

**Alcoa of Australia
Limited**

**Kwinana Refinery -
Gas-Fired Boilers**

**Works Approval
Supporting Document**

May 2026



| Version | Detail | Date | Approved by |
|---------|----------------------------------|---------|-------------|
| 0 | Final version issued for release | 8/05/26 | |

Table Of Contents

| | |
|--|-----------|
| 1. Introduction | 1 |
| 1.1 Purpose | 1 |
| 1.2 Background | 1 |
| 1.3 Application Form | 3 |
| 2. Premises details | 5 |
| 2.1 Works Approval Area | 5 |
| 2.2 Prescribed Premises Categories | 5 |
| 2.3 Land Tenure and Ownership | 5 |
| 3. Approved Activities | 6 |
| 4. Proposed Activities | 12 |
| 4.1 Gas-fired Boilers | 12 |
| 4.2 Other Infrastructure | 13 |
| 4.3 Construction | 13 |
| 4.4 Equipment Commissioning | 15 |
| 4.5 Environmental Commissioning | 15 |
| 4.6 Time Limited Operations | 16 |
| 4.7 Air Quality | 16 |
| 4.7.1 Receptors | 16 |
| 4.7.2 Air Quality Criteria | 19 |
| 4.7.3 Scenarios Modelled | 19 |
| 4.7.4 Meteorological Data and Model Inputs | 20 |
| 4.7.5 Model Results | 23 |
| 4.8 Noise | 28 |
| 4.9 Odour | 28 |
| 5. Other approvals and consultation | 31 |
| 5.1 Regulator Consultation | 31 |
| 5.2 Other Legislation and Approvals | 31 |
| 6. Waste, Emissions And Discharges | 33 |
| 7. Siting and Location | 36 |
| 8. Risk Assessment | 44 |
| 8.1 Risk Assessment Overview | 44 |
| 8.2 Risk and Impact Assessment | 45 |
| 9. Capital Cost | 47 |

10. References 48

Table Index

| | | |
|------------|---|----|
| Table 1-1 | Location of Information Relevant to the DWER Application Form | 4 |
| Table 2-1 | Assessed Design Capacities on L5245/1967/14..... | 5 |
| Table 3-1: | Simplified Water Balance with CARP Production and Steam Loss to Atmosphere (kL/h per evaporator unit)..... | 7 |
| Table 3-2 | Simplified Water Balance without CARP Production and minimal Steam Loss to Atmosphere (kL/h per evaporator unit)..... | 8 |
| Table 4-1 | Design and construction / installation requirements..... | 12 |
| Table 4-2 | Process Inputs..... | 13 |
| Table 4-3 | Process Outputs (per Boiler) | 13 |
| Table 4-4 | Proposed Emissions Monitoring..... | 15 |
| Table 4-5 | Receptors | 17 |
| Table 4-6 | Ambient Air Quality Criteria | 19 |
| Table 4-7 | Sources Modelled in each Scenario | 20 |
| Table 4-8 | Modelled parameters for the Boilers..... | 21 |
| Table 4-9 | Modelled Maximum Off-Site Concentrations for Scenarios 3B and 4B..... | 24 |
| Table 4-10 | 1-hour Average SO ₂ Concentrations at Receptors..... | 25 |
| Table 4-11 | 24-hour Average PM _{2.5} Concentrations at Receptors | 26 |
| Table 4-12 | Annual Average PM _{2.5} Concentrations at Receptors..... | 27 |
| Table 4-13 | Powerhouse Noise Measurements..... | 29 |
| Table 5-1 | Other Legislation..... | 31 |
| Table 6-1 | Emissions and discharges..... | 33 |
| Table 7-1 | Nearby Environmentally Sensitive Receptors and Aspects | 36 |
| Table 8-1 | Consequence Matrix (DWER, 2020) | 44 |
| Table 8-2 | Likelihood Matrix (DWER, 2020) | 45 |
| Table 8-3 | Risk Matrix (DWER, 2020) | 45 |
| Table 8-4 | Risk Assessment | 46 |
| Table 9-1 | Capital Costs | 47 |

Figure Index

| | | |
|------------|--|----|
| Figure 1-1 | Location and Prescribed Premises..... | 2 |
| Figure 3-1 | Refinery Area Infrastructure | 9 |
| Figure 3-2 | Water Transfer Infrastructure | 10 |
| Figure 3-3 | Simplified High Alkalinity Water Management Process Flow Diagram | 11 |
| Figure 4-1 | John Thompson Boilers..... | 14 |
| Figure 4-2 | Air Quality Receptors..... | 18 |
| Figure 4-3 | Modelled Position of Stacks | 22 |

| | |
|---|----|
| Figure 4-4 Nearest Noise Sensitive Premises | 30 |
| Figure 7-1 Land Users | 39 |
| Figure 7-2 Environmentally Sensitive Areas | 40 |
| Figure 7-3 Heritage Sites | 41 |
| Figure 7-4 Wetlands | 42 |
| Figure 7-5 Acid Sulfate Soils Risk Mapping..... | 43 |

Appendices

Appendix 1: Air Dispersion Modelling (MRP, 2026)

1. INTRODUCTION

1.1 Purpose

Alcoa of Australia Limited (Alcoa) is the owner and proponent of the Kwinana Alumina Refinery (Kwinana Refinery) located approximately 27 km south of Perth within the Kwinana Industrial Area (KIA). The location is shown in Figure 1-1.

As part of surplus water management, Alcoa proposes to restart operation of Building 42 at the refinery. Operation of Building 42 is approved via Environmental Licence L5245/1967/14; however, instead of using the existing powerhouse, Alcoa will install up to two gas-fired boilers (the Boilers) to provide steam to Building 42.

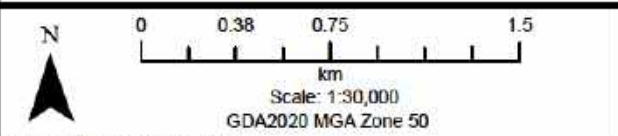
This document has been prepared to support a works approval application for the Boilers.

1.2 Background

Operations at the Kwinana Refinery are approved under Environmental Licence L5245/1967/14. The L5245/1967/14 Prescribed Premises and the proposed Works Approval Area are shown on Figure 1-1. Operations at the Kwinana Refinery include:

- An alumina refinery, which is no longer operational and will be permanently closed.
- A powerhouse, which is no longer operational and will be permanently closed.
- A jetty for export of product and import of chemicals. This also serves Alcoa's other Western Australian operations.
- Product and raw materials storage and handling serving other Western Australian operations.
- Rail loading and unloading facilities.
- Operating Residue Storage Area (RSA Main). Although residue is no longer being deposited, water management systems continue to operate. A Reverse Osmosis Water Treatment Plant (WTP) is under construction at RSA L. Dredge spoil from water storage ponds and filter cake from the WTP are stored inside impoundments.
- Closed Residue Storage Area (RSA ABC).
- Pipeline corridors with pipelines and associated infrastructure supporting active process water management systems.

Alcoa has obligations under the *Contaminated Sites Act 2003* (CS Act) and Condition W1 of L5245/1967/14 to implement the Kwinana Groundwater Monitoring and Management Plan (GMMP) (Alcoa, 2025) which outlines the monitoring and management requirements for the remediation program and related recovery bore abstraction. A significant amount of stormwater is also collected from the refinery process areas and Residue Storage Areas (RSAs) and process water ponds.



Kwinana Building 42 Project

Figure 1-1 Location and Prescribed Premises

Drawing #: EA1P0077_D01
Date: 8/05/2026

Author: smita
Date Printed: 8/05/2026

Path: L:\kwinana\Approvals\EA1P0055 - Building 42\Projects\EA1P0055\EA1P0055.dwg

Historically, groundwater from environmental recovery bores and harvested stormwater was used as process water. The site operated with a negative water balance with the deficit made up with abstracted groundwater. Now that the alumina refinery has ceased to operate, processing does not consume water, currently leaving the site with a surplus. Whilst water will be required for closure processes (dust management, capping and revegetation) there is a need to manage the current water surplus as part of the transition to closure. Alternative solutions have been implemented to manage surplus water:

- Surplus water was initially evaporated in the refinery during the transitional operating phase (TOP). TOP ceased on 15 December 2025.
- Surplus water is currently evaporated via mechanical evaporators at RSA Main.
- A reverse osmosis water treatment plant (WTP) has been approved and is under construction with commissioning scheduled in July 2026.
- A works approval application will be submitted for a Mechanical Vapour Recompression (MVR) Plant to treat high TDS water streams that are not amenable to reverse osmosis at the required rates.
- Subject to DWER approval, the infiltration of treated water is scheduled for quarter 3 of 2026. Once infiltration commences, mechanical evaporation will only be required after extreme rainfall events if at all.

Alcoa proposes to restart evaporator equipment at Building 42 of the alumina refinery as an interim bridging solution to manage high TDS water prior to commissioning of the MVR Plant. As the powerhouse was designed to supply heat and electricity to the entire refinery, it is inefficient to operate for the purpose of operating Building 42 in isolation. Use of the approved powerhouse would require significantly more gas and would generate a large excess of steam that would have to be vented. Accordingly, Alcoa has opted to install small efficient package boilers that are appropriately sized for the project.

For clarity, the operation of existing evaporators at Building 42 and the transfer of water between the refinery and process water ponds is already approved under Environmental Licence L5245/1967/14. This works approval application is for the Boilers only.

The Boilers are self-contained units and can be installed and operational within 3 to 4 weeks of the works approval being granted.

1.3 Application Form

This works approval application has been prepared in accordance with the requirements of Section 59B of the *Environmental Protection Act 1986* (EP Act) and the *Industry Regulation Guide to Licensing* (DWER, 2019). This supporting document is Attachment 3B to the DWER application form.

Table 1-1 reflects the *DWER Application Form* completion matrix and identifies the relevant section of this document that addresses each of the information requirements.

Table 1-1 Location of Information Relevant to the DWER Application Form

| Section in Application Form | | Section in this Document |
|-----------------------------|--|---------------------------|
| Part 1 | Application type | Section 1 |
| Part 2 | Applicant details | Refer to application form |
| Part 3 | Premises details | Section 2 |
| Part 4 | Proposed activities | Section 4 |
| Part 5 | Index of Biodiversity Surveys for Assessment (IBSA) | Not required |
| Part 6 | Other DWER approvals | Section 5.2 |
| Part 7 | Other approvals and consultation | Section 5 |
| Part 8 | Applicant history | Refer to application form |
| Part 9 | Emissions, discharges and waste | Section 6 |
| Part 10 | Siting and location | Section 7 |
| Part 11 | Submission of any other relevant information | Appendix 1 |
| Part 12 | Category checklist | Not required |
| Part 13 | Proposed fee calculation | Section 9 |
| Part 14 | Commercially sensitive or confidential information | Not required |
| Part 15 | Submission of application | Refer to application form |
| Part 16 | Declaration and signature | Refer to application form |
| Attachments | | |
| Attachment 1A | Proof of occupier status | Provided |
| Attachment 1B | ASIC company extract | Provided |
| Attachment 1C | Authorisation to act as a representative of the occupier | Not required |
| Attachment 2 | Premises maps | Figure 3-1 |
| Attachment 3A | Environmental commissioning plan | Not required |
| Attachment 3B | Proposed activities | This document |
| Attachment 3C | Map of area to be cleared | Not required |
| Attachment 3D | Additional information for clearing assessment | Not required |
| Attachment 4 | Marine surveys | Not required |
| Attachment 5 | Other approvals and consultation documentation | Not required |
| Attachment 6A | Emissions and discharges | Section 6 |
| Attachment 6B | Waste acceptance | Not required |
| Attachment 7 | Siting and location | Section 7 |
| Attachment 8 | Additional information submitted | Not required |
| Attachment 9 | Category-specific checklist(s) | Not required |
| Attachment 10 | Proposed fee calculation | Section 9 |
| Attachment 11 | Request for exemption from publication | Not required |

2. PREMISES DETAILS

2.1 Works Approval Area

The Prescribed Premises for Environmental Licence L5245/1967/14 and the Works Approval Area are shown on Figure 1-1. The Works Approval Area is the entirety of Lot 102 on Plan 18242 (Lot 102), which is entirely within the L5245/1967/14 Prescribed Premises.

2.2 Prescribed Premises Categories

Prescribed Premises categories on Environmental Licence L5245/1967/14 are listed in Table 2-1. This works approval application is relevant to Category 67. As the Boilers will never be operated concurrently with the powerhouse, an increase to the assessed design capacity for Category 67 is not required.

Table 2-1 Assessed Design Capacities on L5245/1967/14

| Prescribed premises category description (Schedule 1, <i>Environmental Protection Regulations 1987</i>) | Assessed design capacity |
|---|---|
| Category 5: Processing or beneficiation of metallic or non-metallic ore | 5,000,000 tonnes per year (filter mud cake from filtration facility, dry) |
| Category 46: Bauxite refining | 2,409,000 tonnes per year (smelter grade alumina equivalent) |
| Category 52: Electric power generation | 78.5 MW in aggregate |
| Category 58: Bulk material loading or unloading | 4,818,000 tonnes per year |
| Category 64: Class II or III putrescible landfill site | 1,000 tonnes per year |
| Category 67: Fuel burning | 65,000 m ³ per hour |

2.3 Land Tenure and Ownership

Lot 102 is a freehold allotment owned by Alcoa. A certificate of title is included as Attachment 1A of the works approval application.

3. APPROVED ACTIVITIES

Environmental Licence L5245/1967/14 approves operation of the alumina refinery, including the evaporators in Building 42; transfers of water between the refinery and water storage ponds; and the storage and loading of Concentrated Alumina Refinery Product (CARP). During operations and TOP, the powerhouse provided steam to Building 42. When Building 42 is restarted, steam will be provided from the Boilers. The scope of the works approval is limited to the installation of the Boilers as all other infrastructure is existing and approved under L5245/1967/14.

Building 42 contains five sets of evaporator units (1 to 5), each consisting of a series of heaters and flash tanks. During TOP, Building 42 was supplied with steam from the powerhouse and used to boil water from the Cooling Pond. A broad overview of function is as follows:

- Water from the Cooling Pond, and steam from flash tanks and the powerhouse is passed through the heaters.
- Condensate is collected from the heaters and either pumped to the powerhouse to be evaporated or pumped to the ROWS Pond via the RSA ABC tank.
- Heated liquor is passed through a series of flash tanks where:
 - Steam is produced and directed to the powerhouse or to the heaters
 - Concentrate is produced.
- The final flash tank in each unit includes a barometric condenser, which uses water from the Cooling Pond to cool the concentrate. Cooling water is separated from concentrate and condensate streams but does pick up flash vapour or steam. Cooling water and any absorbed steam is returned to the Cooling Pond.
- Concentrate from evaporator units (including unit 5) was transferred back into the Cooling Pond.
- CARP was produced in Evaporator unit 5 in batches. This was either:
 - directed to the precipitator vessels in Building 45 (if there was storage capacity).
 - directed back to the Cooling Pond.
- CARP was loaded onto trucks at the building 46V CARP Loading facility and transferred to the Pinjarra Refinery for use in the alumina refinery.

The location of Building 42 at the refinery is shown in Figure 3-1. Existing transfer infrastructure between the refinery and water storage ponds is shown in Figure 3-2. Figure 3-3 outlines the key stages in the high alkalinity water management process.

Water is currently being circulated between the Cooling Pond and the BLD35 W2 tank. Alcoa will bleed water from this tank into the 45E Feed Tanks 1 & 2 which will feed Building 42. Alcoa proposes to run 1 – 2 evaporator units in Building 42. Each unit will:

- Take up to ~550 kL/h of process liquor per evaporator unit.
- Produce up to ~70 kL of condensate, which will be transferred to the ROWS Pond (this excludes condensate used as feed water for the Boilers).
- Produce up to 460 kL/hr of concentrate, up to ~20 kL/h of which may be directed to CARP storage. Concentrate will be returned to the feed tanks or sent back to the Cooling Pond.
- Lose up to 20 kL/hr of steam, which will either enter the cooling water and be returned to the Cooling Pond or be vented to atmosphere.

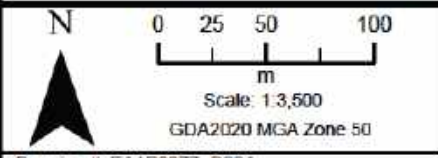
Simplified water balances are provided in Table 3-1 (CARP production and steam loss to atmosphere) and Table 3-2 (no CARP production and no steam losses). The primary purpose of Building 42 is not to remove water, but to treat high TDS water in the Cooling Pond and transfer it as low TDS water to the ROWS Pond. This will manage Cooling Pond storage and water in the ROWS Pond can either be mechanically evaporated or treated in the WTP and (if approved) infiltrated.

Table 3-1: Simplified Water Balance with CARP Production and Steam Loss to Atmosphere (kL/h per evaporator unit)

| Streams | Overall (Building 42 and Boilers) | Storage and Losses | | |
|--|--|---------------------------|-----------------------|--------------------------|
| | | Cooling Pond Losses | ROWS Pond Gains | Steam/ CARP Losses |
| Feed Liquor: | | | | |
| Liquor from Feed Tank | 550 | (550) | | |
| Total Feed | 550 | (550) | | |
| Product/Loss Streams | | | | |
| Condensate to ROWS Pond | (70) | | 70 | |
| Concentrate to Feed Tank and/or Cooling Pond | (440) | 440 | | |
| CARP | (20) | | | 20 |
| Steam to Atmosphere | (20) | | | 20 |
| Steam to Cooling Pond | 0 | | | |
| Total | (550) | 440 | 70 | 20 |
| Balance | 0 | (110) | 70 | 40 |

Table 3-2 Simplified Water Balance without CARP Production and minimal Steam Loss to Atmosphere (kL/h per evaporator unit)

| Streams | Overall (Building 42 and Boilers) | Storage and Losses | | |
|--|--|---------------------------|-----------------------|--------------------------|
| | | Cooling Pond Losses | ROWS Pond Gains | Steam/CA RP Losses |
| Feed Liquor: | | | | |
| Liquor from Feed Tank | 550 | (550) | | |
| Total Feed | 550 | (550) | | |
| Product/Loss Streams | | | | |
| Condensate to ROWS Pond | (70) | | 70 | |
| Concentrate to Feed Tank and/or Cooling Pond | (460) | 460 | | |
| CARP | 0 | 0 | | |
| Steam to Atmosphere | (1) | | | 0 |
| Steam to Cooling Pond | (19) | 19 | | |
| Total | (550) | 480 | 70 | 0 |
| Balance | 0 | (71) | 70 | 1 |



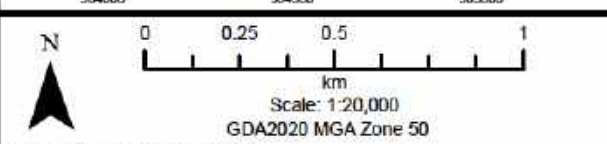
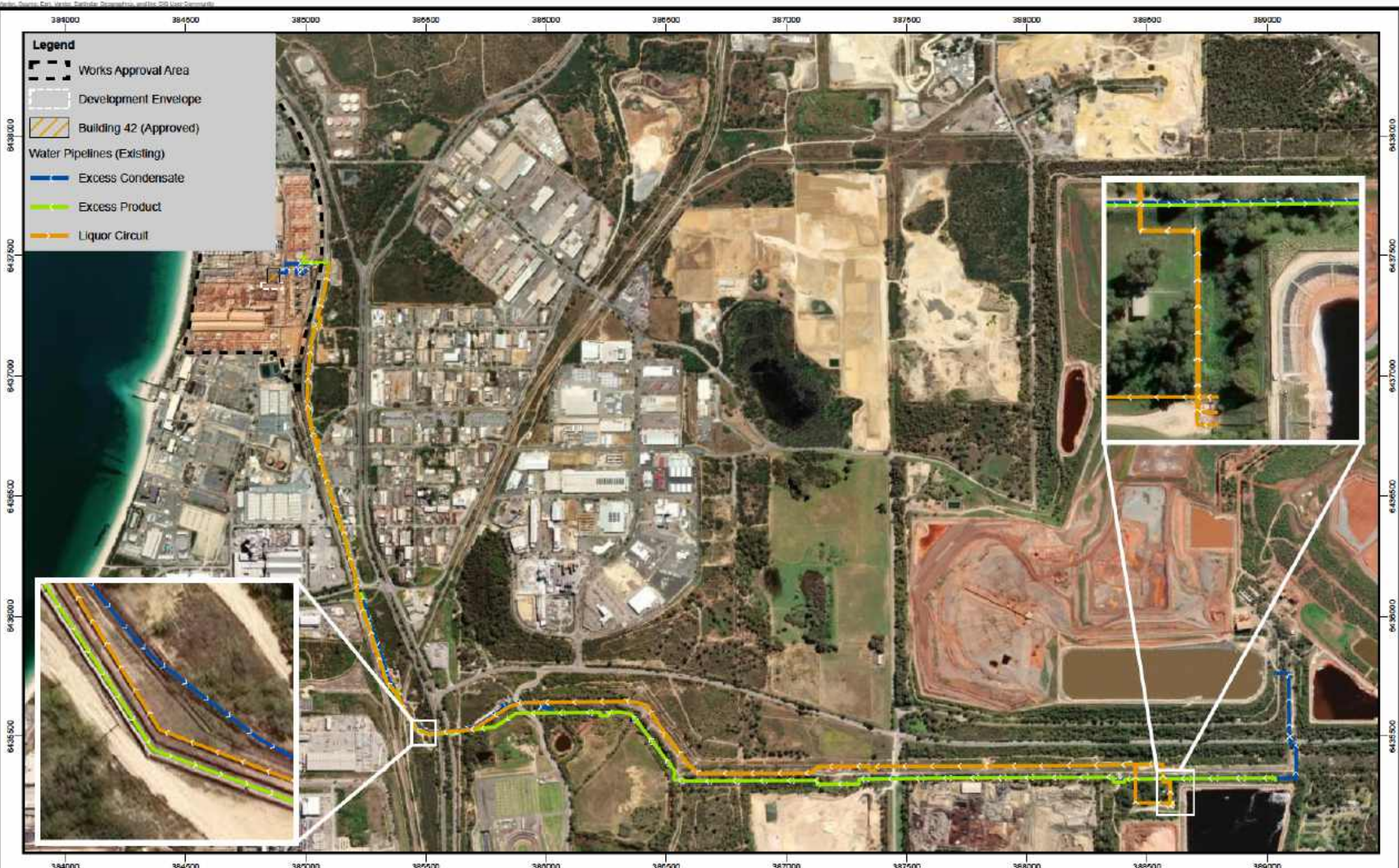
Kwinana Building 42 Project

Figure 3-1 Refinery Area Infrastructure

Drawing #: EA1P0077_D02A
Date: 8/05/2026

Author: smita
Rev: A, A4
Date Printed: 8/05/2026

Path: L:\users\EAApprovals\EA1P0068 - Building 42\Projects\EA1P0068\EA1P0068.aprx



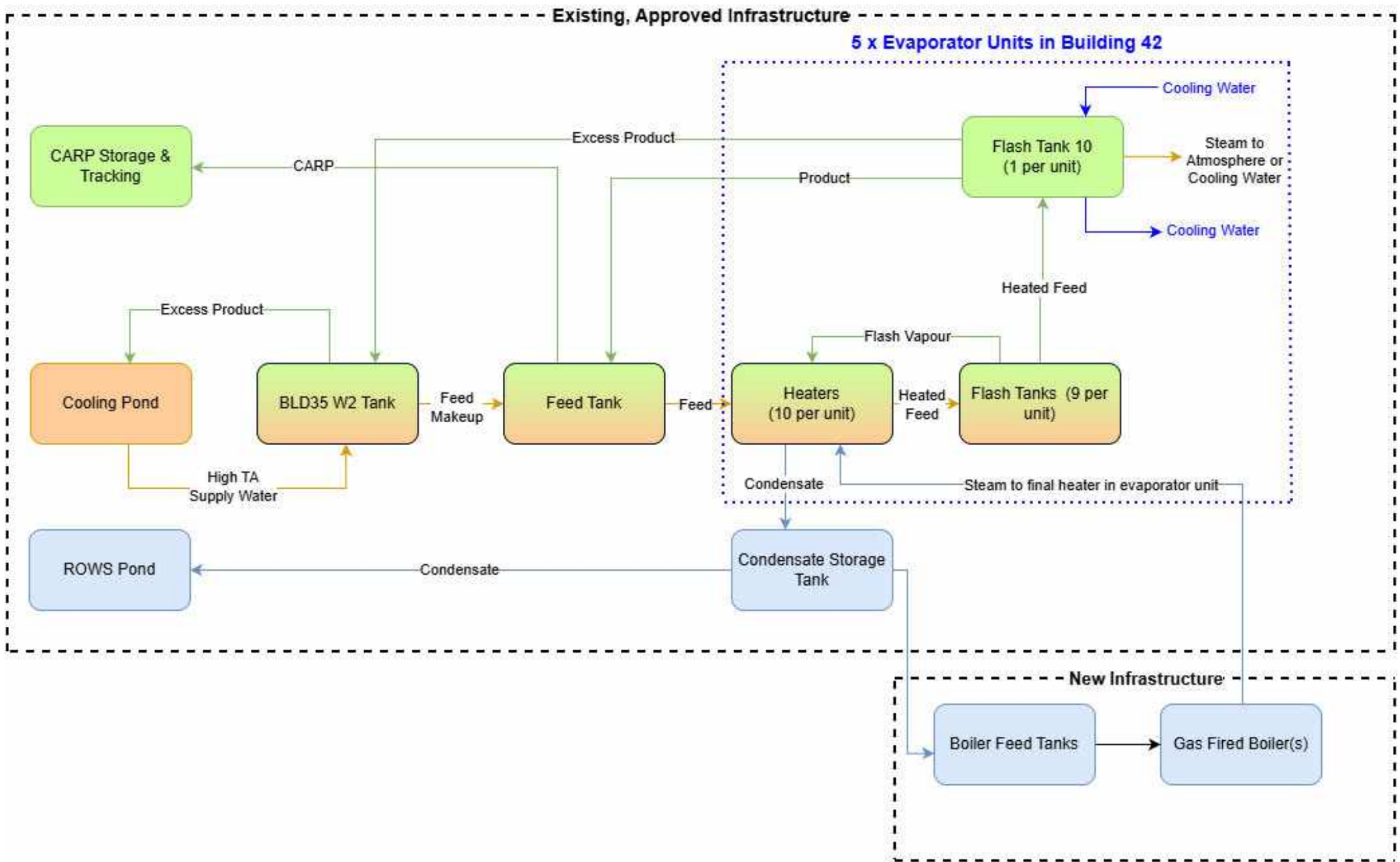
Kwinana Building 42 Project

Figure 3-2 - Water Transfer Infrastructure

Drawing #: EA1P0077_D02B
Date: 8/05/2026

Author: smita
Date Printed: 8/05/2026

Path: L:\kwinana\Approvals\EA1P0088 - Building 42\Project\EA1-0066\EA1P0088.aprx



Kwinana Building 42 Project



Figure 3-3 Simplified Process Flow Diagram

4. PROPOSED ACTIVITIES

Proposed infrastructure includes:

- Up to 2 Boilers with a total of up to 36 MW of thermal output.
- Other infrastructure associated with the boilers including tanks, feedwater lines; steam pipelines; and gas and electrical connections.

4.1 Gas-fired Boilers

The Boilers burn gas to heat water and produce steam, which will be piped to the heaters in Building 42 and used to heat process liquor.

Alcoa proposes to install up to two self-contained gas-fired boilers of a type similar to the John Thompson water-tube boilers illustrated in Figure 4-1. The boilers will be placed adjacent to Building 42 on an existing hardstand inside the Development Envelope shown on Figure 3-1. The approximate dimensions of the Boilers inside the Development Envelope are also shown on this figure.

Alcoa proposes to construct and install the boilers in accordance with the requirements detailed in Table 4-1.

Table 4-1 Design and construction / installation requirements

| New Infrastructure | Design and Construction Requirement | Infrastructure Location |
|---|---|-------------------------|
| 1 Up to 2 gas-fired steam boilers with total thermal output up to 36 MW | <ul style="list-style-type: none"> • Steam Output: up to ~29 tonnes/hr @ 100°C per unit • Max fuel input (natural gas or simulated natural gas): ~2,200 Nm³/hour per unit • Boiler will comply to Australian Standards AS 1228, AS 5601, AS 3000, AS 2593, AS3892 • Boiler flue stack exhaust to be 12 -15 metres above ground level. • Boiler flue contains in-stack heat recovery system. | Figure 3-1 |

Nm³ = normal cubic metre.

Boiler water Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) accumulation will be managed by intermittent controlled blowdown via the water drum to remove settled solids and continuous blowdown via the steam drum to removed dissolved solids. Blowdown water will be discharged into blowdown water tanks which will overflow via pipes to existing surface water containment sumps and transferred to the ROWS Pond.

Periodic cleaning in place will be undertaken approximately twice a year using inhibited sulfuric acid supplied via an IBC. Wastewater will be collected in IBCs and removed from site or directed to sumps for transfer to the ROWS Pond. Temporary hoses will be used.

Process inputs required to operate the Boilers are described in Table 4-2 and Boiler outputs are detailed in Table 4-3. Volumes are estimates and may vary depending on process requirements.

Table 4-2 Process Inputs

| Component | Description | Quantity |
|-------------|---|---------------------------------------|
| Natural Gas | <ul style="list-style-type: none"> Via offtake from existing refinery gas supply lines | ~2,200 Nm ³ /hour per unit |
| Boiler Feed | <ul style="list-style-type: none"> Initially demineralised water, then condensate | ~40kL/h per unit |

Table 4-3 Process Outputs (per Boiler)

| Component | Description | Quantity |
|-------------------------|--|--------------------------------------|
| Steam | <ul style="list-style-type: none"> Steam Temperature 260°C | ~29 tonnes/hr @ 100°C |
| Blowdown Water | <ul style="list-style-type: none"> Total Dissolved Solids: <2,000mg/kg | Typically, 3-5% of Boiler throughput |
| Cleaning in place water | <ul style="list-style-type: none"> Water from periodic chemical descaling of boiler | <1.5 kL per ~6 months. |

4.2 Other Infrastructure

Other infrastructure associated with the boilers includes:

- Feedwater pipelines – condensate return from Building 42 to Boiler Feed Tanks.
- Feed Tanks – each boiler will have a feedwater tank (up to 15 kL) capable of holding hot condensate. Pre-heating of feedwater with steam is included in the boiler package.
- Blowdown water tanks – each Boiler will have a AS1210 compliant tank (up to 5 kL) capable of holding hot blowdown water. Blowdown water in tanks will be piped to existing sumps for collection and transfer back to the ROWS Pond.
- Steam Pipelines to Building 42. Steam lines from the Boilers to Building 42 will be compliant with AS4041 and AS4458.
- Gas supply line from either the BLD110 or powerhouse gas main isolation valves. All gas supply lines will be compliant with AS4041, AS4458 and AS5601.

Tanks will be placed adjacent to boilers inside the Development Envelope shown in Figure 3-1. New pipelines will be constructed between Building 42 and the tanks, sumps and boilers.

4.3 Construction

Limited construction activities are required for the Project. The Boilers are pre-used rental units and do not need to be constructed. They will be trucked to site and placed on existing hardstands inside the Development Envelope shown in Figure 3-1 and water, steam and gas pipelines fitted.

John Thompson SD18



John Thompson SD17.5



Kwinana Building 42 Project



Figure 4-1 John Thompson Boilers

4.4 Equipment Commissioning

Boiler registration, commissioning and certification will comply with *Gas Standards (Gas fitting and Consumer Gas Installations) Regulations 1999, Work Health and Safety (Mines) Regulations 2022, AS5601, AS3814, AS2593 and AS3788*. Commissioning procedures and ITPs will be provided by the equipment supplier to complete verification testing of safety systems, controls, fuel, water, electrical and pressure components to ensure correct installation and operation.

Boilers will be installed and commissioned with controls, interlocks and critical safety protections to prevent unsafe operating conditions. All safety systems will be tested to prove correct shutdown on fault conditions (such as low-water, flame failure, over-pressure and emergency shutdowns). The Boilers are automated units, and limited commissioning is required before they can be operated at a continuous steady state. Commissioning activities include:

- Completion of pre-commissioning inspections.
- Functional testing of controls and interlocks.
- Live testing of critical safety protections (such as low-water, flame failure, over-pressure and emergency shutdowns).
- Initial firing and functional testing across the intended operating range.
- Completed documentation, verified compliance records, and operator training.

Equipment commissioning is anticipated to take ~1 week.

4.5 Environmental Commissioning

The Boiler stacks are an emissions point into the Kwinana airshed. Alcoa requests a 3-month environmental commissioning period to verify that stack emissions are within the vendor-supplied emission concentrations which form the basis of the air quality assessment (See Section 4.7). Emission concentrations vary marginally with the boiler selected and are specified in Section 4.7.4.

Alcoa proposes the in-stack monitoring in Table 4-4 to verify that stack emissions are within criteria. If the initial test results indicate that emissions do not comply during the environmental commissioning period, the testing will be repeated once remedial action has been undertaken.

Table 4-4 Proposed Emissions Monitoring

| Discharge Point | Parameter | Frequency | Averaging Period |
|----------------------|-------------------|-------------------------------------|-----------------------|
| Boiler Flue Stack(s) | CO | Once within 90 days of commencement | Minimum of 30 minutes |
| | NO _x | | |
| | SO ₂ | | |
| | PM ₁₀ | | |
| | PM _{2.5} | | |

Note 1: alternative NATA accredited method for sampling and analysis for required parameter may be used

4.6 Time Limited Operations

Alcoa requests a 180 day time limited operations provision in the Works Approval to allow operation of the Boilers until such time as a licence amendment with operational conditions is granted. Time limited operations are unlikely to differ from licenced operations.

4.7 Air Quality

Alcoa engaged MRP Technical Consultants (MRP) to complete an air quality assessment for the Boilers including modelling of concentrations of carbon monoxide (CO); nitrogen dioxide (NO₂); sulfur dioxide (SO₂); particulate matter less than or equal to 10 µm in diameter (PM₁₀); and particulate matter less than or equal to 2.5 µm in diameter (PM_{2.5}).

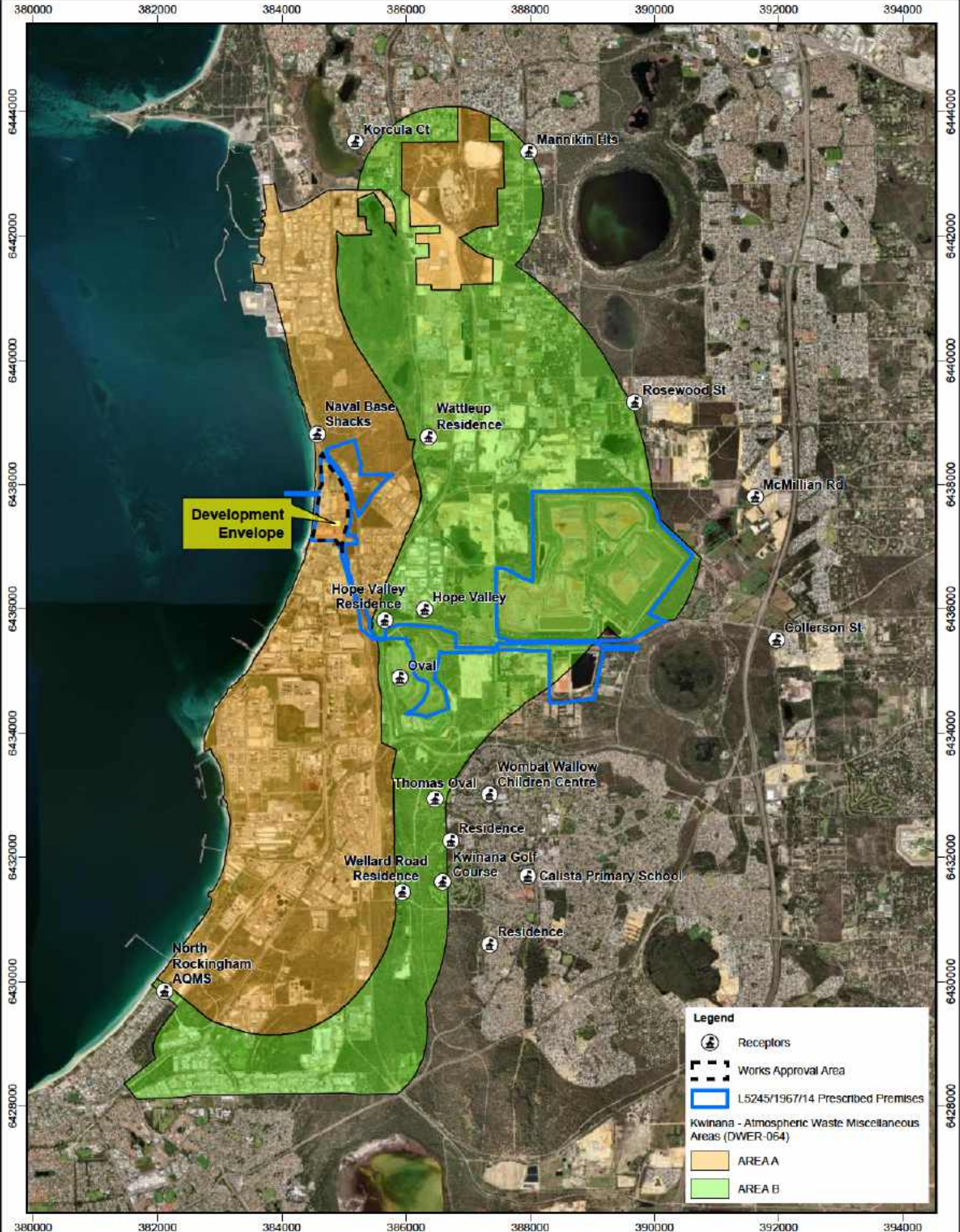
A copy of the modelling report (MRP, 2026) that includes a description of the model and meteorological inputs and validation; modelling results at each receptor and contour maps is provided in Appendix 1.

4.7.1 Receptors

Receptors are listed in Table 4-5 and shown on Figure 4-2. Receptors were selected based on proximity to the Boilers and consistency with other air quality studies in the KIA.

Table 4-5 Receptors

| Receptor | WGS84 UTM50(S) | |
|--------------------------------|----------------|--------------|
| | Easting (m) | Northing (m) |
| Wells Park | 383,090 | 6,431,590 |
| Golf Course | 386,587 | 6,431,618 |
| Thomas Oval | 386,468 | 6,432,951 |
| Oval | 385,900 | 6,434,900 |
| Residence | 386,723 | 6,432,276 |
| North Rockingham AQMS | 382,112 | 6,429,858 |
| Residence | 387,347 | 6,430,608 |
| Hope Valley | 386,300 | 6,436,000 |
| Calista Primary School | 387,961 | 6,431,708 |
| Wombat Wallow Childcare Centre | 387,344 | 6,433,024 |
| Wellard Road Residence | 385,939 | 6,431,453 |
| Korcula Ct | 385,182 | 6,443,529 |
| Mannikin Hts | 387,977 | 6,443,366 |
| Rosewood St | 389,683 | 6,439,335 |
| Collerson St | 391,964 | 6,435,509 |
| Mcmillian Rd | 391,620 | 6,437,812 |
| Naval Base Shacks | 384,569 | 6,438,822 |
| Hope Valley Residence | 385,657 | 6,435,828 |
| Wattleup Residence | 386,361 | 6,438,777 |



Legend

- Receptors
- Works Approval Area
- L5245/1967/14 Prescribed Premises
- Kwinana - Atmospheric Waste Miscellaneous Areas (DWER-054)
- AREA A
- AREA B

N

0 0.5 1 2

km

Scale: 1:75,000

GDA2020 MGA Zone 50



Kwinana Building 42 Project

Figure 4-2 Air Quality Receptors

Drawing #: EA1P0077_D06

Date: 8/05/2026

Author: smita

Rev: A, A4

Date Printed: 8/05/2026

Path: C:\users\EApprovals\EA1P0068 - Building 42\Projects\EA1P0068\EA1P0068.aprx

4.7.2 Air Quality Criteria

MRP compared modelled air quality parameters to the criteria in Table 4-6.

Table 4-6 Ambient Air Quality Criteria

| Pollutant | Averaging Period | Criteria ($\mu\text{g}/\text{m}^3$) | Reference |
|-------------------|--------------------------|---------------------------------------|--------------|
| NO ₂ | 1-hour max | 150 | (NEPC, 2021) |
| | Annual Average | 28 | |
| SO ₂ | 1-hour max ¹ | 196 | (NEPC, 2021) |
| | 24-hour max ¹ | 52 | (EPA, 1999) |
| | Annual Average | 46 | |
| CO | 1-hour max | 30,000 | (DWER, 2019) |
| | 8-hour max | 10,000 | |
| PM ₁₀ | 24-hour max | 46 | (NEPC, 2021) |
| | Annual average | 23 | |
| PM _{2.5} | 24-hour max | 18 | (NEPC, 2021) |
| | Annual average | 6.4 | |

¹ Higher criteria are applied by the EPA under the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy (EPA, 1999); however MRP compared modelling results to NEPC criteria.

