid, significantly reducing instances of nuisance sulphur dioxide gas within the city of Port Pirie and the surrounding environment
- introducing a straight-through process
    - avoiding storage of large tonnages of metal-bearing intermediate materials on-site
    - eliminating a number of sources of metal dust being mobilised on high wind days
    - avoiding energy consumption involved with recirculating large tonnages of intermediate materials within the oxidation smelting process and around the smelter
- recovering energy from the oxidation smelting process, avoiding greenhouse gas emissions associated with equivalent energy generation from fossil fuels
- reducing carbon intensity from improving furnace design and energy efficiency and increasing sulphur dioxide capture and acid production
- reducing potable water consumption
- prefabricating construction modules off-site,
    - reducing construction waste and double handling of construction materials compared with in situ construction.

- avoiding emissions associated with road transport of construction materials.

15.2 Auditing

Auditing of sustainability of activities will be conducted during the construction and operational phases of the Transformation.

A construction environmental management plan (CEMP) and an operations environmental management plan (OEMP) have been drafted (**Appendices K** and **L**) and will be finalised and implemented for the construction and operational phases of the Transformation, respectively. A Transformation environmental officer will conduct daily smelter inspections and scheduled internal audits of construction and commissioning activities to assess compliance with the CEMP and OEMP. Post-commissioning, the requirements of the OEMP will be incorporated into the Nyrstar Port Pirie environmental management system (EMS).

Nyrstar's environmental management system is ISO 14001 certified, and is therefore regularly audited internally and externally against the ISO 14001 standard. The upgraded equipment associated with the Transformation will be incorporated into the EMS and will undergo regular review of environmental aspects and impacts, suitability of mitigation measures, and inclusion in regular internal and external auditing. The sustainability benefits of using ISO 14001 can include:

- reduced cost of waste management
- savings in consumption of energy and materials
- lower distribution costs
- improved corporate social responsibility, visible to regulators, customers and the public.

Nyrstar Port Pirie reports annually on sustainability performance under the National Greenhouse and Energy Reporting Scheme (NGERS) and National Pollution Inventory (NPI). NGERS and NPI reporting will continue post-Transformation and will include emissions associated with the upgraded processes.

15.3 Energy consumption

Efficient use of energy is central to sustainability and climate change mitigation. The Transformation will optimise energy consumption to maximise quality and quantity of products generated, while realising financial savings from energy efficiency.

15.3.1 Process mass balance

Energy efficiency during the operational phase is relative to the quantity of concentrate and residue to be processed and the quantity and quality of outputs generated. **Figure 15-1** provides a simplified operational process flow diagram, with an indicative input and output mass balance for the facility. Processes affected by the Transformation are shown in green. Approximate masses involved are:

- 936,700 tpa smelting feed input
- outputs

- 638,400 tpa slag from the EBS oxidation furnace (which becomes feed for subsequent processes including the blast furnace)
- 262,000 tpa lead bullion from the blast furnace
- 293,580 tpa of acid from the acid facility

Smelter Operations – Process Flow Diagram (option EBS + Blast Furnace)

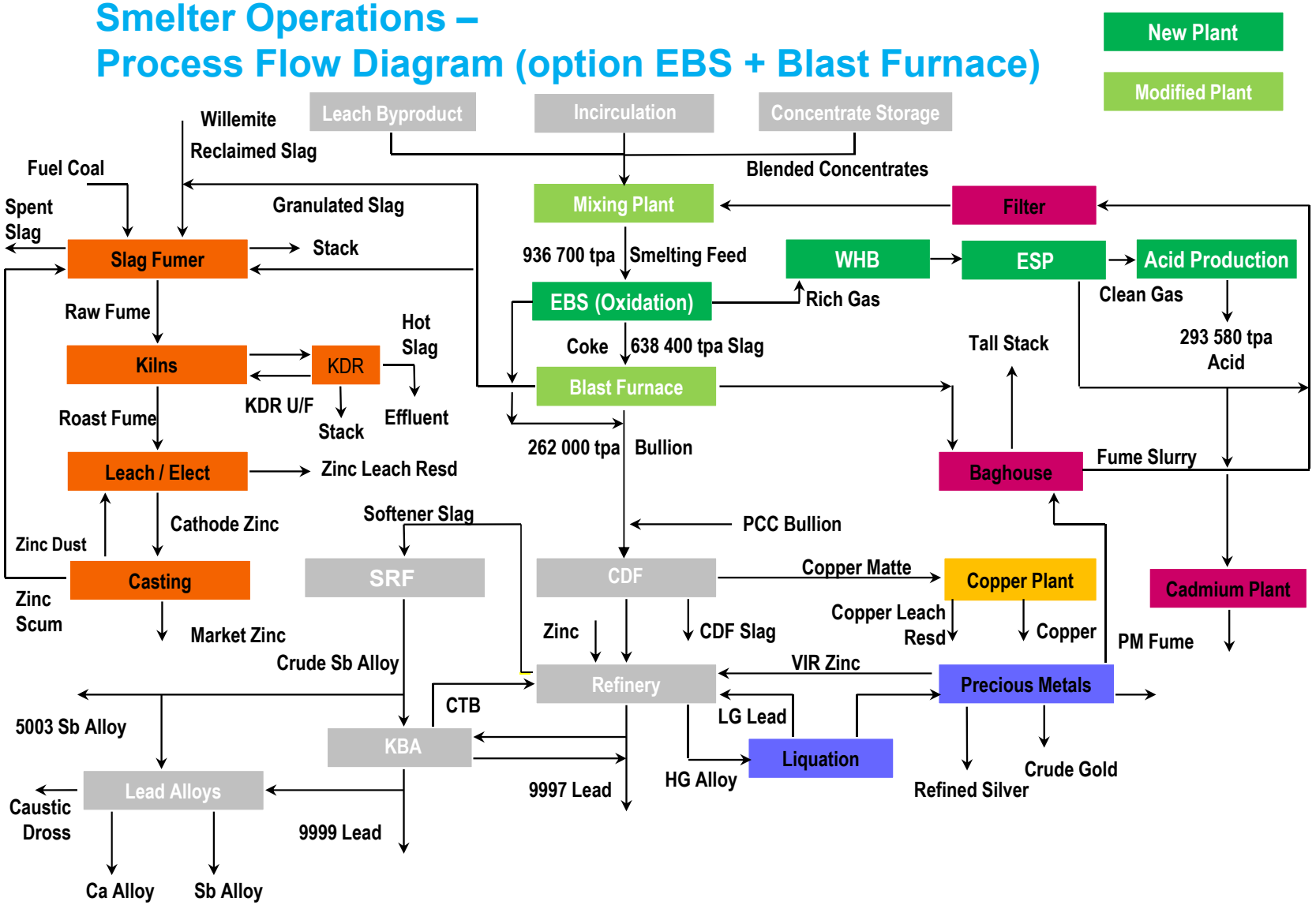


Figure 15-1: Simplified process flow and mass balance, showing Transformation modifications in green

15.3.2 Energy efficiency

Energy efficiency gains as a result of the Transformation will include:

- avoidance of intermediate materials and the energy associated with processing them multiple times
- enclosure of the smelting process, retaining and concentrating heat
- recovery of heat energy and electricity cogeneration
- a reduction in greenhouse gas emissions per tonne of production.

15.3.3 Electricity

The Transformation will increase electricity demand by 20 MW per year. This demand will be supplemented by installing a heat recovery and electricity cogeneration facility. The cogeneration facility will have a net operating electricity output of between 4.8 and 8.1 MW dependent on the designed configuration.

The energy entrained in the waste heat produced by the oxidation smelting process is currently lost to atmosphere. The EBS oxidation furnace will generate off-gas of a higher temperature than the sinter process, making it economically feasible to capture the heat and convert it to electricity.

15.4 Climate change mitigation

Nyrstar Port Pirie seeks to contribute to South Australia's climate change mitigation measures by minimising the emissions intensity of its operations.

During construction of the Transformation, emissions of greenhouse gas will be generated by combustion of fossil fuels by fixed or mobile equipment, including vehicles. Greenhouse gas emissions from the construction phase will be insignificant when compared with historical and post-Transformation greenhouse gas emissions of the smelting operation. Construction emissions are minimal, and would not differentiate the Transformation from current operations.

Operation of the upgraded process facilities will generate greenhouse gas emissions by operation of mobile equipment, and through combustion of coke, coal and natural gas in the smelting process. The EBS oxidation furnace will operate at a higher temperature than the sinter process, but will have efficiency benefits due to being enclosed, enabling the efficient capture of sulphur dioxide and heat, and generating high enough heat to enable cogeneration.

Post-Transformation operational greenhouse gas emissions were estimated in accordance with the *National Greenhouse and Energy Reporting Act 2007* (NGER Act 2007) and associated guidelines. Annual greenhouse gas emissions will be approximately 500 kt of carbon dioxide equivalent emissions (ktCO_2-e). This is an increase in carbon footprint from approximately 350 kt (assuming the facility is operating at capacity).

Assuming an operational life of 30 years for Nyrstar Port Pirie, the greenhouse gas emissions for the lifetime of the facility would be approximately 15 Mt CO_2-e. This is a theoretical estimation, as in practice many parameters will change over those 30 years of life.

Carbon intensity is a measure of carbon emissions per unit of production. The current facility would generate approximately 350 ktCO_2-e emissions to produce 365 kt of product, giving a carbon intensity of approximately 0.96 tCO_2-e/tonne of product.

While the carbon emissions will be higher following the Transformation, more product will be made. The higher carbon emissions of 500 ktCO_2-e will be generated in the manufacture of almost 600 kt of product, including lead, zinc, copper, sulphuric acid, silver and gold. Therefore the carbon intensity of Nyrstar Port Pirie following the Transformation will be approximately 0.84 tCO_2-e/tonne of product, 0.12 tCO_2-e/tonne of product lower than the carbon intensity of current operations.

The significant change in production volumes is primarily due to higher volumes of sulphuric acid manufacture. This is enabled by the capture of over three times as much sulphur dioxide from the EBS oxidation furnace as was possible from the sinter plant, and the ability of the modern acid production facility to convert more of the captured sulphur dioxide into acid than the current facility can achieve.

The Transformation will deliver significant reductions in sulphur dioxide emissions, and major improvements in the air quality of Port Pirie, as well as reducing carbon intensity.

15.5 Climate change adaptation

Nyrstar Port Pirie has considered climate change adaptation in designs for the Transformation. Like Port Pirie, the smelter is on low lying land adjacent to the Port Pirie River. The elevation of the smelter varies from 2 m above Australian Height Datum (AHD) to 14 m AHD.

Due to these low elevations, flooding by coastal inundation is an issue for the Port Pirie Regional Council (PPRC) and Nyrstar. Inundation of some operational, although non-plant, areas of the smelter has occurred in the past during king tides, especially when accompanied with storm surges and/or high river flows. King tides have been observed to reach in excess of 1.7 m AHD (BlueSphere 2012).

The Inter-governmental Panel on Climate Change (IPCC) has modelled global climate and climate influences and produced scenarios of accelerated sea level rise. Based on this work, South Australia's Coastal Protection Board recommends that a mid-range sea level rise of 0.3 m by 2050 be assumed for South Australia. Additionally, the IPCC has emphasised increased magnitude and frequency of extreme events, such as storm surges, as part of the likely climate change scenarios (Coastal Protection Board 2004).

DEWNR has recommended that, to meet the requirements of the Coastal Protection Board's minimum site levels and floor levels for coastal developments, the site be raised by a further 0.7 m or be practically protected against a further 0.7 m of sea level rise (T. Huppatz, 2013, pers. comm., 14 June 2013). Where raising a site is impractical, such as at Nyrstar Port Pirie, DEWNR may accept an alternative management option. A levee bank is an alternative and acceptable option to protect from sea level rise and wave effects (T. Huppatz, 2013, pers. comm., 14 June 2013).

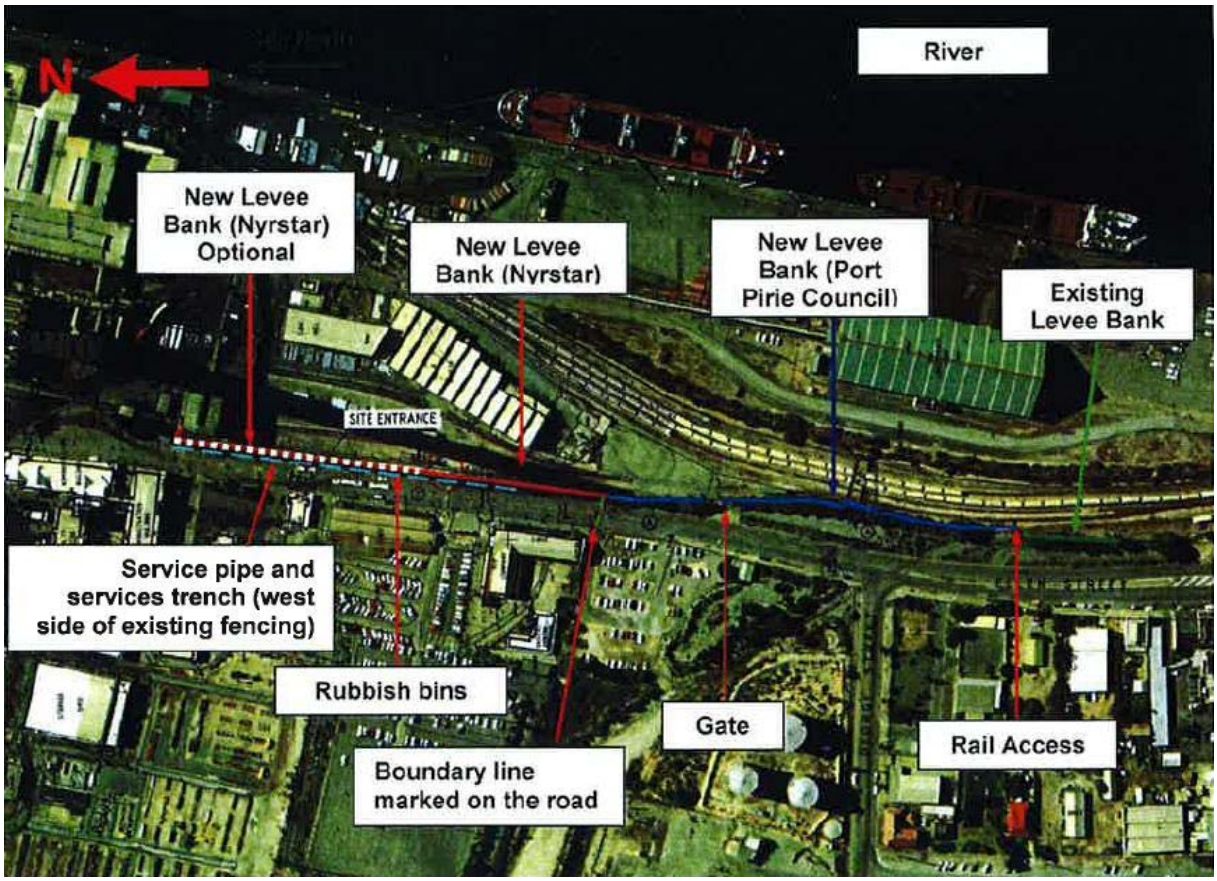


Figure 15-2: Location of levee bank

PPRC have constructed a levee bank to protect various areas of the city, including the CBD, from coastal inundation. Nyrstar is currently investigating the best options for extension of the PPRC levee into the smelter's boundaries as part of the Site Levee Bank project. The options under consideration will protect the smelter from inundation, the CBD against floodwaters flowing through the smelter and the possibility of contaminated liquors entering the Port Pirie River as floodwaters ebb. The location of the proposed levee bank is shown in **Figure 15-2**. Nyrstar will continue to work with the PPRC to address this issue.

Climate change adaptation is an ongoing issue that is being addressed by the Site Levee Bank project, separate from the Transformation.

15.6 Water usage

The current operation consumes approximately 5,164 m^3 per day of potable water. The Transformation is expected to achieve a reduction in potable water requirements of up to 1,300 m^3/day dependent on final configuration.

In addition to potable water, five water systems are associated with the upgraded facility as follows:

- sea water for the cooling system
- process water
- Process Effluent Treatment System (PETS) water
- demineralised water

- sewage treatment system.

These systems form the major components of a complex system of water use and recycling at Nyrstar Port Pirie. The cooling water system is a single pass system and the sewage is treated and redeployed for irrigation. The process water, PETS water and demineralised water are recirculated and recycled through the various process facilities, wastes from one system providing inputs to another. This process of recirculation, recycling and feeding between the various systems reduces potable water consumption and treated process wastewater discharge.

At present rainwater harvesting is not included as part of the scope of the Transformation, although other initiatives for rainwater and stormwater harvesting are being investigated.

16 Hazard and risk management

16.1 Introduction

This chapter summarises Nyrstar's existing risk management framework and discusses the framework's relevance and application to the Transformation. Specific risks during construction and operation are highlighted along with their proposed risk mitigation measures.

16.2 Established risk management

Nyrstar has an established risk management framework aligned with AS/NZS ISO 31000:2009 — as would be expected of an internationally listed company. It has embedded systems of management, governance, standards and guidelines integral to the identification, assessment and continued management of risk.

> Management is responsible for evaluating existing controls and the control effectiveness and determines whether the level of risk being accepted is consistent with the level of risk approved by the board of directors.
>
> Management takes action where it is determined that the Company is being exposed to unacceptable levels of risk and actively encourages all Nyrstar employees to communicate freely risks and opportunities identified.
>
> - Nyrstar Annual Report 2012

The Transformation is, in itself, an outcome of sound risk management principles. Its design and implementation aims to reduce the long term risk exposure to the local community, whilst delivering beneficial economic and social outcomes for the local population.

16.3 Risk evaluation

To identify, assess and manage the risks associated with the project, a risk assessment was necessary, with outcomes documented in a risk profile. The risk assessment (**Appendix G**) consisted of a series of semi-quantitative risk workshops facilitated by a risk management consultant from COOE Pty Ltd. The risk workshop panel included environmental specialists external to Nyrstar and with knowledge of the Transformation and Port Pirie area, as well as project managers from Nyrstar. The use of a single risk consultant enabled consistency across the workshops and in the compilation of the risk profile.

To aid in the identification of potential significant risks, the approach to the workshop was aligned with the risk management process ISO 31000:2009 (**Figure 16-1**), as follows:

- Establish the Context
  - identified the scope of the profile and the activities involved with the project
- Risk Identification
  - identified potential events, during each activity, with the ability to impact the environment
- Risk Analysis and Risk Evaluation

  - assessed the *most likely* consequences of each potential event and the likelihood of the event occurring
  - potential synergistic effects are considered for multiple risk events, where the combined risk of two or more independent events may be more than the sum of the individual risks
- Risk Treatment
  - where the inherent level of risk for an event was assessed as intolerable, identified appropriate control measures until the residual risk was reduced to a level that was acceptable
- Monitoring and Review
  - identified appropriate tracking mechanisms to monitor implementation of agreed controls.