4.7.3 Scenarios Modelled

As Alcoa is considering Boilers from two different suppliers MRP considered two possible Boiler Combinations and used CALPUFF to model the following scenarios:

- Scenario 1 – Known significant existing operations in the KIA, including the Alcoa Kwinana Refinery.
- Scenario 2 – All Scenario 1 sources except the Alcoa Kwinana Refinery as well as planned future significant emissions sources.
- Scenario 3A – The Boilers only (Boiler Combination 1). This assesses the contribution of the Boilers to the airshed.
- Scenario 3B – Cumulative emissions from the Boilers (Boiler Combination 1) and current and future sources (excludes bauxite processing operations at the Kwinana Refinery).
- Scenario 4A – The Boilers only (Boiler Combination 2). This assesses the contribution of the Boilers to the airshed.
- Scenario 4B – Cumulative emissions from the Boilers (Boiler Combination 2) and current and future sources (excludes bauxite processing operations at the Kwinana Refinery).

The sources included in each scenario are listed in Table 4-7. Note that Scenarios 1 and 2 were modelled for NO_x only to provide for comparison of model outputs with air quality measurements at North Rockingham. Scenarios 3A and 4A provide the marginal impact of the boilers and Scenarios 3B and 4B provide the cumulative air quality impact from the Boilers and all other significant sources in the KIA.

Table 4-7 Sources Modelled in each Scenario

| Infrastructure | Scenario | | | |
|--|----------|---|---------|---------|
| | 1 | 2 | 3A & 4A | 3B & 4B |
| AGR cyanide plant | ✓ | ✓ | | ✓ |
| CSBP nitric acid plant | ✓ | ✓ | | ✓ |
| CSBP ammonia plant | ✓ | ✓ | | ✓ |
| Synergy HEGT facility | ✓ | ✓ | | ✓ |
| Alcoa refinery | ✓ | | | |
| Newgen power station | ✓ | ✓ | | ✓ |
| Cockburn 2 power station | ✓ | ✓ | | ✓ |
| Kleenheat gas processing facility | ✓ | ✓ | | ✓ |
| Nickel West refinery | ✓ | ✓ | | ✓ |
| Tronox pigment plant | ✓ | ✓ | | ✓ |
| CSBP ammonia plant expansion | | ✓ | | ✓ |
| Kwinana waste to energy facility | | ✓ | | ✓ |
| East Rockingham waste to energy facility | | ✓ | | ✓ |
| Covalent lithium plant | | ✓ | | ✓ |
| Tianqui lithium plant | | ✓ | | ✓ |
| BP renewable energy project | | ✓ | | ✓ |
| AGL Kwinana Swift power station upgrade | | ✓ | | ✓ |
| The Boilers | | | ✓ | ✓ |

4.7.4 Meteorological Data and Model Inputs

Meteorological data were simulated using the Weather Research and Forecasting Model and compared against measurements from the nearest weather stations at Jandakot Airport and Garden Island. Source emissions were obtained from publicly available sources including DWER studies; environmental approval documents; NPI reports; and emissions information supplied by operators.

MRP considered two combinations of boilers:

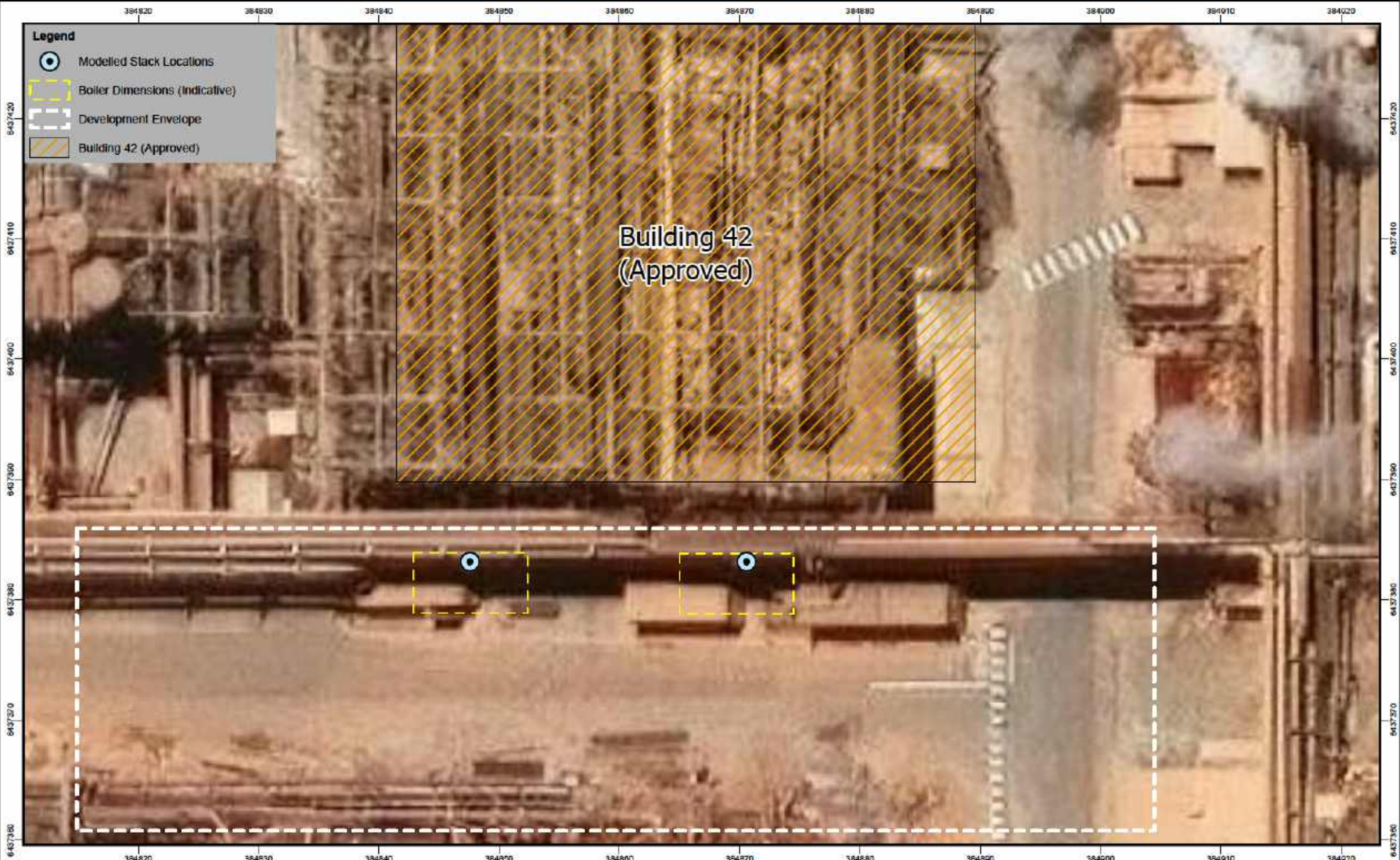
- 2 x John Thompson SD18.
- 1 x John Thompson SD17.5 and 1 x John Thompson SD18.

Modelled parameters for the Boilers are provided in Table 4-8. The modelled position of the stacks is shown in relation to the Development Envelope in Figure 4-3. The Development Envelope has been sized such that the constructed positions of the stacks will be no more than 30 m from the modelled locations, which is unlikely to have a material effect on the conclusions of the air quality assessment.

Table 4-8 Modelled parameters for the Boilers

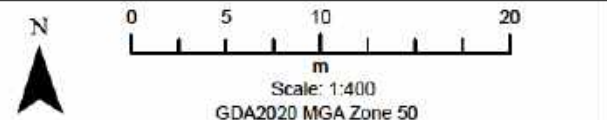
| Parameter | Combination 1 (Scenarios 3A&B) | | Combination 2 (Scenarios 4A&B) | |
|--------------------------------------|--------------------------------|--------------------|--------------------------------|----------------------|
| | Boiler 1 | Boiler 2 | Boiler 1 | Boiler 2 |
| Boiler | John Thompson SD18 | John Thompson SD18 | John Thompson SD18 | John Thompson SD17.5 |
| Easting (m) ¹ | 384,870 | 384,847 | 384,870 | 384,847 |
| Northing (m) ¹ | 6,437,394 | 6,437,394 | 6,437,394 | 6,437,394 |
| Stack height (m) | 12 | 12 | 12 | 15 |
| Diameter (m) | 0.8 | 0.8 | 0.8 | 1.2 |
| Exit velocity (m/s) | 27.85 | 27.85 | 27.85 | 12.00 |
| Exit temperature (°K) | 543.15 | 543.15 | 543.15 | 623 |
| Modelled Emission rates (g/s) | | | | |
| NO _x | 1.81 | 1.81 | 1.81 | 0.893 |
| SO ₂ | 0.03668 | 0.03668 | 0.03668 | 0.03556 |
| CO | 0.3207 | 0.3207 | 0.3207 | 0.7773 |
| PM ₁₀ | 0.007839 | 0.007839 | 0.007839 | 0.0076 |
| PM _{2.5} | 0.007839 | 0.007839 | 0.007839 | 0.0076 |
| Emission Concentrations | | | | |
| NO _x | 100 | 100 | 100 | 106 |
| SO ₂ | 1 | 1 | 1 | 1 |
| CO | 20 | 20 | 20 | 50 |
| PM ₁₀ | 0.56 | 0.56 | 0.56 | 0.56 |
| PM _{2.5} | 0.56 | 0.56 | 0.56 | 0.56 |

¹ WGS84, UTM Zone 50S



- Legend**
- Modelled Stack Locations
 - Boiler Dimensions (Indicative)
 - Development Envelope
 - Building 42 (Approved)

Building 42
(Approved)



Kwinana Building 42 Project

Figure 4-3 Modelled Position of Stacks

4.7.5 Model Results

MRP predicted air quality at each receptor; the maximum concentrations outside the Alcoa Prescribed Premises (Maximum Off-site concentration); and the maximum concentrations outside Areas A and B of the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy (Kwinana EPP).

Scenarios 3B and 4B predict air quality at receptors when the Boilers and all other significant emission sources in the KIA are operating. The predicted maximum off-site concentrations under these scenarios is provided in Table 4-9. If these are within criteria, then air quality impacts are unlikely.

Table 4-9 shows that the predicted maximum offsite concentration of all parameters is within criteria apart from SO₂ over 1-hour; and 24-hour and annual PM_{2.5}. Of these:

- 1-hour SO₂ concentrations at receptors for Scenarios 3B and 4B are provided in Table 4-10 and are within the criterion.
- 24-hour PM_{2.5} concentrations at receptors for Scenarios 3B and 4B are provided in Table 4-11 and are within the criterion.
- Annual PM_{2.5} concentrations at receptors for Scenarios 3A, 3B, 4A and 4B are provided in Table 4-12. Background levels and modelled concentrations at each receptor exceed the criterion under Scenarios 3B and 4B. However, modelling of the Boilers only (Scenarios 3A and 4A) shows that the contribution of the Boilers to the exceedance is negligible (<1% of the criterion), as expected from gas combustion.

MRP concluded that the contribution of the Boilers to regional air quality is minor, unlikely to result in unacceptable air quality impacts or materially change the existing air quality environment within the Kwinana region.

The full report, including descriptions of the model, results and air quality maps is provided in Appendix 1.

Table 4-9 Modelled Maximum Off-Site Concentrations for Scenarios 3B and 4B

| Parameter | Averaging Period | Criteria | Background | | Scenario 3B | | Scenario 4B | |
|-------------------|------------------|-------------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|
| | | µg/m ³ | µg/m ³ | % of criterion | µg/m ³ | % of criterion | µg/m ³ | % of criterion |
| NO ₂ | 1-hour | 150 | 35.7 | 24% | 147 | 98% | 147 | 98% |
| | Annual | 28 | 11.3 | 40% | 22 | 80% | 22 | 80% |
| SO ₂ | 1-hour | 196 | 10.5 | 5% | 216 | 110% | 216 | 110% |
| | 24-hour | 52 | 7.9 | 15% | 24 | 47% | 24 | 47% |
| | Annual | 46 | 5.2 | 11% | 8.9 | 19% | 8.9 | 19% |
| CO | 1-hour | 30,000 | 521 | 2% | 1376 | 5% | 1376 | 5% |
| | 8-hour | 10,000 | 343 | 3% | 886 | 9% | 886 | 9% |
| PM ₁₀ | 24-hour | 46 | 15.9 | 35% | 28.5 | 62% | 28.5 | 62% |
| | Annual | 23 | 13.2 | 57% | 15.02 | 65% | 15.02 | 65% |
| PM _{2.5} | 24-hour | 18 | 8.6 | 48% | 21.1 | 117% | 21.1 | 117% |
| | Annual | 6.4 | 7.6 | 119% | 9.4 | 147% | 9.4 | 147% |

Reference conditions 25°C and 101.3 kPa

Table 4-10 1-hour Average SO₂ Concentrations at Receptors

| Receptor | Criterion | Background | | Scenario 3B | | Scenario 4B | |
|--------------------------------|-------------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|
| | µg/m ³ | µg/m ³ | % of criterion | µg/m ³ | % of criterion | µg/m ³ | % of criterion |
| Maximum Outside Buffer Area | 196 | 10.5 | 5% | 96 | 49% | 96 | 49% |
| Wells Park | | | | 47 | 24% | 47 | 24% |
| Golf Course | | | | 37 | 19% | 37 | 19% |
| Thomas Oval | | | | 38 | 19% | 38 | 19% |
| Oval | | | | 62 | 32% | 62 | 32% |
| Residence | | | | 31 | 16% | 31 | 16% |
| North Rockingham AQMS | | | | 31 | 16% | 31 | 16% |
| Residence | | | | 27 | 14% | 27 | 14% |
| Hope Valley | | | | 71 | 36% | 71 | 36% |
| Calista Primary School | | | | 29 | 15% | 29 | 15% |
| Wombat Wallow Childcare Centre | | | | 35 | 18% | 35 | 18% |
| Wellard Road Residence | | | | 23 | 12% | 23 | 12% |
| Korcula Ct | | | | 27 | 14% | 27 | 14% |
| Mannikin Hts | | | | 31 | 16% | 31 | 16% |
| Rosewood St | | | | 22 | 11% | 22 | 11% |
| Collerson St | | | | 19 | 10% | 19 | 10% |
| Mcmillian Rd | | | | 21 | 11% | 21 | 11% |
| Naval Base Shacks | | | | 32 | 16% | 32 | 16% |
| Hope Valley Residence | | | | 83 | 42% | 83 | 42% |
| Wattleup Residence | | | | 35 | 18% | 35 | 18% |

Reference conditions 25°C and 101.3 kPa

Table 4-11 24-hour Average PM_{2.5} Concentrations at Receptors

| Receptor | Criterion | Background | | Scenario 3 | | Scenario 4 | |
|--------------------------------|-------------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|
| | µg/m ³ | µg/m ³ | % of criterion | µg/m ³ | % of criterion | µg/m ³ | % of criterion |
| Maximum outside buffer area | 18 | 8.6 | 48% | 16.1 | 89% | 16.1 | 89% |
| Wells Park | | | | 15.6 | 87% | 15.6 | 87% |
| Golf Course | | | | 10.5 | 58% | 10.5 | 58% |
| Thomas Oval | | | | 10.7 | 60% | 10.7 | 60% |
| Oval | | | | 11.6 | 65% | 11.6 | 65% |
| Residence | | | | 10.5 | 58% | 10.5 | 58% |
| North Rockingham AQMS | | | | 12.4 | 69% | 12.4 | 69% |
| Residence | | | | 10.7 | 60% | 10.7 | 60% |
| Hope Valley | | | | 11 | 61% | 11 | 61% |
| Calista Primary School | | | | 10.2 | 57% | 10.2 | 57% |
| Wombat Wallow Childcare Centre | | | | 10.2 | 57% | 10.2 | 57% |
| Wellard Road Residence | | | | 11.9 | 66% | 11.9 | 66% |
| Korcula Ct | | | | 9.6 | 53% | 9.6 | 53% |
| Mannikin Hts | | | | 9.9 | 55% | 9.9 | 55% |
| Rosewood St | | | | 10.1 | 56% | 10.1 | 56% |
| Collerson St | | | | 9.5 | 53% | 9.5 | 53% |
| Mcmillian Rd | | | | 9.9 | 55% | 9.9 | 55% |
| Naval Base Shacks | | | | 10.9 | 61% | 10.9 | 61% |
| Hope Valley Residence | | | | 11.4 | 63% | 11.4 | 63% |
| Wattleup Residence | | | | 10.8 | 60% | 10.8 | 60% |

Reference conditions 25°C and 101.3 kPa

Table 4-12 Annual Average PM_{2.5} Concentrations at Receptors

| Receptor | Criterion | Background | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
|--------------------------------|----------------------|----------------------|----------------|----------------------|----------------|----------------------|----------------|----------------------|----------------|----------------------|----------------|
| | (µg/m ³) | (µg/m ³) | % of criterion | (µg/m ³) | % of criterion | (µg/m ³) | % of criterion | (µg/m ³) | % of criterion | (µg/m ³) | % of criterion |
| Max. outside buffer area | 6.4 | 7.6 | 119% | 0.01 | <1% | 8.7 | 136% | 0.01 | <1% | 8.7 | 136% |
| Wells Park | | | | 0.0002 | <1% | 8.2 | 129% | 0.0002 | <1% | 8.2 | 129% |
| Golf Course | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| Thomas Oval | | | | 0.0002 | <1% | 7.9 | 123% | 0.0002 | <1% | 7.9 | 123% |
| Oval | | | | 0.0003 | <1% | 8.1 | 126% | 0.0003 | <1% | 8.1 | 126% |
| Residence | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| North Rockingham AQMS | | | | 0.0001 | <1% | 7.9 | 123% | 0.0001 | <1% | 7.9 | 123% |
| Residence | | | | 0.0001 | <1% | 7.7 | 121% | 0.0001 | <1% | 7.7 | 121% |
| Hope Valley | | | | 0.0005 | <1% | 8 | 126% | 0.0005 | <1% | 8 | 126% |
| Calista Primary School | | | | 0.0001 | <1% | 7.8 | 121% | 0.0001 | <1% | 7.8 | 121% |
| Wombat Willow Childcare Centre | | | | 0.0002 | <1% | 7.8 | 122% | 0.0002 | <1% | 7.8 | 122% |
| Wellard Road Residence | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| Korcula Ct | | | | 0.0004 | <1% | 7.7 | 121% | 0.0004 | <1% | 7.7 | 121% |
| Mannikin Hts | | | | 0.0004 | <1% | 7.7 | 121% | 0.0004 | <1% | 7.7 | 121% |
| Rosewood St | | | | 0.0005 | <1% | 7.7 | 121% | 0.0005 | <1% | 7.7 | 121% |
| Collerson St | | | | 0.0002 | <1% | 7.7 | 120% | 0.0002 | <1% | 7.7 | 120% |
| Mcmillian Rd | | | | 0.0002 | <1% | 7.7 | 121% | 0.0002 | <1% | 7.7 | 121% |
| Naval Base Shacks | | | | 0.002 | <1% | 7.8 | 122% | 0.002 | <1% | 7.8 | 122% |
| Hope Valley Residence | | | | 0.0006 | <1% | 8.2 | 128% | 0.0006 | <1% | 8.2 | 128% |
| Wattleup Residence | | | | 0.0022 | <1% | 7.8 | 123% | 0.0022 | <1% | 7.8 | 123% |

4.8 Noise

Several premises generate noise in the Kwinana Industrial Area and receptors are likely to receive noise from multiple sources.

Boilers feed pumps are anticipated to have a sound power of ~90 dB(A) at 1 m and fans ~85 dB(A) at 1 m when operational. The Boilers are a substitute steam source and will never be operated concurrently with the powerhouse. For comparison, the Powerhouse noise measurements in Table 4-13 demonstrate the Boilers are significantly quieter than the powerhouse. The Boilers are smaller and a comparable distance to the nearest noise sensitive premises (Figure 4-4).

Alcoa notes that as processing of bauxite has ceased and several significant noise sources, additional to the powerhouse, are not operating, the noise emissions from the Prescribed Premises are significantly lower than under normal operations approved under L5245/1967/14.

4.9 Odour

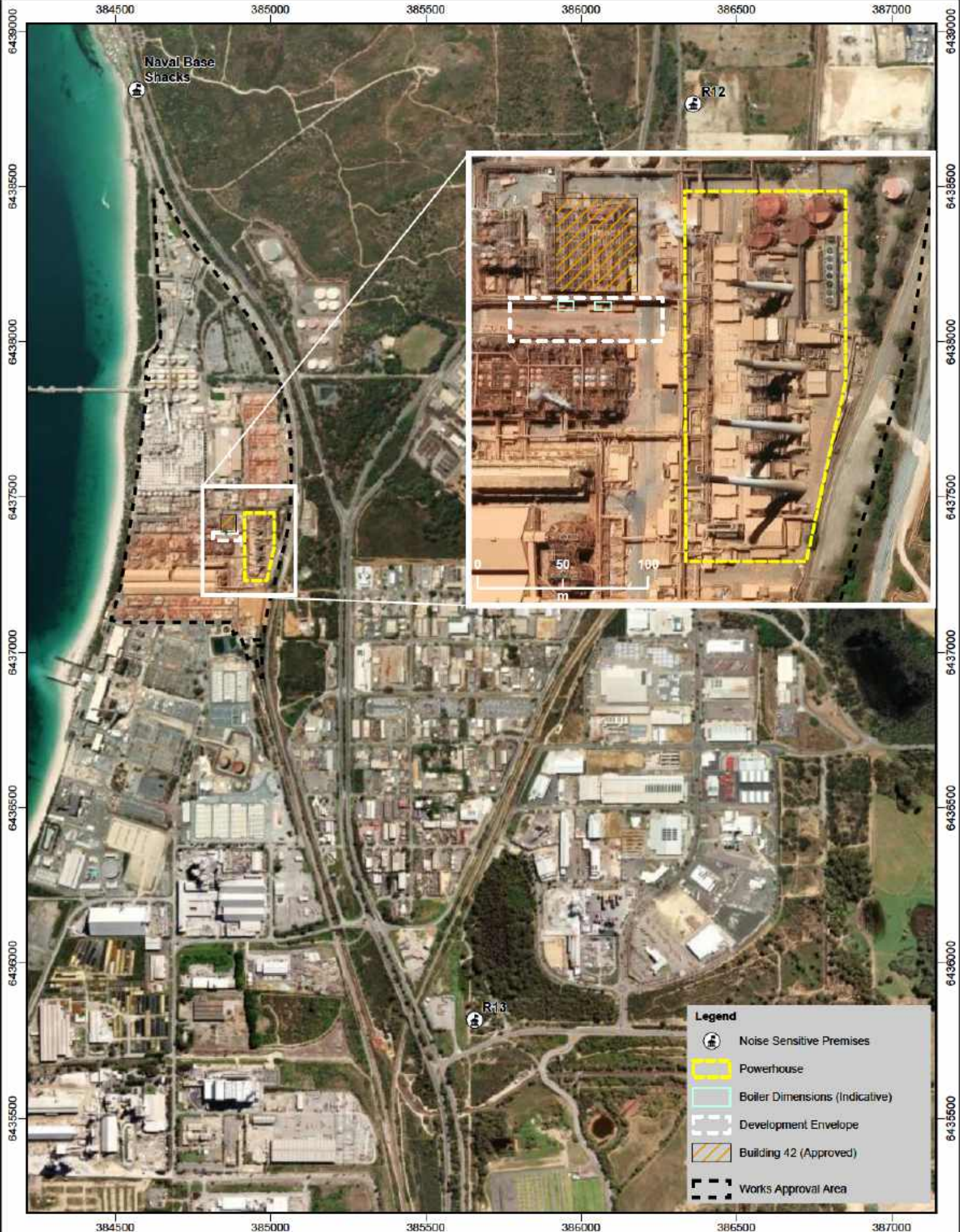
Limited odour emissions are anticipated from natural gas combustion in the Boilers and odour is not considered further in the risk assessment.

Odours may be generated when process water is heated in Building 42 (approved under L5245/1967/14 and not included in this works approval); however, as most of the refinery is non-operational, overall odour emissions from the Prescribed Premises will be lower than historically.

Table 4-13 Powerhouse Noise Measurements

| Noise Measurement | Measurement Location | LAeq, dB(A) |
|---|----------------------|---------------|
| Boiler Fan Enclosures | 1m from Equipment | 106.8 - 111.4 |
| Steam Releases | 1m from Equipment | 89.2 - 103.5 |
| Turbine 3 | 1m from Equipment | 97 - 103.4 |
| High Steam Discharge 3 | 1m from Equipment | 100.6 |
| Turbine 6 | 1m from Equipment | 97.3 - 99.5 |
| Boilers (1,3,4,6,8) Natural Gas Piping | 1m from Equipment | 87.7 - 99.2 |
| Turbines (3,5,7) – Underneath (Ground Floor) | Area Average | 95.9 - 99.2 |
| High Steam Discharge 3&4 Control Valves | 1m from Equipment | 96.4 - 98.9 |
| Turbine 7 | 1m from Equipment | 97.7 - 98.8 |
| Air Compressors (3&5) | 1m from Equipment | 93.9 - 98.5 |
| FP37 - Turbine 6 | Area Average | 98.5 |
| FP33 - Turbine 3 | Area Average | 97.8 |
| FP38 - Turbine 7 | Area Average | 97.8 |
| Turbine 5 | 1m from Equipment | 97.4 - 97.8 |
| Boiler Feed Pumps (4,5,7) | 1m from Equipment | 93 - 97.1 |
| PRV Station 2 – Steam Release Piping | 1m from Equipment | 96.6 |
| FP36 - Turbine 5 | Area Average | 96.3 |
| Boiler Forced Draft Fan Motors | 1m from Equipment | 86.6 - 96 |
| Steam Discharge Line (BLR 6 HS-V-109) | 1m from Equipment | 95.7 |
| Boiler Forced Draft Fans | 1m from Equipment | 90.9 - 94.3 |
| Deaerator Pump 3 | 1m from Equipment | 88.9 - 93.9 |
| Pump - (South of Cooling Towers) | 1m from Equipment | 93.45 |
| PRV Station 2 Valve | 1m from Equipment | 93.4 |
| Powerhouse 2nd Floor | Area Average | 92.9 |
| Powerhouse Ground floor | Area Average | 91.8 |
| Boilers (6&7) Natural Gas Piping | Walking Average @1m | 88.2 - 91.2 |
| Powerhouse 3rd Floor | Area Average | 90.6 |
| Boiler 1 Feed Water Piping | 1m from Equipment | 86.7 |
| Boiler 6 Feed Water Control Valve (1st Floor) | 1m from Equipment | 86.3 |
| Cooling Water Pumps (1,2,4) | 1m from Equipment | 82.9 - 85.3 |
| Powerhouse 1st Floor | Area Average | 83 |

Source: Wood (2024)



6439000
6438500
6438000
6437500
6437000
6436500
6436000
6435500

384500 385000 385500 386000 386500 387000

6439000
6438500
6438000
6437500
6437000
6436500
6436000
6435500

Legend

- Noise Sensitive Premises
- Powerhouse
- Boiler Dimensions (Indicative)
- Development Envelope
- Building 42 (Approved)
- Works Approval Area

N

0 50 100 200 300 400 500

m

Scale: 1:15,000

GDA2020 MGA Zone 50



Kwinana Building 42 Project

Figure 4-4 Nearest Noise Sensitive Premises

5. OTHER APPROVALS AND CONSULTATION

5.1 Regulator Consultation

Alcoa has a regular monthly meeting with representatives of the Industry Licencing, Water, and Contaminated Sites branches of DWER. The restart of Building 42 and the installation of the Boilers was discussed on 25 February 2026; 25 March 2026; and 22 April 2026.

5.2 Other Legislation and Approvals

No other environmental approvals are relevant to the Boilers. A summary of other relevant legislation and approvals is provided in Table 5-1.

Table 5-1 Other Legislation

| Approval | Description |
|--|---|
| <i>Rights in Water and Irrigation Act 1914</i> | |
| 5C Licence to Abstract | Not required. The Project does not include abstraction of groundwater or surface water. Alcoa holds GWL159085(3) which approves abstraction for industrial purposes. |
| 26D Licence to Construct | Not required. Project does not include the construction of abstraction or reinjection bores |
| Bed and Banks Permit | Not required. No disturbance to the bed and banks of a watercourse is proposed. |
| <i>Environmental Protection Act 1986, Part IV</i> | |
| Ministerial Statement | Not required. Significant impacts to key environmental factors are not anticipated. Emissions associated with the Boilers are expected to be lower than those associated with the powerhouse. |
| <i>Environmental Protection Act 1986, Part V, Division 2</i> | |
| Clearing Permit | Not required. No clearing of native vegetation is required. |
| <i>Biodiversity Conservation Act 2016</i> | |
| Section 40 Authorizations. | Not required. No taking or disturbing threatened fauna is proposed. |

| Approval | Description |
|--|--|
| <i>Contaminated Sites Act 2003</i> | |
| Mandatory Auditors Report | <p>Not required</p> <p>Lot 102 on P18242 has been classified <i>Contaminated – remediation required</i>. Alkaline groundwater plumes are actively managed using recovery bores, natural attenuation, and monitoring in accordance with the <i>Kwinana Groundwater Monitoring and Management Plan (GMMP)</i> (Alcoa, 2025).</p> <p>The proposed activities will not exacerbate the existing contamination or necessitate a review of the management controls detailed within the GMMP.</p> |
| <i>Dangerous Goods Safety Act 2004</i> | |
| Dangerous Goods Licence | Alcoa holds dangerous goods storage licence DGS001582 for the Kwinana Alumina Refinery. An amendment is not required for the Boilers. |
| <i>Alumina Refinery Agreement Act 1961</i> | |
| None | <p>Not required</p> <p>Amendments to the state agreement act are not required.</p> |
| <i>Environment Protection and Biodiversity Conservation Act 1999</i> | |
| Ministerial Statement | <p>Not required.</p> <p>Significant impacts to protected matters are not anticipated.</p> |
| <i>National Greenhouse and Energy Reporting Act 2007</i> | |
| None | <p>Greenhouse gas emissions from Alcoa’s operations in Australia exceed the reporting thresholds and are reported to the Clean Energy Regulator annually.</p> <p>The Kwinana Refinery has historically been a registered facility under the Safeguard Mechanism; however, Scope 1 emissions are anticipated to be below the threshold.</p> |



6. WASTE, EMISSIONS AND DISCHARGES

Emissions and discharges for each phase of the Project are described in Table 6-1.

Table 6-1 Emissions and discharges

| Source of Emission or Discharge | Emission or Discharge Type | Volume and Frequency | Proposed Controls | Location |
|---|----------------------------|---|---|------------------------|
| Construction Phase | | | | |
| Installation of boilers and supporting infrastructure | Dust | <ul style="list-style-type: none"> Limited dust is expected during construction due to the small scale of the Project and as all surfaces are sealed. | <ul style="list-style-type: none"> None. Surfaces are already sealed. | Refinery - Figure 3-1. |
| | Noise | <ul style="list-style-type: none"> Construction noise will consist of mobile equipment movements and use of hand-held tools. Material noise emissions associated with construction are not expected. | <ul style="list-style-type: none"> Vehicles, machinery, and equipment fitted with standard noise control devices. Operate HV, LV, equipment, and machinery in an efficient manner. Speed limits are in place and enforced. These limit engine noise emissions. | |
| | Waste | <ul style="list-style-type: none"> Minor quantities of packaging and construction wastes may be generated. | <ul style="list-style-type: none"> Implementation of existing waste management system. | |



| Source of Emission or Discharge | Emission or Discharge Type | Volume and Frequency | Proposed Controls | Location |
|--|--|---|---|------------------------|
| Commissioning / Operational Phase | | | | |
| Boilers | Stack emissions including particulates, CO, NO _x and SO _x . | <ul style="list-style-type: none"> Ongoing | <ul style="list-style-type: none"> Boilers operated and maintained in accordance with manufacturer's specifications. Stack to be no less than 12m high. Boiler designed for efficient combustion. Stack testing to verify emissions are within predicted limits. Emissions to air anticipated to be lower than during operation of the refinery. | Refinery - Figure 3-1. |
| | Cumulative noise emissions from the Boilers, Building 42, other activities at the refinery and neighbouring industrial operations. | <ul style="list-style-type: none"> Ongoing | <ul style="list-style-type: none"> Boilers operated and maintained in accordance with manufacturer's specifications. Noise from Boilers is less than from the Powerhouse, which will not be operated while the Boilers are running. Cumulative noise from alumina refinery anticipated to be significantly lower than during normal operation. | Refinery - Figure 3-1 |
| | Blowdown water | <ul style="list-style-type: none"> Ongoing | <ul style="list-style-type: none"> Blowdown water captured in purpose built tank and piped to existing sumps for transfer to the lined ROWS Pond. Surfaces are sealed | Refinery - Figure 3-1 |



| Source of Emission or Discharge | Emission or Discharge Type | Volume and Frequency | Proposed Controls | Location |
|---------------------------------|---|--|--|-----------------------|
| | Cleaning in Place chemicals and waste water | <ul style="list-style-type: none"> Minor quantities produced Intermittently | <ul style="list-style-type: none"> Temporary hoses used to transfer chemicals and wastewater to and from IBCs. Wastewater either removed from site by licenced contractor or directed to sumps for transfer to lined ROWS Pond. Surfaces are sealed | Refinery - Figure 3-1 |

7. SITING AND LOCATION

The Project is in the Kwinana Industrial Area (KIA) ~27 km south of the Perth Central Business District and 4.5 km north of Kwinana City Centre. An assessment of the Project against the Environmental Siting Guideline (DWER, 2020) is provided in Table 7-1.

Table 7-1 Nearby Environmentally Sensitive Receptors and Aspects

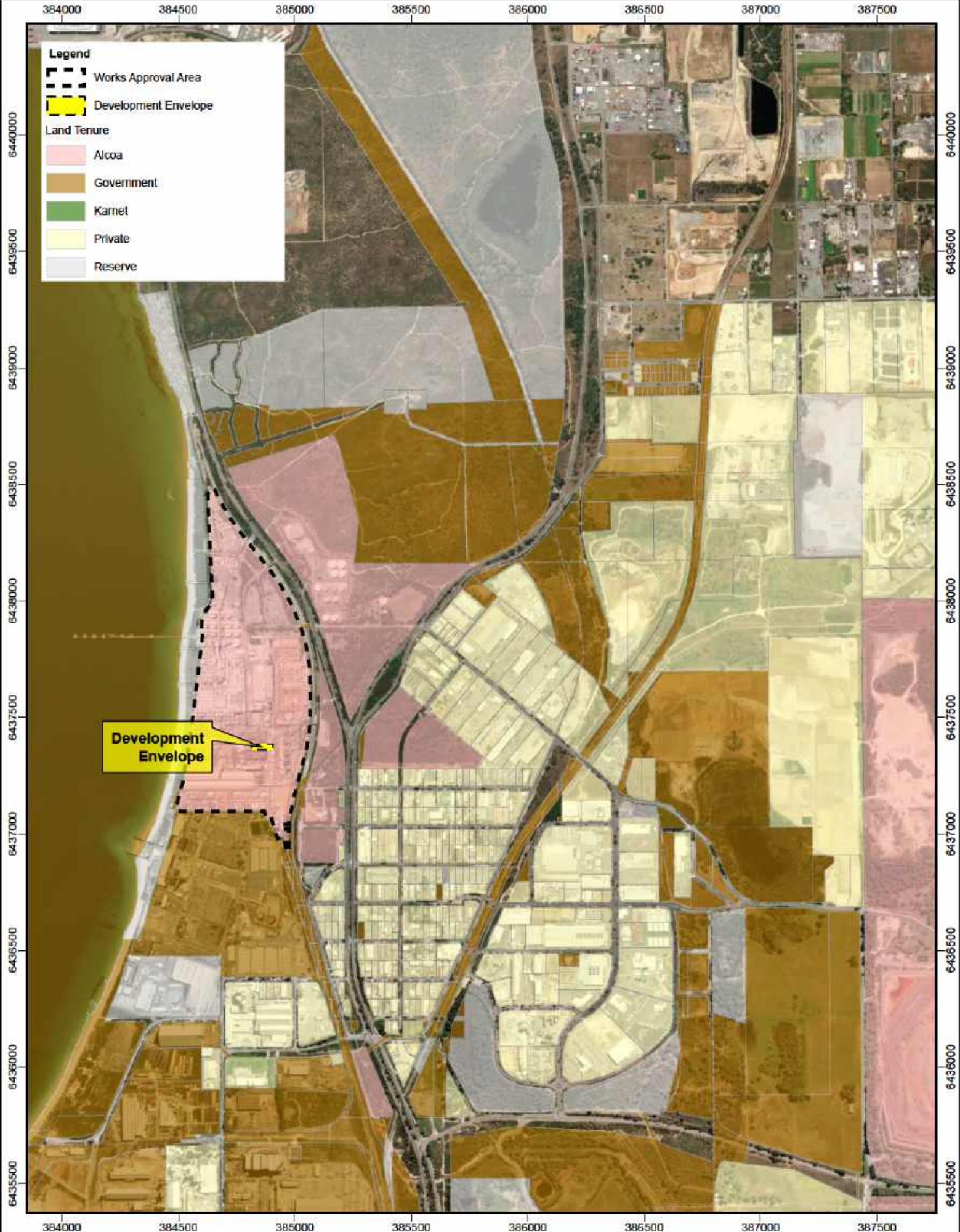
| Type / Classification | Description | Distance + Direction | Proposed controls to prevent or mitigate adverse impacts (if applicable) |
|--|---|--|---|
| Sensitive Land Uses / Users | <p>Land users are shown in Figure 7-1 and receptors in Figure 4-2 and Figure 4-4. The proposed works are restricted to industrial land holdings within the KIA. Neighbouring properties include industrial land, state-owned land, public beaches, Naval Base Caravan Park and residential properties.</p> <p>Noise and emissions to air are expected to be lower than during approved operations. Air quality modelling predicts that the Boilers will not cause a decline in air quality. Significant impacts to receptors are not anticipated.</p> | <p>Adjacent industrial properties and public beaches. Naval Base Shacks are ~330m north of the Works Approval Area and ~1.5km north of the of the Boilers.</p> | <ul style="list-style-type: none"> • Selection of natural gas boilers, which is a cleaner fuel than diesel alternatives. • Boilers operated and maintained in accordance with manufacturer's specifications. • Stack to be no less than 12m high. • Boiler designed for efficient combustion. • Stack testing to verify emissions are within predicted limits. |
| Environmentally Sensitive Areas (ESAs) | <p>ESAs mapped by DWER (DWER-046) are shown in Figure 7-2. The closest ESA is associated with Bush Forever Site 346. There are no ESAs in the Works Approval Area and impacts are not anticipated.</p> | <p>Bush Forever Site 346 is adjacent to Works Approval Area and ~650m NW of the Boilers.</p> | <p>Siting of Project in refinery complex where no additional disturbance is required.</p> |
| Threatened / Priority Ecological Communities (TECs / PECs) | <p>TECs and PECs are known to occur on the Swan Coastal Plain. None occur in the Works Approval Area. Flora surveys and DBCA regional mapping indicate the following TECs and PECs in and around the Alcoa Kwinana Landholdings:</p> | <p>None within Works Approval Area.</p> | <p>Siting of Project in refinery complex where no additional disturbance is required.</p> |



| Type / Classification | Description | Distance + Direction | Proposed controls to prevent or mitigate adverse impacts (if applicable) |
|-------------------------------------|--|---|--|
| | <ul style="list-style-type: none"> • <i>Melaleuca huegelii</i> – <i>Melaleuca systena</i> shrublands on limestone ridges (Critically Endangered). • Banksia woodlands of the Swan Coastal Plain (Priority 3) • Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain (Priority 3) <p>All of these are also listed under the EPBC Act. There are no TECs and PECs in the Works Approval Area due to the absence of any intact vegetation. No additional disturbance is proposed and impacts to vegetation are not anticipated.</p> | | |
| Threatened and/or priority fauna | Conservation significant fauna occur in remnant habitat in the Kwinana Industrial Area. The Western Australia area has been historically cleared and no additional disturbance is proposed. Impacts are not anticipated. | No habitat is present within the Works Approval Area. | Siting of Project in refinery complex where no additional disturbance is required. |
| Threatened and/or priority flora | Conservation significant flora are known to occur in the Kwinana Industrial Area. The Works Approval Area has previously been cleared and no additional disturbance is proposed. Impacts are not anticipated. | None in Works Approval Area. | Siting of Project in refinery complex where no additional disturbance is required. |
| Aboriginal and other heritage sites | Aboriginal Heritage Sites registered and lodged sites (DPLH-099 and DPLH-100), Local Heritage Sites (DPLH-008) and State Registered Heritage Sites (DPLH-006) are shown in Figure 7-3. The Works Approval Area does not intersect any of the abovementioned spatial datasets. No additional disturbance is proposed and impacts are not anticipated. | <ul style="list-style-type: none"> • Lodged Aboriginal Site 20865 located ~270m north-east of the Works Approval Area. • Local & State Registered site P17868 located ~140m north of the Works Approval Area. | Siting of Project in refinery complex where no additional disturbance is required. |
| Public drinking water source areas | The Works Approval Area is not located within a defined public drinking water source area (PDWSA). | None in or downgradient of Works Approval Area. | None |



| Type / Classification | Description | Distance + Direction | Proposed controls to prevent or mitigate adverse impacts (if applicable) |
|--|---|---|--|
| | The nearest PDWSA is the Jandakot Underground Water Pollution Control Area, ~7.5 km east and up-gradient of the Works Approval Area. Impacts are not anticipated | | |
| Rivers, lakes, oceans, and other bodies of surface water, etc. | The Works Approval Area is 50m east of Cockburn Sound. The Boilers are unlikely to impact Cockburn Sound. There are no defined watercourses in or near the Works Approval Area. Wetlands are shown in Figure 7-4. There are no wetlands in or down-gradient on the Works Approval Area. | <ul style="list-style-type: none"> • Cockburn Sound – 50 m E of Works Approval Area. • Lake Mount Brown: ~1.6km NE of Works Approval Area. • Unknown wetland ~0.2 km E of Works Approval Area. • Unknown Wetland ~1.1 km SE of Works Approval Area. | None |
| Acid sulfate soils | Acid sulphate soil (ASS) risk areas (DWER 055) are shown in Figure 7-5. No ASS risk areas have been identified in the Works Approval Area and no groundwater drawdown or disturbance of soils is proposed. ASS impacts are not anticipated | Risk areas identified: <ul style="list-style-type: none"> • ~1.6km NE of Works Approval Area. • ~1.7km E of Works Approval Area. | None |



Legend

- Works Approval Area
- Development Envelope

Land Tenure

- Alcoa
- Government
- Karnet
- Private
- Reserve

Development Envelope

N

0 100 200 400 600

m

Scale: 1:20,000

GDA2020 MGA Zone 50

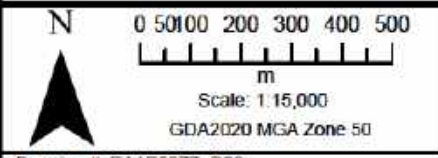


Kwinana Building 42 Project

Figure 7-1 Land Users



Development Envelope



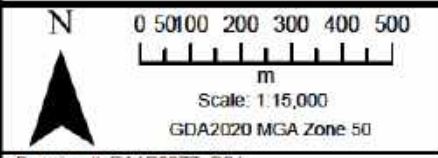
Kwinana Building 42 Project

Figure 7-2 Environmentally Sensitive Areas

Drawing #: EA1P0077_D03
Date: 8/05/2026

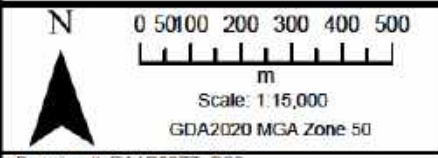
Author: smita
Rev: A | A4
Date Printed: 8/05/2026

Path: L:\users\EApprovals\EA1P0068 - Building 42\Projects\EA1P0068\EA1P0068.aprx



Kwinana Building 42 Project

Figure 7-3 Heritage Sites



Kwinana Building 42 Project

Figure 7-4 Wetlands

384500

385000

385500

386000

386500


387000

Legend

 Development Envelope

 Works Approval Area

Acid Sulfate Soil Risk Map, Swan Coastal Plain (DWER-055)

 1 - High to moderate risk of ASS occurring within 3m of natural soil surface

6438500

6439000

6438500

6438000

6437500

6437000

6436500

6438500

6439000

6438500

6438000

6437500

6437000

6436500

Development Envelope



384500

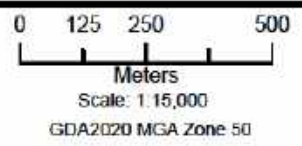
385000

385500

386000

386500

387000



Kwinana Building 42 Project

Figure 7-5 Acid Sulfate Soils

Drawing #: EA1P0077_D05

Author: smita

Date: 8/05/2026

Rev: A, A4

Date Printed: 8/05/2026

Path: L:\users\EAApprovals\EA1P0068 - Building 42\Projects\EA1P0068\EA1P0068.aprx

8. RISK ASSESSMENT

8.1 Risk Assessment Overview

A risk assessment of the proposed activities was completed in accordance with DWER guidance for risk assessments (DWER, 2020). DWER consequence criteria are in Table 8-1, likelihood definitions in Table 8-2 and the risk matrix in Table 8-3.