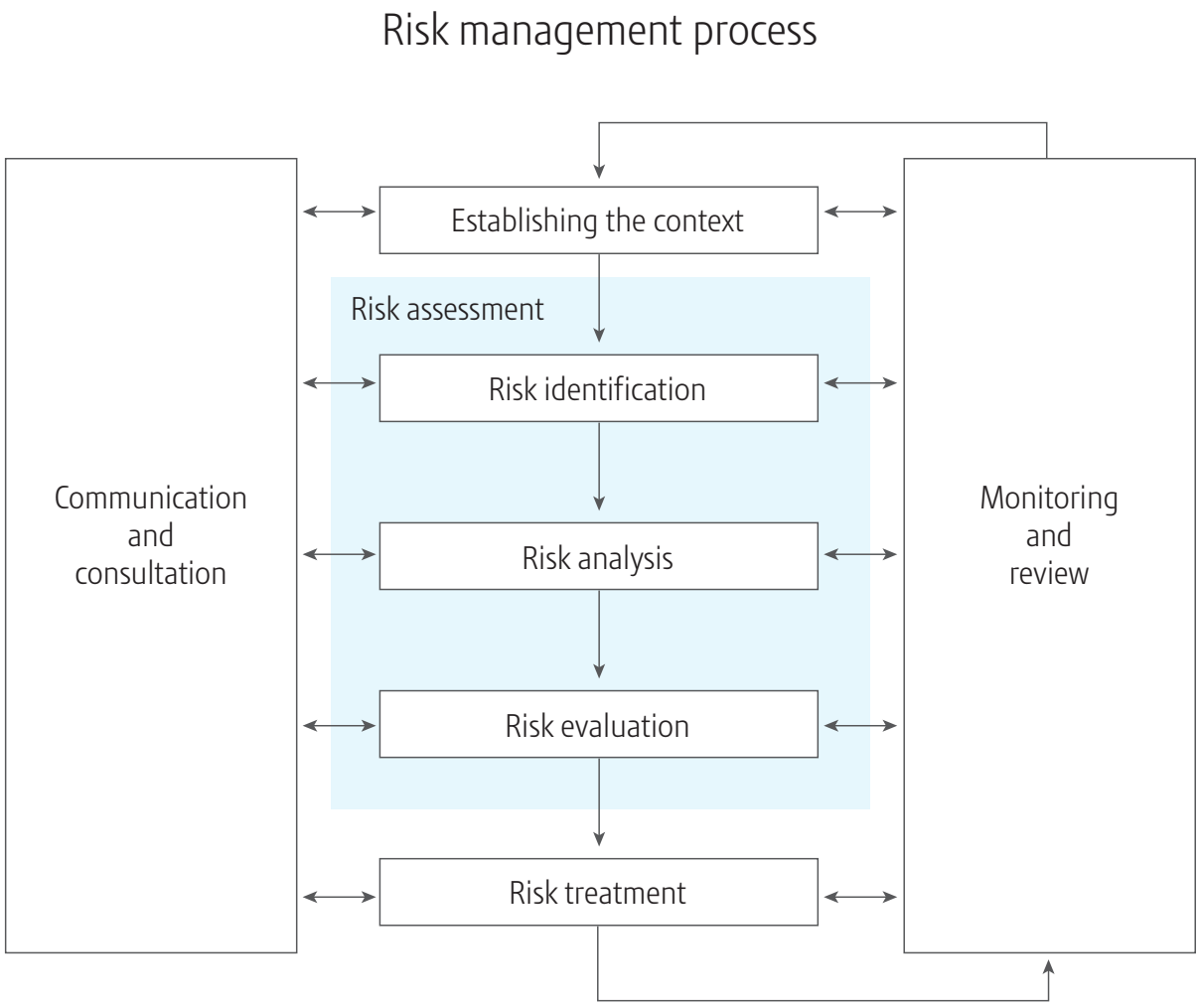


Figure 16-1: Risk management process (AS/NZS ISO 31000:2009)

Those activities which were identified as having the potential to impact the environment or local community were included in the risk profile. Due to the scope and intent of this Public Environmental Report, where operational risks and occupational health and safety risks were

identified, yet had no impact on the environment or community, these were excluded from this risk profile but noted for inclusion on separate risk profiles. This approach was deemed appropriate since both risk types have risk management systems already established within the business (**Section 16.2**).

The reference tables used for the risk assessment (**Table 16–1** and **Table 16–2**) were taken from the corporate risk assessment criteria currently in use within Nyrstar. Utilising these existing tables in the workshop provided the benefit of increased ease at transferring assessed risks into existing project risk profiles as well as the high degree of familiarity that many of the workshop participants had with the tables from previous use.

Consequence levels were chosen on the basis of the expected (most likely) impact on the environment. Emphasis was placed on the Environment and Community consequence criteria due to the nature of risk profile. Although consideration was given to the other criteria classifications, they did not drive the overall consequence level since it was deemed that these were more operational concerns and would not have aided in informing the community.

Some activities or events were considered where the activity would not proceed unless the fundamental design of the associated infrastructure was inherently safe. Where inherently safe designs were required as a consideration or assumption, these were noted in the *risk identification* section of the risk profile.

Table 16–1: Risk consequence

Level	Financial (EBITDA)	Growth (NPV)	People	Environment and community	Reputation	Legal
6	>€100m loss or gain	>€500m loss or gain	Multiple fatalities or significant irreversible effects on 10's of people	Regional and long term impact on an area of significant environmental value. Destruction of an important population of plants and animals with recognised conservation value. Complete remediation impossible. Complete loss of trust by affected community threatening the continued viability of the business	Prominent International media coverage. Long term impact on share price. Leads to changes at NMC or Board level.	Public inquiry taking up considerable resources and Executive management time. Major litigation or prosecution with damages/fines of >€50m+ plus significant costs. Custodial sentence for a manager. Suspension of shares by the FSMA.
5	>€10m, <€100m loss or gain	>€50m - <€500m loss or gain	Single fatality and/or severe irreversible disability to one or more persons	Destruction of an important population of plants or animals or of an area of significant environmental value. Complete remediation not practical or possible. Long-term community unrest and outrage significantly impacting business performance	National media coverage over several days. Shareholders and Board exercise control. Potential for class action. Major customers cancel key contracts.	Major litigation or prosecution with damages or fines of <€50m+ plus significant costs. Imposition of a fine by the FSMA. Major breach of regulation leading to cancellation of operating license.

4	>€1m, <€10m loss or gain	>€5m, <€50m loss or gain	Extensive injuries/illnesses or irreversible disability or impairment to one or more persons	Extensive and medium-term impact to an area, plants or animals of recognised environmental value. Remediation possible but may be difficult or expensive. Community protest requiring intervention and substantial management attention	State media coverage over several days. Publicly disclosed involvement by regulator(s).	Litigation or prosecution costing <€5m or involving substantial management time (Manager level and above). Publishing of a warning by the FSMA. Breach of regulation leading to suspension of operating license.
3	>€100k, <€1m loss or gain	>€500k, <€5m loss or gain	Medium term reversible disability to one or more persons. Significant medical treatment, disabling or lost time injury	Localised and medium term impact to areas, plants or animals of significant environmental value. Remediation may be difficult or expensive. Persistent community complaints	State media coverage. Interest by regulator(s) and NGOs.	Major breach of regulation with punitive fine. Involvement of senior management
2	>€10k, <€100k loss or gain	>€50k, <€500k loss or gain	Recordable injuries or illnesses with up to one week of job restrictions or lost time	Localised and short term impact to an area, plants or animals of environmental value. Minor remediation is required. Complaints from interested parties	Local media coverage interest by local NGOs. One or two community complaints.	Breach of regulation with investigation or report to authority with possible prosecution and fine
1	<€10k loss or gain	<€50k loss or gain	Minor injury or illness, first aid or medical treatment without job restrictions	Localised and short term environmental or community impact requiring no or very minor remediation	Kept on site. No media or community interest	Minor legal issues, non-compliances and breaches of regulation.

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Likelihood refers to the probability of frequency of an event occurring. The likelihood category was selected on the basis of the chance that the environment could be affected at the chosen level of consequence.

Table 16–2: Risk Likelihood

Level	Criteria
F	Is expected to occur in most circumstances, or could occur within days to weeks
E	Could occur in most circumstances, or could occur within weeks to months
D	Has occurred before in Nyrstar, or could occur within months to years
C	Has occurred before in the industry, or could occur within the next few years
B	Has occurred elsewhere, or could occur within decades
A	Requires exceptional circumstances and is unlikely, even in the long term or only occurs as a "100 year event"

A matrix combining consequence and likelihood levels is used to establish the overall risk level. The Risk Matrix (**Table 16–3**) shows risk levels from low to very high and determines the level of response required to adequately manage the risk.

Table 16–3: Risk matrix

Likelihood Rating							
	F	Medium	Medium	High	Very High	Very High	Very High
	E	Low	Medium	High	High	Very High	Very High
	D	Low	Medium	Medium	High	Very High	Very High
	C	Low	Low	Medium	High	High	Very High
	B	Low	Low	Medium	Medium	High	Very High
	A	Low	Low	Low	Medium	High	High
		1	**2**	**3**	**4**	**5**	**6**
		Consequences					

In total, 64 unique and inherent risks were identified during the workshop. These risks were identified as having a potential impact to the environment if not mitigated. Of these 64 inherent risks, 13 risks were identified as having an unacceptable (high) potential risk to the

environment, and 27 risks were identified as acceptable (medium) but would require ongoing monitoring.