Table 8-1 Consequence Matrix (DWER, 2020)

| Consequence | Consequence Description | |
|-------------|---|---|
| | Environment | Public health* and amenity (such as air and water quality, noise and odour) |
| Severe | <ul style="list-style-type: none"> Onsite impacts: catastrophic Offsite impacts local scale: high level or above Offsite impacts wider scale: mid-level or above Mid to long-term or permanent impact to an area of high conservation value or special significance[^] Specific Consequence Criteria (for environment) are significantly exceeded | <ul style="list-style-type: none"> Loss of life Adverse health effects: high level or ongoing medical treatment Specific Consequence Criteria (for public health) are significantly exceeded Local scale impacts: permanent loss of amenity |
| Major | <ul style="list-style-type: none"> Onsite impacts: high level Offsite impacts local scale: mid-level Offsite impacts wider scale: low level Short-term impact to an area of high conservation value or special significance[^] Specific Consequence Criteria (for environment) are exceeded | <ul style="list-style-type: none"> Adverse health effects: mid-level or frequent medical treatment Specific Consequence Criteria (for public health) are exceeded Local scale impacts: high level impact to amenity |
| Moderate | <ul style="list-style-type: none"> Onsite impacts: mid-level Offsite impacts local scale: low level Offsite impacts wider scale: minimal Specific Consequence Criteria (for environment) are at risk of not being met | <ul style="list-style-type: none"> Adverse health effects: low level or occasional medical treatment Specific Consequence Criteria (for public health) are at risk of not being met Local scale impacts: mid-level impact to amenity |
| Minor | <ul style="list-style-type: none"> Onsite impacts: low level Offsite impacts local scale: minimal Offsite impacts wider scale: not detectable Specific Consequence Criteria (for environment) likely to be met | <ul style="list-style-type: none"> Specific Consequence Criteria (for public health) are likely to be met Local scale impacts: low level impact to amenity |
| Slight | <ul style="list-style-type: none"> Onsite impact: minimal Specific Consequence Criteria (for environment) met | <ul style="list-style-type: none"> Local scale: minimal impacts to amenity Specific Consequence Criteria (for public health) criteria met |

[^] For areas of high conservation value or special significance, we will use the Guideline: Environmental siting to inform our decision

* In applying public health criteria, we may use the Department of Health's Health risk assessment (scoping) guidelines

'Onsite' means within the prescribed premises boundary

Table 8-2 Likelihood Matrix (DWER, 2020)

| Likelihood | Likelihood Description |
|----------------|--|
| Almost certain | The risk event is expected to occur in most circumstances |
| Likely | The risk event will probably occur in most circumstances |
| Possible | The risk event could occur at some time |
| Unlikely | The risk event will probably not occur in most circumstances |
| Rare | The risk event may only occur in exceptional circumstances |

Table 8-3 Risk Matrix (DWER, 2020)

| Likelihood | Consequence | | | | |
|----------------|-------------|--------|----------|---------|---------|
| | Slight | Minor | Moderate | Major | Severe |
| Almost Certain | Medium | High | High | Extreme | Extreme |
| Likely | Medium | Medium | High | High | Extreme |
| Possible | Low | Medium | Medium | High | Extreme |
| Unlikely | Low | Medium | Medium | Medium | High |
| Rare | Low | Low | Medium | Medium | High |

8.2 Risk and Impact Assessment

Potential emissions, impacts, controls and risk evaluation associated with the proposal are provided in Table 8-4.

Table 8-4 Risk Assessment

| Risk Event | | | | | Residual Risk | | |
|---|------------------------------|---|--|--|---------------|-------------|------------|
| Potential Emission | Potential Pathway | Potential Receptor | Potential Adverse Impact | Controls | Likelihood | Consequence | Likelihood |
| Construction: | | | | | | | |
| Dust from vehicles or construction activities | Windborne particulate matter | Neighbouring industrial and other properties Environmental values: wetlands and biodiversity | Human health and amenity impacts, including, respiratory illness and nuisance dust. Impacts to biodiversity, flora, and fauna health. | <ul style="list-style-type: none"> Surfaces are already sealed. Negligible dust anticipated | Rare | Slight | Low |
| Construction Noise | Atmosphere | Neighbouring industrial and other properties | Amenity impacts | <ul style="list-style-type: none"> Vehicles, machinery, and equipment fitted with standard noise control devices. HV, LV, equipment, and machinery operated in an efficient manner. Speed limits are in place and enforced. These limit engine noise emissions. | Unlikely | Slight | Low |
| Hydrocarbon or chemical spills | Discharge to ground | Soil and groundwater | Localised impacts to soil and groundwater | <ul style="list-style-type: none"> Surfaces are already sealed. Spills to be cleaned up | Unlikely | Slight | Low |
| Commissioning and Operations: | | | | | | | |
| Air emissions from Boiler Stacks | Air and wind | Neighbouring industrial and other properties | Human health and impacts | <ul style="list-style-type: none"> Selection of natural gas rather than diesel boilers. Modelling predicts Boilers are unlikely to cause significant air quality impacts. Boilers operated and maintained in accordance with manufacturer's specifications. Stack to be no less than 12m high. Boiler designed for efficient combustion Stack testing to confirm SO₂, NO₂ and CO emissions are within predicted criteria. | Unlikely | Minor | Medium |
| Noise | Atmosphere | Neighbouring industrial and other properties | Amenity impacts | <ul style="list-style-type: none"> Maintenance in accordance with manufacturers specifications. Boilers are quieter than the powerhouse Overall decline in noise from Prescribed Premises expected as site transitions to closure. | Unlikely | Minor | Medium |
| Wastewater | Discharge to ground | Soil and groundwater | Minor local impacts to soil and groundwater | <ul style="list-style-type: none"> Surfaces are sealed Blowdown water captured in purpose built tank and piped to existing sumps for transfer to the lined ROWS Pond. Temporary hoses used to transfer inhibited sulfuric acid and wastewater during periodic chemical cleaning. Wastewater from periodic chemical cleaning either removed from site by licenced contractor or directed to sumps for transfer to lined ROWS Pond. Water captured in existing sumps and directed to lined ROWS Pond. | Possible | Slight | Low |



9. CAPITAL COST

An estimate of capital costs is provided in Table 9-1. [REDACTED] capital costs equates to a works approval application fee of [REDACTED]. Note that the Boilers will be rented and are not included in the capital cost estimate.

Table 9-1 Capital Costs

A large black rectangular box redacts the content of Table 9-1, which would otherwise contain the capital cost estimates.

10. REFERENCES

- Alcoa. (2025). *Kwinana Groundwater Monitoring and Management Plan*. Perth: Alcoa of Australia Limited.
- DWER. (2019). *Guideline: Air emissions*. Perth: Department of Water and Environmental Regulation.
- DWER. (2019). *Industry Regulation Guide to Licensing: Activities Regulated Under the Environmental Protection Act 1986 and Environmental Protection Regulations 1987*. Perth: Department of Water and Environmental Regulation.
- DWER. (2020). *Guideline: Environmental Siting: Part V, Division 3, Environmental Protection Act 1986*. Perth: Department of Water and Environmental Regulation.
- DWER. (2020). *Guideline: Risk Assessments: Part V, Division 3, Environmental Protection Act 1986*. Perth: Department of Water and Environmental Regulation.
- EPA. (1999). *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy*. Perth: Environmental Protection Authority.
- MRP. (2026). *Kwinana Refinery Boiler: Air Quality Assessment*. Perth: MRP Technical Consulting.
- NEPC. (2021). *National Environment Protection (Ambient Air Quality) Measure*. Adelaide: National Environment Protection Council.
- Wood. (2024). *Alcoa Kwinana Occupational Noise Survey 2024*. Melbourne: Wood Australia Pty Ltd.



Appendix 1: Air Dispersion Modelling (MRP, 2026)

Intended For
Alcoa of Australia

Document type
Final Report

Date
7th May 2026

Kwinana Refinery Boiler Air Quality Assessment

Alcoa



Project Name **Kwinana Refinery Boiler Air Quality Assessment**
Project No. **01-0090**
Document Type **Final Report**
Version **Final**
Date **7th May 2026**
Prepared By **Lachlan Dowsett**
Approved By **Martin Parsons**

| Revision | Date | Made by | Approved by | Description |
|----------|-----------------------------|----------------------------------|----------------|---------------|
| A | 28 th April 2026 | Lachlan Dowsett & Caelan Whiting | Martin Parsons | Initial issue |
| B | 6 th May 2026 | Caelan Whiting | Martin Parsons | Updated draft |
| Final | 7 th May 2026 | Martin Parsons | Martin Parsons | Final |

MRP Technical Consulting Pty Ltd prepared this report in accordance with the scope of work as outlined in our proposal to Alcoa of Australia dated 13/4/2026 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent MRP's professional judgement based on information made available during the course of this assignment and are true and correct to the best of MRP's knowledge as at the date of the assessment.

MRP did not independently verify all of the written or oral information provided during the course of this investigation. While MRP has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to MRP was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

This report has been prepared for Alcoa of Australia and may not be relied upon by any other person or entity without MRP's express written permission.

MRP Technical Consulting Pty Ltd
ACN: 679 732 453
ABN: 15679732453

Table of Contents

| | | |
|-------|--|-----|
| 1 | Introduction | 1 |
| 2 | Air quality criteria | 4 |
| 2.1 | Ambient air quality criteria | 4 |
| 3 | Ambient monitoring..... | 5 |
| 3.1 | Existing environment..... | 5 |
| 3.2 | Peak-to-mean ratio | 7 |
| 4 | Air dispersion modelling and methodology | 8 |
| 4.1 | Air dispersion model | 8 |
| 4.2 | Meteorological data | 9 |
| 4.2.1 | Metrological model configuration | 10 |
| 4.2.2 | Analysis of meteorological model results..... | 12 |
| 4.2.3 | Meteorological validation | 18 |
| 4.3 | Modelled scenarios..... | 19 |
| 4.3.1 | Scenario 1 – Current operations | 19 |
| 4.3.2 | Scenario 2 – Future sources | 20 |
| 4.3.3 | Scenario 3 – Boiler combination 1..... | 20 |
| 4.3.4 | Scenario 4 – Boiler combination 2..... | 20 |
| 4.4 | Emissions estimates and stack parameters | 21 |
| 4.5 | Treatment of oxides of nitrogen..... | 22 |
| 5 | Results..... | 23 |
| 5.1 | Model validation | 23 |
| 5.2 | Air quality assessment results | 24 |
| 6 | Summary | 132 |
| 7 | Limitations..... | 133 |
| 8 | References..... | 133 |

Tables

| | |
|--|----|
| Table 2-1: Ambient air quality criteria | 4 |
| Table 2-2: Ambient air quality criteria | 5 |
| Table 3-1: DWER background monitoring concentrations – Kwinana | 6 |
| Table 4-1: Discrete Receptor Locations | 9 |
| Table 4-2: Performance evaluation summary – Wind speed and wind direction | 18 |
| Table 4-3: Summary of source parameters and emission estimates of the proposed boilers for Scenario 3 – Boiler combination 1 | 21 |
| Table 4-4: Summary of source parameters and emission estimates of the proposed boilers for Scenario 4 – Boiler combination 2..... | 22 |
| Table 4-5: Monitored concentrations of O ₃ (ppb) at North Rockingham AQMS (1 st July 2023 to 30 th June 2024) | 23 |

| | |
|--|----|
| Table 5-1: Summary of maximum 1-hour average and annual average predicted GLCs of NO ₂ at sensitive receptor locations..... | 25 |
| Table 5-2: Summary of maximum 1-hour and 24-hour averages, and annual average predicted GLCs of SO ₂ at sensitive receptor locations..... | 27 |
| Table 5-3: Summary of maximum 1-hour and 8-hour average predicted GLCs of CO at sensitive receptor locations..... | 30 |
| Table 5-4: Summary of maximum 24-hour average and annual average predicted GLCs of PM ₁₀ at sensitive receptor locations..... | 32 |
| Table 5-5: Summary of maximum 24-hour average and annual average predicted GLCs of PM _{2.5} at sensitive receptor locations..... | 34 |

Figures

| | |
|--|----|
| Figure 1-1: Overview of region | 2 |
| Figure 1-2: Source location | 3 |
| Figure 3-1: Background air quality monitoring study ambient monitoring sites | 7 |
| Figure 4-1: Boundaries of the four nested grids used for modelling, with an outline of the Western Australian coastline for reference. | 11 |
| Figure 4-2: Comparison of measured (above) and modelled (below) wind roses for Jandakot. . | 13 |
| Figure 4-3. Mean wind speeds for the innermost grid. The location of the Colpoys Point meteorological site is shown by the small diamond. | 14 |
| Figure 4-4: Quantile-quantile plot of modelled and measured wind speeds at Jandakot. | 15 |
| Figure 4-5: Comparison of measured (above) and modelled (below) wind roses at Colpoys Point..... | 16 |
| Figure 4-6: Quantile-quantile plot of modelled and measured wind speeds at Colpoys Point... | 17 |
| Figure 4-7: Frequency plot for the distribution of modelled against measured temperatures at Jandakot. | 17 |
| Figure 5-1: Quantile-Quantile Plot of Predicted and Monitored 1-hour Average Concentrations of NO ₂ at the North Rockingham AQMS..... | 24 |
| Figure 5-2: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 1: Current operations - Cumulative..... | 36 |
| Figure 5-3: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 1: Current operations - Cumulative | 37 |
| Figure 5-4: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 1: Current operations - Cumulative..... | 38 |
| Figure 5-5 Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 1: Current operations - Cumulative | 39 |
| Figure 5-6: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 2: Future approved - Cumulative..... | 40 |

| | |
|--|----|
| Figure 5-7: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 2: Future approved - Cumulative | 41 |
| Figure 5-8: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 2: Future approved - Cumulative | 42 |
| Figure 5-9: Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 2: Future approved - Cumulative | 43 |
| Figure 5-10: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 44 |
| Figure 5-11: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 45 |
| Figure 5-12: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 46 |
| Figure 5-13: Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 47 |
| Figure 5-14: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 48 |
| Figure 5-15: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 49 |
| Figure 5-16: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 50 |
| Figure 5-17: Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 51 |
| Figure 5-18: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 52 |
| Figure 5-19: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 53 |
| Figure 5-20: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 54 |
| Figure 5-21: Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 55 |
| Figure 5-22: Predicted maximum 1-hour average GLCs of NO ₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 56 |
| Figure 5-23: Predicted maximum 1-hour average GLCs of NO ₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 57 |
| Figure 5-24: Predicted annual average GLCs of NO ₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 58 |
| Figure 5-25: Predicted annual average GLCs of NO ₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 59 |
| Figure 5-26: Predicted maximum 1-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 60 |

| | |
|---|----|
| Figure 5-27: Predicted maximum 1-hour average GLCs of SO ₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 61 |
| Figure 5-28: Predicted maximum 24-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 62 |
| Figure 5-29: Predicted maximum 24-hour average GLCs of SO ₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 63 |
| Figure 5-30: Predicted annual average GLCs of SO ₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 64 |
| Figure 5-31: Predicted annual average GLCs of SO ₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 65 |
| Figure 5-32: Predicted maximum 1-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 66 |
| Figure 5-33: Predicted maximum 1-hour average GLCs of SO ₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 67 |
| Figure 5-34: Predicted maximum 24-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 68 |
| Figure 5-35: Predicted maximum 24-hour average GLCs of SO ₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 69 |
| Figure 5-36: Predicted annual average GLCs of SO ₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 70 |
| Figure 5-37: Predicted annual average GLCs of SO ₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 71 |
| Figure 5-38: Predicted maximum 1-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 72 |
| Figure 5-39: Predicted maximum 1-hour average GLCs of SO ₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 73 |
| Figure 5-40: Predicted maximum 24-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 74 |
| Figure 5-41 Predicted maximum 24-hour average GLCs of SO ₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 75 |
| Figure 5-42: Predicted annual average GLCs of SO ₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 76 |
| Figure 5-43: Predicted annual average GLCs of SO ₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 77 |
| Figure 5-44: Predicted maximum 1-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 78 |
| Figure 5-45: Predicted maximum 1-hour average GLCs of SO ₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 79 |
| Figure 5-46: Predicted maximum 24-hour average GLCs of SO ₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 80 |

| | |
|---|-----|
| Figure 5-47: Predicted maximum 24-hour average GLCs of SO ₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 81 |
| Figure 5-48: Predicted annual average GLCs of SO ₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 82 |
| Figure 5-49: Predicted annual average GLCs of SO ₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 83 |
| Figure 5-50: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 84 |
| Figure 5-51: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 85 |
| Figure 5-52: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 86 |
| Figure 5-53: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 87 |
| Figure 5-54: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 88 |
| Figure 5-55: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 89 |
| Figure 5-56: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 90 |
| Figure 5-57: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 91 |
| Figure 5-58: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 92 |
| Figure 5-59: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 93 |
| Figure 5-60: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 94 |
| Figure 5-61: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 95 |
| Figure 5-62: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 96 |
| Figure 5-63: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 97 |
| Figure 5-64: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 98 |
| Figure 5-65: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 99 |
| Figure 5-66: Predicted maximum 24-hour average GLCs of PM ₁₀ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 100 |

| | |
|---|-----|
| Figure 5-67: Predicted maximum 24-hour average GLCs of PM ₁₀ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 101 |
| Figure 5-68: Predicted annual average GLCs of PM ₁₀ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 102 |
| Figure 5-69: Predicted annual average GLCs of PM ₁₀ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 103 |
| Figure 5-70: Predicted maximum 24-hour average GLCs of PM ₁₀ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 104 |
| Figure 5-71: Predicted maximum 24-hour average GLCs of PM ₁₀ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 105 |
| Figure 5-72: Predicted annual average GLCs of PM ₁₀ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 106 |
| Figure 5-73: Predicted annual average GLCs of PM ₁₀ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 107 |
| Figure 5-74: Predicted maximum 24-hour average GLCs of PM ₁₀ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 108 |
| Figure 5-75: Predicted maximum 24-hour average GLCs of PM ₁₀ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 109 |
| Figure 5-76: Predicted annual average GLCs of PM ₁₀ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 110 |
| Figure 5-77: Predicted annual average GLCs of PM ₁₀ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 111 |
| Figure 5-78: Predicted maximum 24-hour average GLCs of PM ₁₀ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 112 |
| Figure 5-79: Predicted maximum 24-hour average GLCs of PM ₁₀ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 113 |
| Figure 5-80: Predicted annual average GLCs of PM ₁₀ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 114 |
| Figure 5-81: Predicted annual average GLCs of PM ₁₀ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 115 |
| Figure 5-82: Predicted maximum 24-hour average GLCs of PM _{2.5} (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 116 |
| Figure 5-83: Predicted maximum 24-hour average GLCs of PM _{2.5} (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 117 |
| Figure 5-84: Predicted annual average GLCs of PM _{2.5} (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation | 118 |
| Figure 5-85: Predicted annual average GLCs of PM _{2.5} (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation | 119 |
| Figure 5-86: Predicted maximum 24-hour average GLCs of PM _{2.5} (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 120 |

| | |
|---|-----|
| Figure 5-87: Predicted maximum 24-hour average GLCs of PM _{2.5} (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 121 |
| Figure 5-88: Predicted annual average GLCs of PM _{2.5} (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative | 122 |
| Figure 5-89: Predicted annual average GLCs of PM _{2.5} (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative | 123 |
| Figure 5-90: Predicted maximum 24-hour average GLCs of PM _{2.5} (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 124 |
| Figure 5-91: Predicted maximum 24-hour average GLCs of PM _{2.5} (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 125 |
| Figure 5-92: Predicted annual average GLCs of PM _{2.5} (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation | 126 |
| Figure 5-93: Predicted annual average GLCs of PM _{2.5} (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation | 127 |
| Figure 5-94: Predicted maximum 24-hour average GLCs of PM _{2.5} (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 128 |
| Figure 5-95: Predicted maximum 24-hour average GLCs of PM _{2.5} (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 129 |
| Figure 5-96: Predicted annual average GLCs of PM _{2.5} (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative | 130 |
| Figure 5-97: Predicted annual average GLCs of PM _{2.5} (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative | 131 |

1 Introduction

Alcoa of Australia Limited (Alcoa) has commenced transition activities associated with the permanent closure of its Kwinana alumina refinery. As part of this transition, Alcoa is implementing surplus water management measures, including the proposed restart of evaporation processes at Building 42. These activities are required to safely manage site water balances during the closure and decommissioning phase of operations.

Historically, steam for Building 42 was supplied from the central powerhouse. However, as part of the refinery closure strategy, the powerhouse is no longer operational. To support the proposed evaporation activities, Alcoa is therefore proposing to install and operate two purpose-built boilers, each with a nominal thermal capacity of 18 MW, to provide an independent and efficient source of steam to Building 42.

The use of dedicated boilers represents a more efficient and targeted approach to steam generation for this specific function during the closure phase, compared to recommissioning legacy infrastructure.

This assessment has been undertaken to quantify and evaluate atmospheric emissions including nitrogen dioxide (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO) and particulate matter (PM₁₀ and PM_{2.5}) that are associated with the operation of two 18 MW boilers in two potential configurations and to assess their potential impacts on ambient air quality. Atmospheric dispersion modelling has been used to predict ground-level concentrations of relevant pollutants and to assess compliance with applicable ambient air quality criteria and environmental protection objectives. The results of this assessment will inform regulatory decision-making and ensure that the proposed operation can be undertaken in a manner that is protective of human health and the environment.

The approach, methodology and results of the air dispersion modelling as well as the predicted impacts are detailed in the following report.

An overview of the region modelled as part of this assessment including sensitive receptor locations explicitly included in the assessment, the prescribed facility boundary, and the Kwinana Industry buffer area are presented in Figure 1-1. The location of the boilers is presented in Figure 1-2.



Figure 1-1: Overview of region

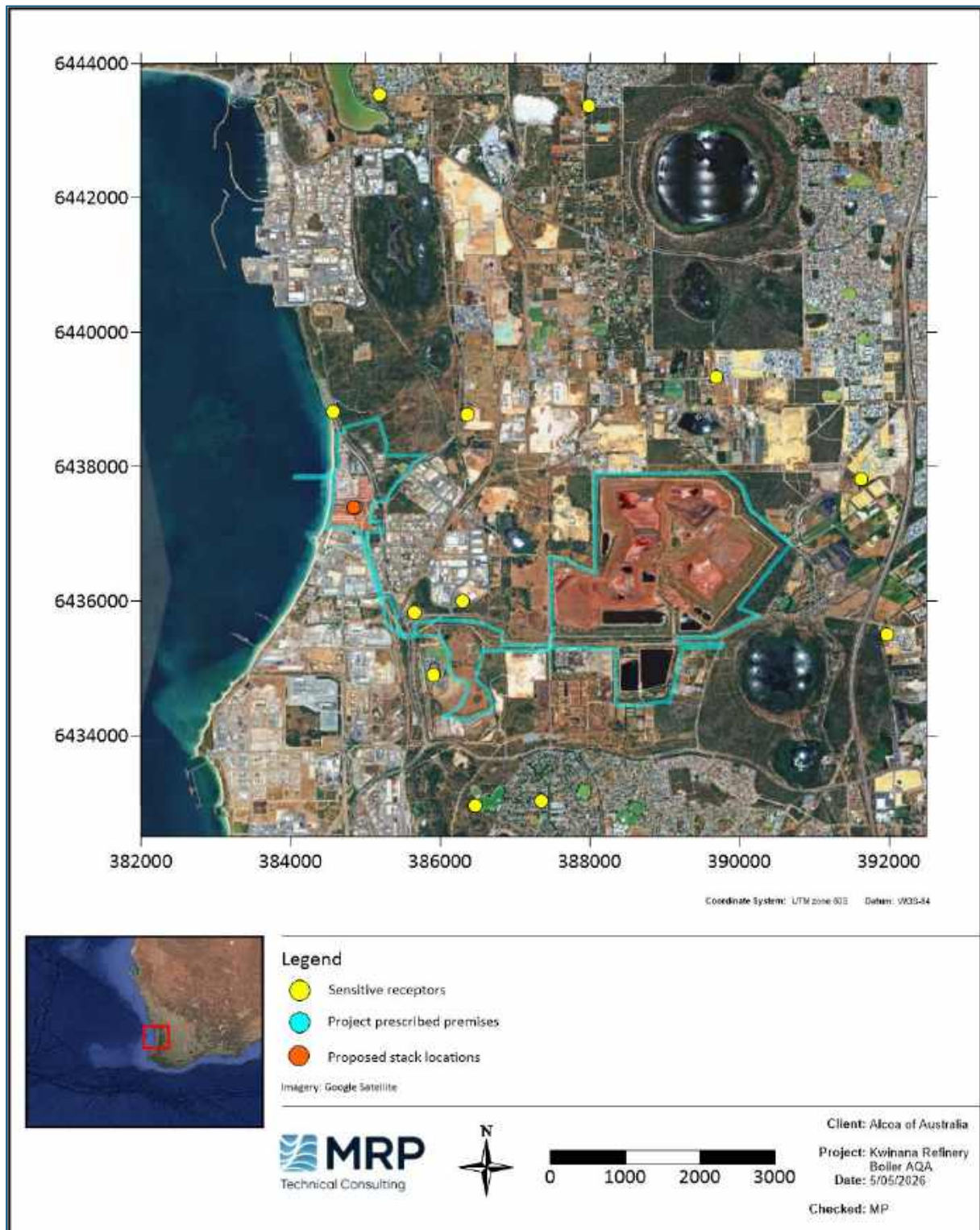


Figure 1-2: Source location

2 Air quality criteria

2.1 Ambient air quality criteria

The Department of Water and Environmental Regulation (DWER) published the Guidance Statement for Risk Assessments in February 2017 (DWER, 2017) and the draft Guideline: Air Quality Emissions in October 2019 (DWER, 2019), which refers to air quality criteria that may be considered in determining public health and environmental impacts. The publication containing air quality criteria relevant to this assessment is the National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPC, 2021). A summary of the air quality criteria outlined in the NEPMs and DWER's air emission guidelines are presented in Table 2-1.

Table 2-1: Ambient air quality criteria

| Pollutant | Averaging Period | Criteria ($\mu\text{g}/\text{m}^3$) ¹ | Reference |
|-------------------|------------------|--|--------------------|
| NO ₂ | 1-hour max | 150 | NEPC (2021) |
| | Annual average | 28 | |
| SO ₂ | 1-hour max | 196 | NEPC (2021) |
| | 24-hour max | 52 | |
| | Annual average | 55 | Kwinana EPP (1999) |
| CO | 1-hour max | 30,000 | DWER (2019) |
| | 8-hour max | 10,000 | |
| PM ₁₀ | 24-hour max | 46 | NEPC (2021) |
| | Annual average | 23 | |
| PM _{2.5} | 24-hour max | 18 | NEPC (2021) |
| | Annual average | 6.4 | |

Notes:

1. Referenced to 25°C and 101.3 kPa

In addition to the ambient air quality criteria presented in Table 2-1, the Environmental Protection Authority (EPA) established an Environmental Protection Policy (EPP) in Kwinana in 1992. The Kwinana EPP was formally reviewed in 1999 and re-issued unchanged. The 1992 Regulations remain in force and were amended in 1999 to reflect the policy title change. The Policy defines three areas (Areas A, B and C), where:

- Area A is the area of land on which heavy industry is located;
- Area B is outside Area A and is zoned for industrial purposes from time to time under a Metropolitan Region Scheme or a town planning scheme and is referred to hereafter within this report as the Kwinana Buffer Area; and
- Area C is beyond Areas A and B and is predominantly rural and residential.

Sulphur dioxide standards and limits were set for the three areas, increasing in stringency from Area A to Area C (Table 2-2). The most important of these with respect to controlling air quality are the standards and limits averaged over 1-hour periods. Similarly, ambient standards and limits were established for total suspended particulates.

The EPP provides for a redetermination of these limits as and when required, e.g. to accommodate new industries or variations to existing industry emissions. There have been two redeterminations. The latest redetermination was undertaken in April 2019.

Table 2-2: Ambient air quality criteria

| Averaging period | Classification | Concentration ($\mu\text{g}/\text{m}^3$) ¹ | | |
|------------------|----------------|---|--------|--------|
| | | Area A | Area B | Area C |
| 1-hour | Standard | 700 | 500 | 350 |
| | Limit | 1,400 | 1,000 | 700 |
| 24-hour | Standard | 200 | 150 | 125 |
| | Limit | 365 | 200 | 200 |
| Annual | Standard | 60 | 50 | 50 |
| | Limit | 80 | 60 | 60 |

Notes:

1. Referenced to 0°C and 101.3 kPa

Where applicable, predicted concentrations were compared against the more conservative ambient air quality criteria for all pollutants of concern as outlined in Table 2-1. In the absence of available data from the NEPM guideline for various averaging periods, guidelines were sourced from the Kwinana EPP (1999).

3 Ambient monitoring

3.1 Existing environment

A representative background concentration of the pollutants of concern in the Kwinana region was required to assess potential cumulative impacts for the purposes of this study. No specific guidance for selection of an appropriate background level is provided in Western Australia. Accordingly, in Victoria, the State Environmental Protection Policy (Ambient Air Quality) (SEPP (AQM)) (EPA Victoria, 2001) states that the 70th percentile concentration (concentration which is exceeded by 30% of concentrations for that averaging period) should be adopted as the background level.

The DWER conduct ongoing ambient air quality monitoring within the Kwinana region for criteria pollutants such as ozone (O₃), NO₂, CO, SO₂, particles less than 10 μm in diameter (PM₁₀) and particles less than 2.5 μm in diameter (PM_{2.5}), the results of which are reported annually. The DWER reports annually the 75th percentile for 1-hour and 24-hour average concentration at its monitoring stations in Western Australia. Hence, in absence of reported 70th percentile values, the 75th percentile 1-hour and 24-hour as well as the annual average concentrations for the pollutants of interest were obtained from a number of monitoring stations (DWER 2022) and are presented in Table 3-1.

The relevant DWER monitoring stations in the region include North Rockingham, South Lake and Wattleup, all of which have been considered for the background monitoring of the various pollutants where data is available. The highest averaging values have been selected as the background concentration values for the various pollutants for the cumulative assessment across the region which can be seen in Table 3-1.

It is noted that concentrations of ambient PM_{2.5} monitored at the South Lake AQMS exceeded the annual average NEPM criteria before any modelling was undertaken.

Table 3-1: DWER background monitoring concentrations – Kwinana

| Pollutant | Averaging period | Concentration (ppm) | Concentration (µg/m ³) ¹ | Station |
|-------------------|---|---------------------|---|------------------|
| NO ₂ | 75 th percentile 1-hour | 0.016 | 30.1 | North Rockingham |
| | Annual average | 0.005 | 9.4 | |
| | 75 th percentile 1-hour | 0.019 | 35.7 | South Lake |
| | Annual average | 0.006 | 11.3 | |
| SO ₂ | 75 th percentile 1-hour | 0.004 | 10.5 | North Rockingham |
| | 75 th percentile 24-hour | 0.003 | 7.9 | |
| | Annual average | 0.001 | 2.6 | |
| | 75 th percentile 1-hour | 0.002 | 5.2 | South Lake |
| | 75 th percentile 24-hour | 0.001 | 2.6 | |
| | Annual average | 0.002 | 5.2 | |
| | 75 th percentile 1-hour | 0.002 | 5.2 | Wattleup |
| | 75 th percentile 24-hour | 0.001 | 2.6 | |
| Annual average | 0.001 | 2.6 | | |
| CO | 75 th percentile 1-hour | 0.5 | 521 | South Lake |
| | 75 th percentile 8-hour ² | 0.3 | 343 | |
| PM ₁₀ | 75 th percentile 24-hour | - | 15.9 | South Lake |
| | Annual average | - | 13.2 | |
| PM _{2.5} | 75 th percentile 24-hour | - | 8.6 | South Lake |
| | Annual average | - | 7.6 | |

Notes:

1. Referenced to 25°C and 101.3 kPa
2. Calculated based on a peak-to-mean ratio using the 8-hour average predicted ground level concentrations (GLCs)
3. Shaded values represent the maximum background concentration values for each pollutant and their respective averaging periods which have been adapted for the cumulative assessment

It should also be noted that the values used as indicative of background concentrations are likely conservative as they would contain contributions from the industrial sources that have been explicitly modelled. In addition, the South Lake and Wattleup monitors, whilst in the direction of the prevailing winds of the region, are located some distance from the Kwinana Industrial Area (KIA) and would be impacted by traffic emissions, however use of this data provides a conservative basis on which to assess the potential risk associated with the project.



Figure 3-1: Background air quality monitoring study ambient monitoring sites

3.2 Peak-to-mean ratio

In order to assess the potential cumulative 8-hour average impacts of CO Ground Level Concentrations (GLCs), a peak to mean concentration formula as recommended by the Vic EPA (2013) was adopted to convert monitored background 1-hour averaged concentrations of CO into 8-hour averaged CO background concentrations.

The equation is as follows:

$$C_t = (C_A) \left(\frac{T_A}{T_t} \right)^{0.2}$$

Where:

C_t = the concentration at the required averaging period

C_A = the concentration at the known averaging period

T_t = the time in minutes for the required averaging period

T_A = the time in minutes for the known averaging period

Equation 3-1: Peak-to-mean ratio

4 Air dispersion modelling and methodology

4.1 Air dispersion model

The CALPUFF modelling system was utilised to undertake air dispersion modelling. CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model. It utilises three-dimensional wind fields to simulate the effects of the temporal and spatial meteorological conditions on pollutant transport, transformation, and removal. CALPUFF also allows for three-dimensional characterisation of land use and surface characteristics such as height and density of vegetation. CALPUFF is often used in a regulatory environment in situations where other regulatory models such as AERMOD may not be suitable due to complex terrain or proximity to the coast.

The following model set-up options within CALPUFF were used:

- Meteorological grid of 29 km by 39 km encompassing the KIA, Rockingham, and South Lakes;
- Meteorological grid spacings of 1 km;
- Sampling grid of 20 km by 25 km and 200 m spacing; and
- No chemical transformation.

In addition to the gridded receptors for CALPUFF, discrete receptors were positioned throughout the modelled domain to represent residential dwellings and nearby recreational locations to provide a quantitative assessment of GLCs in sensitive areas of interest. These discrete receptors are summarised in Table 4-1 and are also highlighted in Figure 1-1.

Table 4-1: Discrete Receptor Locations

| Receptor | Easting (m) ¹ | Northing (m) ¹ |
|--------------------------------|--------------------------|---------------------------|
| Wells Park | 383,090 | 6,431,590 |
| Golf Course | 386,587 | 6,431,618 |
| Thomas Oval | 386,468 | 6,432,951 |
| Oval | 385,900 | 6,434,900 |
| Residence | 386,723 | 6,432,276 |
| North Rockingham AQMS | 382,112 | 6,429,858 |
| Residence | 387,347 | 6,430,608 |
| Hope Valley | 386,300 | 6,436,000 |
| Calista Primary School | 387,961 | 6,431,708 |
| Wombat Wallow Childcare Centre | 387,344 | 6,433,024 |
| Wellard Road Residence | 385,939 | 6,431,453 |
| Korcula Ct | 385,182 | 6,443,529 |
| Mannikin Hts | 387,977 | 6,443,366 |
| Rosewood St | 389,683 | 6,439,335 |
| Collerson St | 391,964 | 6,435,509 |
| McMillian Rd | 391,620 | 6,437,812 |
| Naval Base Shacks | 384,569 | 6,438,822 |
| Hope Valley Residence | 385,657 | 6,435,828 |
| Wattleup Residence | 386,361 | 6,438,777 |

Notes:

1. UTM Zone 50S

4.2 Meteorological data

The meteorology of the required site was simulated using the Weather Research and Forecasting Model (Michalakes et al. 2001), subsequently referred to as "WRF". This is a state-of-the-art numerical model, which uses the basic laws of physics and thermodynamics to calculate the evolution of a region's meteorology in time and space. While originally released in 2001, it has been continuously updated since that date. Version 4.2 was used in this assessment.

It represents the interactions of many variables, including wind velocity, air pressure, temperature and humidity, cloud, rain, plus surface characteristics like soil moisture, land use type, vegetation structure, ground roughness and water surface temperature. These are represented on a set of three-dimensional grids, covering the full depth of the atmosphere and a horizontal region that may be only a few kilometres wide, or cover the whole globe. Normally it is

used in “nested” mode, in which the broader scales surrounding a region of particular interest are represented at coarse resolution, while those centred on that region are represented on a fine scale.

The model was considered appropriate in this instance for use with the CALPUFF model as it takes into consideration the complex meteorology of a coastal environment and incorporates the impacts of the thermally induced boundary layer that impacts emissions from sources in the KIA.

4.2.1 Metrological model configuration

The model was run using four nests, with south-north resolution 27000, 9000, 3000 and 1000 metres, and west-east resolution 85 per cent of these values.

The centre of the modelling region was set at -32.175°S, 115.75°E. All four nested grids were of size 37 by 46 cells, using a polar grid, each centred within the next largest (Figure 4-1). The extent of the outermost grid was chosen to ensure that a large width of ocean was represented to the west and south of Western Australia, experience showing that this was needed to ensure adequate model accuracy.

The run simulated the period 1 July 2023 to 30 June 2024. This period was preceded by a three-day “run up”, provided to permit model parameters to stabilise. Experience has shown that since the model was initialised using high-resolution measured data, a good match between modelled and measured values developed within a few hours.

Input boundary and initial conditions for the model were obtained using the ERA5 reanalyses (Herzbach et al. 2023). The data used comprised a subset of the global data set, at 1° horizontal resolution with 16 levels from the surface to 50 hPa, covering the region from 90° to 165°E and 65° to 0°S.

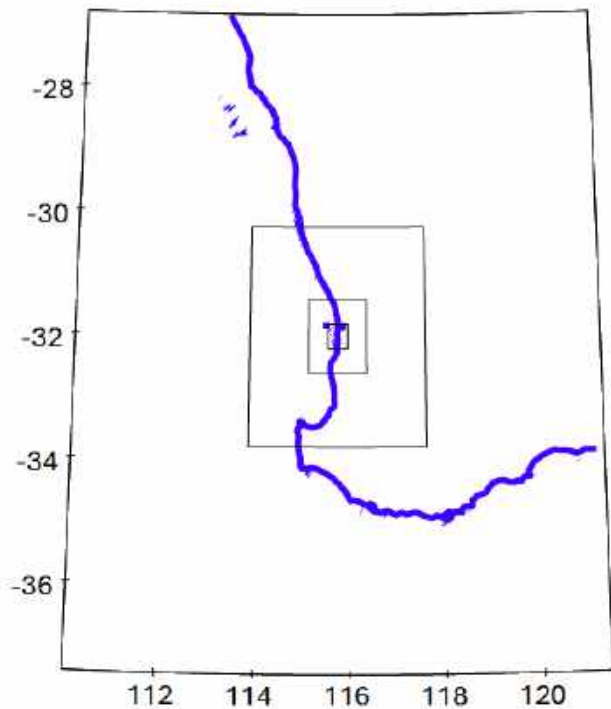


Figure 4-1: Boundaries of the four nested grids used for modelling, with an outline of the Western Australian coastline for reference.

Other configurations comprised:

- Providing for time-varying sea surface temperatures, based on global data records;
- Output of model results at hourly intervals for the innermost grid, three-hourly intervals for the next three and six-hourly for the outermost;
- Lateral boundary conditions for the outermost nest provided by global measured data, with two-way transfer of boundary data at the edges of inner nests;
- Adaptive time steps;
- 28 model layers, with interfaces between near-surface layers at heights of about 20, 50, 90, 160, 250, 360, 550 and 760 m;
- Microphysics using the WRF Single-Moment 6-class scheme (option 6), cumulus physics using the Kain-Fritsch scheme (option 1), longwave radiation using the Rapid Radiative Transfer Model (option 1), shortwave radiation using the Dudhia scheme (option 1), surface layer using the revised MM5 surface layer scheme (option 1). These were found not to be crucial options, all reasonable choices giving similar results;
- Surface physics using the Noah Land Surface Model;
- Four soil layers;
- Boundary layer physics using the YSU scheme. This choice has been found to give reliable results, and permits the use of the topographic wind adjustment scheme (which had negligible effect in this case);
- Non-hydrostatic modelling for all nests; and
- Nested boundary relaxation width of four cells.

Land use classes employed in the model were based on the MODIFIED_IGBP_MODIS_NOAH data set, with the exceptions:

- For the region of Jandakot Airport, index 17 corresponding to bare ground was used.
- Land use classes in the section of the innermost grid west of 115.85° and south of -32.05° were altered based on satellite imagery of the area, on a grid of nine arc seconds.

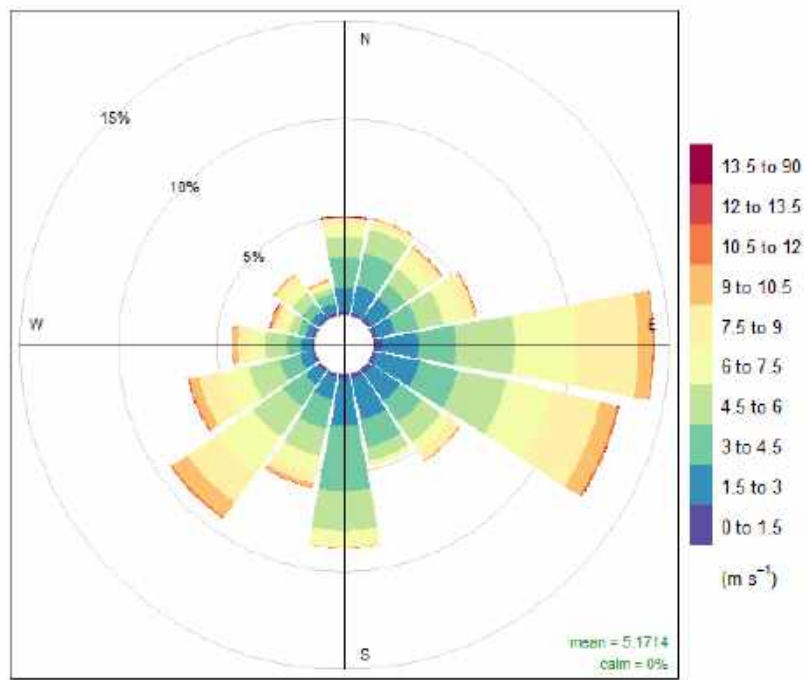
WRF was run using only the standard initial and boundary condition inputs:

- Site measurements were not included, because it was desired to be able to compare model estimates with measurements. Should data from measurement sites have been incorporated in the model run, this would not have been feasible, since the validation process would have involved comparison of measurements with a derivative of those measurements; and
- Nudging of model calculations towards the ongoing values in the ERA5 analyses (using the “grid nudging” approach) was evaluated, but the results of an analysis run showed little effect on model estimates.

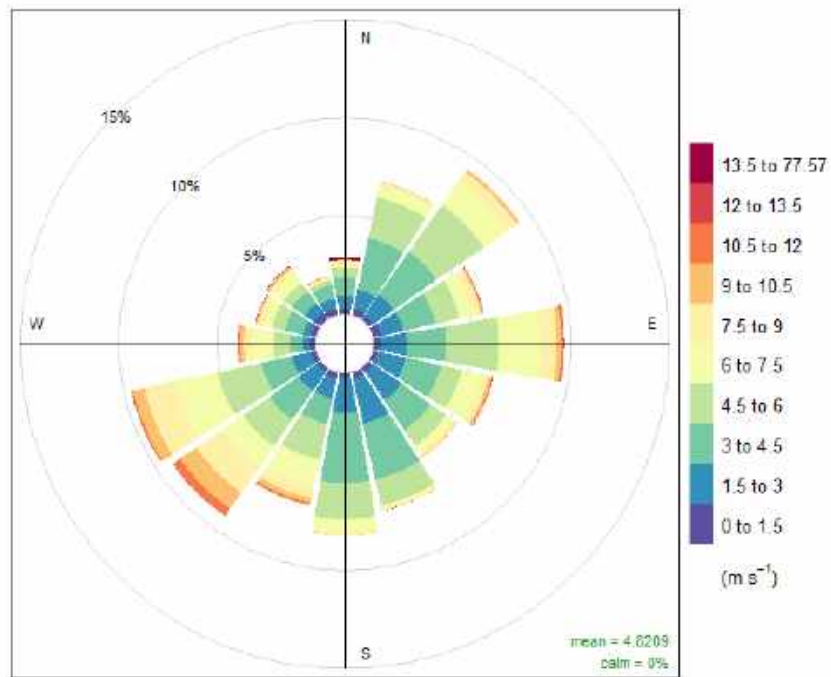
The CALMET meteorology files were generated for the period 28 June 2023 to 30 June 2024 (noting that the initial three days were a run-up period for WRF) with a grid size of 29 points west-east and 39 points south-north, and 12 levels corresponding to the lowest 12 levels used by WRF. The southwest grid origin was located at UTM zone 50, 367000 m east and 6419000 m north, using grid intervals of 1000 m. This grid was located within innermost WRF modelling grid, with about four cells clear on all sides to exclude the region of transition of meteorological fields from the next larger modelling grid.

4.2.2 Analysis of meteorological model results

Model estimates were compared against measurements made at the nearest locations of publicly available meteorological data, the Bureau of Meteorology site at Jandakot Airport, and three on Garden Island (Garden Island HSF, Colpoy’s Point and Armament Jetty). The Jandakot site is within an open airfield area, so tends to experience increased wind speeds. Figure 4-2 compares the wind roses for the measured and modelled winds at Jandakot. The two wind roses show general similarity, except for more frequent and stronger measured winds from the east. As shown in Figure 4-2, despite the use of the “barren land” land use class for the aerodrome, there was little enhancement of mean wind speeds. The lower modelled wind speeds compared to measurement are shown as a quantile-quantile plot in Figure 4-4, as a drop in the curve about 6 m/s. It appears that to achieve improved validation at Jandakot, modelling at higher resolution would be required.

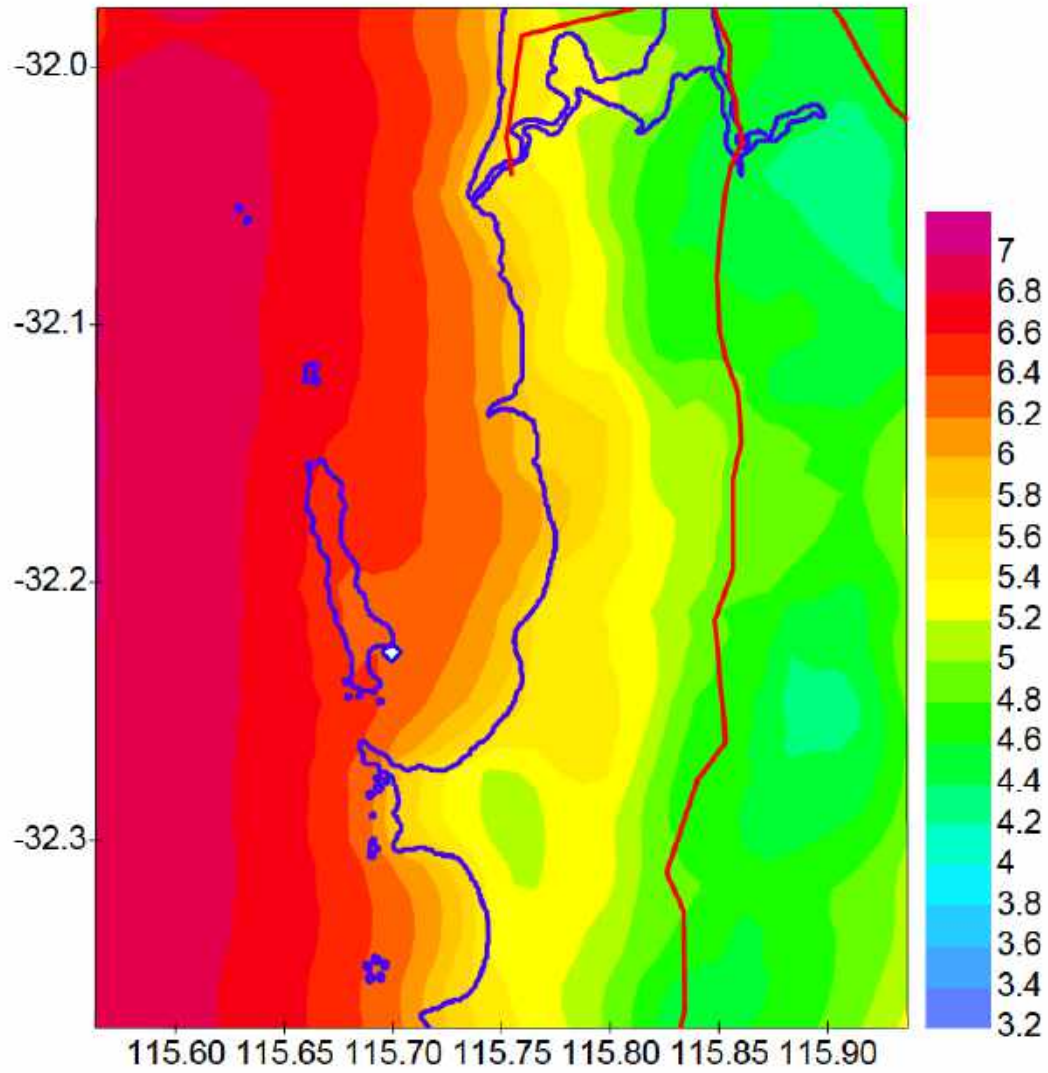


Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)

Figure 4-2: Comparison of measured (above) and modelled (below) wind roses for Jandakot.



Average 10m Speed

Figure 4-3. Mean wind speeds for the innermost grid. The location of the Colpoy's Point meteorological site is shown by the small diamond.

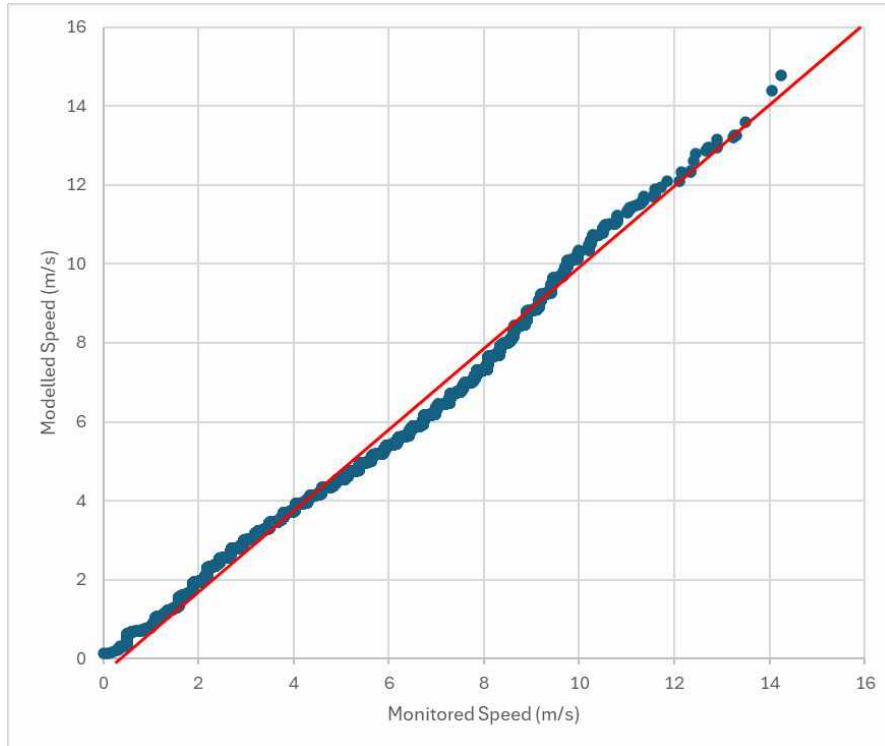
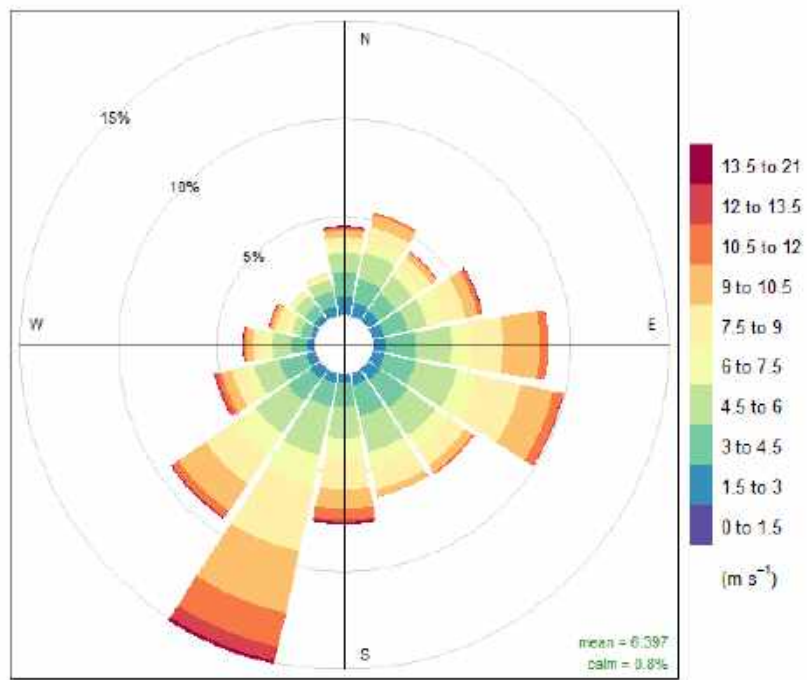


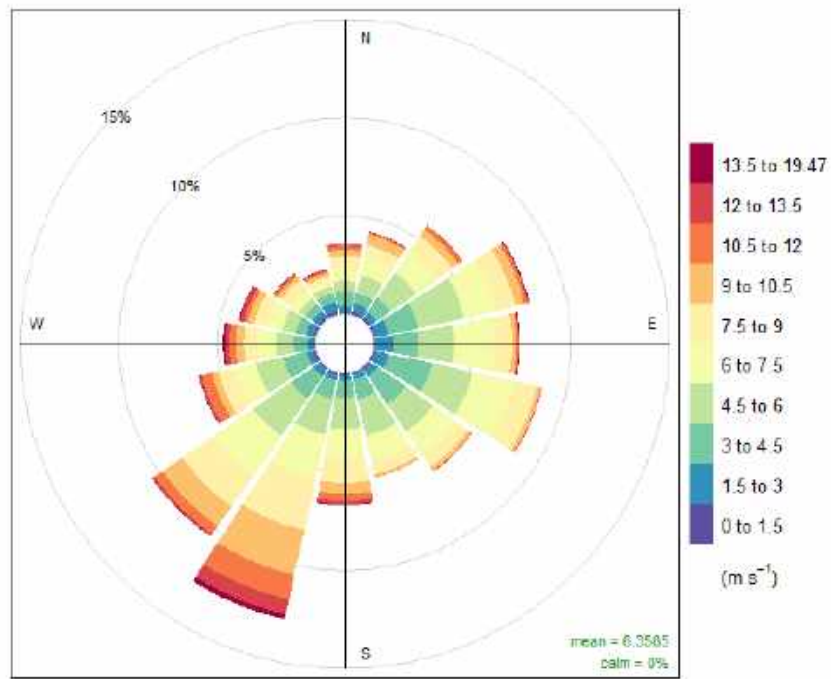
Figure 4-4: Quantile-quantile plot of modelled and measured wind speeds at Jandakot.

Modelling of winds in the vicinity of Garden Island might be expected to be problematic, due to the poor resolution of the island on a 1 km grid. However, the comparison of modelled and measured values at all sites showed reasonable agreement.

For example, Figure 4-5 shows wind roses for the Colpoys Point site, which is located on the horn-shaped point in the northern section of the naval base. There is an appearance of broad similarity, which is confirmed by the quantile-quantile plot comparing the two wind speed distributions (Figure 4-6). Comparisons for the Garden Island HSF and Armament Jetty sites were closely similar.



Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)

Figure 4-5: Comparison of measured (above) and modelled (below) wind roses at Colpo's Point.

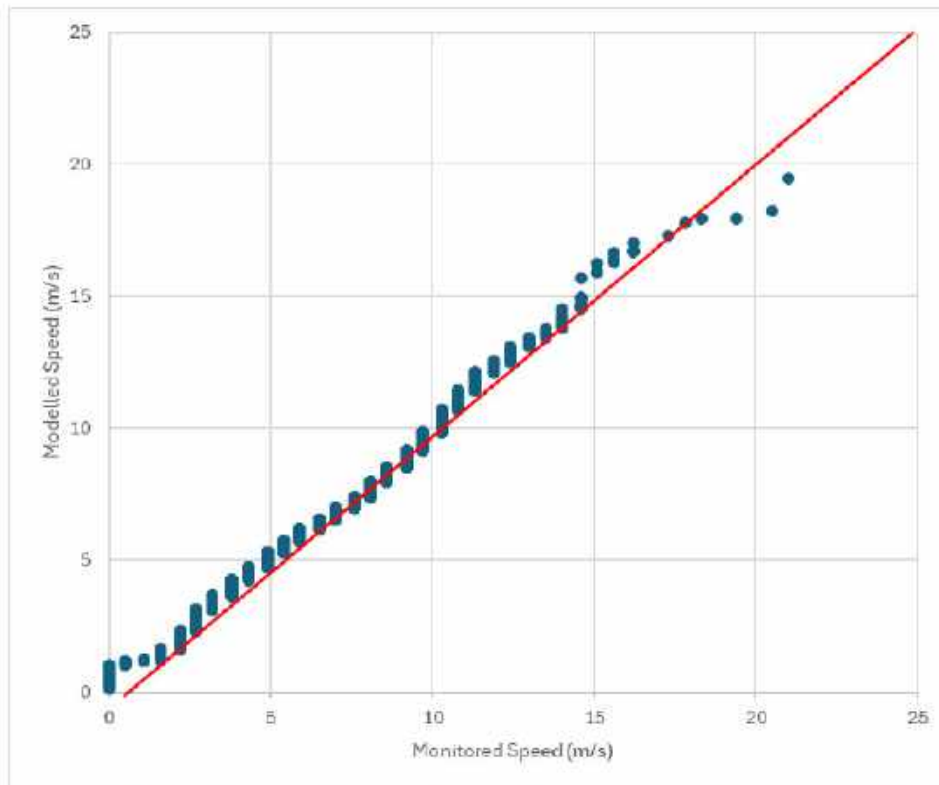


Figure 4-6: Quantile-quantile plot of modelled and measured wind speeds at Colpoys Point

Figure 4-7 shows a comparison of modelled and measured temperatures at the Jandakot site. This corresponds to a scatter plot, in which modelled and measured values matched in time are plotted against each other, but instead of a mass of dots, the data are presented as a frequency distribution. The standard deviation of the relationship was 1.9°C , with a slope of 0.96, both considered to be reasonable results.

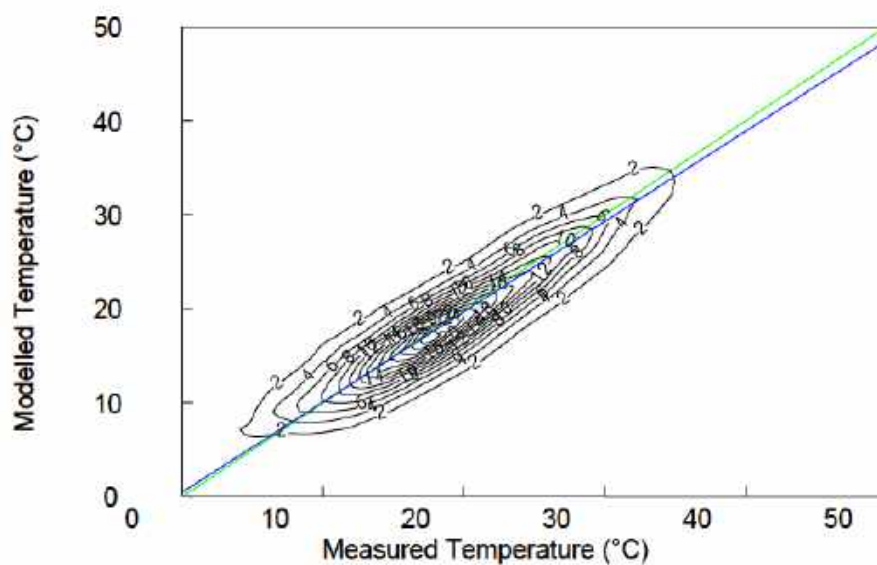


Figure 4-7: Frequency plot for the distribution of modelled against measured temperatures at Jandakot.

4.2.3 Meteorological validation

To validate the use of the WRF gridded meteorological dataset for the current modelling assessment, three statistical measures comparing wind speed and wind direction from WRF-predicted and BOM-observed data for the modelled dataset were evaluated. The statistical measures for evaluation include:

- **Wind Speed – Root Mean Square Error (RMSE):** This is an acceptable average measure of the difference or error between predicted and observed values. Low RMSE values in a model indicate that the model is explaining most of the variation in the observations. The benchmark for wind speed RMSE of <2 m/s has been extracted from Emery et al., 2001.
- **Wind Speed – Index of Agreement (IOA):** IOA reflects the ratio of the total RMSE to the sum of two differences – between each prediction and the observed mean, and each observation and the observed mean. Emery et al., 2001 suggests that an IOA of 60 per cent or greater represents a good correlation. An IOA of 1 means a perfect correlation between predicted and observed.
- **Wind Direction – Gross Error (E):** calculated as the mean absolute difference in prediction-observation pairings with valid data within a given analysis region and for a given period (hourly or daily). The benchmark for wind speed RMSE of ≤ 30 degrees has been extracted from Emery et al., 2001.

The benchmarks, derived from Emery et al. (2001), were based upon the evaluation of the Pennsylvania State University/ National Centre for Atmospheric Research (PSU/NCAR) Fifth generation Mesoscale Model (MM5) and the Regional Atmospheric Modelling System (RAMS) application. They provide context, when comparing predicted results to observed results, for the reviewer. A result which does not meet the benchmark does not necessarily determine the strength of the predicted values and critical evaluation is therefore imperative when understanding the results. A summary of the WRF performance evaluation results at Colpoy's point and Jandakot Airport is presented in Table 4-2.

Table 4-2: Performance evaluation summary – Wind speed and wind direction

| Pollutant | Units | Performance Evaluation Criteria | Colpoy's Point | Jandakot Airport |
|----------------------------|---------|---------------------------------|----------------|------------------|
| Wind Speed total RMSE | m/s | <2 | 1.87 | 1.67 |
| Wind Speed IOA | % | >60 | 84 | 80 |
| Wind Direction Gross Error | degrees | ≤ 30 | 26.0 | 30.9 |

The results indicate that the wind direction gross error was marginally over the performance benchmark for wind direction, however the other performance benchmarks were met at Jandakot and all benchmarks at Colpoy's Point closer to the sources of interest were met indicating that the modelled meteorological data is considered suitable for use in the KIA.

4.3 Modelled scenarios

A summary of the scenarios considered in this air quality assessment are provided below. The assessment has considered the impacts of two configurations of the proposed boilers. The first configuration used the same boiler type for both boilers (Boiler 1 and 2) as supplied from a vendor, using a stack height of 12m. The second configuration used one of the boilers from the first configuration run (12m stack height) for Boiler 1 as well as different boiler type from a different vendor which had a stack height of 15m for Boiler 2. Both configurations modelled the Boiler 1 and 2 stacks in the same locations.

For scenarios 1 and 2 (current and future approved sources), only NO_x was modelled in order to validate the model against monitoring data in the region.

Upset conditions were not included as part of this assessment as the stack vendors indicated that the emissions profile under normal operations does not change during other potential operational scenarios e.g. startup and shutdown (per comms. Alcoa 15 April 2026).

4.3.1 Scenario 1 – Current operations

Scenario 1 included all known significant existing operations in the KIA excluding current and proposed AGL sources that were operating during the modelled period between 1st July 2023 and 30th June 2024.

The sources that were included in the existing scenario included the following sources:

- AGR's sodium cyanide plant;
- CSBP's nitric acid plant;
- CSBP's ammonia plant;
- Synergy's HEGT facility;
- Alcoa's refinery including the powerhouse, calciner and liquor burner;
- Newgen power station;
- Cockburn 2 power station;
- The Kleenheat gas processing facility;
- Nickel West's refinery; and
- Tronox's pigment plant.

Emissions information and source parameters were obtained from a number of publicly available information including studies undertaken by the DWER, approvals documentation and values reported to the NPI as well as emissions information supplied by some operators in the region.

In addition to these sources, an assumed background concentration, representative of other non-industry sources was included in this scenario, as discussed in Section 3.

A validation assessment was undertaken using existing sources where the results of the modelling were compared against monitored data at the North Rockingham AQMS for the modelling period. The results of this validation are discussed further in Section 5.1.

4.3.2 Scenario 2 – Future sources

Scenario 2 included the emissions and background concentrations as outlined in Scenario 1 with the addition of future approved (yet to operate) and expected operational sources in the KIA. This included the addition of the following sources.

- CSBP's ammonia plant expansion;
- The Kwinana waste to energy facility;
- The East Rockingham waste to energy facility;
- The Covalent lithium plant;
- The Tianqui lithium plant;
- The BP renewable energy project; and
- AGL Kwinana Swift power station upgrade.

Alcoa's powerhouse, calciners and liquor burner (modelled as part of scenario 1) were not included in scenario 2, as Alcoa's refinery is not expected to be operational during the operation of the boilers. This corresponds to a net reduction in emissions of key pollutants from the Alcoa facility during the operation of the boilers.

4.3.3 Scenario 3 – Boiler combination 1

Boiler combination 1 included the proposed operation of two boilers with 12m stacks as described in Table 4-3. This operational scenario has been considered both in isolation and cumulatively as described below:

- Scenario 3a – Boiler combination 1 – Isolation
- Scenario 3b – Boiler combination 1 – Cumulative

Scenario 3a included emissions from only the two proposed boilers operating continuously in isolation. Scenario 3b included emissions from all current and future approved emissions sources and assumed background concentration representative of other non-industry sources in the region as outlined in Scenario 2, as well as emissions from the proposed additional boilers as modelled in Scenario 3a.

4.3.4 Scenario 4 – Boiler combination 2

Boiler combination 2 included the proposed operation of one boiler using a 12m stack (as modelled in Scenario 3 and one additional boiler from another vendor using a 15m stack as described in Table 4-4. This operational scenario has been considered both in isolation and cumulatively as described below:

- Scenario 4a – Boiler combination 2 – Isolation
- Scenario 4b – Boiler combination 2 – Cumulative

Scenario 4a included emissions from only the two proposed boilers operating continuously. Scenario 4b included emissions from all emissions sources and background concentrations as outlined in Scenario 2, as well as emissions from the proposed additional boilers in Scenario 4a.

4.4 Emissions estimates and stack parameters

A summary of the stack parameters and emissions data for the two boiler configurations used in the modelling assessment for the proposed boilers in scenarios 3 and 4 are presented in Table 4-3 and Table 4-4 below, respectively. Emission rates for NO_x, SO₂, CO and PM were provided by Alcoa based off vendor specifications.

Table 4-3: Summary of source parameters and emission estimates of the proposed boilers for Scenario 3 – Boiler combination 1

| Parameter | Units | Boiler 1 | Boiler 2 |
|--|-------------------|-----------|-----------|
| Easting | m ¹ | 384,870 | 384,847 |
| Northing | m ¹ | 6,437,394 | 6,437,394 |
| Stack height | m | 12 | 12 |
| Diameter | m | 0.8 | 0.8 |
| Exit velocity | m/s | 27.85 | 27.85 |
| Exit temperature | K | 543.15 | 543.15 |
| Mass Emission rates used in the modelling | | | |
| NO _x | g/s | 1.81 | 1.81 |
| SO ₂ | g/s | 0.0367 | 0.0367 |
| CO | g/s | 0.3207 | 0.3207 |
| PM ₁₀ | g/s | 0.0078 | 0.0078 |
| PM _{2.5} | g/s | 0.0078 | 0.0078 |
| Emissions Concentrations | | | |
| NO _x | ppm | 100 | 100 |
| SO ₂ | ppm | 1 | 1 |
| CO | ppm | 20 | 20 |
| PM ₁₀ | mg/m ³ | 0.56 | 0.56 |
| PM _{2.5} | mg/m ³ | 0.56 | 0.56 |

Notes:

1. UTM Zone 50S

Table 4-4: Summary of source parameters and emission estimates of the proposed boilers for Scenario 4 – Boiler combination 2

| Parameter | Units | Boiler 1 | Boiler 2 |
|---|-------------------|-----------|-----------|
| Easting | m ¹ | 384,870 | 384,847 |
| Northing | m ¹ | 6,437,394 | 6,437,394 |
| Stack height | m | 12 | 15 |
| Diameter | m | 0.8 | 1.2 |
| Exit velocity | m/s | 27.85 | 12.00 |
| Exit temperature | K | 543.15 | 623 |
| Mass Emission rates used in the modelling | | | |
| NO _x | g/s | 1.81 | 0.893 |
| SO ₂ | g/s | 0.0367 | 0.0356 |
| CO | g/s | 0.3207 | 0.7773 |
| PM ₁₀ | g/s | 0.0078 | 0.0076 |
| PM _{2.5} | g/s | 0.0078 | 0.0076 |
| Emissions Concentrations | | | |
| NO _x | ppm | 100 | 106 |
| SO ₂ | ppm | 1 | 1 |
| CO | ppm | 20 | 50 |
| PM ₁₀ | mg/m ³ | 0.56 | 0.56 |
| PM _{2.5} | mg/m ³ | 0.56 | 0.56 |

Notes:

1. UTM Zone 50S

4.5 Treatment of oxides of nitrogen

MRP has applied the Ozone Limiting Method (OLM) to predict ground level concentrations of NO₂ as specified by the USEPA (see Cole and Summerhays 1979; Tikvart 1996) and NSW Environment Protection Authority (NSW EPA, 2016). This method assumes that all the available ozone in the atmosphere will react with nitric oxide (NO) in the plume until either all the available ozone or all the NO is used up. This approach is conservative in that it assumes that the atmospheric reaction is instant when the reaction often takes place over a longer period.

Measured hourly average ozone concentrations were obtained from the North Rockingham AQMS between 1st July 2023 and 30th June 2024 and utilised in this assessment. A summary of the ozone concentrations in the assessment is presented in Table 4-5. The sources were modelled using a unit emission rate and were then combined in post processing using the OLM scheme outlined in the CALNO2 module from CALPUFF on an hour-by-hour basis.

Table 4-5: Monitored concentrations of O₃ (ppb) at North Rockingham AQMS (1st July 2023 to 30th June 2024)

| Data Availability | Max 1-hour ¹ | Max 8-hour ^{1,2} | 70th percentile 1-hour | Annual Average |
|-------------------|-------------------------|---------------------------|------------------------|----------------|
| 99.9% | 64.2 | 48.9 | 29.5 | 24.4 |

Notes:

1. Referenced to 20°C and 101.3 kPa
2. 8-hour average O₃ criteria – 65 ppb

5 Results

5.1 Model validation

To assess the performance of the model, predicted concentrations were compared against monitored NO₂ concentrations at the North Rockingham AQMS as shown in Figure 5-1. A quantile–quantile (Q/Q) plot was prepared by plotting equivalent quantiles of the monitored and modelled datasets against each other. This approach allows a direct comparison of the distributional characteristics of the model predictions relative to observed concentrations across the full range of values. Points lying close to the 1:1 line indicate good agreement between the distributions of modelled and monitored concentrations. Systematic deviation from the 1:1 line indicates bias in the model predictions at particular quantiles.

Figure 5-1 shows that the model captures the overall distribution of observed concentrations reasonably well, with points generally aligned with the 1:1 line. Some divergence is evident at the upper quantiles, where the model tends to overpredict relative to monitored values, indicating a conservative bias at higher concentrations. Despite the slight over prediction, the model is considered to be performing reasonably and is considered suitable to assess the potential risk to health from the proposed project in the region.

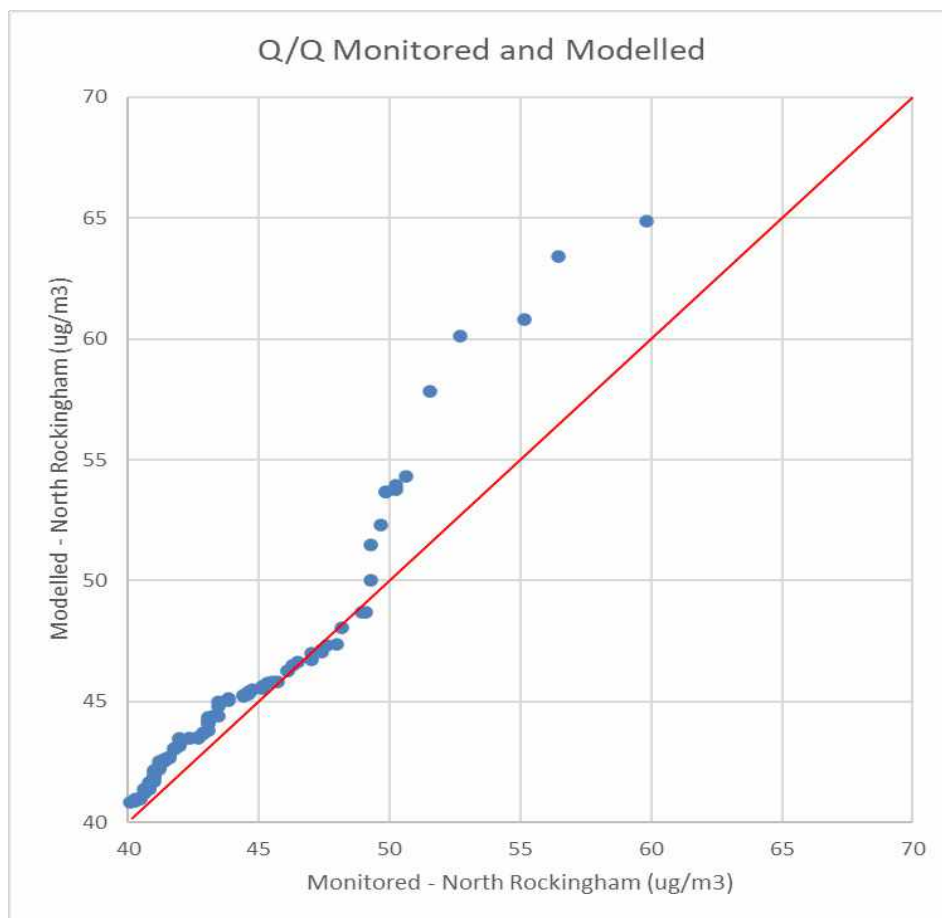


Figure 5-1: Quantile-Quantile Plot of Predicted and Monitored 1-hour Average Concentrations of NO₂ at the North Rockingham AQMS

5.2 Air quality assessment results

A summary of the predicted NO₂, SO₂, CO, PM₁₀ and PM_{2.5} GLCs at various locations outside the prescribed premises boundary, outside the Kwinana buffer area and at sensitive receptor locations, operating both in isolation and cumulatively are presented in the tables below. The results presented at the nominated receptor locations are mostly below the relevant criteria, with the exception of annually averaged PM_{2.5} for the cumulative scenarios 3b and 4b. It is noted that the annual average monitored concentrations of PM_{2.5} at the South Lake AQMS already exceeded the NEPM criteria before any modelling was undertaken and that the exceedances are mainly considered to be associated with other sources such as regional traffic emissions. The maximum modelled concentration of PM_{2.5} at the sensitive receptors from the proposed boilers in isolation was 0.03% of the NEPM annual average criteria.

Contour plots of the predicted GLCs for each of the scenarios and relevant averaging periods are presented in the figures below. Cumulative short-term impacts from NO₂ were considered to be the main pollutant of concern. The contour plots show that in general all the predicted concentrations are below the relevant criteria except for some isolated exceedances of the SO₂, and PM_{2.5} criteria predicted to occur in close vicinity of various sources in the region. No exceedances were predicted of NO₂, CO or PM₁₀ for any averaging period or the maximum 24-hour and annual average SO₂ criteria at any location in the modelled domain.