Importantly, of all 64 unique risks identified, all were assessed and managed to an acceptable residual/mitigated risk level where a status of ALARP (as low as reasonably practicable) was achieved. This was achieved via design criteria, management plans or existing monitoring procedures and protocol.

Risks mitigated through the implementation of controls will have an associated tracking mechanism to monitor effectiveness of implemented controls.

16.4 Construction

The construction phase presents risks for Nyrstar as the Transformation transitions the plant from its current state to an up-to-date, safer, and more efficient mode of operation.

The risk profile highlights many of the legacy issues that the plant faces from its many decades of operation. These issues are well known by Nyrstar, the local community and external agencies. Nyrstar's partnerships with environmental specialists and the ever increasing availability of technology and techniques in construction, will allow Nyrstar to manage risks to an acceptable level.

Environmental impacts on air, soil and water quality will be tracked using the existing environmental monitoring program already in place in the plant and in the surrounding area.

Several risks were identified for the construction phase that may impact upon acid sulphate soils and groundwater in the area. Mitigation and control measures are being designed with environmental consultants. The existing environmental monitoring program will be leveraged to monitor and track the efficacy of implemented control measures and achievement of expected outcomes.

Though no unique hazardous materials or dangerous substances were identified during the risk assessment, storage arrangements for existing materials and any new materials will be managed according to existing Nyrstar procedures and guidelines for hazardous materials.

The smelter is an industrial site closed to the general public. Nyrstar have safety systems in place to facilitate the safe management and control of personnel onto the smelter, their safety and site inductions and, where required, escort. Safety of all personnel on-site will continue to be managed under Nyrstar's existing Occupation Health and Safety Management system.

16.5 Operation

The PER outlines the reduced risks to the community from operating the new facility. However, **Appendix G** highlights several risks inherent in the operation of the new facility that will require ongoing management.

Where these can be mitigated through better engineering they have been recorded and are to form the basis of further discussion at the design phase. Other risks are inherent to the design of the facility and require further mitigation. Where a control measure is required to

mitigate the risk to an acceptable level, a corresponding tracking mechanism has been identified to monitor the ongoing implementation of that particular control measure.

The prevention, management and mitigation of spills or leaks will remain an ongoing activity for Nyrstar. Current practices to prevent environmental contamination will be augmented by the Transformation outcomes, which currently include improvements to bunding, water collection and re-use pits. The expectation remains that there is no further significant contamination to the environment and the existing environmental monitoring program will be used to track and monitor the achievement of these outcomes.

16.6 Seismic risks

The preliminary design analysis that Nyrstar has undertaken for each of the major structures for the Transformation have considered all principal loading conditions (including earthquake loading) and the required load combinations in accordance with the relevant Australian codes.

16.7 Proposed risk management

Risk management is an ongoing process and as the project progresses and information becomes available, or changes, the relevant risk profiles will be managed through Nyrstar's existing risk management framework.

The controls required to mitigate all risks to a level acceptable for stakeholders were discussed, agreed and recorded in the risk profile. Alongside each risk, the environmental outcomes expected during the Transformation were recorded, along with the tracking mechanisms necessary to monitor these commitments.

These expected environmental outcomes, controls and mechanisms for tracking will be used to inform the strategies, which will be documented in the Environmental Management Plan. To enable ongoing management of the risks and implementation at the project level, the risks identified in the annex will be transferred to the relevant project risk register for the relevant project phase.

16.8 Proponent's commitment

Nyrstar is committed to the operation of the smelter with minimal risks to the surrounding environment. The Transformation offers very significant improvement to the smelter's environmental performance including the halving of lead-based emissions and a ten-fold reduction of SO_2 emissions from the tall stack. There are also a number of other environmental performance improvements outlined in this PER.

This hazard and risk identification process has identified a number of control measures to enable mitigation of risks to an acceptable level. The implementation of these control measures is achievable and practical, and where the residual risk levels are medium, there will be ongoing environmental performance monitoring and implementation of trigger mechanisms should they be required.

17 Waste management

17.1 Introduction

This chapter describes the waste management and recycling practices and procedures currently operating at the smelter. It then outlines the waste management strategies for the construction and operational phases of the project and discusses how the waste hierarchy principals will be incorporated.

17.2 Existing waste management

As described in **Chapter 3,** the smelter is licenced by the EPA for a variety of waste management and recycling activities (EPA licence 775). Nyrstar's existing procedure — *Nyrstar Port Pirie Procedure: Recycling and Waste Management* — describes how site-generated waste material is appropriately recycled or disposed of, to comply with company standards and the EPA licence. The procedure applies to the collection, recycling and disposal of waste across the smelter and refers to other Nyrstar procedures including:

- landfill management
- asbestos and synthetic mineral fibres
- asbestos removal and disposal permit
- waste transport certificates
- waste oil and grease disposal
- office paper recycling
- scrap metal recycling.

Nyrstar manages on-site waste according to a waste management hierarchy that prescribes a preferred order of waste management practices. The order, from most to least preferred, is: avoid, reduce, reuse, recycle, recover, treat and dispose. Nyrstar have a significant number of waste streams and many of these are reused or recycled on-site.

17.2.1 Landfill management

The smelter contains a licenced landfill occupying approximately 17,000 m^2 which accepts solid industrial waste generated by the smelter as well as minor amounts of putrescible food wastes that are collected from crib rooms and a separate dedicated and licenced cell accepts waste asbestos.

A survey of the landfill was conducted in November 2009 to develop a proposed final contour plan and determine the airspace remaining. The landfill's available airspace was calculated to be 34,000 m^3 and so has an expected life in excess of 10 years based on current filling rates. The current waste disposal rate is approximately 1,000 tonnes per annum.

17.3 Construction wastes

Due to the proposed construction methodology of prefabricated modules, construction waste will be minimised. Construction wastes will mainly arise from decommissioning, demolition and civil works associated with the preparation of the smelter for module installation, and from construction of the additional sea water intake.

17.3.1 Modular construction

The majority of the equipment associated with the upgrade will be fabricated in modules, and fitted out at the manufacturers' premises. The modules will be delivered in the sequence that they are required.

The modules will be shipped to the smelter via the Port Pirie wharf facility, off loaded and transported into their final location (via the temporary laydown yard when required). The modules will be levelled, grouted in position and interconnecting piping, cables and instrumentation will be installed.

The prefabrication of modules significantly reduces construction waste and impact on the environment, aligning this construction methodology with sustainability principals. Prefabrication has been shown to reduce construction waste by over 50% (Jaillon *et al.* 2009).

17.3.2 Demolition

Some existing structures and/or equipment will become redundant and be decommissioned during the Transformation. Demolition of some structures will entail the removal of the structure while leaving the foundations, while others will also require removal of the foundations. Some redundant buildings will be left standing to be reused for an alternative purpose or removed at a later date.

Demolished materials will be salvaged for reuse or recycling where possible. They will be separated into waste streams and stockpiled on-site. Materials that cannot be reused or recycled will be disposed of at the smelter's landfill.

Steel and concrete from decommissioning and demolition will form the bulk of the waste generated during the construction phase. An estimate of the volume of these wastes is provided in **Table 17–1,** along with the amount of asbestos proposed to be removed.

Table 17–1: Major construction wastes

Waste	Amount
Steel	582 Tonnes
Concrete	1980 m^3
Asbestos	1500 m^2

17.3.3 Earthworks

Excavations will be required for various purposes, including for cabling, pipe work and footings. Excavations will generate waste spoil which will be stockpiled at the smelter. A range of management options may be employed to deal with waste spoil including decontamination (if required), processing through the smelter to recover metals or use as fill elsewhere on-site. Earthworks will be undertaken in consultation with the voluntarily appointed SA EPA accredited Contamination Auditor.

17.3.4 Contaminated wastes

Wastes from the decommissioning, demolition and earthworks associated with the construction phase may be contaminated. The bulk of these wastes including steel, concrete, and spoil can be decontaminated, reused or recycled on-site. Metals can be recovered from some materials, such as spoil, by processing through the smelter.

17.3.5 Summary

A summary of the wastes likely to be generated, their sources and planned management measures is presented in **Table 17–2**.

Table 17–2: Construction waste summary

Waste	Sources	Management
Steel	Demolished equipment and buildings	Recycle
Concrete	Demolished footings, over pour	Recycle
Spoil	Excavations for footings, pipes and cabling, and road upgrades	Decontaminate (process to recover metals)
Wood	Buildings, formwork	Chipping and mulch for revegetation on-site
Asbestos	Demolished equipment and buildings	In accordance with the smelter Asbestos Management Procedure[1]
Cardboard	Packaging	Recycle
Plastics	Packaging	Recycle, disposal
Cabling	Infrastructure	Recycle, disposal
General mixed waste	Construction, cribs, abolition areas	Recycle, disposal
Oil and grease (including filters)	Vehicle and equipment maintenance	Recycle, disposal

[1]Nyrstar is licenced to remove and dispose of Asbestos at the smelter.

In accordance with the smelter's EPA Licence (775), there is a landfill on-site, part of which is licenced to receive asbestos. Materials that are unable to be reused or recycled will be deposited in the smelter's landfill in accordance with Nyrstar's Landfill Management Procedure.

17.4 Operational wastes

The major operational waste stream from Nyrstar Port Pirie is spent slag, which is on-sold. There will be no additional operational wastes associated with the Transformation.

The Transformation is focused on the upgrade of the primary lead smelting process. Outputs from the transformed process will provide feed for the refinery, and copper and zinc production processes.