Table 5-1: Summary of maximum 1-hour average and annual average predicted GLCs of NO₂ at sensitive receptor locations

| 1-hour maximum NO ₂ ground level concentrations | | | | | | | | | | | | | | | |
|--|-------------------------|------------|-------------|---------------------------------|-------------|------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | Criteria | Background | % guideline | Scenario 1 | | Scenario 2 | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | | | Current operations - Cumulative | | Future approved - Cumulative | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | | | | 132 | 88% | 147 | 98% | 56 | 38% | 147 | 98% | 48 | 32% | 147 | 98% |
| Max. outside buffer area | | | | 115 | 77% | 137 | 92% | 56 | 38% | 137 | 92% | 48 | 32% | 137 | 92% |
| Rec_001 | Wells Park | | | 90 | 60% | 92 | 61% | 8 | 5% | 92 | 61% | 5 | 4% | 92 | 61% |
| Rec_002 | Golf Course | | | 78 | 52% | 113 | 75% | 6 | 4% | 113 | 75% | 4 | 2% | 113 | 75% |
| Rec_003 | Thomas Oval | | | 82 | 55% | 102 | 68% | 12 | 8% | 102 | 68% | 5 | 3% | 102 | 68% |
| Rec_004 | Oval | | | 101 | 67% | 120 | 80% | 14 | 9% | 120 | 80% | 10 | 7% | 120 | 80% |
| Rec_005 | Residence | | | 89 | 59% | 107 | 71% | 12 | 8% | 107 | 71% | 4 | 3% | 107 | 71% |
| Rec_006 | North Rockingham AQMS | | | 80 | 54% | 82 | 55% | 6 | 4% | 82 | 55% | 3 | 2% | 82 | 55% |
| Rec_007 | Residence | | | 76 | 50% | 113 | 75% | 9 | 6% | 113 | 75% | 3 | 2% | 113 | 75% |
| Rec_008 | Hope Valley | | | 87 | 58% | 101 | 67% | 23 | 15% | 101 | 67% | 14 | 9% | 101 | 67% |
| Rec_009 | Calista Primary School | | | 73 | 48% | 106 | 71% | 6 | 4% | 106 | 71% | 5 | 3% | 106 | 71% |
| Rec_010 | Wombat Wallow Childcare | | | 76 | 51% | 97 | 65% | 8 | 5% | 97 | 65% | 6 | 4% | 97 | 65% |
| Rec_011 | Wellard Road Residence | | | 86 | 57% | 110 | 74% | 6 | 4% | 110 | 74% | 4 | 3% | 110 | 74% |
| Rec_012 | Korcula Ct | | | 94 | 63% | 105 | 70% | 8 | 5% | 106 | 71% | 6 | 4% | 106 | 71% |
| Rec_013 | Mannikin Hts | | | 108 | 72% | 104 | 69% | 8 | 6% | 105 | 70% | 5 | 4% | 105 | 70% |
| Rec_014 | Rosewood St | | | 83 | 55% | 80 | 53% | 11 | 7% | 81 | 54% | 8 | 5% | 81 | 54% |
| Rec_015 | Collerson St | | | 80 | 40% | 74 | 49% | 16 | 11% | 75 | 50% | 10 | 7% | 75 | 50% |
| Rec_016 | Mcmillan Rd | | | 74 | 50% | 79 | 53% | 13 | 9% | 79 | 53% | 11 | 7% | 79 | 53% |
| Rec_017 | Naval Base Shacks | | | 92 | 62% | 115 | 77% | 25 | 17% | 120 | 80% | 20 | 13% | 118 | 79% |
| Rec_018 | Hope Valley Residence | | | 99 | 66% | 113 | 76% | 21 | 14% | 113 | 76% | 17 | 12% | 113 | 76% |
| Rec_019 | Wattleup Residence | | | 100 | 67% | 89 | 60% | 22 | 15% | 90 | 60% | 18 | 12% | 90 | 60% |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| Annual average NO _x ground level concentrations | | | | | | | | | | | | | | | | |
|--|-------------------------|------------|------|---------------------------------|-------------|------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------|
| Receptor | Criteria | Background | | Scenario 1 | | Scenario 2 | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | | |
| | | | | Current operations - Cumulative | | Future approved - Cumulative | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) |
| Max. offsite | | | | 19 | 68% | 22 | 80% | 2 | 7% | 22 | 80% | 2 | 6% | 22 | 80% | |
| Max. outside buffer area | | | | 17 | 59% | 18 | 63% | 1 | 5% | 18 | 63% | 1 | 4% | 18 | 63% | |
| Rec_001 | Wells Park | | | 15 | 53% | 15 | 54% | 0.04 | <1% | 15 | 54% | 0.03 | <1% | 15 | 54% | |
| Rec_002 | Golf Course | | | 13 | 46% | 13 | 47% | 0.02 | <1% | 13 | 47% | 0.02 | <1% | 13 | 47% | |
| Rec_003 | Thomas Oval | | | 13 | 46% | 14 | 49% | 0.03 | <1% | 14 | 49% | 0.02 | <1% | 14 | 49% | |
| Rec_004 | Oval | | | 14 | 50% | 17 | 61% | 0.06 | <1% | 17 | 61% | 0.05 | <1% | 17 | 61% | |
| Rec_005 | Residence | | | 13 | 46% | 13 | 47% | 0.03 | <1% | 13 | 47% | 0.02 | <1% | 13 | 47% | |
| Rec_006 | North Rockingham AQMS | | | 13 | 46% | 13 | 48% | 0.02 | <1% | 13 | 48% | 0.02 | <1% | 13 | 48% | |
| Rec_007 | Residence | | | 12 | 44% | 13 | 45% | 0.02 | <1% | 13 | 45% | 0.01 | <1% | 13 | 45% | |
| Rec_008 | Hope Valley | | | 14 | 48% | 16 | 56% | 0.10 | <1% | 16 | 57% | 0.08 | <1% | 16 | 57% | |
| Rec_009 | Calista Primary School | 28 | 11.3 | 40% | 12 | 44% | 13 | 46% | 0.03 | <1% | 13 | 46% | 0.02 | <1% | 13 | 46% |
| Rec_010 | Wombat Wallow Childcare | | | | 13 | 45% | 13 | 47% | 0.04 | <1% | 13 | 47% | 0.03 | <1% | 13 | 47% |
| Rec_011 | Wollard Road Residence | | | | 13 | 46% | 13 | 47% | 0.03 | <1% | 13 | 47% | 0.02 | <1% | 13 | 47% |
| Rec_012 | Korcula Ct | | | | 12 | 43% | 13 | 45% | 0.08 | <1% | 13 | 45% | 0.06 | <1% | 13 | 45% |
| Rec_013 | Mannikin Hts | | | | 12 | 44% | 13 | 45% | 0.09 | <1% | 13 | 45% | 0.06 | <1% | 13 | 45% |
| Rec_014 | Rosewood St | | | | 13 | 45% | 13 | 46% | 0.10 | <1% | 13 | 46% | 0.08 | <1% | 13 | 46% |
| Rec_015 | Collerson St | | | | 12 | 43% | 12 | 44% | 0.04 | <1% | 12 | 44% | 0.03 | <1% | 12 | 44% |
| Rec_016 | Mcmillan Rd | | | | 12 | 43% | 13 | 45% | 0.04 | <1% | 13 | 45% | 0.03 | <1% | 13 | 45% |
| Rec_017 | Naval Base Shacks | | | | 13 | 46% | 14 | 49% | 0.41 | 1% | 14 | 50% | 0.31 | 1% | 14 | 50% |
| Rec_018 | Hope Valley Residence | | | | 14 | 50% | 17 | 60% | 0.12 | <1% | 17 | 60% | 0.09 | <1% | 17 | 60% |
| Rec_019 | Wattleup Residence | | | | 14 | 49% | 14 | 49% | 0.45 | 2% | 14 | 51% | 0.35 | 1% | 14 | 50% |

Notes:

1. Reference conditions 25°C and 101.3 kPa

Table 5-2: Summary of maximum 1-hour and 24-hour averages, and annual average predicted GLCs of SO₂ at sensitive receptor locations

| Receptor | | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | 1-hour maximum SO ₂ ground level concentrations | | | | | | | |
|--------------------------|--------------------------------|----------------------------------|---|----------------------|--|----------------------|-----------------------------------|----------------------|----------------------------------|----------------------|-----------------------------------|------|
| | | | | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | |
| Max. offsite | | | | | 3 | 1% | 216 | 110% | 2 | <1% | 216 | 110% |
| Max. outside buffer area | | | | | 2 | 1% | 96 | 49% | 2 | <1% | 96 | 49% |
| Rec_001 | Wells Park | | | | 0.2 | <1% | 47 | 24% | 0.2 | <1% | 47 | 24% |
| Rec_002 | Golf Course | | | | 0.1 | <1% | 37 | 19% | 0.1 | <1% | 37 | 19% |
| Rec_003 | Thomas Oval | | | | 0.4 | <1% | 38 | 19% | 0.2 | <1% | 38 | 19% |
| Rec_004 | Oval | | | | 0.4 | <1% | 62 | 32% | 0.3 | <1% | 62 | 32% |
| Rec_005 | Residence | | | | 0.2 | <1% | 31 | 16% | 0.1 | <1% | 31 | 16% |
| Rec_006 | North Rockingham AQMS | | | | 0.1 | <1% | 31 | 16% | 0.1 | <1% | 31 | 16% |
| Rec_007 | Residence | | | | 0.1 | <1% | 27 | 14% | 0.1 | <1% | 27 | 14% |
| Rec_008 | Hope Valley | | | | 0.5 | <1% | 71 | 36% | 0.4 | <1% | 71 | 36% |
| Rec_009 | Calista Primary School | 196 | 10.5 | 5% | 0.2 | <1% | 29 | 15% | 0.1 | <1% | 29 | 15% |
| Rec_010 | Wombat Wallow Childcare Centre | | | | 0.2 | <1% | 35 | 18% | 0.2 | <1% | 35 | 18% |
| Rec_011 | Wellard Road Residence | | | | 0.1 | <1% | 23 | 12% | 0.1 | <1% | 23 | 12% |
| Rec_012 | Korcula Ct | | | | 0.2 | <1% | 27 | 14% | 0.2 | <1% | 27 | 14% |
| Rec_013 | Mannikin Hts | | | | 0.2 | <1% | 31 | 16% | 0.2 | <1% | 31 | 16% |
| Rec_014 | Rosewood St | | | | 0.2 | <1% | 22 | 11% | 0.2 | <1% | 22 | 11% |
| Rec_015 | Collerson St | | | | 0.3 | <1% | 19 | 10% | 0.3 | <1% | 19 | 10% |
| Rec_016 | Mcmillan Rd | | | | 0.3 | <1% | 21 | 11% | 0.3 | <1% | 21 | 11% |
| Rec_017 | Naval Base Shacks | | | | 1.0 | <1% | 32 | 16% | 0.6 | <1% | 32 | 16% |
| Rec_018 | Hope Valley Residence | | | | 0.5 | <1% | 83 | 42% | 0.5 | <1% | 83 | 42% |
| Rec_019 | Wattleup Residence | | | | 0.5 | <1% | 35 | 18% | 0.5 | <1% | 35 | 18% |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| 24-hour maximum SO ₂ ground level concentrations | | | | | | | | | | | |
|---|----------------------------------|----------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | Criteria (µg/m ³) | Background | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | (µg/m ³) | % guideline | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | 52 | 7.9 | 15% | 0.4 | <1% | 24 | 47% | 0.4 | <1% | 24 | 47% |
| Max. outside buffer area | | | | 0.3 | <1% | 18 | 35% | 0.3 | <1% | 18 | 35% |
| Rec_001 Wells Park | | | | 0.01 | <1% | 13 | 26% | 0.01 | <1% | 13 | 26% |
| Rec_002 Golf Course | | | | 0.01 | <1% | 11 | 20% | 0.01 | <1% | 11 | 20% |
| Rec_003 Thomas Oval | | | | 0.02 | <1% | 12 | 23% | 0.02 | <1% | 12 | 23% |
| Rec_004 Oval | | | | 0.03 | <1% | 17 | 33% | 0.02 | <1% | 17 | 33% |
| Rec_005 Residence | | | | 0.01 | <1% | 11 | 22% | 0.01 | <1% | 11 | 22% |
| Rec_006 North Rockingham AQMS | | | | 0.01 | <1% | 11 | 22% | 0.01 | <1% | 11 | 22% |
| Rec_007 Residence | | | | 0.01 | <1% | 10 | 19% | 0.01 | <1% | 10 | 19% |
| Rec_008 Hope Valley | | | | 0.05 | <1% | 16 | 30% | 0.05 | <1% | 16 | 30% |
| Rec_009 Callista Primary School | | | | 0.01 | <1% | 10 | 20% | 0.01 | <1% | 10 | 20% |
| Rec_010 Wombat Wallow Childcare Centre | | | | 0.03 | <1% | 11 | 21% | 0.02 | <1% | 11 | 21% |
| Rec_011 Wellard Road Residence | | | | 0.01 | <1% | 10 | 19% | 0.01 | <1% | 10 | 19% |
| Rec_012 Korcula Ct | | | | 0.02 | <1% | 10 | 19% | 0.02 | <1% | 10 | 19% |
| Rec_013 Mannikin Hts | | | | 0.02 | <1% | 10 | 20% | 0.02 | <1% | 10 | 20% |
| Rec_014 Rosewood St | | | | 0.05 | <1% | 11 | 21% | 0.05 | <1% | 11 | 21% |
| Rec_015 Collerson St | | | | 0.03 | <1% | 10 | 19% | 0.03 | <1% | 10 | 19% |
| Rec_016 Mcmillian Rd | | | | 0.03 | <1% | 11 | 21% | 0.03 | <1% | 11 | 21% |
| Rec_017 Naval Base Shacks | | | | 0.11 | <1% | 13 | 25% | 0.10 | <1% | 13 | 25% |
| Rec_018 Hope Valley Residence | | | | 0.06 | <1% | 19 | 36% | 0.07 | <1% | 19 | 36% |
| Rec_019 Wattleup Residence | 0.08 | <1% | 12 | 22% | 0.08 | <1% | 12 | 22% | | | |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| Annual average SO ₂ ground level concentrations | | | | | | | | | | | |
|--|----------------------------------|---|-----|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | 46 | 5.2 | 11% | 0.05 | <1% | 8.9 | 19% | 0.05 | <1% | 8.9 | 19% |
| Max. outside buffer area | | | | 0.03 | <1% | 6.5 | 14% | 0.04 | <1% | 6.5 | 14% |
| Rec_001 Wells Park | | | | 0.0008 | <1% | 5.8 | 13% | 0.0008 | <1% | 5.8 | 13% |
| Rec_002 Golf Course | | | | 0.0005 | <1% | 5.5 | 12% | 0.0006 | <1% | 5.5 | 12% |
| Rec_003 Thomas Oval | | | | 0.0008 | <1% | 5.6 | 12% | 0.0008 | <1% | 5.6 | 12% |
| Rec_004 Oval | | | | 0.0015 | <1% | 6.0 | 13% | 0.0014 | <1% | 6.0 | 13% |
| Rec_005 Residence | | | | 0.0006 | <1% | 5.5 | 12% | 0.0006 | <1% | 5.5 | 12% |
| Rec_006 North Rockingham AQMS | | | | 0.0006 | <1% | 5.6 | 12% | 0.0006 | <1% | 5.6 | 12% |
| Rec_007 Residence | | | | 0.0004 | <1% | 5.4 | 12% | 0.0004 | <1% | 5.4 | 12% |
| Rec_008 Hope Valley | | | | 0.0023 | <1% | 6.1 | 13% | 0.0023 | <1% | 6.1 | 13% |
| Rec_009 Callista Primary School | | | | 0.0006 | <1% | 5.4 | 12% | 0.0006 | <1% | 5.4 | 12% |
| Rec_010 Wombat Wallow Childcare Centre | | | | 0.0009 | <1% | 5.5 | 12% | 0.0009 | <1% | 5.5 | 12% |
| Rec_011 Wellard Road Residence | | | | 0.0006 | <1% | 5.5 | 12% | 0.0006 | <1% | 5.5 | 12% |
| Rec_012 Korcula Ct | | | | 0.0017 | <1% | 5.4 | 12% | 0.0017 | <1% | 5.4 | 12% |
| Rec_013 Mannikin Hts | | | | 0.0019 | <1% | 5.4 | 12% | 0.0019 | <1% | 5.4 | 12% |
| Rec_014 Rosewood St | | | | 0.0023 | <1% | 5.5 | 12% | 0.0023 | <1% | 5.5 | 12% |
| Rec_015 Collerson St | | | | 0.0010 | <1% | 5.4 | 12% | 0.0010 | <1% | 5.4 | 12% |
| Rec_016 Mcmillian Rd | | | | 0.0010 | <1% | 5.4 | 12% | 0.0010 | <1% | 5.4 | 12% |
| Rec_017 Naval Base Shacks | | | | 0.0094 | <1% | 5.6 | 12% | 0.0093 | <1% | 5.6 | 12% |
| Rec_018 Hope Valley Residence | | | | 0.0026 | <1% | 6.7 | 14% | 0.0026 | <1% | 6.7 | 14% |
| Rec_019 Wattleup Residence | 0.0101 | <1% | 5.7 | 12% | 0.0105 | <1% | 5.7 | 12% | | | |

Notes:

- Reference conditions 25°C and 101.3 kPa

Table 5-3: Summary of maximum 1-hour and 8-hour average predicted GLCs of CO at sensitive receptor locations

| 1-hour maximum CO ground level concentrations | | | | | | | | | | | | | |
|---|--------------------------------|----------------------------------|---|----|----------------------|----------------------------------|----------------------|-----------------------------------|----------------------|----------------------------------|----------------------|-----------------------------------|--|
| Receptor | | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | |
| Max. offsite | | | | | 22 | <1% | 1,376 | 5% | 35 | <1% | 1,376 | 5% | |
| Max. outside buffer area | | | | | 19 | <1% | 1,258 | 4% | 35 | <1% | 1,258 | 4% | |
| Rec_001 | Wells Park | | | | 1.4 | <1% | 862 | 3% | 2.5 | <1% | 862 | 3% | |
| Rec_002 | Golf Course | | | | 0.9 | <1% | 886 | 2% | 2.4 | <1% | 886 | 2% | |
| Rec_003 | Thomas Oval | | | | 3.5 | <1% | 646 | 2% | 3.0 | <1% | 646 | 2% | |
| Rec_004 | Oval | | | | 3.4 | <1% | 882 | 3% | 3.4 | <1% | 882 | 3% | |
| Rec_005 | Residence | | | | 1.6 | <1% | 671 | 2% | 2.9 | <1% | 671 | 2% | |
| Rec_006 | North Rockingham AQMS | | | | 0.8 | <1% | 772 | 3% | 2.6 | <1% | 772 | 3% | |
| Rec_007 | Residence | | | | 0.7 | <1% | 659 | 2% | 2.1 | <1% | 659 | 2% | |
| Rec_008 | Hope Valley | | | | 4.5 | <1% | 703 | 2% | 7.5 | <1% | 703 | 2% | |
| Rec_009 | Calista Primary School | 30,000 | 521 | 2% | 1.4 | <1% | 715 | 2% | 2.1 | <1% | 715 | 2% | |
| Rec_010 | Wombat Wallow Childcare Centre | | | | 1.6 | <1% | 851 | 2% | 2.6 | <1% | 851 | 2% | |
| Rec_011 | Wellard Road Residence | | | | 1.0 | <1% | 681 | 2% | 2.6 | <1% | 681 | 2% | |
| Rec_012 | Korcula Ct | | | | 1.5 | <1% | 676 | 2% | 2.6 | <1% | 677 | 2% | |
| Rec_013 | Mannikin Hts | | | | 1.3 | <1% | 616 | 2% | 2.5 | <1% | 616 | 2% | |
| Rec_014 | Rosewood St | | | | 2.0 | <1% | 666 | 2% | 3.6 | <1% | 666 | 2% | |
| Rec_015 | Collerson St | | | | 2.4 | <1% | 590 | 2% | 5.1 | <1% | 590 | 2% | |
| Rec_016 | McMillian Rd | | | | 2.9 | <1% | 652 | 2% | 4.6 | <1% | 652 | 2% | |
| Rec_017 | Naval Base Shacks | | | | 8.7 | <1% | 725 | 2% | 9.7 | <1% | 725 | 2% | |
| Rec_018 | Hope Valley Residence | | | | 4.2 | <1% | 874 | 3% | 8.6 | <1% | 874 | 3% | |
| Rec_019 | Wattleup Residence | | | | 4.3 | <1% | 738 | 2% | 8.7 | <1% | 738 | 2% | |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| 8-hour maximum CO ground level concentrations | | | | | | | | | | | | |
|---|--------------------------------|----------------------------------|---|-----|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | | 10,000 | 343 | 3% | 5 | <1% | 886 | 9% | 11 | <1% | 886 | 9% |
| Max. outside buffer area | | | | | 5 | <1% | 539 | 5% | 11 | <1% | 539 | 5% |
| Rec_001 | Wells Park | | | | 0.3 | <1% | 501 | 5% | 0.6 | <1% | 501 | 5% |
| Rec_002 | Golf Course | | | | 0.2 | <1% | 390 | 4% | 0.6 | <1% | 390 | 4% |
| Rec_003 | Thomas Oval | | | | 0.4 | <1% | 412 | 4% | 0.8 | <1% | 412 | 4% |
| Rec_004 | Oval | | | | 0.6 | <1% | 445 | 4% | 0.8 | <1% | 445 | 4% |
| Rec_005 | Residence | | | | 0.2 | <1% | 399 | 4% | 0.7 | <1% | 399 | 4% |
| Rec_006 | North Rockingham AQMS | | | | 0.2 | <1% | 458 | 5% | 0.4 | <1% | 458 | 5% |
| Rec_007 | Residence | | | | 0.1 | <1% | 375 | 4% | 0.5 | <1% | 375 | 4% |
| Rec_008 | Hope Valley | | | | 0.9 | <1% | 395 | 4% | 2.0 | <1% | 395 | 4% |
| Rec_009 | Callista Primary School | | | | 0.3 | <1% | 377 | 4% | 0.5 | <1% | 377 | 4% |
| Rec_010 | Wombat Wallow Childcare Centre | | | | 0.5 | <1% | 401 | 4% | 0.9 | <1% | 401 | 4% |
| Rec_011 | Wellard Road Residence | | | | 0.2 | <1% | 382 | 4% | 0.4 | <1% | 382 | 4% |
| Rec_012 | Korcula Ct | | | | 0.4 | <1% | 390 | 4% | 0.7 | <1% | 390 | 4% |
| Rec_013 | Mannikin Hts | | | | 0.3 | <1% | 374 | 4% | 0.6 | <1% | 374 | 4% |
| Rec_014 | Rosewood St | | | | 1.0 | <1% | 373 | 4% | 1.7 | <1% | 373 | 4% |
| Rec_015 | Collerson St | | | | 0.4 | <1% | 364 | 4% | 0.8 | <1% | 364 | 4% |
| Rec_016 | McMillian Rd | | | | 0.6 | <1% | 364 | 4% | 0.9 | <1% | 364 | 4% |
| Rec_017 | Naval Base Shacks | | | | 2.1 | <1% | 415 | 4% | 3.3 | <1% | 417 | 4% |
| Rec_018 | Hope Valley Residence | | | | 1.6 | <1% | 453 | 5% | 3.0 | <1% | 453 | 5% |
| Rec_019 | Wattleup Residence | 1.7 | <1% | 409 | 4% | 3.0 | <1% | 409 | 4% | | | |

Notes:

- Reference conditions 25°C and 101.3 kPa

Table 5-4: Summary of maximum 24-hour average and annual average predicted GLCs of PM₁₀ at sensitive receptor locations

| 24-hour maximum PM ₁₀ ground level concentrations | | | | | | | | | | | | |
|--|----------------------------------|---|------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|-----|
| Receptor | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | | |
| | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | |
| Max. offsite | | | | 0.1 | <1% | 28.5 | 62% | 0.1 | <1% | 28.5 | 62% | |
| Max. outside buffer area | | | | 0.1 | <1% | 23.4 | 51% | 0.1 | <1% | 23.4 | 51% | |
| Rec_001 | Wells Park | 46 | 15.9 | 35% | 0.003 | <1% | 23.0 | 50% | 0.003 | <1% | 23.0 | 50% |
| Rec_002 | Golf Course | | | | 0.002 | <1% | 17.8 | 39% | 0.003 | <1% | 17.8 | 39% |
| Rec_003 | Thomas Oval | | | | 0.004 | <1% | 18.1 | 39% | 0.003 | <1% | 18.1 | 39% |
| Rec_004 | Oval | | | | 0.006 | <1% | 19.0 | 41% | 0.005 | <1% | 19.0 | 41% |
| Rec_005 | Residence | | | | 0.002 | <1% | 17.8 | 39% | 0.003 | <1% | 17.8 | 39% |
| Rec_006 | North Rockingham AQMS | | | | 0.002 | <1% | 19.7 | 43% | 0.002 | <1% | 19.7 | 43% |
| Rec_007 | Residence | | | | 0.001 | <1% | 18.1 | 39% | 0.002 | <1% | 18.1 | 39% |
| Rec_008 | Hope Valley | | | | 0.011 | <1% | 18.3 | 40% | 0.010 | <1% | 18.3 | 40% |
| Rec_009 | Calista Primary School | | | | 0.003 | <1% | 17.5 | 38% | 0.003 | <1% | 17.5 | 38% |
| Rec_010 | Wombat Wallow Childcare Centre | | | | 0.006 | <1% | 17.6 | 38% | 0.005 | <1% | 17.6 | 38% |
| Rec_011 | Wellard Road Residence | | | | 0.002 | <1% | 19.2 | 42% | 0.002 | <1% | 19.2 | 42% |
| Rec_012 | Korcula Ct | | | | 0.004 | <1% | 16.9 | 37% | 0.004 | <1% | 16.9 | 37% |
| Rec_013 | Mannikin Hts | | | | 0.003 | <1% | 17.2 | 37% | 0.003 | <1% | 17.2 | 37% |
| Rec_014 | Rosewood St | | | | 0.010 | <1% | 17.5 | 38% | 0.010 | <1% | 17.5 | 38% |
| Rec_015 | Collerson St | | | | 0.006 | <1% | 16.8 | 37% | 0.006 | <1% | 16.8 | 37% |
| Rec_016 | McMillian Rd | | | | 0.006 | <1% | 17.3 | 38% | 0.006 | <1% | 17.3 | 38% |
| Rec_017 | Naval Base Shacks | | | | 0.023 | <1% | 18.2 | 40% | 0.021 | <1% | 18.2 | 40% |
| Rec_018 | Hope Valley Residence | | | | 0.014 | <1% | 18.8 | 41% | 0.014 | <1% | 18.8 | 41% |
| Rec_019 | Wattleup Residence | | | | 0.016 | <1% | 18.1 | 39% | 0.016 | <1% | 18.1 | 39% |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| Annual average PM ₁₀ ground level concentrations | | | | | | | | | | | |
|---|----------------------------------|----------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | Criteria (µg/m ³) | Background | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | (µg/m ³) | % guideline | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | 23 | 13.2 | 57% | 0.01 | <1% | 15.02 | 65% | 0.01 | <1% | 15.02 | 65% |
| Max. outside buffer area | | | | 0.01 | <1% | 14.27 | 62% | 0.01 | <1% | 14.27 | 62% |
| Rec_001 Wells Park | | | | 0.0002 | <1% | 13.8 | 60% | 0.0002 | <1% | 13.8 | 60% |
| Rec_002 Golf Course | | | | 0.0001 | <1% | 13.4 | 58% | 0.0001 | <1% | 13.4 | 58% |
| Rec_003 Thomas Oval | | | | 0.0002 | <1% | 13.5 | 58% | 0.0002 | <1% | 13.5 | 58% |
| Rec_004 Oval | | | | 0.0003 | <1% | 13.7 | 59% | 0.0003 | <1% | 13.7 | 59% |
| Rec_005 Residence | | | | 0.0001 | <1% | 13.4 | 58% | 0.0001 | <1% | 13.4 | 58% |
| Rec_006 North Rockingham AQMS | | | | 0.0001 | <1% | 13.5 | 59% | 0.0001 | <1% | 13.5 | 59% |
| Rec_007 Residence | | | | 0.0001 | <1% | 13.3 | 58% | 0.0001 | <1% | 13.3 | 58% |
| Rec_008 Hope Valley | | | | 0.0005 | <1% | 13.6 | 59% | 0.0005 | <1% | 13.6 | 59% |
| Rec_009 Callista Primary School | | | | 0.0001 | <1% | 13.3 | 58% | 0.0001 | <1% | 13.3 | 58% |
| Rec_010 Wombat Wallow Childcare Centre | | | | 0.0002 | <1% | 13.4 | 58% | 0.0002 | <1% | 13.4 | 58% |
| Rec_011 Wellard Road Residence | | | | 0.0001 | <1% | 13.4 | 58% | 0.0001 | <1% | 13.4 | 58% |
| Rec_012 Korcula Ct | | | | 0.0004 | <1% | 13.3 | 58% | 0.0004 | <1% | 13.3 | 58% |
| Rec_013 Mannikin Hts | | | | 0.0004 | <1% | 13.3 | 58% | 0.0004 | <1% | 13.3 | 58% |
| Rec_014 Rosewood St | | | | 0.0005 | <1% | 13.3 | 58% | 0.0005 | <1% | 13.3 | 58% |
| Rec_015 Collerson St | | | | 0.0002 | <1% | 13.3 | 58% | 0.0002 | <1% | 13.3 | 58% |
| Rec_016 Mcmillian Rd | | | | 0.0002 | <1% | 13.3 | 58% | 0.0002 | <1% | 13.3 | 58% |
| Rec_017 Naval Base Shacks | | | | 0.0020 | <1% | 13.4 | 58% | 0.0020 | <1% | 13.4 | 58% |
| Rec_018 Hope Valley Residence | | | | 0.0006 | <1% | 13.8 | 60% | 0.0006 | <1% | 13.8 | 60% |
| Rec_019 Wattleup Residence | 0.0022 | <1% | 13.4 | 58% | 0.0022 | <1% | 13.4 | 58% | | | |

Notes:

- Reference conditions 25°C and 101.3 kPa

Table 5-5: Summary of maximum 24-hour average and annual average predicted GLCs of PM_{2.5} at sensitive receptor locations

| 24-hour maximum PM _{2.5} ground level concentrations | | | | | | | | | | | | |
|---|----------------------------------|---|-----|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|-----|
| Receptor | Criteria (µg/m ³) | Background (µg/m ³) % guideline | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | | |
| | | | | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | |
| Max. offsite | | | | 0.1 | <1% | 21.1 | 117% | 0.1 | <1% | 21.1 | 117% | |
| Max. outside buffer area | | | | 0.1 | <1% | 16.1 | 89% | 0.1 | <1% | 16.1 | 89% | |
| Rec_001 | Wells Park | 18 | 8.6 | 48% | 0.0030 | <1% | 15.6 | 87% | 0.0029 | <1% | 15.6 | 87% |
| Rec_002 | Golf Course | | | | 0.0020 | <1% | 10.5 | 58% | 0.0027 | <1% | 10.5 | 58% |
| Rec_003 | Thomas Oval | | | | 0.0041 | <1% | 10.7 | 60% | 0.0032 | <1% | 10.7 | 60% |
| Rec_004 | Oval | | | | 0.0056 | <1% | 11.6 | 65% | 0.0049 | <1% | 11.6 | 65% |
| Rec_005 | Residence | | | | 0.0023 | <1% | 10.5 | 58% | 0.0029 | <1% | 10.5 | 58% |
| Rec_006 | North Rockingham AQMS | | | | 0.0021 | <1% | 12.4 | 69% | 0.0020 | <1% | 12.4 | 69% |
| Rec_007 | Residence | | | | 0.0012 | <1% | 10.7 | 60% | 0.0021 | <1% | 10.7 | 60% |
| Rec_008 | Hope Valley | | | | 0.0110 | <1% | 11.0 | 61% | 0.0101 | <1% | 11.0 | 61% |
| Rec_009 | Calista Primary School | | | | 0.0031 | <1% | 10.2 | 57% | 0.0029 | <1% | 10.2 | 57% |
| Rec_010 | Wombat Wallow Childcare Centre | | | | 0.0057 | <1% | 10.2 | 57% | 0.0053 | <1% | 10.2 | 57% |
| Rec_011 | Wellard Road Residence | | | | 0.0020 | <1% | 11.9 | 66% | 0.0020 | <1% | 11.9 | 66% |
| Rec_012 | Korcula Ct | | | | 0.0041 | <1% | 9.6 | 53% | 0.0037 | <1% | 9.6 | 53% |
| Rec_013 | Mannikin Hts | | | | 0.0032 | <1% | 9.9 | 55% | 0.0033 | <1% | 9.9 | 55% |
| Rec_014 | Rosewood St | | | | 0.0102 | <1% | 10.1 | 56% | 0.0103 | <1% | 10.1 | 56% |
| Rec_015 | Collerson St | | | | 0.0060 | <1% | 9.5 | 53% | 0.0060 | <1% | 9.5 | 53% |
| Rec_016 | McMillian Rd | | | | 0.0058 | <1% | 9.9 | 55% | 0.0058 | <1% | 9.9 | 55% |
| Rec_017 | Naval Base Shacks | | | | 0.0232 | <1% | 10.9 | 61% | 0.0206 | <1% | 10.9 | 61% |
| Rec_018 | Hope Valley Residence | | | | 0.0135 | <1% | 11.4 | 63% | 0.0143 | <1% | 11.4 | 63% |
| Rec_019 | Wattleup Residence | | | | 0.0161 | <1% | 10.8 | 60% | 0.0164 | <1% | 10.8 | 60% |

Notes:

1. Reference conditions 25°C and 101.3 kPa

| Annual average PM _{2.5} ground level concentrations | | | | | | | | | | | |
|--|----------------------------------|----------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|----------------------------------|-------------|-----------------------------------|-------------|
| Receptor | Criteria (µg/m ³) | Background | | Scenario 3a | | Scenario 3b | | Scenario 4a | | Scenario 4b | |
| | | (µg/m ³) | % guideline | Boiler combination 1 - Isolation | | Boiler combination 1 - Cumulative | | Boiler combination 2 - Isolation | | Boiler combination 2 - Cumulative | |
| | | | | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline | (µg/m ³) | % guideline |
| Max. offsite | 6.4 | 7.6 | 119% | 0.01 | <1% | 9.4 | 147% | 0.01 | <1% | 9.4 | 147% |
| Max. outside buffer area | | | | 0.01 | <1% | 8.7 | 136% | 0.01 | <1% | 8.7 | 136% |
| Rec_001 Wells Park | | | | 0.0002 | <1% | 8.2 | 129% | 0.0002 | <1% | 8.2 | 129% |
| Rec_002 Golf Course | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| Rec_003 Thomas Oval | | | | 0.0002 | <1% | 7.9 | 123% | 0.0002 | <1% | 7.9 | 123% |
| Rec_004 Oval | | | | 0.0003 | <1% | 8.1 | 126% | 0.0003 | <1% | 8.1 | 126% |
| Rec_005 Residence | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| Rec_006 North Rockingham AQMS | | | | 0.0001 | <1% | 7.9 | 123% | 0.0001 | <1% | 7.9 | 123% |
| Rec_007 Residence | | | | 0.0001 | <1% | 7.7 | 121% | 0.0001 | <1% | 7.7 | 121% |
| Rec_008 Hope Valley | | | | 0.0005 | <1% | 8.0 | 126% | 0.0005 | <1% | 8.0 | 126% |
| Rec_009 Callista Primary School | | | | 0.0001 | <1% | 7.8 | 121% | 0.0001 | <1% | 7.8 | 121% |
| Rec_010 Wombat Wallow Childcare Centre | | | | 0.0002 | <1% | 7.8 | 122% | 0.0002 | <1% | 7.8 | 122% |
| Rec_011 Wellard Road Residence | | | | 0.0001 | <1% | 7.8 | 122% | 0.0001 | <1% | 7.8 | 122% |
| Rec_012 Korcula Ct | | | | 0.0004 | <1% | 7.7 | 121% | 0.0004 | <1% | 7.7 | 121% |
| Rec_013 Mannikin Hts | | | | 0.0004 | <1% | 7.7 | 121% | 0.0004 | <1% | 7.7 | 121% |
| Rec_014 Rosewood St | | | | 0.0005 | <1% | 7.7 | 121% | 0.0005 | <1% | 7.7 | 121% |
| Rec_015 Collerson St | | | | 0.0002 | <1% | 7.7 | 120% | 0.0002 | <1% | 7.7 | 120% |
| Rec_016 Mcmillian Rd | | | | 0.0002 | <1% | 7.7 | 121% | 0.0002 | <1% | 7.7 | 121% |
| Rec_017 Naval Base Shacks | | | | 0.0020 | <1% | 7.8 | 122% | 0.0020 | <1% | 7.8 | 122% |
| Rec_018 Hope Valley Residence | | | | 0.0006 | <1% | 8.2 | 128% | 0.0006 | <1% | 8.2 | 128% |
| Rec_019 Wattleup Residence | 0.0022 | <1% | 7.8 | 123% | 0.0022 | <1% | 7.8 | 123% | | | |

Notes:

1. Reference conditions 25°C and 101.3 kPa

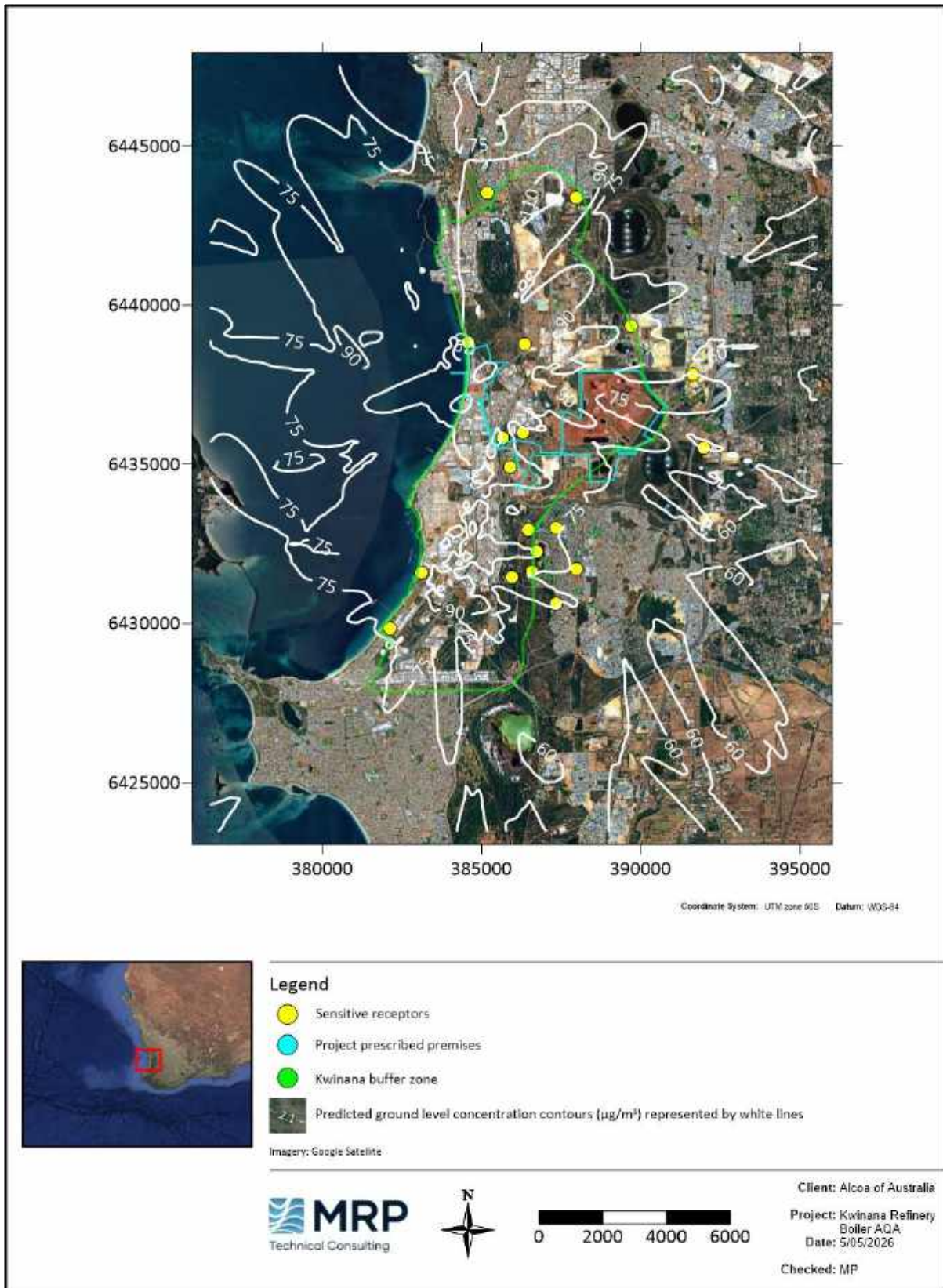


Figure 5-2: Predicted maximum 1-hour average GLCs of NO₂ (Across modelled domain) – Scenario 1: Current operations - Cumulative



Figure 5-3: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 1: Current operations - Cumulative

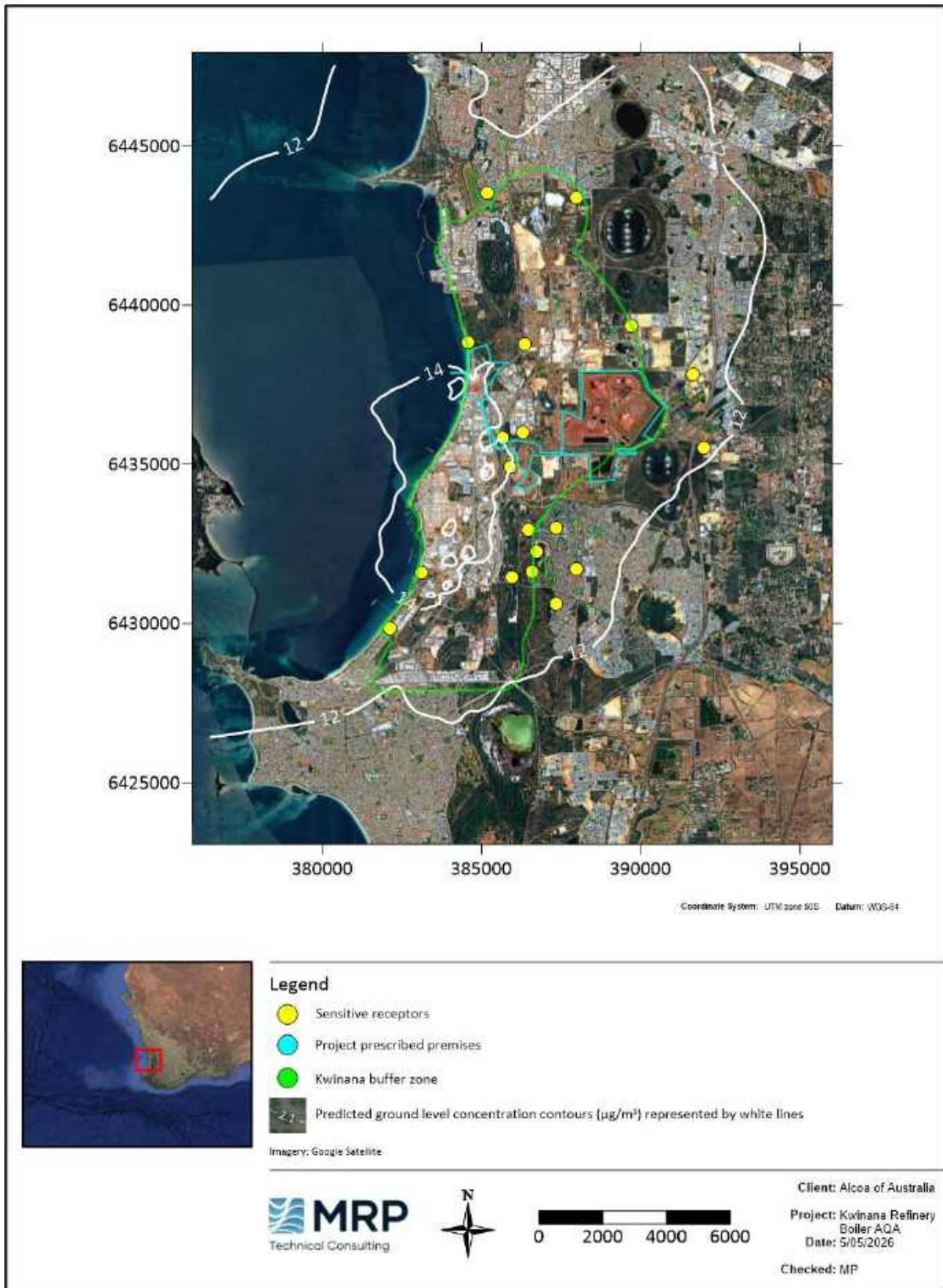


Figure 5-4: Predicted annual average GLCs of NO_2 (Across modelled domain) – Scenario 1: Current operations - Cumulative



Figure 5-5 Predicted annual average GLCs of NO₂ (Zoomed in) – Scenario 1: Current operations - Cumulative

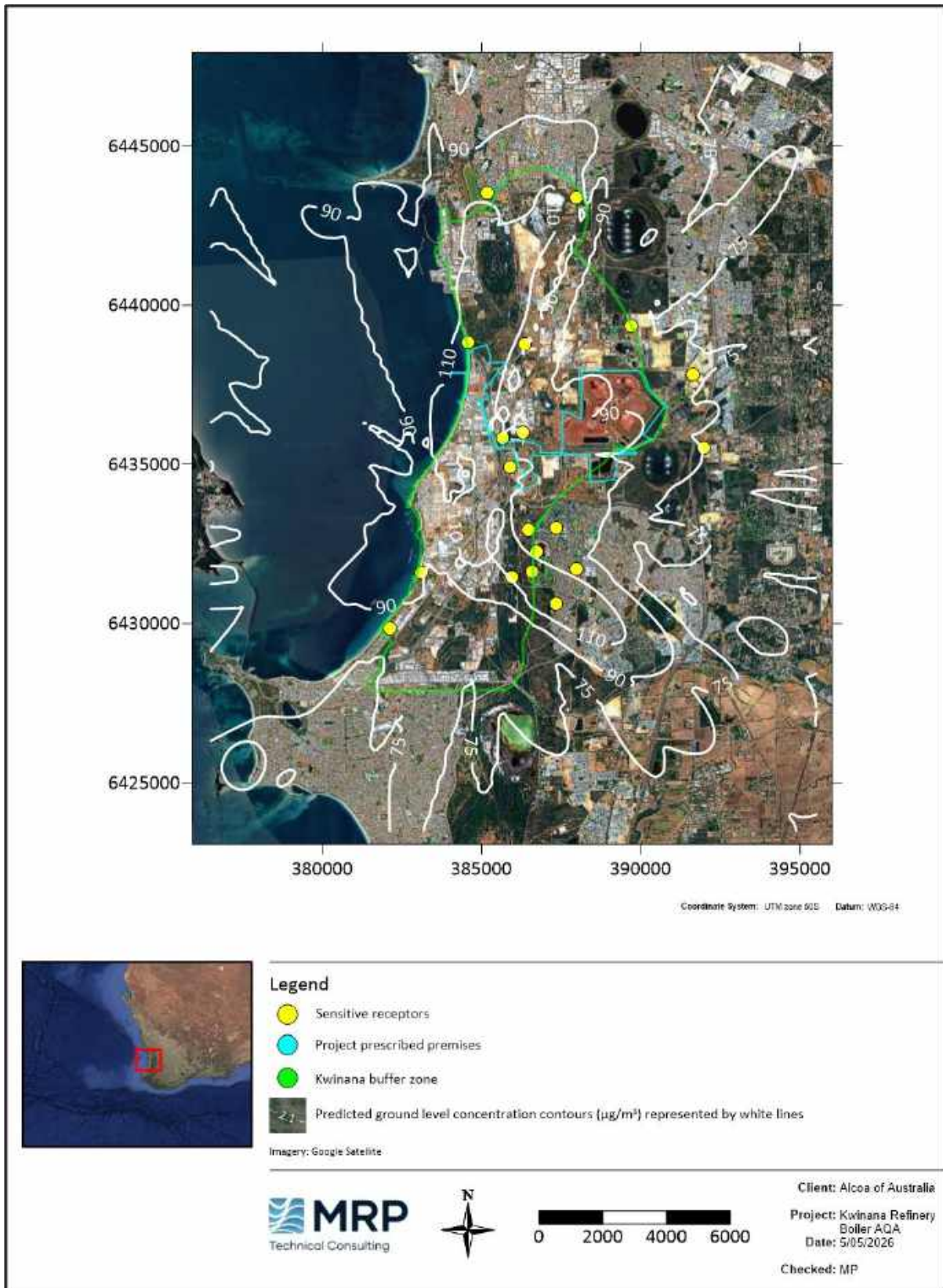


Figure 5-6: Predicted maximum 1-hour average GLCs of NO_2 (Across modelled domain) – Scenario 2: Future approved - Cumulative



Figure 5-7: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 2: Future approved - Cumulative



Figure 5-8: Predicted annual average GLCs of NO_2 (Across modelled domain) – Scenario 2: Future approved - Cumulative



Figure 5-9: Predicted annual average GLCs of NO_2 (Zoomed in) – Scenario 2: Future approved - Cumulative

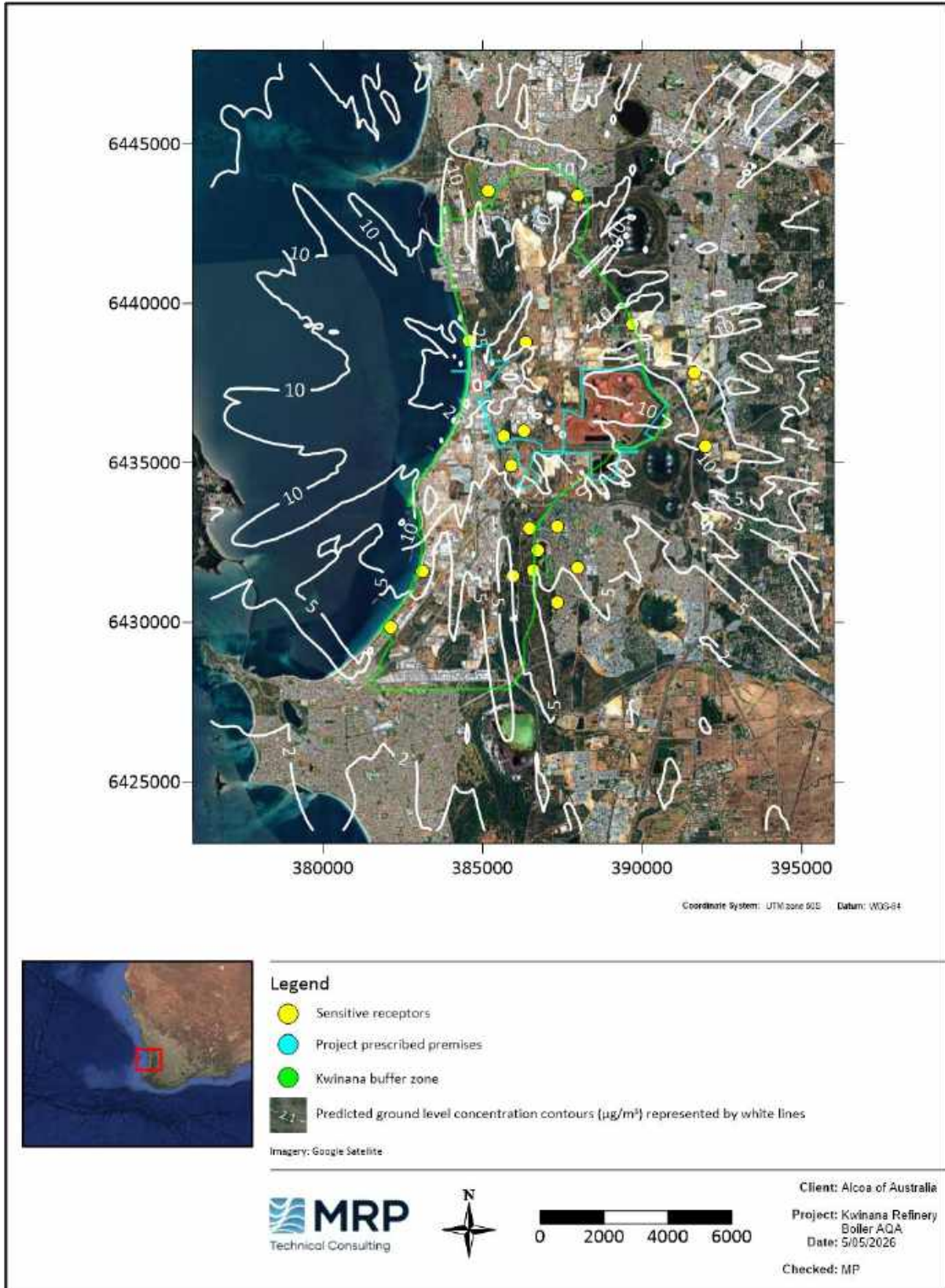


Figure 5-10: Predicted maximum 1-hour average GLCs of NO_2 (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation



Figure 5-11: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

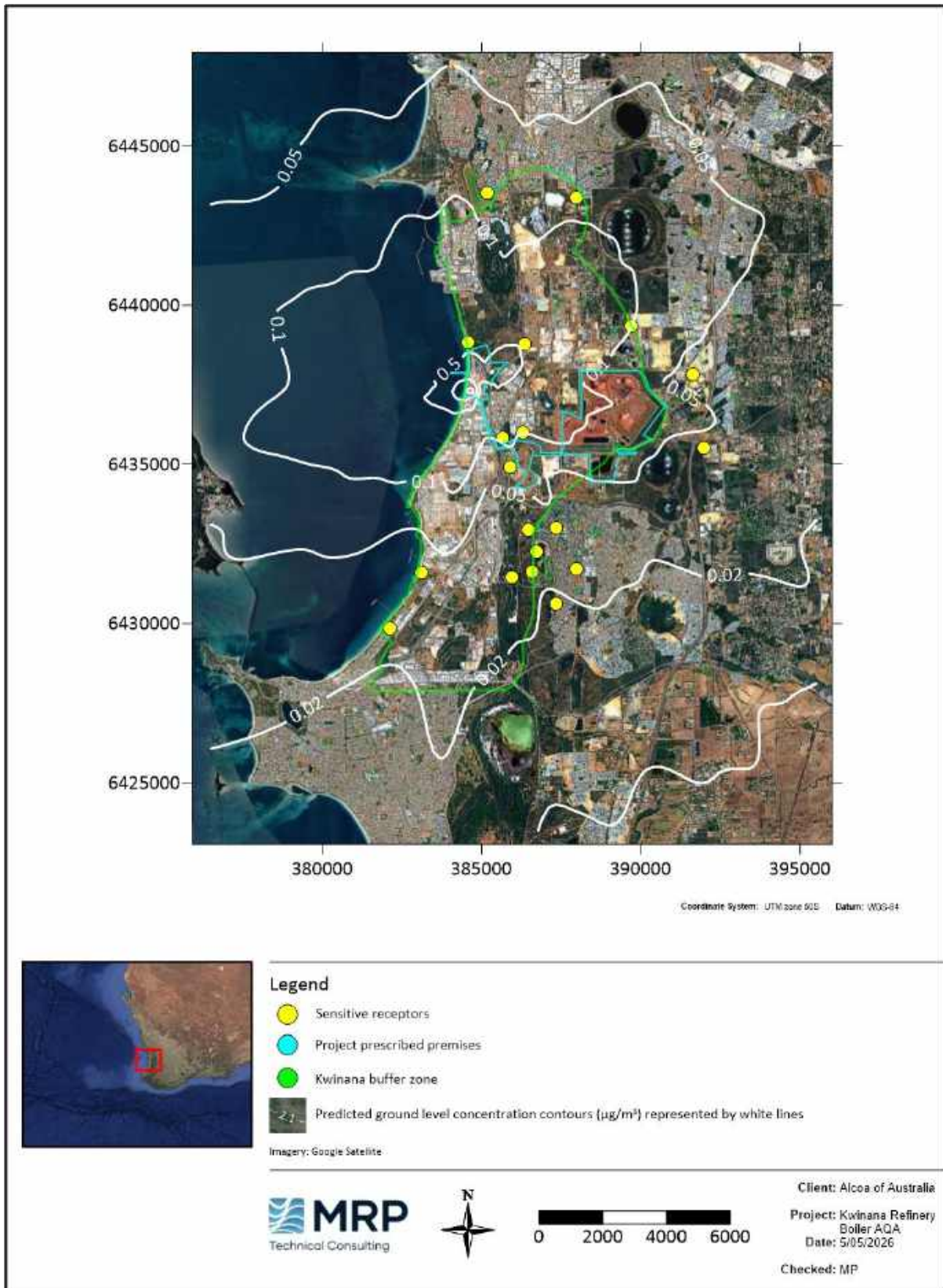


Figure 5-12: Predicted annual average GLCs of NO₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

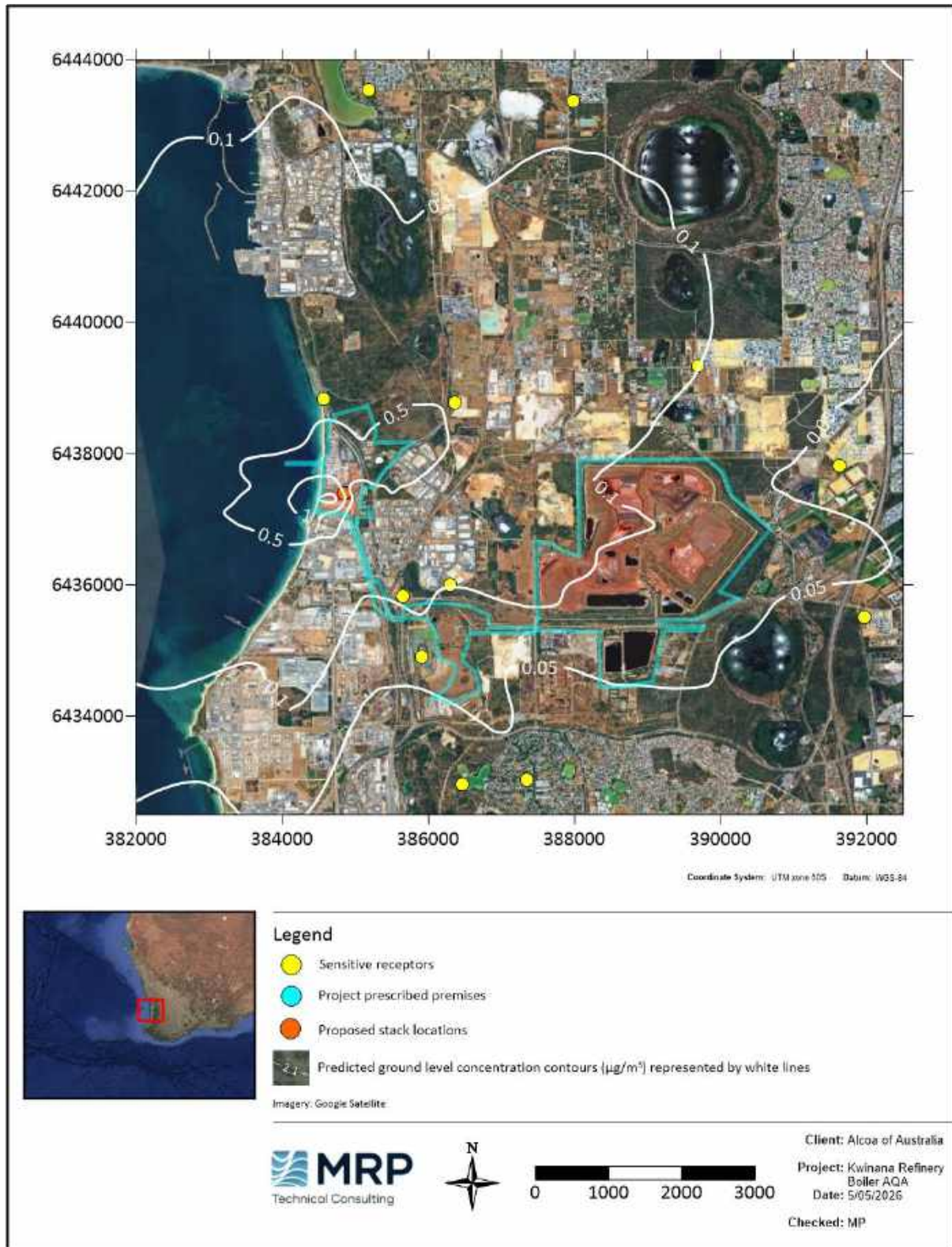


Figure 5-13: Predicted annual average GLCs of NO₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

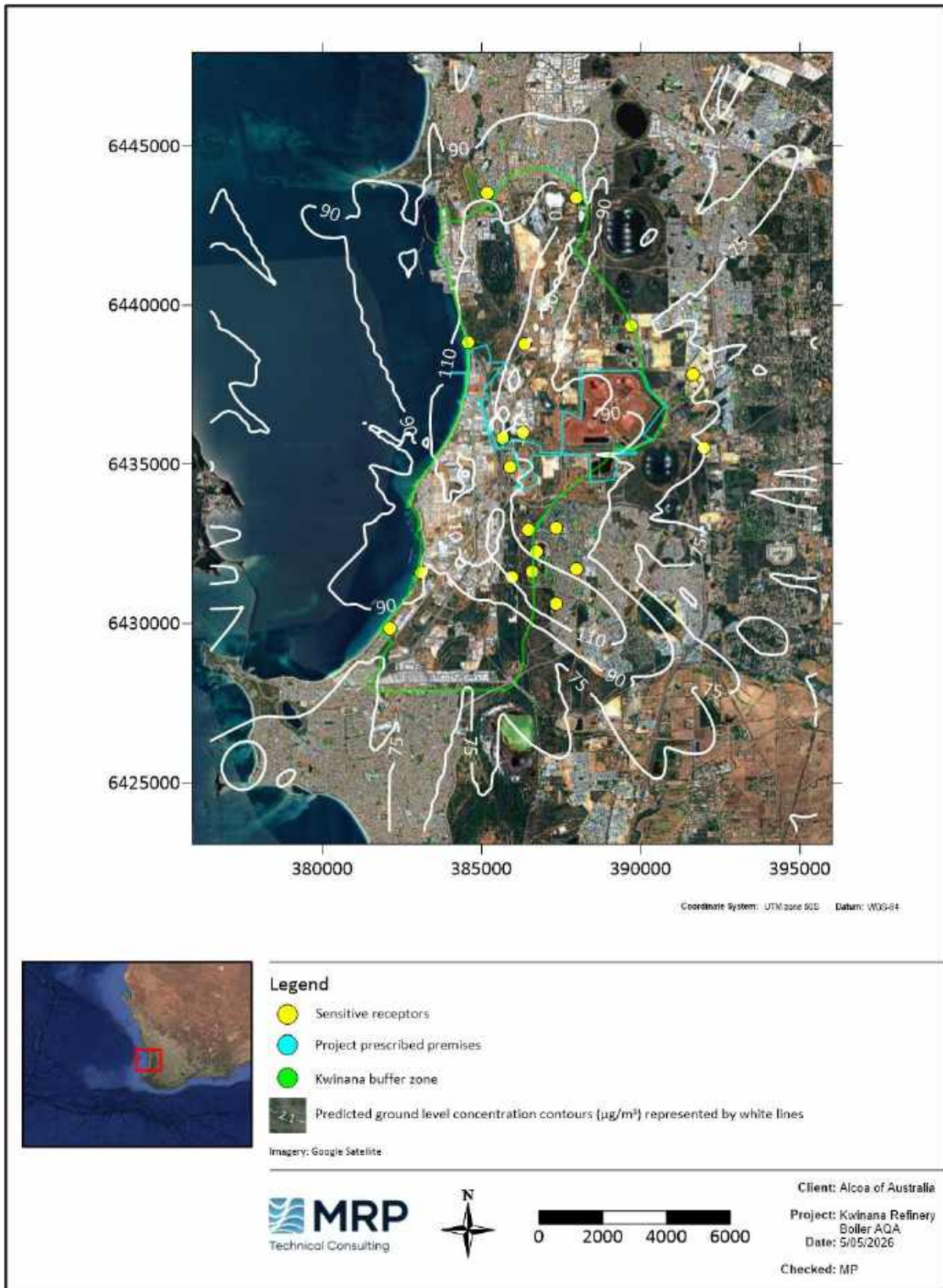


Figure 5-14: Predicted maximum 1-hour average GLCs of NO₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-15: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

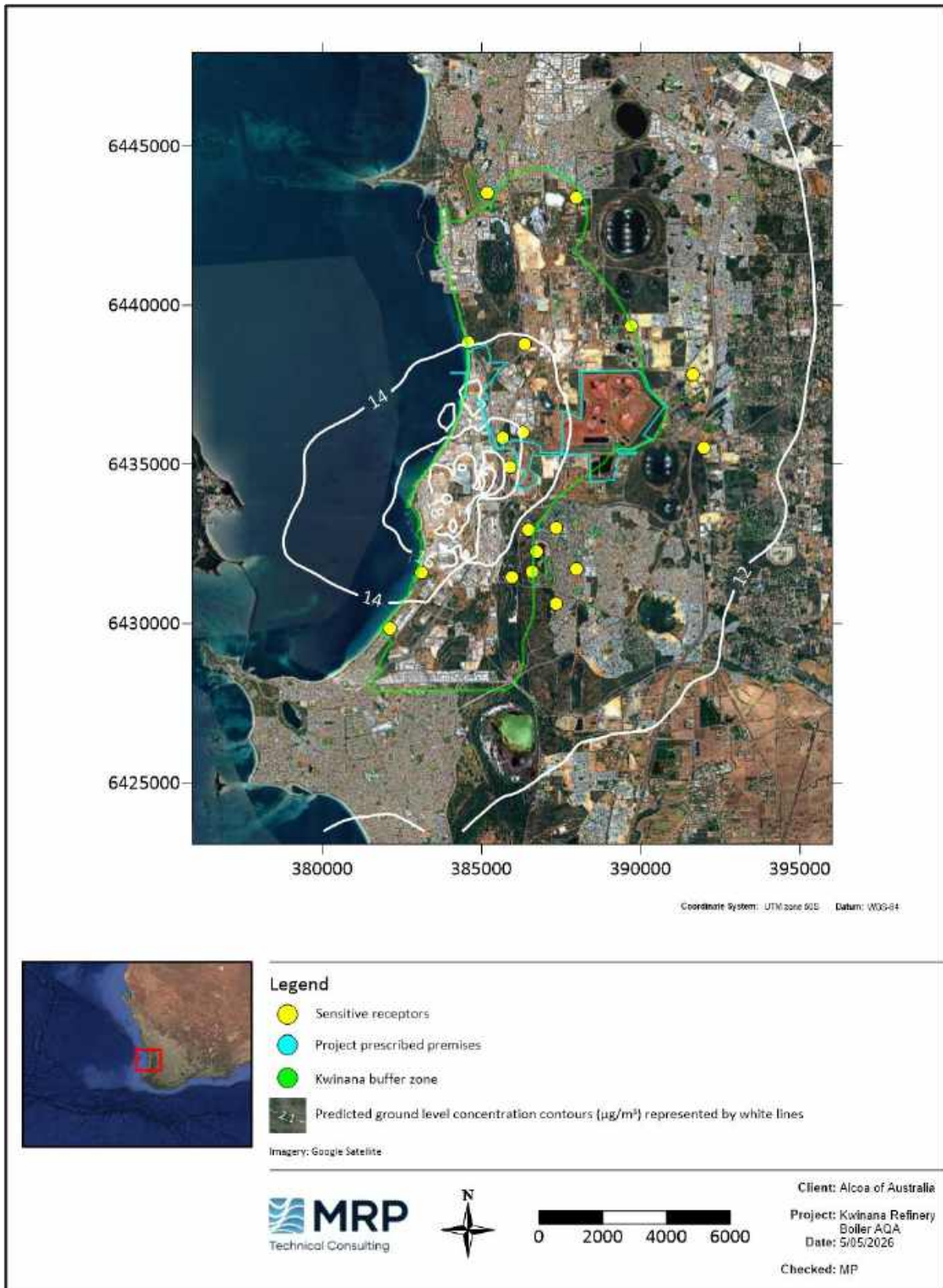


Figure 5-16: Predicted annual average GLCs of NO₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

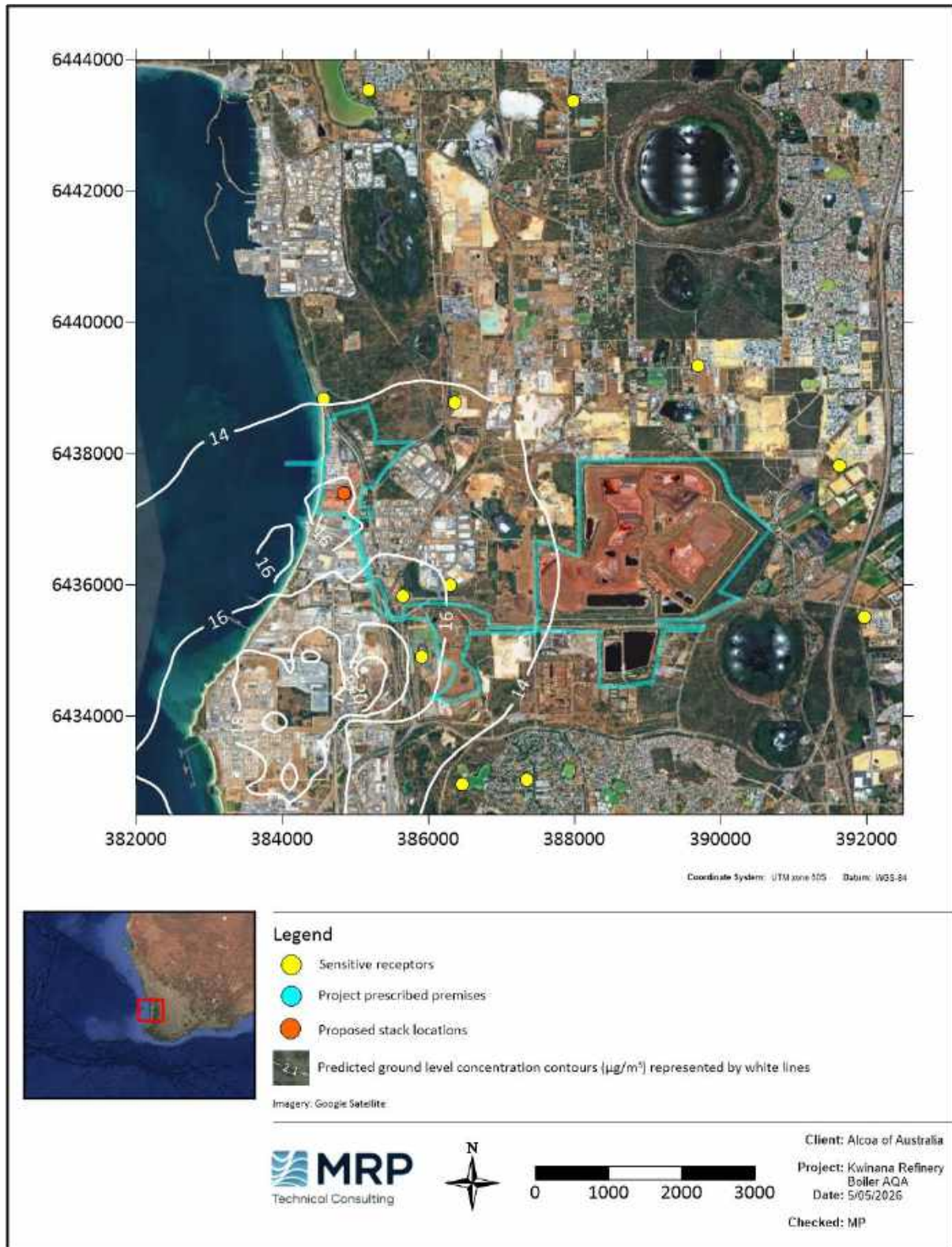


Figure 5-17: Predicted annual average GLCs of NO₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

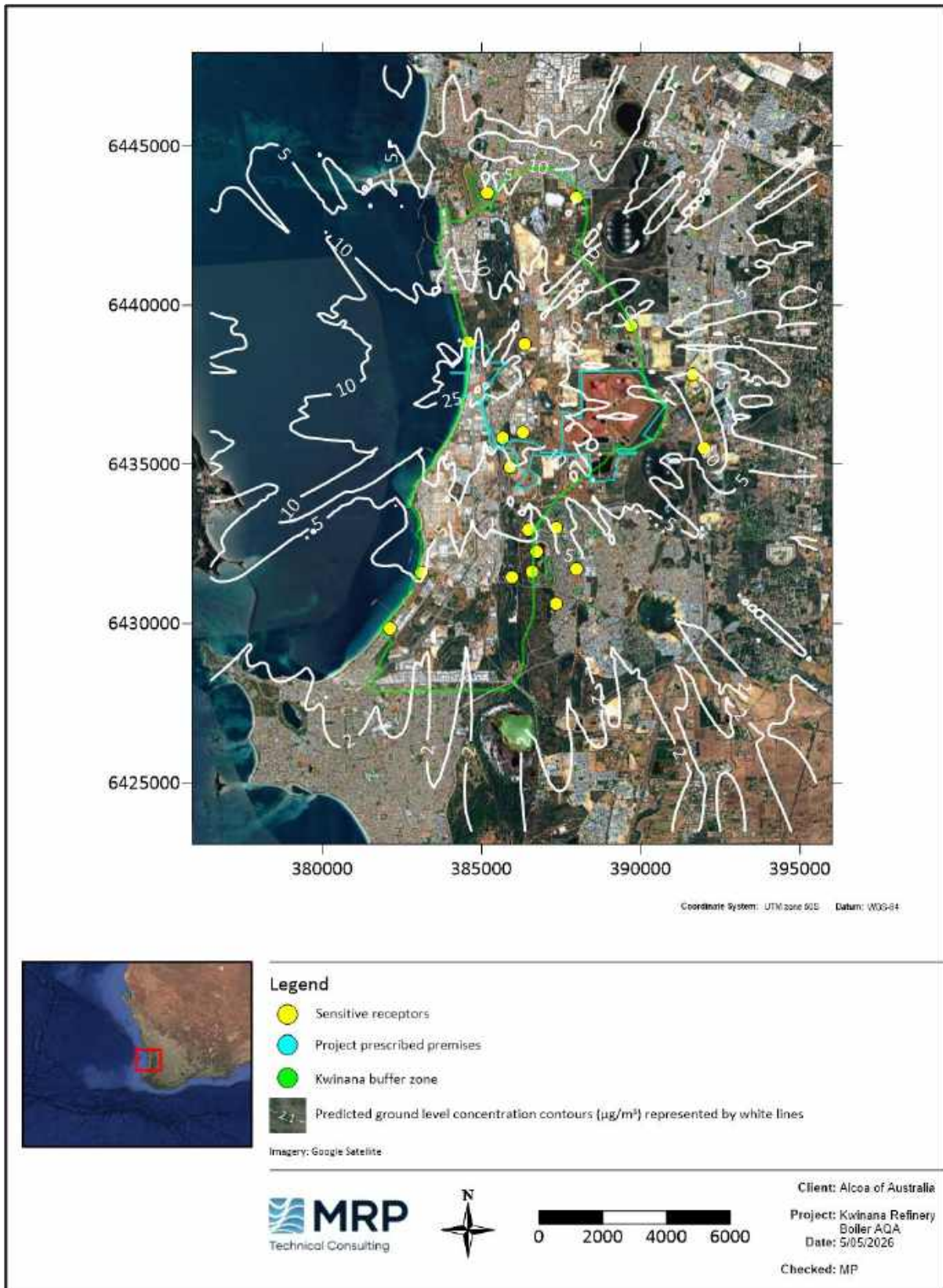


Figure 5-18: Predicted maximum 1-hour average GLCs of NO_2 (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-19: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

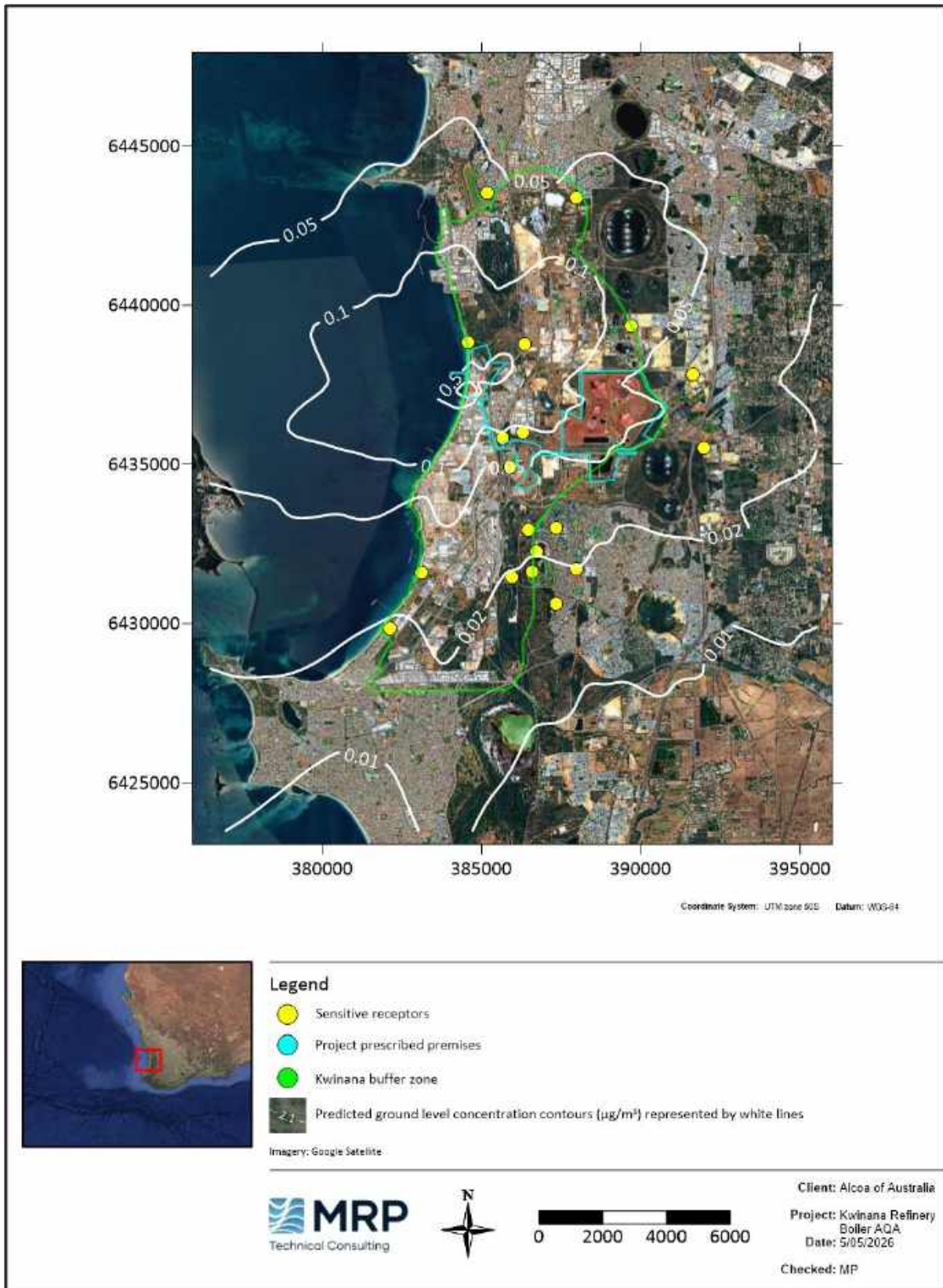


Figure 5-20: Predicted annual average GLCs of NO₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-21: Predicted annual average GLCs of NO₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

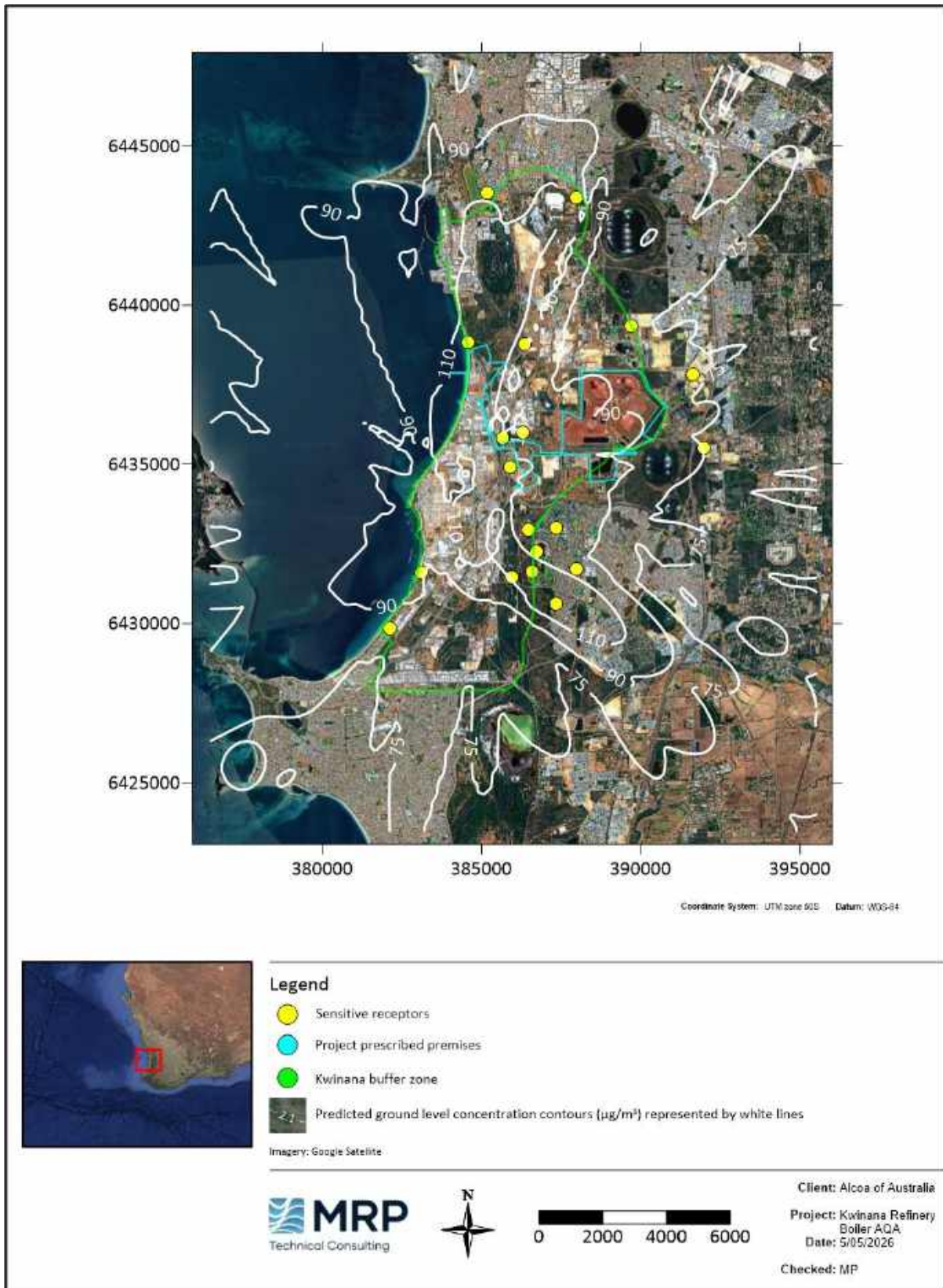


Figure 5-22: Predicted maximum 1-hour average GLCs of NO₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-23: Predicted maximum 1-hour average GLCs of NO₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-24: Predicted annual average GLCs of NO_2 (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-25: Predicted annual average GLCs of NO₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