Process water from the new facilities will be transferred to the existing Process Effluent Treatment System (PETS), which removes contaminants including metals. Treated water is returned to the process water system for reuse, or discharges via the sedimentation ponds and the licenced discharge from smelter.

The Transformation includes the construction and operation of an additional sea water cooling system. This system will be a single pass non-contact heat exchanger and includes a trim cooler to adjust the sea water return temperature. The potential impact of heat emissions on the marine environment and controls are discussed in **Chapter 12**.
General maintenance wastes, such as grease, oil and packaging, will continue to be generated and managed in accordance with existing smelter waste management protocols.

18 Environmental management

18.1 Introduction

Nyrstar Port Pirie operates an Environmental Management System (EMS) certified to Australian Standards (AS/NZS ISO 14001, 2004). Transformation activities, from construction to the operational phase, will be managed through the development and implementation of Environmental Management Plans (EMP) aligning with the existing management systems.

A separate construction environmental management plan (CEMP) and an operations environmental management plan (OEMP) will be developed prior to commencement of the relevant phase. These will incorporate specific control measures designed to suit the plant and equipment selected in the final design. Both the CEMP and OEMP will address comments from the public review and approvals process.

The CEMP and OEMP will describe the controls proposed to prevent, monitor and manage potential impacts and will be incorporated with the existing Environmental Monitoring and Reporting Program (EMRP). The CEMP, OEMP and modified EMRP will be integrated into the Nyrstar EMS and submitted to relevant authorities for approval prior to the commencement of each phase.

A draft construction environmental management plan (draft CEMP) and a draft operations environmental management plan (draft OEMP), have been developed to provide a basis for the public review and approvals process. These are provided in **Appendix J** and **Appendix K** and summarised in the following sections.

18.2 Draft construction environmental management plan

The draft CEMP outlines the responsibilities of the Nyrstar Project Manager in protecting the community and environment during the construction phase (including decommissioning, demolition and construction activities). The draft CEMP provides a framework for the implementation of appropriate control measures and practices to achieve risk levels that are as low as reasonably practicable (ALARP).

The aim of the draft CEMP is to provide a framework of proposed environmental management and monitoring during construction activities of the Transformation, as identified from the Risk Assessment (**Chapter 16**). The draft CEMP will feed into the final CEMP to implement the strategies and control measures identified during the PER Risk Assessment.

The draft CEMP addresses the following:

- background and smelter summary information
- roles and responsibilities of parties involved
- regulatory, licensing and legislative requirements
- identification of potential environmental and social aspects
- identification of quality control measures to manage impacts and achieve risk levels ALARP for each aspect.

Health and safety requirements for employees and organisational risks will be addressed by updating the current operational Nyrstar Management System information.

18.2.1 Responsibilities for implementing the draft CEMP

The following responsibilities have been assigned:

Nyrstar Project Manager

- Overview the implementation of the draft CEMP and the development and implementation of the CEMP.
- Allocate sufficient funds and resources to fully implement every component of the CEMP.

Contractors

- Contribute to the development of the CEMP to ensure that every environmental aspect covered in the draft CEMP is fully incorporated.
- The contractor is responsible for any environmental or social impacts attributed to any work, plant and equipment that fall within the boundaries of their contract.
- Ensure Nyrstar's intent to significantly reduce the current environmental and social impacts during and after construction.

Consultants

- Contribute to the development of the CEMP to ensure that every environmental aspect covered in the draft CEMP is fully incorporated.
- The consultant is responsible for any environmental or social impacts that may be attributable to specialist advice that they provide.
- Ensure Nyrstar's intent to significantly reduce the current environmental and social impacts during and after construction.

Supervisors

- All supervisors are responsible for implementing the control measures and, directly or through specially trained environmental specialists, monitor that the management systems are working as intended.

Employees

- All persons working on the construction of the Transformation are responsible for understanding the environmental and social management systems.
- All persons working on the construction phase will fully understand and implement the control measures and follow the procedures associated with their work.

18.2.2 Management objectives during the construction phase

The Risk Assessment (**Chapter 16**) identified 11 environmental and social aspects that are potentially at risk and in need of continual control measures. The draft CEMP specifies activities and procedures or strategies that will be employed to achieve the objectives identified for each aspect as summarised below.

- Air Quality

    - Air quality is maintained within current levels by prevention of lead emissions from any additional sources during the construction phase.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
    - To receive no complaints from adjoining commercial/industrial neighbours or smelter personnel.
- By-products and waste
    - To prevent any spills or leakage.
    - To minimise impacts on existing waste facilities.
    - To minimise environmental impacts associated with waste generation and accidental spills.
    - To maximise waste minimisation, recycling, reuse and recovery.
- Community health
    - To reduce lead, sulphur dioxide and particulate emissions to below current levels.
    - To be in compliance with the relevant State regulatory instruments, namely *Environment Protection (Air Quality) Policy 1994*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
    - Community amenity
    - To receive no community amenity complaints.
- Noise
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Noise) Policy 2007*.
    - To receive no noise complaints from the community.
- Natural resources
    - Achieve no adverse impacts on flora and fauna from the Transformation.
    - To be in compliance with the relevant State regulations.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Sub-surface soil quality
    - To achieve no adverse impacts to soil from the Transformation.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
    - Water quality
    - To achieve no contamination of surface water from the Transformation.
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Water Quality) Policy 2003*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Groundwater
    - To achieve no contamination of groundwater from the Transformation.
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Water Quality) Policy 2003*.

    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Vibration
    - To receive no receive no complaints relating to vibration from the community.
    - Visual amenity
    - To receive no visual amenity complaints from the community.

18.3 Draft operations environmental management plan

The draft OEMP outlines the responsibilities of the Nyrstar Project Manager in protecting the community and environment during the Operational Phase (commissioning, operations and maintenance). The draft OEMP provides a framework for the implementation of appropriate control measures and practices to achieve risk levels that are as low as reasonably practicable (ALARP).

The aim of the draft OEMP is to provide a framework of environmental management and monitoring proposed for the Transformation post-construction, as identified from the Risk Assessment (**Chapter 16**). The draft OEMP is intended to be a precursor for the OEMP, which is designed to provide strategies and control measures identified during the PER Risk Assessment to protect the community and environment.

The draft OEMP addresses the following:

- background and smelter summary information
- roles and responsibilities of parties involved
- regulatory, licensing and legislative requirements
- identification of potential environmental and social aspects
- identification of quality control measures to manage impacts and achieve risk levels ALARP for each aspect.

Health and safety requirements for employees and organisational risks will be addressed by upgrading the current operational Nyrstar Management System.

18.3.1 Responsibilities for implementing the draft OEMP

The following responsibilities have been assigned:

Project Manager

- Overview the implementation of the draft OEMP and the development and implementation of the OEMP.
- Allocate sufficient funds and resources to fully implement every component of the OEMP.

Contractor

- Contribute to the development of the OEMP to ensure that every environmental aspect covered in the draft OEMP is fully incorporated.
- The contractor is responsible for any environmental or social impacts attributed to any work, facility and equipment that fall within their contract.

- Ensure Nyrstar's intent to significantly reduce the current environmental and social impacts.

Consultant

- Contribute to the development of the OEMP to ensure that every environmental aspect covered in the draft OEMP is fully incorporated.
- The consultant is responsible for any environmental or social impacts that may be attributable to specialist advice that they provide.
- Ensure Nyrstar's intent to significantly reduce the current environmental and social impacts.

Supervisors

- All supervisors are responsible for implementing the control measures and directly or through specially trained environmental specialist monitor that the management systems are working as intended.

Employees

- All employees are responsible for understanding the environmental and social management systems.
- All employees will fully understand and implement the control measures and follow the procedures associated with their work.

18.3.2 Management objectives during the operational phase

The Risk Assessment (**Chapter 16**) identified a number of environmental and social aspects that are potentially at risk. The draft OEMP specifies activities and procedures or strategies that will be employed to achieve the objectives identified for each aspect, as summarised below.

- Air Quality
    - To reduce lead, sulphur dioxide and particulate emissions to below the current levels and to be in compliance with the relevant State regulatory instruments, namely *Environment Protection (Air Quality) Policy 1994*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
    - To receive no complaints from adjoining commercial/industrial neighbours or smelter personnel.
- By-product and waste generation
    - To prevent any spills or leakage.
    - To minimise impacts on existing waste facilities.
    - To minimise environmental impacts associated with waste generation and accidental spills.
    - To maximise waste minimisation, recycling, reuse and recovery.
- Community health
    - To reduce lead, sulphur dioxide and particulate emissions to below current levels.

    - To be in compliance with the relevant State regulatory instruments, namely *Environment Protection (Air Quality) Policy 1994*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Community amenity
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Air Quality) Policy 1994* and *Environment Protection (Noise) Policy 2007*.
    - To receive no noise, odour or visual amenity complaints from the community.
    - To not adversely affect Port Pirie skyline, beyond that outlined in the Port Pirie (Regional Council) Development Plan (DPTI, 2013).
- Noise
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Noise) Policy 2007*.
    - No receive no noise complaints from the community.
    - Natural resources
    - No achieve no adverse impacts on flora and fauna from the Transformation.
    - To be in compliance with the relevant State regulations.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Odour
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Air Quality) Policy 1994*.
    - To receive no complaints of odour from the community.
    - Sub-surface soil quality
    - To achieve no adverse impacts on soil from the Transformation.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Surface water quality
    - To achieve no contamination of surface water from the Transformation.
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Water Quality) Policy 2003*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Groundwater
    - To achieve no contamination of groundwater from the Transformation.
    - To be in compliance with relevant State regulatory instruments, namely *Environment Protection (Water Quality) Policy 2003*.
    - To be in compliance with site-specific South Australian EPA Licence agreements.
- Visual amenity
    - To receive no visual amenity complaints from the community.
    - To not adversely affect Port Pirie skyline beyond that outlined in the Port Pirie (Regional Council) Development Plan (DPTI, 2013).