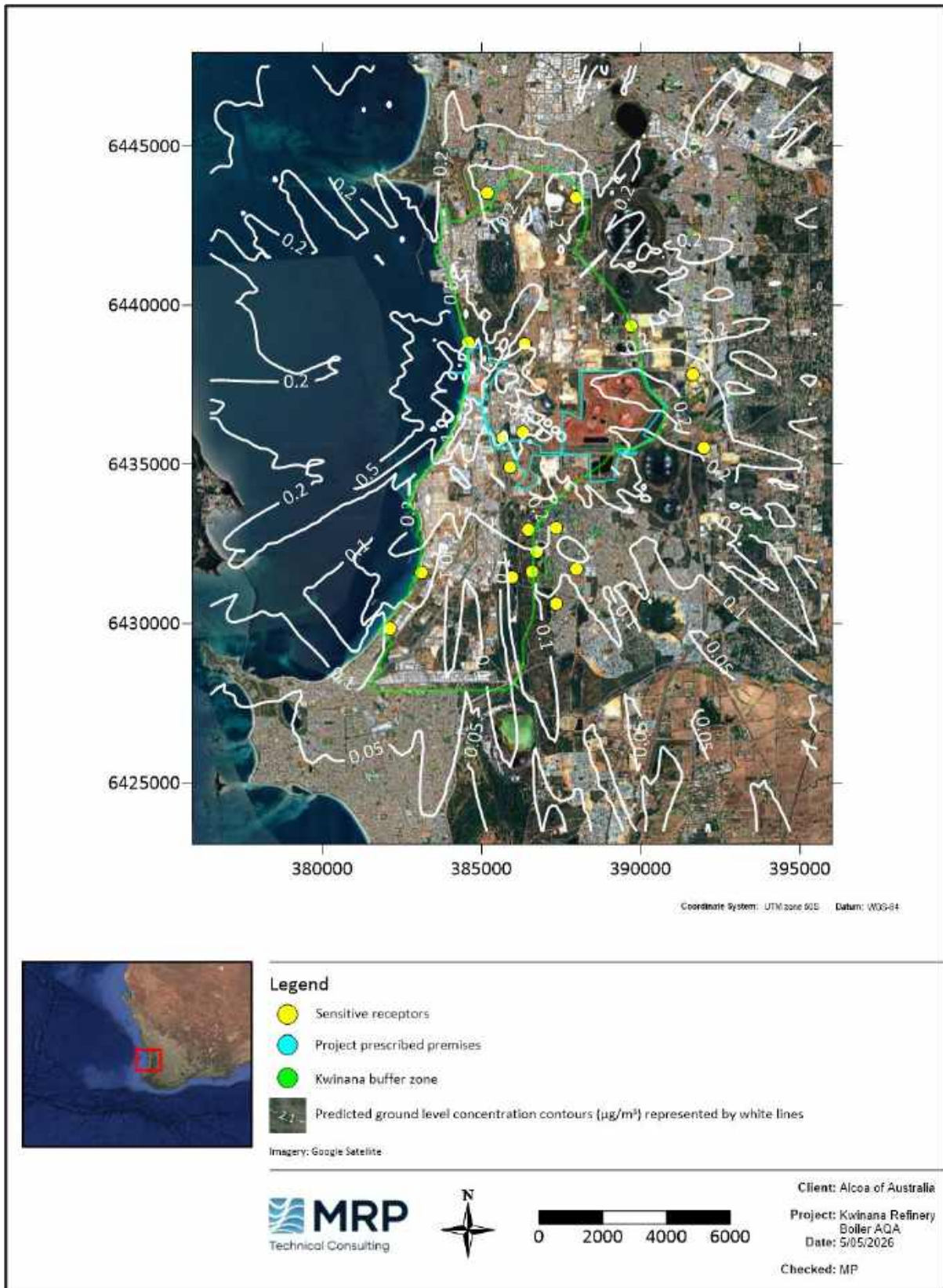


Figure 5-26: Predicted maximum 1-hour average GLCs of SO₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

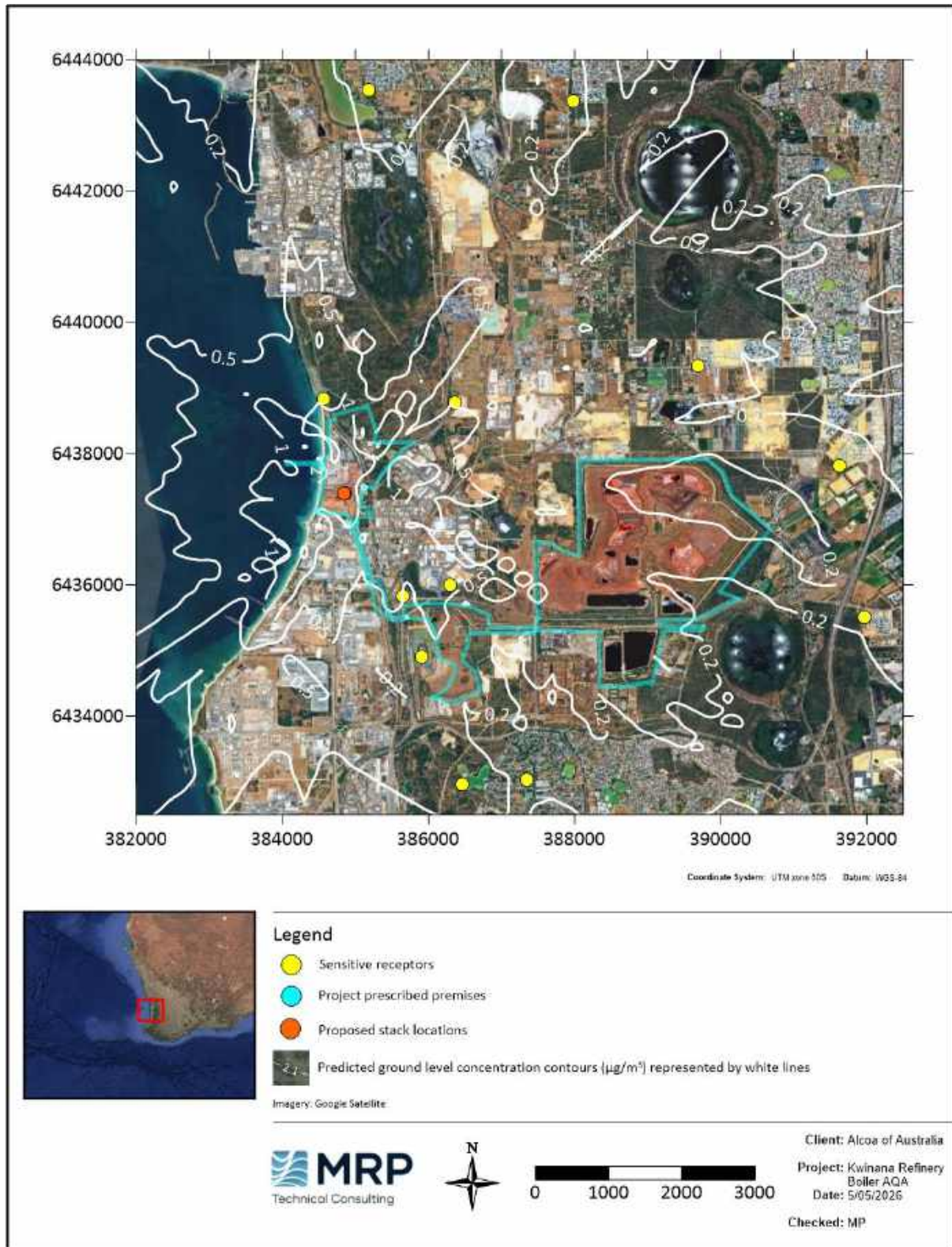


Figure 5-27: Predicted maximum 1-hour average GLCs of SO₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

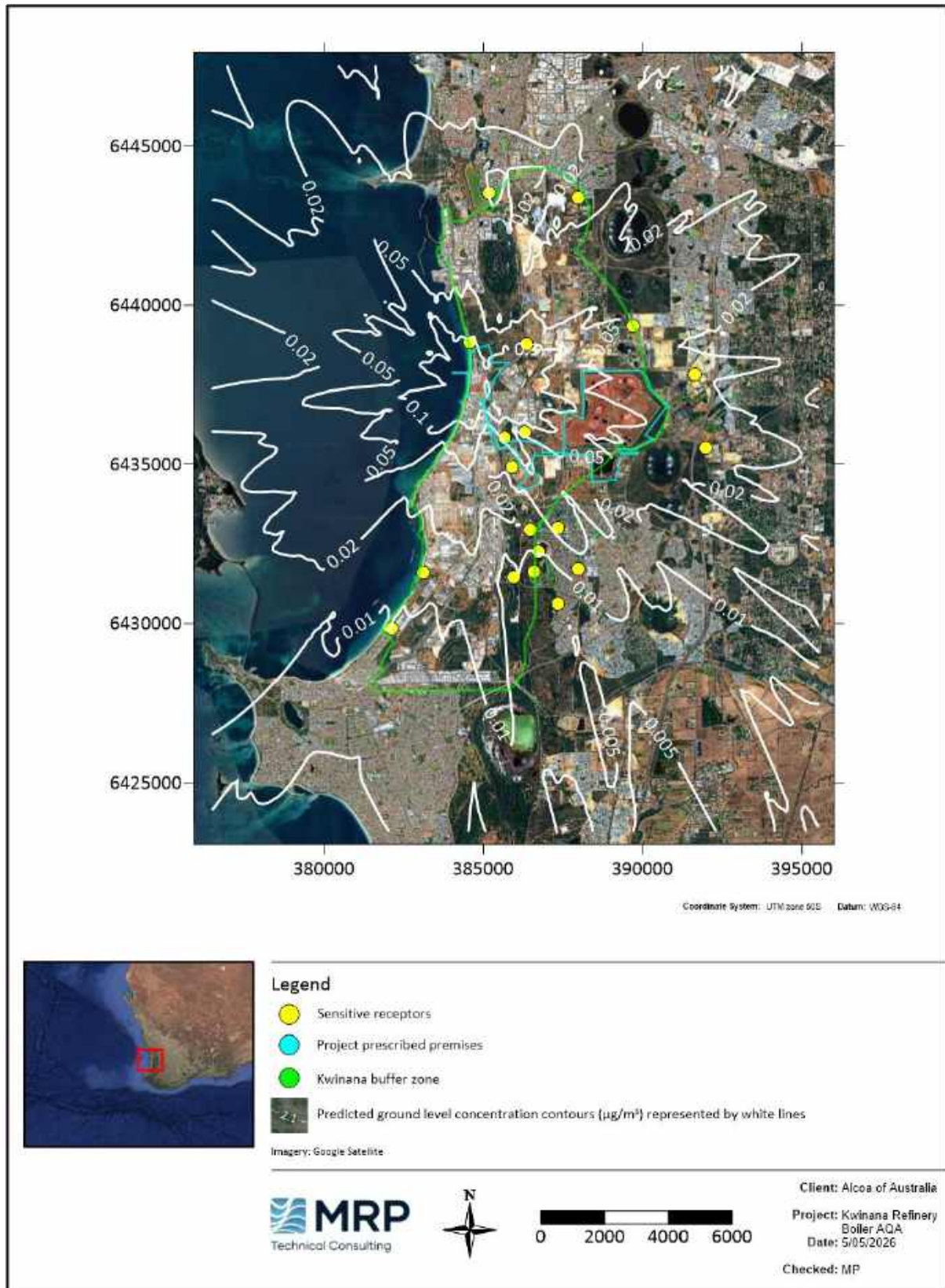


Figure 5-28: Predicted maximum 24-hour average GLCs of SO₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

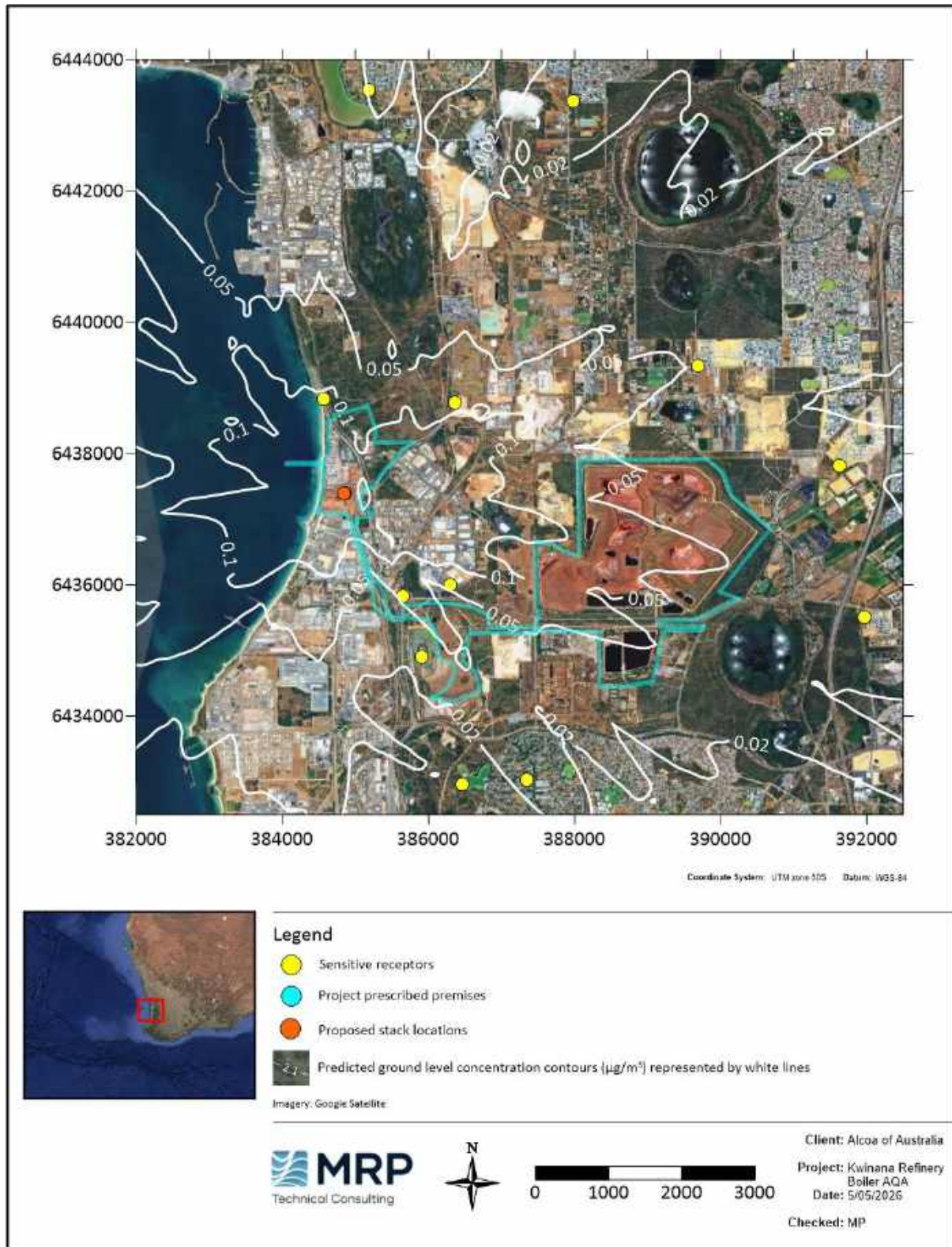


Figure 5-29: Predicted maximum 24-hour average GLCs of SO₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

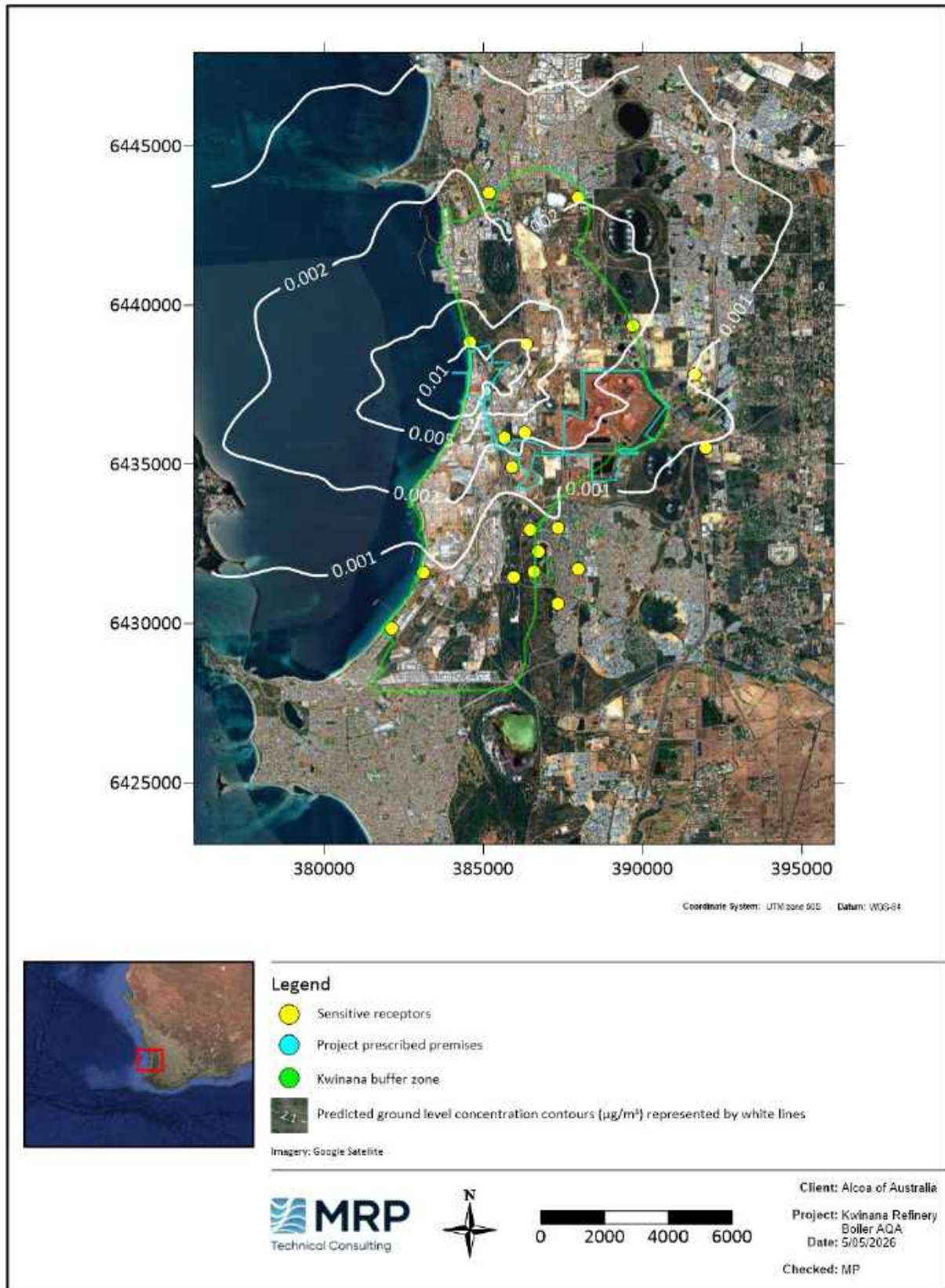


Figure 5-30: Predicted annual average GLCs of SO₂ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

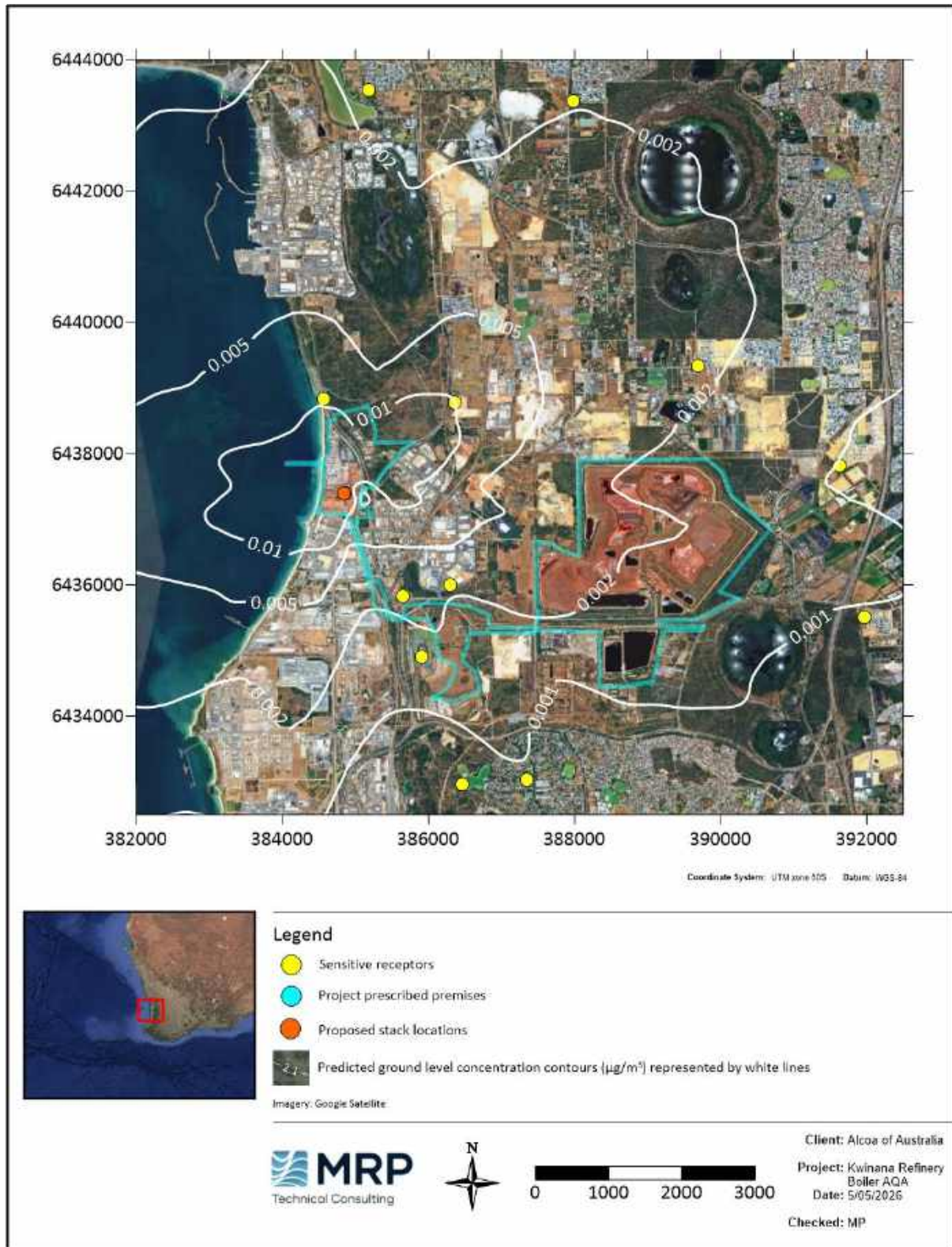


Figure 5-31: Predicted annual average GLCs of SO₂ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

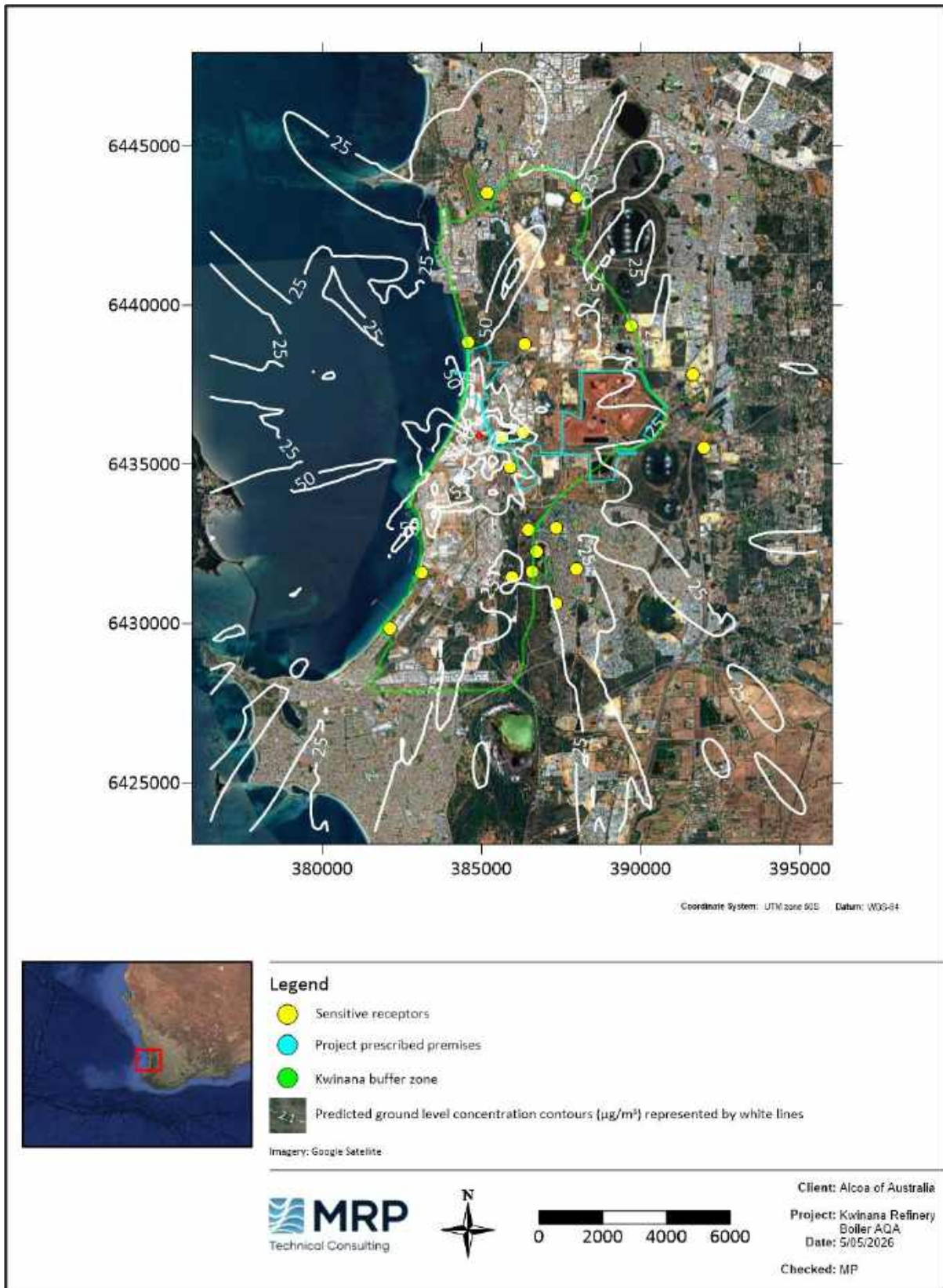


Figure 5-32: Predicted maximum 1-hour average GLCs of SO₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-33: Predicted maximum 1-hour average GLCs of SO₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

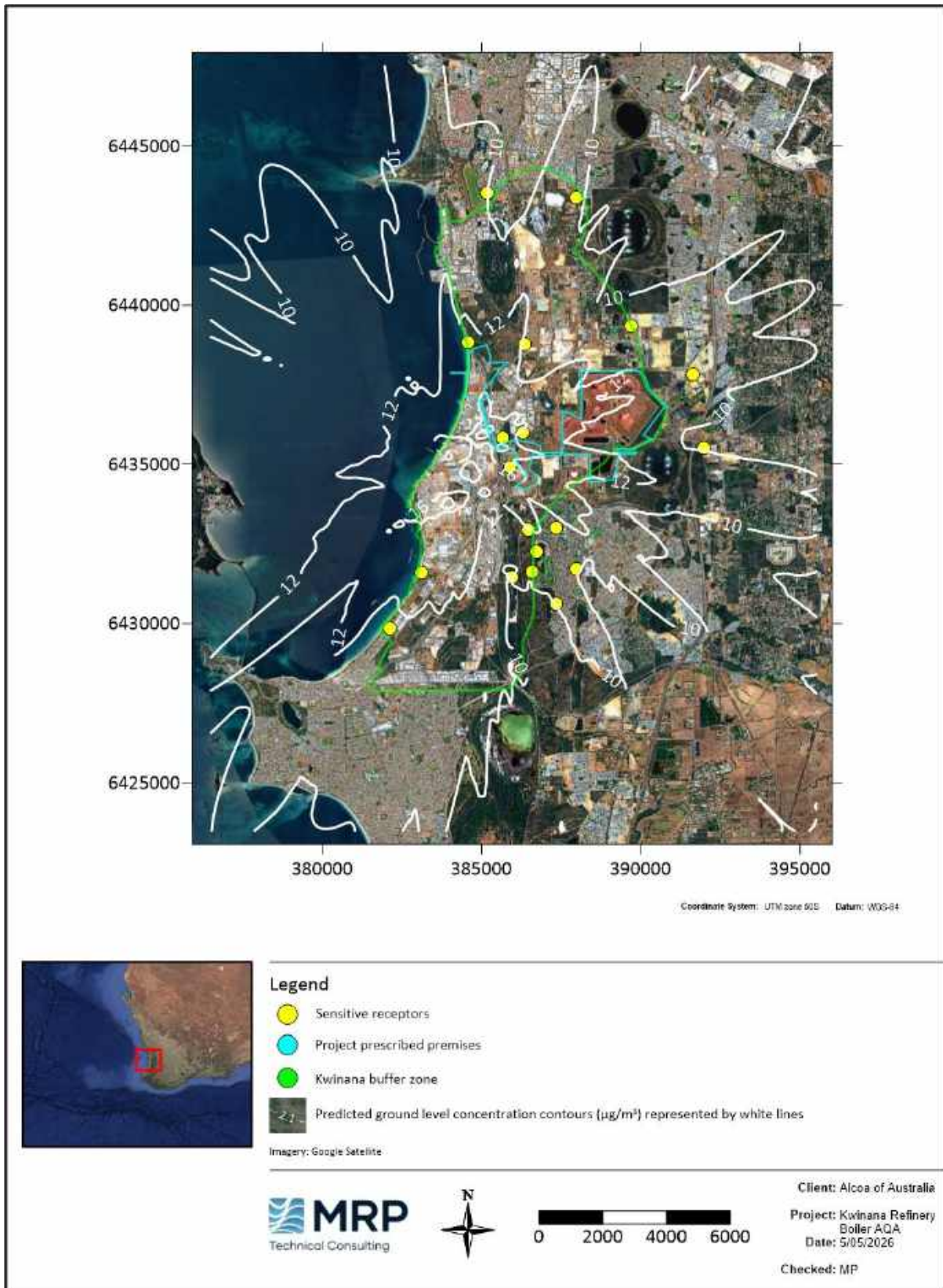


Figure 5-34: Predicted maximum 24-hour average GLCs of SO₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-35: Predicted maximum 24-hour average GLCs of SO₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

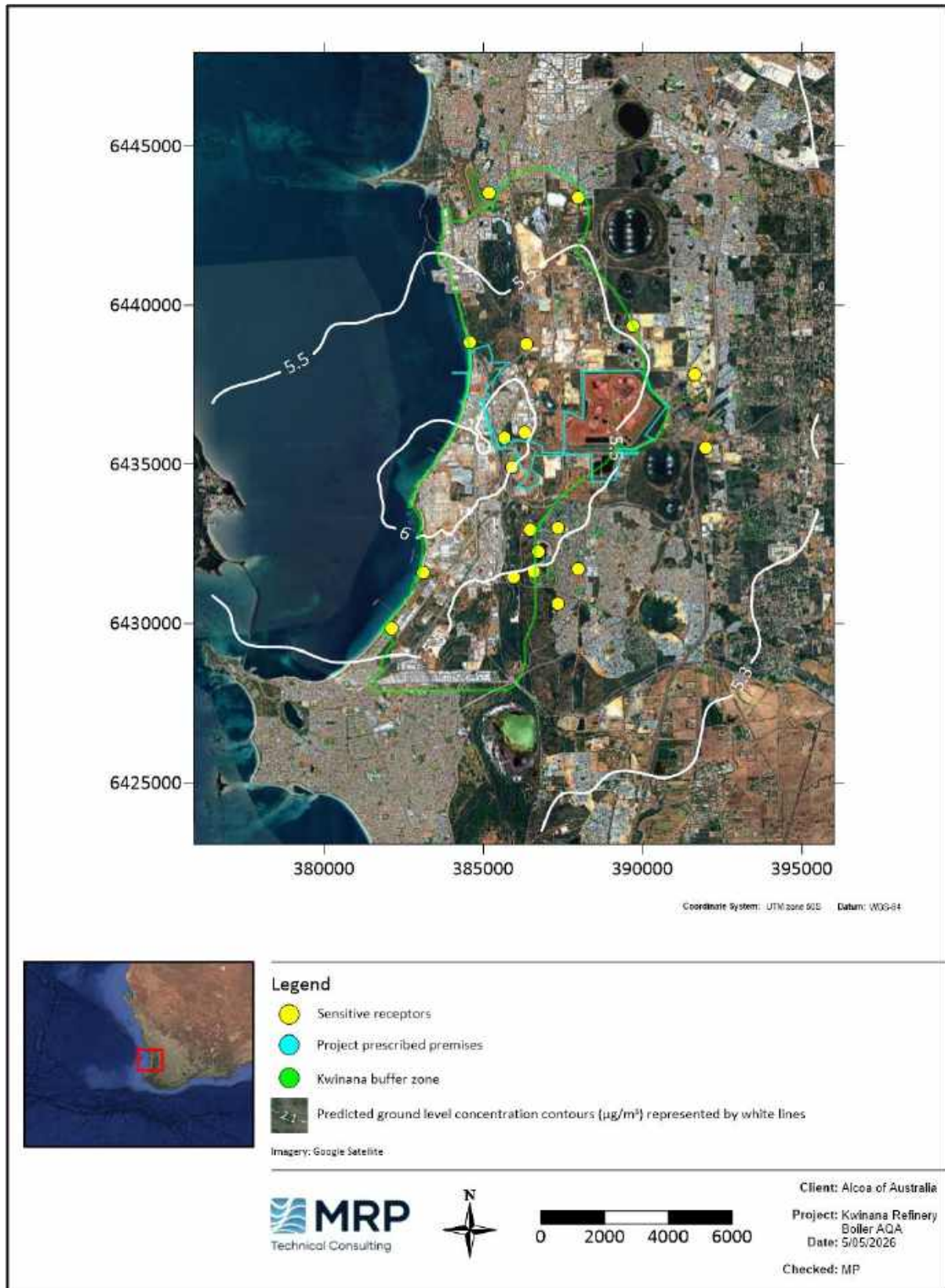


Figure 5-36: Predicted annual average GLCs of SO₂ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-37: Predicted annual average GLCs of SO₂ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

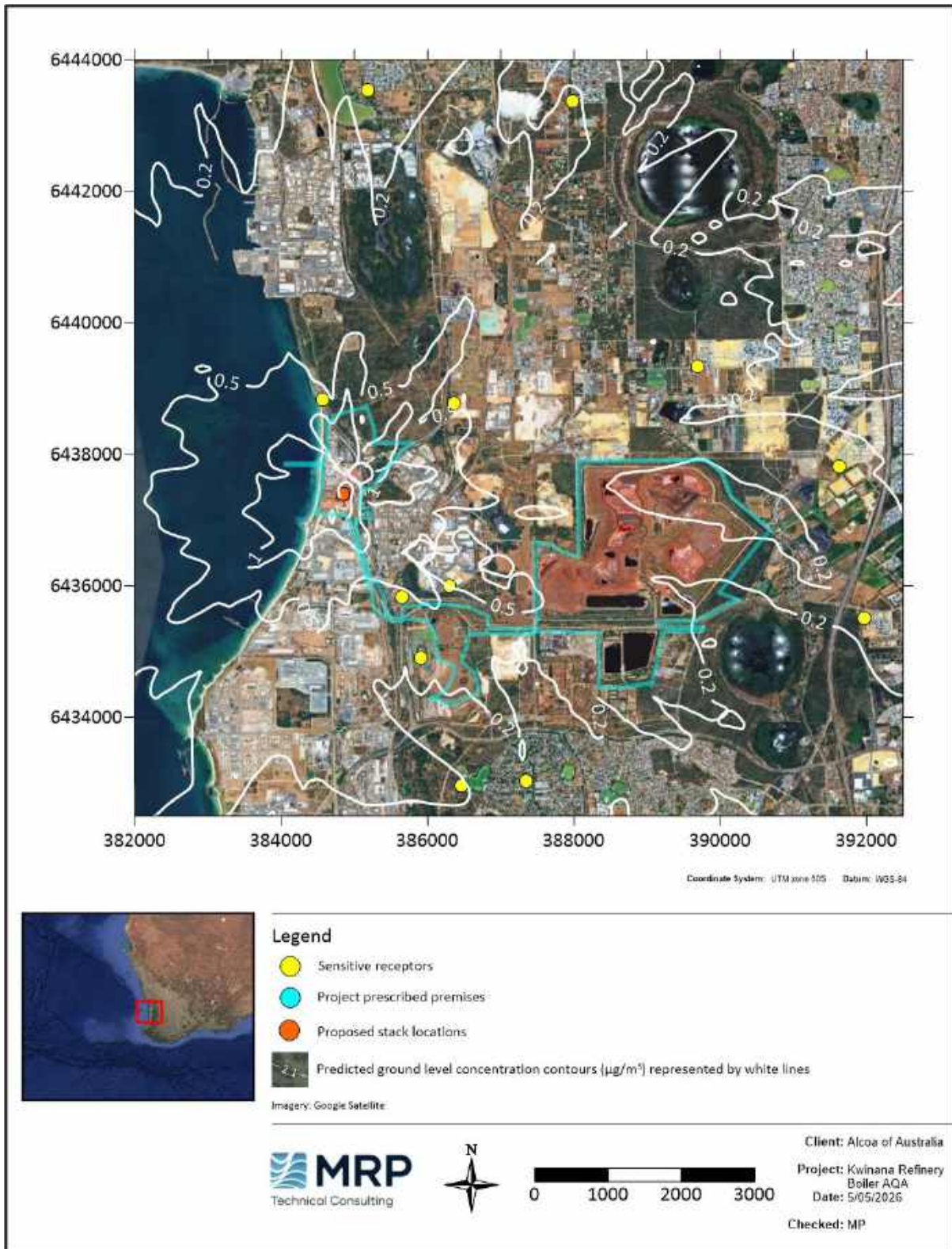


Figure 5-39: Predicted maximum 1-hour average GLCs of SO₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-41 Predicted maximum 24-hour average GLCs of SO₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

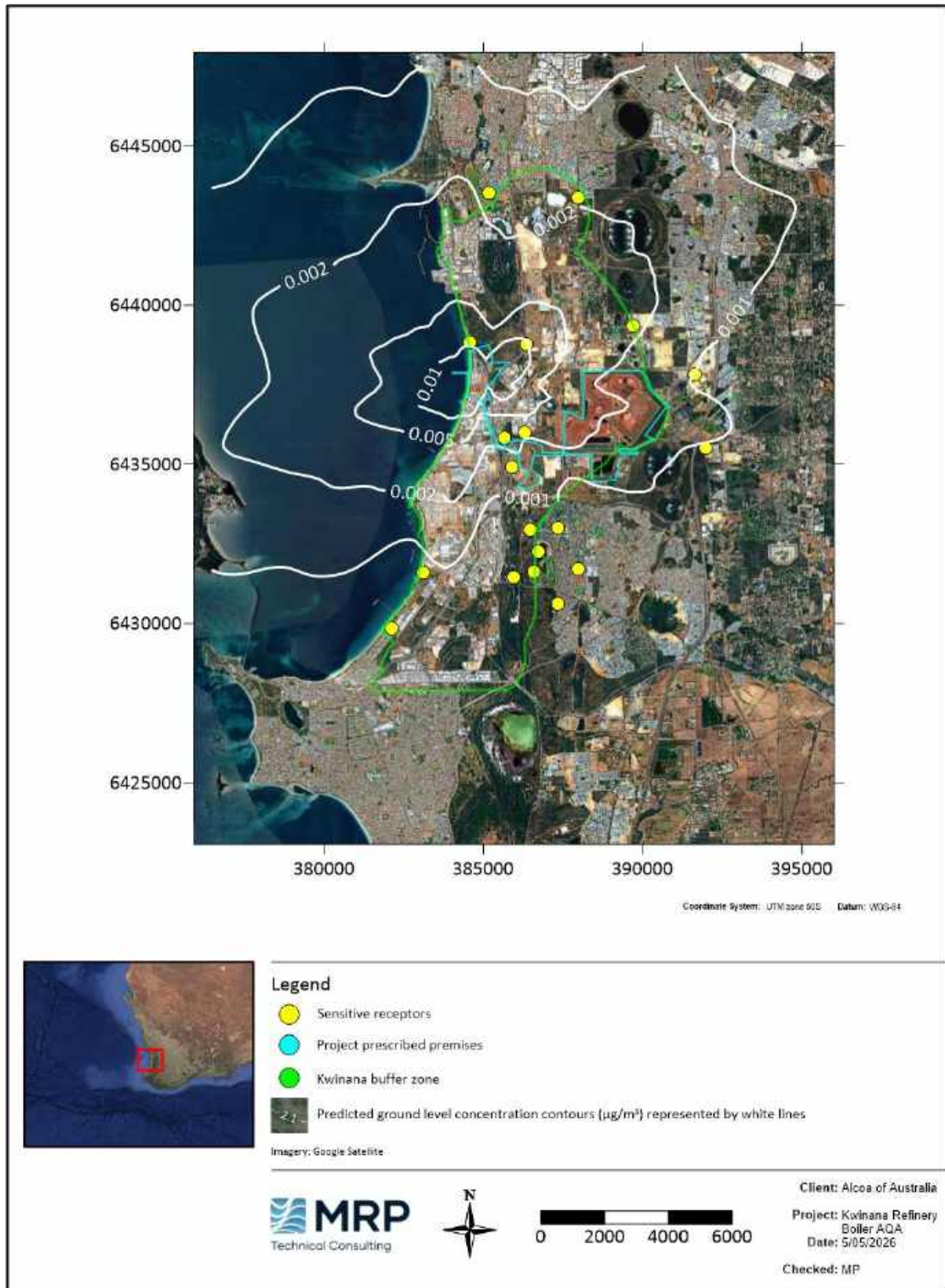


Figure 5-42: Predicted annual average GLCs of SO₂ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-43: Predicted annual average GLCs of SO₂ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