18.4 Draft environmental monitoring and reporting plan

The draft CEMP and draft OEMP, presented in **Appendix J** and **Appendix K**, provide details of the monitoring and reporting that will be undertaken by Nyrstar and its representatives to track the performance of the management measures put in place to protect the social and environmental impacts.

Once the designs are finalised and the facility and equipment are selected the monitoring and reporting components of the draft CEMP and draft OEMP will be refined and transferred to the Nyrstar EMRP.

18.5 Conclusions

The Transformation is expected to reduce the overall environmental and social impacts from Nyrstar Port Pirie. A comprehensive Environmental Risk Assessment was undertaken (**Chapter 16**), identifying control measures that would minimise the environmental footprint of Transformation activities.

The draft CEMP and draft OEMP have been developed as precursors to the CEMP, OEMP and upgraded EMRP to provide a basis for the public review and approvals process. The objectives for protecting the environment and community are summarised in **Sections 18.2** and **18.3** with more detail provided in **Appendix J** and **Appendix K**, the basis of updating the current EMRP to address activities related to the Transformation is presented in **Section 18.4**.

Nyrstar intent of reducing the impacts on the environment and community from the current smelter operations is clearly demonstrated by this project and proposed control to reduce the level of impact to as low as reasonably practicable.

19 References

Ainslie, RC, Johnson, DA & Offler, EW 1989, Monitoring Seagrass Communities in the Vicinity of a Cooling Water Discharge in the Upper Spencer Gulf, S.A. Unpublished, Electricity Trust of South Australia.

Ambrose, RF, Schmitt, RJ & Osenberg, CW 1996, 'Predicted and observed environmental impacts — can we foretell ecological change?', in RJ Schmitt and CW Osenberg (eds), *Detecting Ecological Impacts: Concepts and Applications in Coastal Habitats*, Academic Press Inc, CA, pp. 345–369.

Attorney-General's Department, Government of South Australia 2013, *South Australian Legislation*, South Australian Government, retrieved 5 June 2013, <http://www.legislation.sa.gov.au/LZ/C/A/Development%20Act%201993.aspx >.

Australian Bureau of Statistics 2009-10, *National Regional Profile: Port Pirie City and Districts*, Australia.

Australian Bureau of Statistics 2012, 'Census quick stats', retrieved June 2013, <http://www.censusdata.abs.gov.au/census_services/getproduct/census/2011/quickstat/0>.

Australian Bureau of Statistics 2013, *Port Pirie City and Districts regional profile* (cat no. 1379.0.55.001), Australia.

Australian Geological Survey Organisation 1998, *Australian Ports Environmental Data & Risk Analysis. Phase 1: Literature Review*, Petroleum and Marine Division, AGSO, Canberra.

Australian Quarantine and Inspection Service 2008, *Australian Ballast Water Management Requirements,* Department of Agriculture, Fisheries and Forestry, Canberra.

B, Mizon, K, Taylor, A, Korsch, M, Stauber, J, Davies, JM, Louie', H, Wu, M, Antin, L 2008, 'Longitudinal monitoring of selected elements in blood of healthy young children', *Journal of Trace Elements in Medicine and Biology*, vol. 22, pp. 206–214.

Baker, JL 2004, *Towards a System of Ecologically Representative Marine Protected Areas in South Australian Marine Bioregions - Technical Report*, Coast and Marine Conservation Branch, Department for Environment and Heritage, Adelaide.

Barnett, E 2001, *The Status of South Australia's Estuaries: A Proposal for a State Estuary Program*. Department for Environment and Heritage, South Australia.

Bascom, R, Bromberg, PA, Costa, DA, Devlin, R, Dockery, DW, Frampton, MW, Lambert, W, Samet, JM, Speizer, FE & Utell, M 1996, 'Health effects of outdoor air pollution', *Am. J. Resp. Crit. Care Med*, vol. 3, no.50, p. 153.

BHP Billiton 2009, *Olympic Dam Expansion Draft Environmental Impact Statement,* BHP Billiton, Adelaide.

Blue Sphere 2013, *Implications of Transformation for Soil, Surface Water and Groundwater Management*, Nyrstar Port Pirie Pty Ltd, Australia.

Blue Sphere Environmental 2012, *Site History Review, Nyrstar Port Pirie, Ellen Street Port Pirie, SA,* Nyrstar Port Pirie Pty Ltd, Australia.

Botelho, DA, Barry, ME, & Brook, JB 2013, 'Spencer Gulf and Climate Change', *Natural History of Spencer Gulf*, Royal Society of South Australia [In Press].

Brierley, AS & Kingsford, MJ 2009, 'Impacts of climate change on marine organisms and ecosystems', *Current Biology*, vol. 19, no. 14, pp. R602–R614.

Bryars, S 2003, *An Inventory of Important Coastal Fisheries Habitats in South Australia, Fisheries Habitat Program*, Department of Primary Industries and Resources of South Australia (PIRSA), Adelaide.

Bureau of Meteorology, Australian Government 2012, *Climate Statistics for Australian Locations:* PORT PIRIE NYRSTAR COMPARISON*,* Retrieved 5 June 2013, <http://www.bom.gov.au/climate/averages/tables/cw_021043.shtml>.

Bureau of Meteorology, Australian Government 2012, *Climate Statistics for Australian Locations:* WHYALLA AERO*,* Retrieved 5 June 2013, <http://www.bom.gov.au/climate/averages/tables/cw_018120.shtml>.

Cantrell, CA 2008, 'Review of methods for linear least-squares fitting of data and application to atmospheric chemistry problems', *Atmos. Chem. Phys,* vol. 8, pp. 5477–5487.

Carpenter, G & Langdon, P 2013, 'Waterbirds of Upper Spencer Gulf', *Natural History of Spencer Gulf*, Royal Society of South Australia [In Press].

Centres for Disease Control and Prevention 2005, *Preventing lead poisoning in young children,* Centres for Disease Control and Prevention, retrieved 30 May 2013, <http://www.cdc.gov/nceh/lead/publications/prevleadpoisoning.pdf>.

Centres for Disease Control and Prevention 2012, *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. Report of the Advisory Committee on Childhood Lead Poisoning Prevention,* Centres for Disease Control and Prevention, retrieved 30 May 2013, <http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf>.

Centres for Disease Control and Prevention 2012, *Update on Blood Lead Levels in Children*, Centres for Disease Control and Prevention, retrieved 30 May 2013, <www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm>.

Cheshire, AC, Collings, GJ, Edyvane, KS & Westphalen, G 2000, *Overview of the Conservation Status of Australian Marine Macroalgae*: *A Report to Environment Australia*, Department of Environmental Biology, University of Adelaide.

Coleman, P & Cook, F 2007, *Community Estuarine Monitoring Manual*, The Environment Protection Agency, Australia.

Commission, DA 2013, 'Guidelines for the preparation of a Public Environmental Report, Port Pirie Smelter Transformation (Mid North)', in Department of Planning, T. A. I. (ed), Nyrstar Port Pirie Pty Ltd, Australia.

Consulting Environmental Engineers Consultants 2008, *The Desalination Project Marine Biology*, CEE Consultants, Richmond, Victoria.

COOE Pty Ltd 2008, *Port Pirie Smelter - Summary of the 5 year marine monitoring program 2002 – 2007,* COOE Pty Ltd for Zinifex, Port Pirie.

Corbin, T & Wade, S 2004, *Heavy metal concentrations in razorfish (Pinna bicolor) and sediments across northern Spencer Gulf*, Environment Protection Authority, Adelaide.

CSIRO Land and Water 2013, 'Australian Soil Resource Information System', retrieved 20 June 2013, < http://www.asris.csiro.au/mapping/viewer.htm>.

De Guia, MB 1982, *Investigation of the effects of thermal effluents on mangrove stands at Torrens Island, South Australia*. M. Env. St. Thesis, University of Adelaide.

Deloitte Access Economics 2012, *Economic Modelling of Port Pirie*, Department for Manufacturing, Innovation, Trade, Resources and Energy, Australia.

Department for Manufacturing, Innovation, Trade, Resources and Energy 2012, *Socio economic Considerations in Port Pirie*, DMITRE, South Australia.

Department of Climate Change and Energy Efficiency 2011, *Climate change risk to coastal buildings and infrastructure,* Australian Government department of Climate Change and Energy Efficiency, Canberra, retrieved 21 June 2013, <http:www.climatechange.gov.au/publications/coastline/climate-change-risk-to-coastal.aspx>.

Department of Education, Employment and Workplace Relations, 'Labour Market Portal', retrieved June 2013, <http://deewr.gov.au/labour-market-information-portal-0>.

Department of Environment and Heritage 2005, *National standards for criteria air pollutants in Australia. Air quality fact sheet,* retrieved 27 June 2013, <http://www.environment.gov.au/atmosphere/airquality/publications/standards.html>.

Department of Environment, Water and Natural Resources 2012, *Upper Spencer Gulf Marine Park Management Plan Summary,* DEWNR, South Australia.

Department of Further Education, Employment, Science and Technology (DFEEST) 2012. 'Workforce Wizard', retrieved 29 May 2012, <http://www.skills.sa.gov.au/workforce-information/workforce-wizard>.

Department of Further Education, Employment, Science and Technology (DFEEST) 2010, *Workforce Planning and Policy, Regional Profile: Yorke and Mid North 2010*, Government of South Australia.

Department of Sustainability and Environment (DSE) 2008, 'Victorian Desalination Plant, Environmental Effects of Marine Structures', *DSE, Melbourne,* vol. 2, retrieved 4 April 2011, <http://www.water.vic.gov.au/programs/desalination/environment2/EES/ees-reportvolume2-marine>.

Department of Sustainability, Environment, Water, Population and Communities 2005, *National standards for criteria air pollutants 1 in Australia: Air quality fact sheet*, retrieved 30 May 2013, <http://www.environment.gov.au/atmosphere/airquality/publications/standards.html>.

Department of Sustainability, Environment, Water, Population and Communities 2013, *Environment Protection and Biodiversity Conservation Act*, retrieved 5 June 2013, <http://www.environment.gov.au/epbc/>

Department of the Environment and Heritage 2005, *Sulfur dioxide. Air quality fact sheet*, retrieved 27 June 2013, <http://www.environment.gov.au/atmosphere/airquality/publications/sulfurdioxide.html>.

Development Assessment Commission (DAC) South Australia 2013, *Guidelines for the Preparation of a Public Environmental Report for the Port Pirie Smelter Transformation Proposal (Mid North),* Nrystar Port Pirie Ltd, South Australia.

Dittmann, S & Baggalley, S 2013, 'Mangroves and Mudflats in Spencer Gulf', *Natural History of Spencer Gulf*, Royal Society of South Australia [In Press].

Electricity Trust of South Australia 1977, *Northern Power Station — Environmental Impact Statement, Parts 1 and 2,* Adelaide.

Emig, C & Roldan, C 1992, 'The occurrence in Australia of three species of Phoronida (Lophophorata) and their distribution in the Pacific area', *Records of the South Australian Museum*, vol. 26, no. 1, pp. 1–8.

Employment Health and Wellness Programme 2013*, Environment and Health Feasibility Study — Port Pirie Smelter Transformation*, Environment and Health Working Party, Nyrstar Port Pirie Tranformation Project, South Australia.

Environment Canada, 2013, *Sulphur Oxide Emissions,* retrieved 27 June 2013, <www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=402A9845-1>.

Environmental Protection Agency South Australia, 2012, *National Pollutant Inventory (NPI) Sulfur dioxide,* EPA, South Australia, retrieved 27 June 2013, <http://www.epa.sa.gov.au/environmental_info/air_quality/air_quality_in_south_australia/national_pollutant_inventory_npi/sulfur_dioxide>.

Environmental Resources of Australia 1973, *Hydrological survey, Northern Spencer Gulf*, Petrochemical Consortium of South Australia.

European Commission 2008, *Air Quality Standards, Directive 2008/50/EC*, European Parliament and the Council on ambient air quality and cleaner air for Europe, retrieved 21 May 2008 <http://ec.europa.eu/environment/air/quality/standards.htm>.

Ferguson, J 1983, 'Concentrations and speciation of lead, zinc and cadmium, in seawater-like smelter effluent and adjacent marine environments, Port Pirie, South Australia', *Australian Journal of Marine and Freshwater Research*, vol. 34, pp. 375–385.

Fotheringham, D & Coleman, P 2008, 'Salt marshes', *Natural History of Gulf St Vincent*, Royal Society of South Australia.

Gaylard, S 2013, 'Marine Pollution in Spencer Gulf', *Natural History of Spencer Gulf*, [In press].

Gaylard, S Thomas, S & Nelson M 2011, 'An assessment of the current status of bioavailable metal contamination across South Australia using translocated mussels Mytilus galloprovincalis',*Transactions of the Royal Society of South Australia*, vol. 135, no.1, pp. 39–54.

GHD 2009, *Report on SO_2 modelling for exposure assessment in Port Pirie. Stage 2 — Tall stack modelling*, GHD, Victoria.

Government of South Australia 2005, *Strategic Infrastructure Plan for South Australia: 2005/6–2014/15: Building South Australia*, Government of South Australia, South Australia.

Government of South Australia 2007,*Tackling Climate Change: South Australia's Greenhouse Strategy 2007–2020*, Government of South Australia, South Australia.

Government of South Australia 2011, *In a great state: South Australia's Strategic Plan,* Government of South Australia, South Australia.

Harris, B & O'Brien, B 1998, *Australia's Ports Environmental Data and Risk Analysis. Phase 1: Literature Review*, *Report to Australian Quarantine Inspection Service (AQIS) by Petroleum and Marine Division,* Australian Geological Survey Organisation, Canberra.

Hibberd, MF 2012, *Preliminary Analysis of meteorological and Lead Data from Port Pirie Monitoring Sites,* CSIRO, Australia.

Hobday, AJ, Okey, TA, Poloczanska, ES, Kunz, TJ & Richardson, AJ 2006, *Impacts of climate change on Australian marine life: Part A, Executive Summary*, Australian Greenhouse Office, Canberra.

Hodgson, BR 1979, *The Hydrology and Zooplankton Ecology of Lake Macquarie and Tuggerah lakes, New South Wales*, Unpublished PhD thesis, University of New South Wales.

Houde, ED & Bartsch, J 2009, 'Mortality', in North, EW, Gallego, A & Petitgas, P (eds), *Manual of recommended practices for modelling physical — biological interactions during fish early life*, ICES Cooperative Research Report no. 295, International Council for the Exploration of the Sea (ICES), Denmark.

Houde, ED 1989, 'Comparative growth, mortality, and energetics of marine fish larvae: temperature and implied latitudinal effects', *Fishery Bulletin US*, vol. 87, pp. 471–495.

Houde, ED 2002, 'Mortality', in Fuiman, LA & Werner, RG (eds), *Concepts, Fisheries Sciences: The Unique Contribution of Early Life Stages*, Chapter 3, Blackwell Scientific Publishing, Oxford.

Hutchings, PA, Ward, TJ, Waterhouse, JH & Walker, L 1993, 'Infauna of marine sediments and seagrass beds of Upper Spencer Gulf near Port Pirie, South Australia', *Transactions of the Royal Society of South Australia,* vol. 117, pp. 1–14.

Infrastructure, D. O. P. T. A. 2013, *Development Plan, Port Pirie (RC),* South Australia.

International Maritime Organisation (IMO) 2008, 'International Convention for the Control and Management of Ships' Ballast Water and Sediments', IMO, London, retrieved 22 June 2008, <http://www.imo.org/Conventions/mainframe.asp?topic_id=867>.

Jaillon, L, Poon, CS and Chiang, YH 2009, 'Quantifying the Waste Reduction Potential of Using Prefabrication in Building Construction in Hong Kong', *Waste Management*, vol. 29, no. 1, pp. 309–320.

Johnson, J 1976, *Observations on Subtidal Communities near Thomas Playford Power Station, Northern Spencer Gulf*, Aquatic Ecology Group, S. Aust. Dept. of Agriculture and Fisheries, Internal Report No. 10, Australia.

Johnson, J 1981, *Hydrological data for upper Spencer Gulf 1975–1978,* Fisheries Research Paper No. 3, South Australian Department of Fisheries.

Jones, GK 1979, 'Biological investigations on the marine scale fishery in Spencer Gulf', Unpublished report to South Australian Department of Agriculture and Fisheries, Adelaide.

King, MG 1979, *The biology of the western king prawn Penaeus latisulcatus Kishinouye and aspects of the Fishery in South Australia*, Master of Science Thesis, University of Adelaide.

Kinhill 1982, *Northern Power Station Extension: Draft Environmental Impact Statement*, Electricity Trust of South Australia, Adelaide.

Kleypas, JA, Feely, RA, Fabry, VJ, Langdon, C, Sabine, CL, & Robbins, LL 2006, 'Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research', A report for a workshop, St Petersburg, FL, April 18–20, 2005, sponsored by the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the US Geological Survey.

Klimont, Z, Smith, SJ & Cofala, J 2013, 'The last decade of global anthropogenic sulfur dioxide emissions,' *Environmental Research Letters,* vol. 8, no. 1, pp. 2000–2011

Knight, MA, Tsolos, A & Doonan, AM 2005, *South Australian Fisheries and Aquaculture Information and Statistics Report*, Research report series no. 67, South Australia Research and Development Institute (SARDI), Adelaide.

Kranz, BD, Simon, DL &Leonardi, BG 2004, 'The behavior and routes of lead exposure in pregrasping infants', *J Exp Anal Environ Epidemiology* , vol. 14, no. 4, pp. 300–311.

Maynard, EJ, Franks, LJ & Malcolm, MS 2005, *The Port Pirie Lead Implementation Program: Future Focus and Directions,* retrieved 5 June 2013 <www.health.sa.gov.au/pehs/PDF-files/ptpirie-future-focus-06.pdf, 2005>.

McDonald, B 2008, *The influence of seagrass habitat architecture and integrity on associated faunal assemblages*, PhD thesis, School of Biological Sciences, Faculty of Science and Engineering, Flinders University, Adelaide.

McLaren, NE & Wiltshire, DJ 1984, *Northern Spencer Gulf Marine Biology Study*, South Australian Department of Environment and Planning, Adelaide.

National Environment Protection Council (NEPC) 1998, *National Environment Protection (Ambient Air Quality) Measure*, Adelaide, retrieved 16 October 2006, <www.ephc.gov.au/pdf/Air_Quality_NEPM/air_nepm_as_varied0503 scaleplus.pdf>.

National Environment Protection Council (NEPC) 2001, *Data Collection and Handling*, *National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 5,* Adelaide, retrieved 16 October 2006, <www.ephc.gov.au/nepms/air/pdf/TP5_Data_Collection.pdf>.

National Environment Protection Council 1998, *National Environmental Protection Measure and Impact Statement for Ambient Air Quality,* NEPC Service Corporation, Adelaide, South Australia.

National Health and Medical Research Council (NHMRC) 2009a, *Blood lead levels for Australians*, Australian Govrnment, retrieved June 2013, <www.nhmrc.gov.au/guidelines/publications/new36new37>.

National Health and Medical Research Council (NHMRC) 2009b, *Information Paper - Blood lead levels for Australians*, Australian Government, retrieved June 2013, <www.nhmrc.gov.au/_files_nhmrc/publications/attachments/gp2-lead-info-paper.pdf>.

National Health and Medical Research Council 2009a, *NHMRC Information Paper: Blood lead levels for Australians*, NHMRC, Australia.

National Health and Medical Research Council 2009b, *Blood lead levels for Australians*, NHMRC, Australia, retrieved 30 May 2013, <www.nhmrc.gov.au/guidelines/publications/new36new37>.

National Occupational Health and Safety Commission 1994, *National Standard for the Control of Inorganic Lead at Work; NOHSC:1012*, National Occupational Health and Safety Commission, retrieved <www.safeworkaustralia.gov.au/sites/swa>.

National Pollutant Inventory 2013a, *2011/2012 report for NYRSTAR PORT PIRIE PTY LTD, Nyrstar Port Pirie - Port Pirie, SA,* retrieved 27 June 2013,

<http://www.npi.gov.au/npidata/action/load/emission-by-individual-facility-result/criteria/state/SA/year/2012/jurisdiction-facility/SA0018>.

National Pollutant Inventory 2013b, *2011/2012 report for FLINDERS OPERATING SERVICES PTY LTD, PLAYFORD POWER STATION - Port Augusta, SA,* retrieved 27 June 2013, <http://www.npi.gov.au/npidata/action/load/emission-by-individual-facility-result/criteria/state/SA/year/2012/jurisdiction-facility/SA0017>.

National Pollutant Inventory 2013c, *2011/2012 report for Flinders Operating Services Pty Ltd Northern Power Station - Port AUgusta SA,* retrieved 27 June 2013, <http://www.npi.gov.au/npidata/action/load/emission-by-individual-facility-result/criteria/state/SA/year/2012/jurisdiction-facility/SA0015>.

National Pollution Inventory (NPI) 2013, *National Pollution Inventory Data*, Australian Government, retrieved 1 May 2013 <http://www.npi.gov.au/data/search.html>.

National Toxicology Program 2012, 'NTP Monograph on health effects of low-level lead', US Department of Health and Human Services, retrieved 13 June 2012, <http://ntp.niehs.nih.gov/NTP/ohat/Lead/Final/MonographHealthEffectsLowLevelLead_prepublication_508.pdf>.

Needleman, H L & Bellinger, D 1991, 'The health effects of low level exposure to lead', *Annual Review of Public Health*, vol. 12, pp. 111–140.

Noye, J 1984, 'Physical processes and pollution in the waters of Spencer Gulf', *Marine Geology,* vol. 61, pp. 197–220.

Nrystar 2013, *Smelting operations*, Nyrstar, retrieved 7 June 2013, <http://www.nyrstar.com/operations/Pages/smelting.aspx>.

Nunes, RA & Lennon, GW 1986, 'Physical property distributions and seasonal trends in Spencer Gulf, South Australia: an inverse estuary', *Australian Journal of Marine and Freshwater Research,* vol. 37, pp. 39–53.

Nunes, RA 1985, *Catalogue of Data from a Systematic Programme of Oceanographic Measurements in Northern Spencer Gulf from 1982 to 1985*, Cruise Report no. 9, School of Earth Sciences, Flinders University, Adelaide.

Nunes, RA, Lennon, GW & Bowers, GW 1990, 'Physical behaviour of a large, negative or inverse estuary', *Continental Shelf Research,* vol. 10, pp. 277–309.

Nyrstar 2013, *A New Port Pirie, Transforming the Future*, Web brochure, Nyrstar website, retrieved 12 June 2013, <http://www.nyrstar.com/operations/Documents/NYR%20Hydra%20Brochure_201112.pdf>

O'Connor, J, Parbery, D & Strauss, W 1974, 'The effects of phytotoxic gases on native Australian plant species: Part 1. Acute effects of sulphur dioxide', *Environmental Pollution* , vol. 7, pp. 7–23.

PAE Holmes 2012, *Nyrstar Port Pire - Fugitive metals emissions study*, National Pollutant Inventory, retrieved June 2012, <http://www.npi.gov.au/publications/emission-estimation-technique/pubs/ffugitive.pdf>.

Parsons Brinkerhoff (PB) 2013, *Port Pirie Smelter Transformation Development Application*, Report for Nyrstar, retrieved 8 March 2013, <http://www.nyrstar.com/investors/en/news/Pages/1661946.aspx>.

Pope, CA, Burnett, RT, Thun, MJ, Calle, EE, Krewski, D, Ito, K & Thurston, GD 2002, 'Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution', *Journal of the American Medical Association,* vol. 287, pp. 1132–1141.

Raimondi, P 2008, 'Estimation of ecological impacts due to use of seawater in a desalinization facility (in a NEPA/CEQA context) — entrainment and impingement losses', Online reference to a presentation in Californian Department of Water Resources, retrieved May 2008, <http://www.owue.water.ca.gov/recycle/desal/Docs/Entrainment_impingement.pdf>.

Secretariat of the Convention on Biological Diversity (CBD) 2009, *Scientific synthesis of the impacts of ocean acidification on marine biodiversity,* CBD Technical Series No. 46, CBD, Montreal.

Seddon, S, Connolly, RM & Edyvane, KS 2000, 'Large scale seagrass dieback in northern Spencer Gulf, South Australia', *Aquatic Botany*, vol. 66, pp. 297–310.

Simon, DL, Maynard, EJ & Thomas, KD 2007, 'Living in a Sea of Lead - Changes in Blood and Hand Lead of Infants Living Near a Smelter', *J Exp Sci Environ Epi*, vol. 17, pp. 248–259.

South Australia Environment Protect Act 1993 version 1.1, 2013.

South Australian Government (SA Govt.) 2013a, *Seven strategic priorities*, South Australian Government, retrieved 26 June 2013, <http://www.priorities.sa.gov.au/>.

South Australian Government (SA Govt.) 2013b, *SA Strategic Plan, Strategic Priorities*, South Australian Government, retrieved 26 June 2013, <http://saplan.org.au/pages/seven-strategic-priorities>.

Standards Australia 2004, *Risk Management, AS/NZS 4360:2004*, Standards Australia, Sydney.

Steinbeck, J, Hedgepeth, J, Raimondi, P, Cailliet, G & Mayer, D 2007, *Assessing power plant cooling water intake system entrainment impacts,* report for the California Energy Commission CEC-700-2007-010.

Streeton, JA 1997, *A Review of Existing Health Data on Six Pollutants,* National Environment Protection Council, Australia.

Suppiah, R, Preston, B, Whetton, P, McInnes, K, Jones, R, Macadam, I, Bathols, J & Kirono, D 2006, *Climate Change Under Enhanced Greenhouse Conditions in South Australia*, CSIRO, Melbourne.

The Ecology Lab Pty Ltd 2005, *Marine Ecological Assessment for the Desalination Planning Study*, Report for GHD on behalf of Sydney Water Corporation, Report no. 340405 F, The Ecology Lab Pty Ltd, Marine and Freshwater Studies, Brookvale, NSW.

The Royal Society 2005, *Ocean Acidification Due to Increasing Atmospheric Carbon Dioxide*, The Royal Society, London.

United States Environmental Protection Agency 2007, 'Review of the NAAQ standard for lead: policy assessment of scientific and technical information', *OAQPS Staff Paper: EPA-542/R-07-013*, pp. 5–16.

United States Environmental Protection Agency 2008, 'Lead air quality standards', retrieved 2008, <www.epa.gov/air/lead/standards.html>.

United States Environmental Protection Agency 2008, 'National ambient air quality standards (NAAQS)', retrieved 2008, <http://www.epa.gov/air/criteria.html>.

US Centers for Disease Control 2005, *Preventing lead poisoning in young children,* retrieved 2005, <www.cdc.gov/nceh/lead/publications/prevleadpoisoning.pdf, 2005>.

Ward, T, Warren, L & Swaine, D 1982, *Effects of Heavy Metals on Aquatic Life*, Final Report ILZRO Project CH-6/ZH-212.

Ward, TJ, Warren, LJ & Tiller, KG 1984, 'The Distribution and Effects of Metals in the Marine Environment Near a Lead-Zinc Smelter, South Australia', in Nriagu J. [ed], *Environmental Impacts of Smelters*, John Wiley and Sons Inc.

Wiltshire, K, Rowling, K & Deveney, M 2010, *Introduced marine species in South Australia: a review of records and distribution mapping*, SARDI Publication No. F2010/000305-1. SARDI Research Report Series No. 468, p. 232, South Australian Research and Development Institute (Aquatic Sciences), Adelaide.

World Health Organization 2005, *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide: Global update 2005 — Summary of risk assessment*.

World Health Organization 2013, *Health Effects of Particulate Matter, Policy implications for countries in eastern Europe, Caucasus and central Asia,* World Health Organization Regional Office for Europe, Denmark.