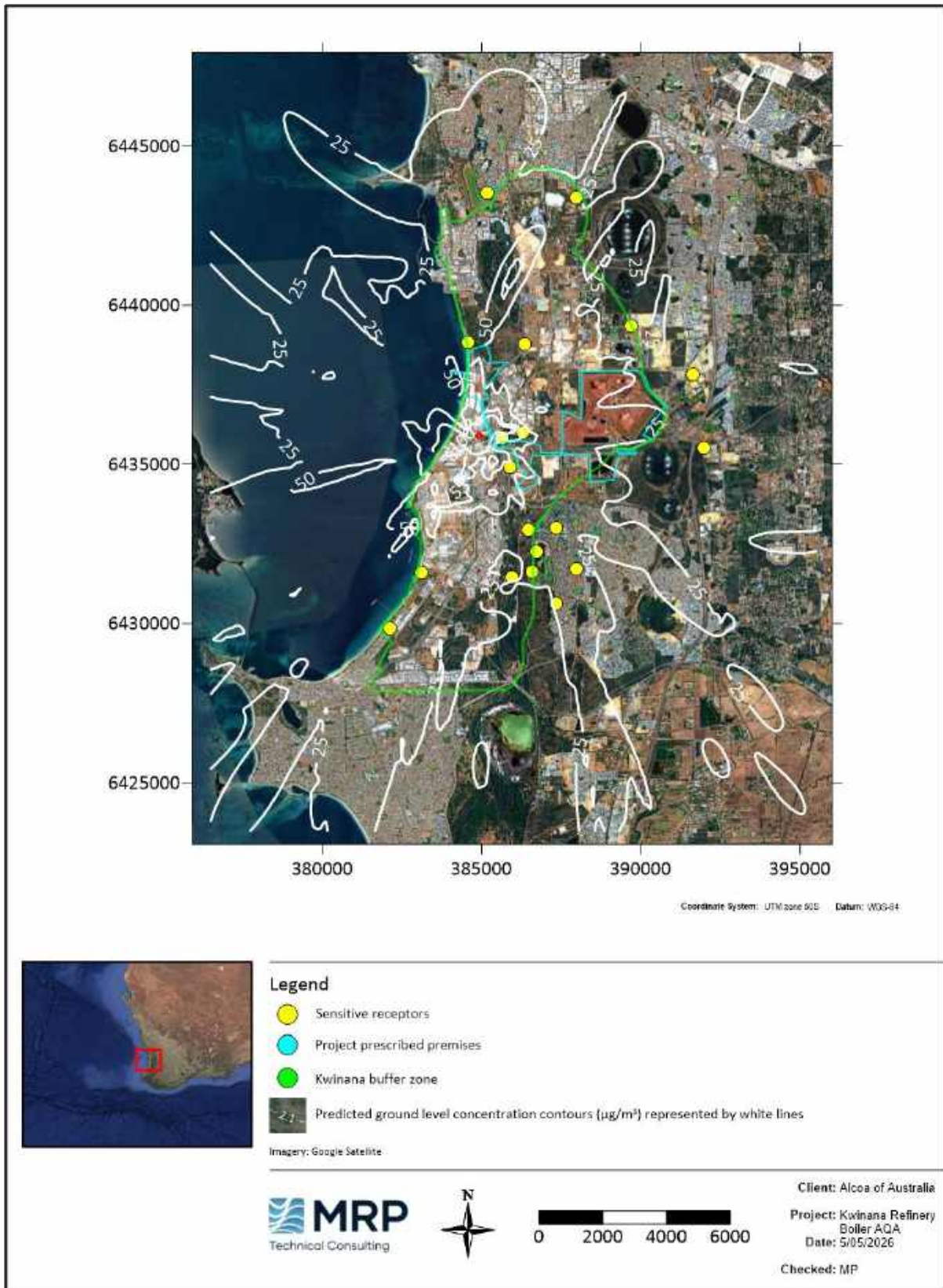


Figure 5-44: Predicted maximum 1-hour average GLCs of SO₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-45: Predicted maximum 1-hour average GLCs of SO₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

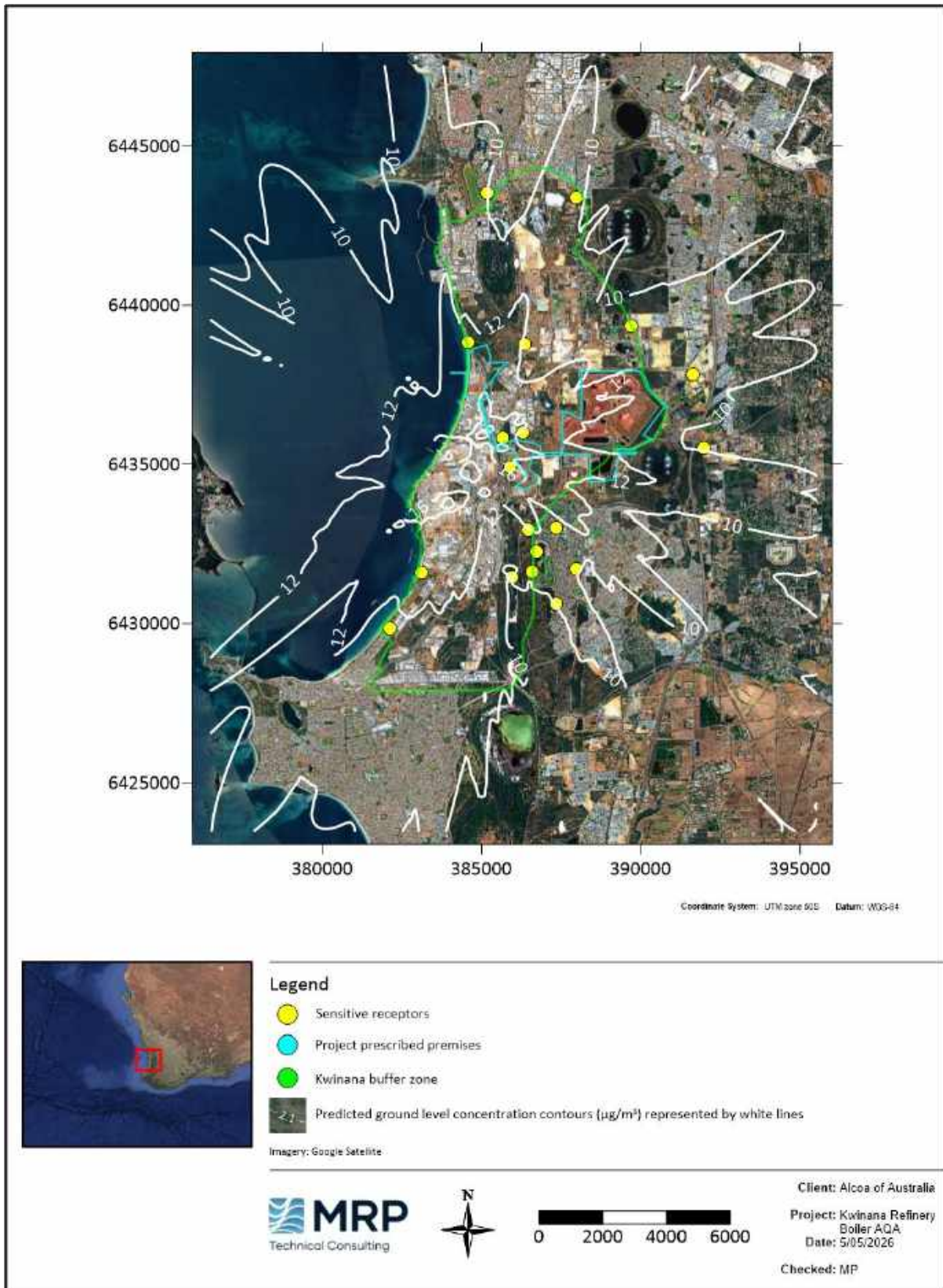


Figure 5-46: Predicted maximum 24-hour average GLCs of SO₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-47: Predicted maximum 24-hour average GLCs of SO₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

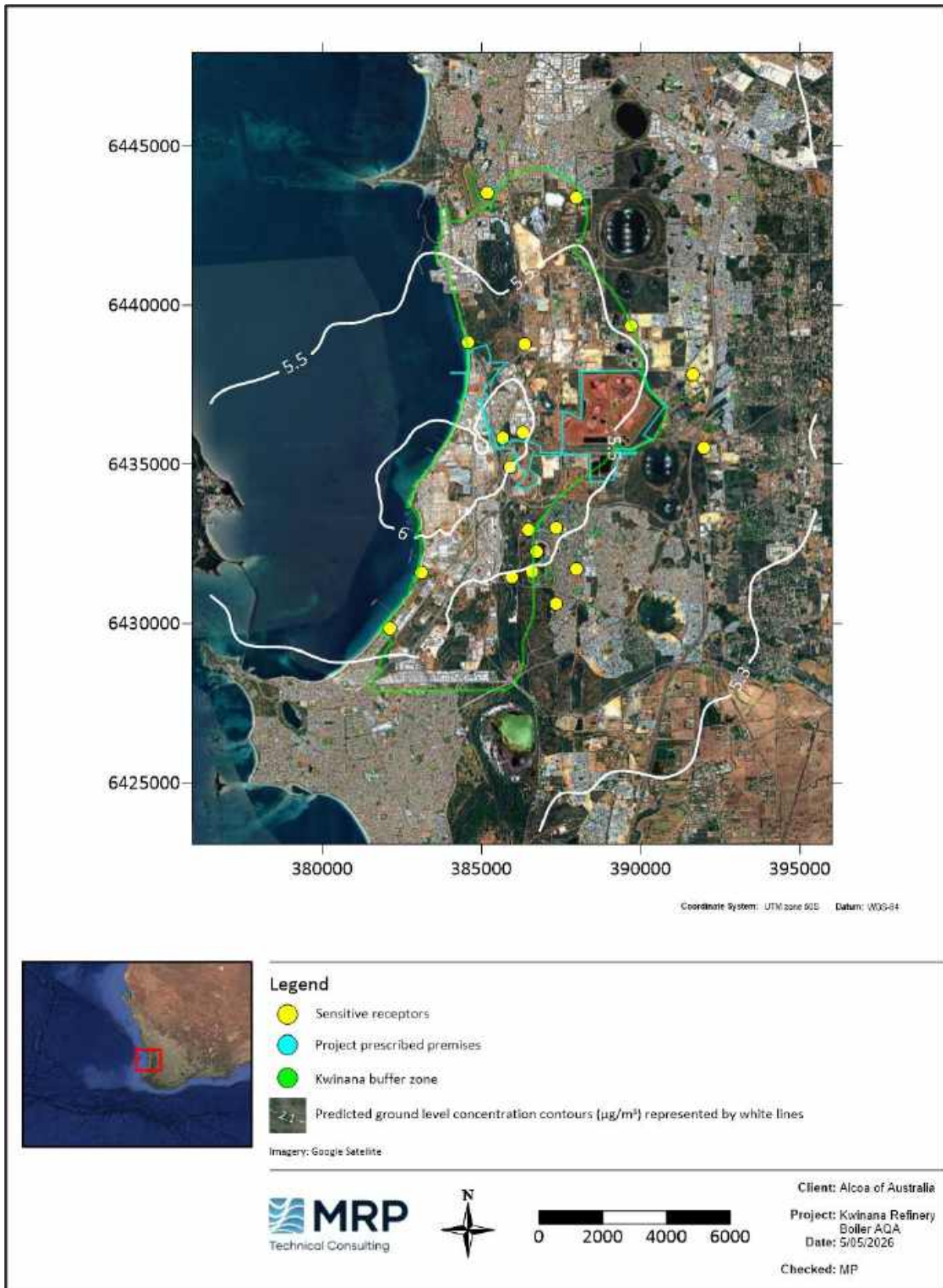


Figure 5-48: Predicted annual average GLCs of SO₂ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative

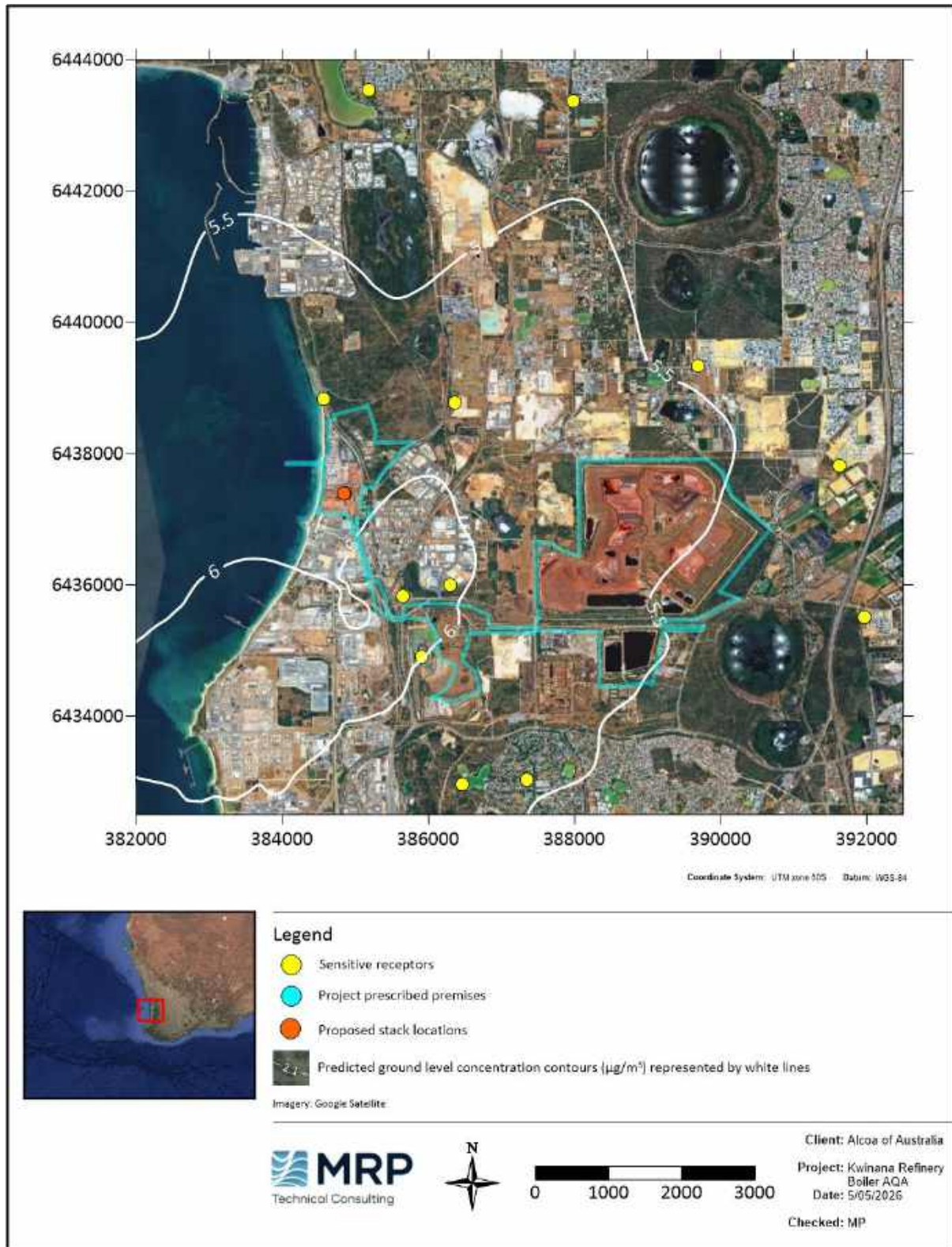


Figure 5-49: Predicted annual average GLCs of SO₂ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

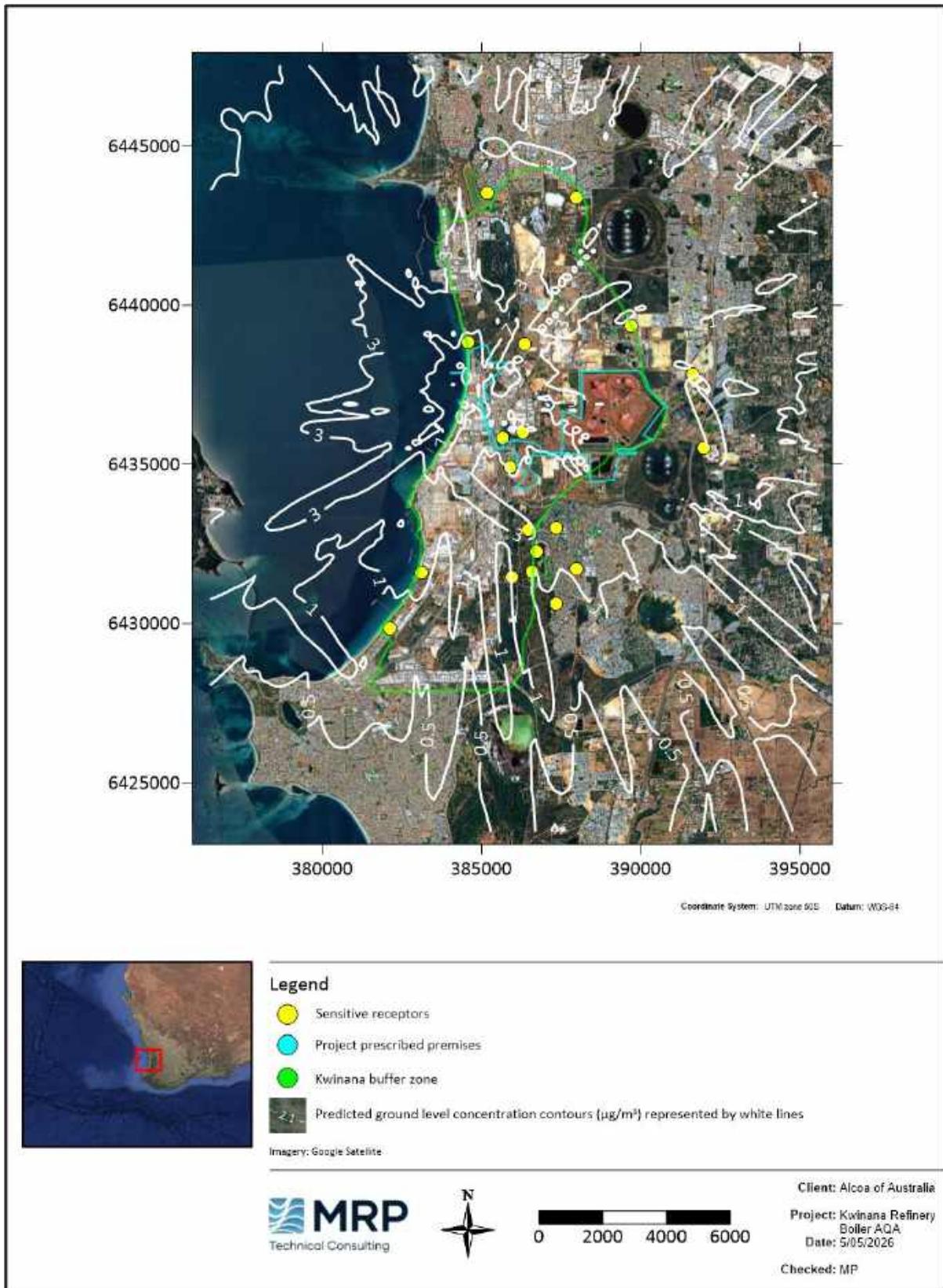


Figure 5-50: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

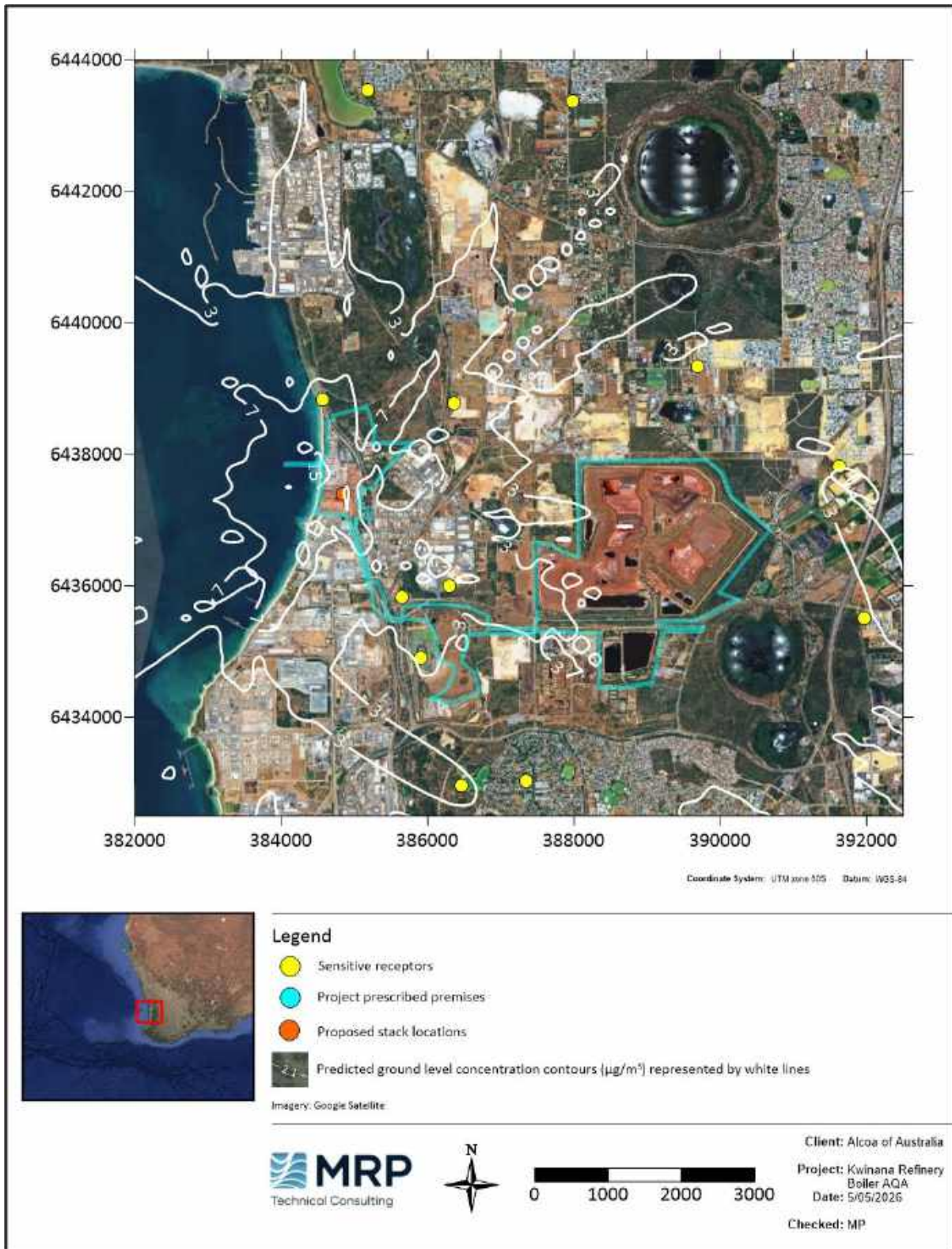


Figure 5-51: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

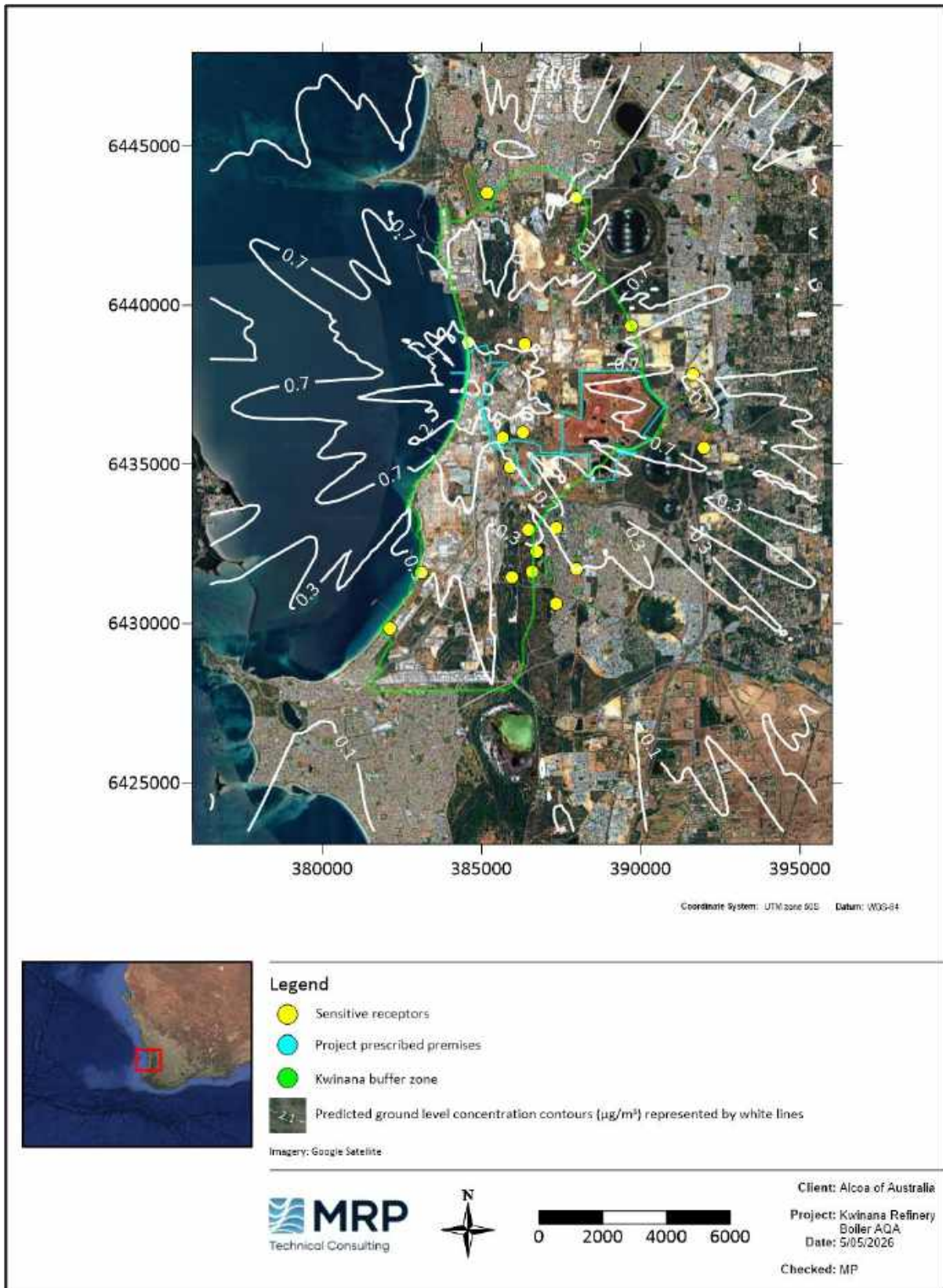


Figure 5-52: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation



Figure 5-53: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation



Figure 5-54: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-55: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

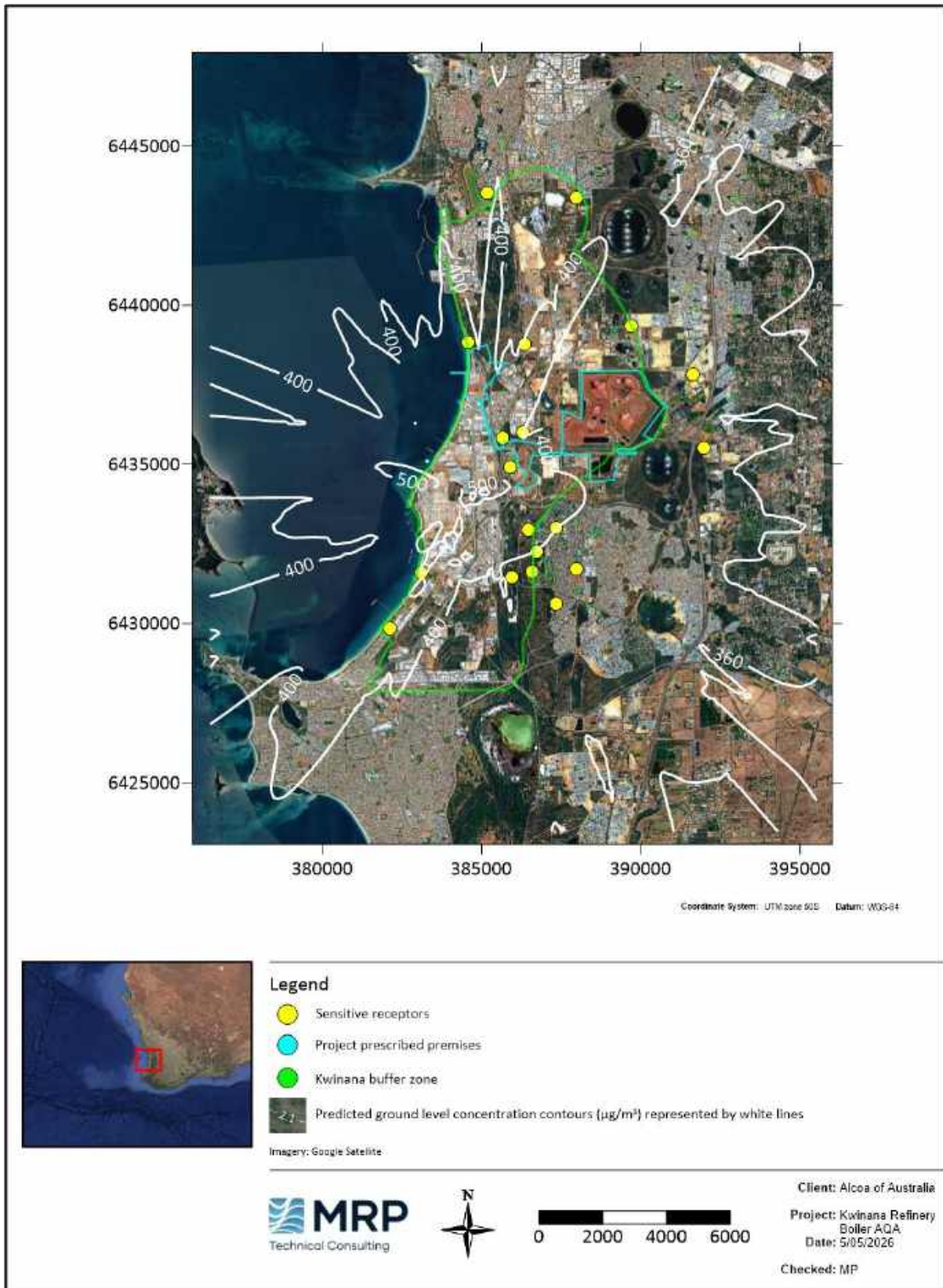


Figure 5-56: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

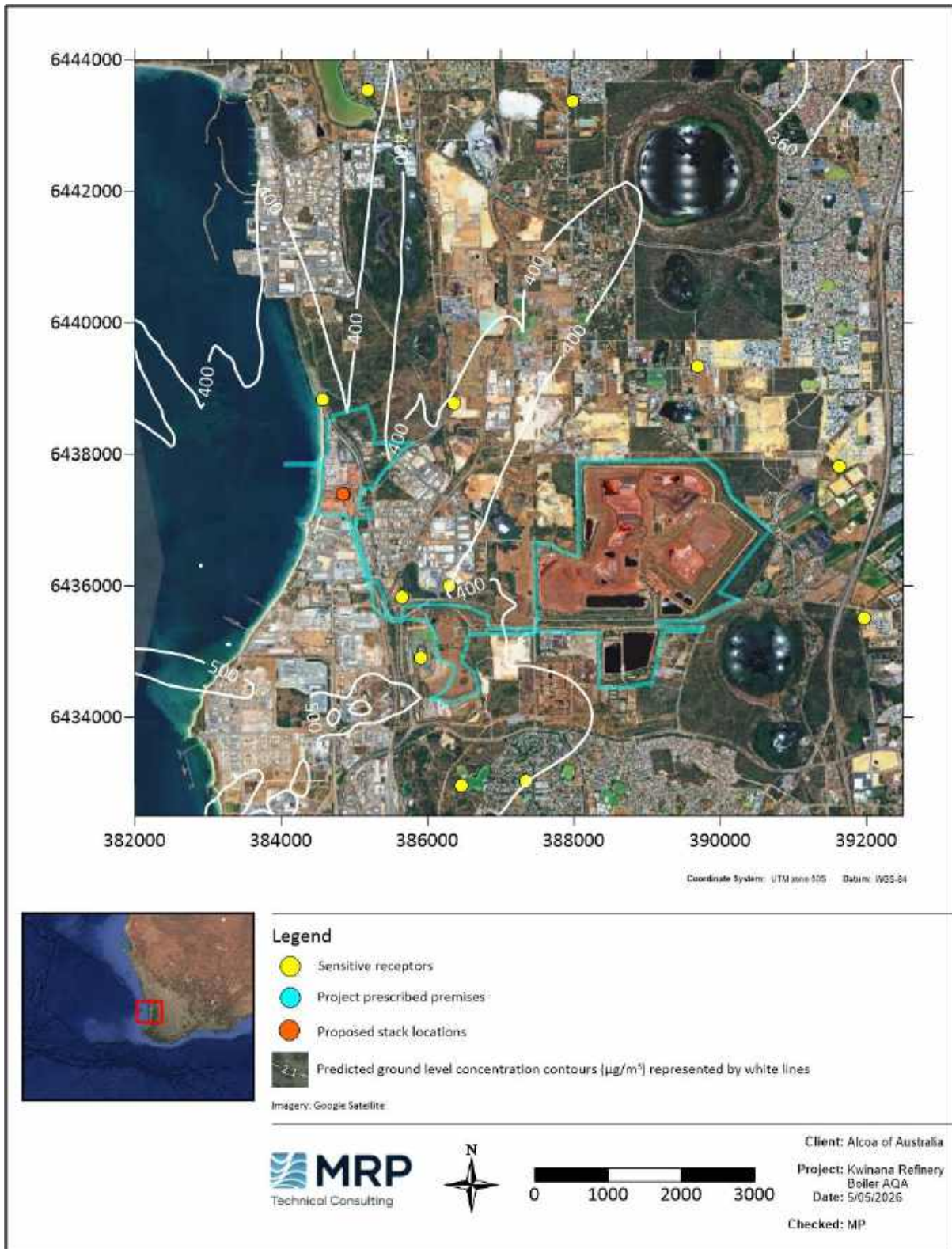


Figure 5-57: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

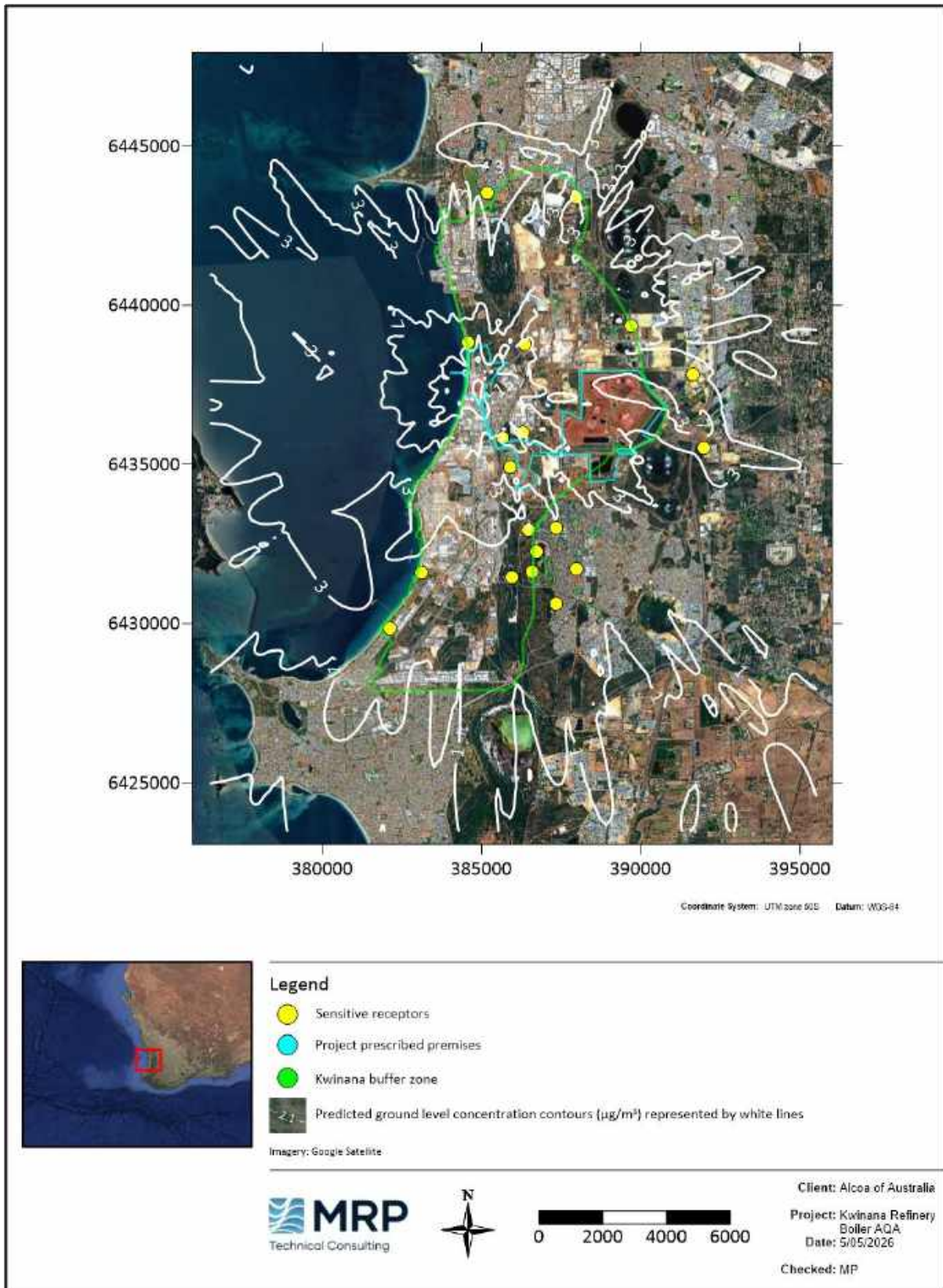


Figure 5-58: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation

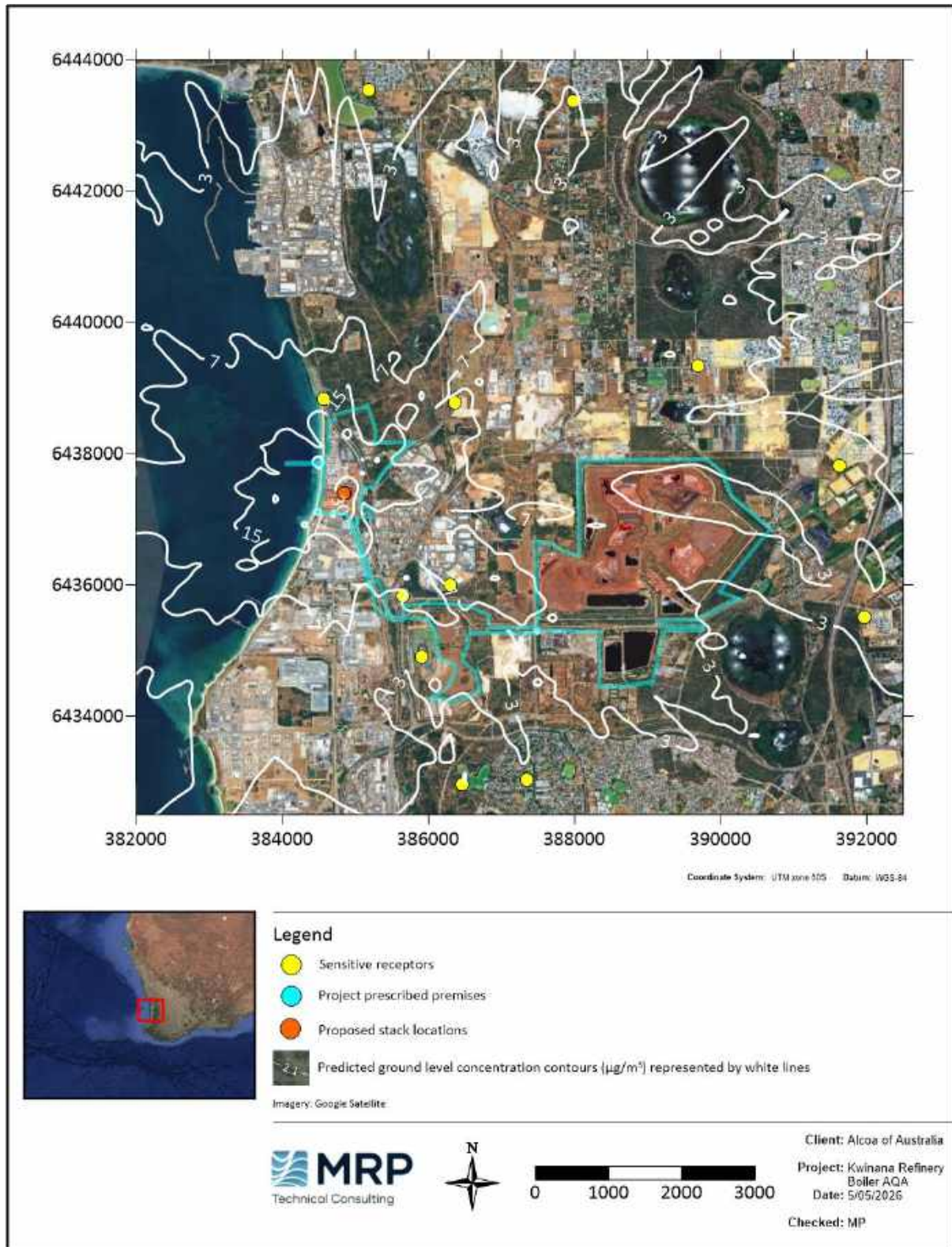


Figure 5-59: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

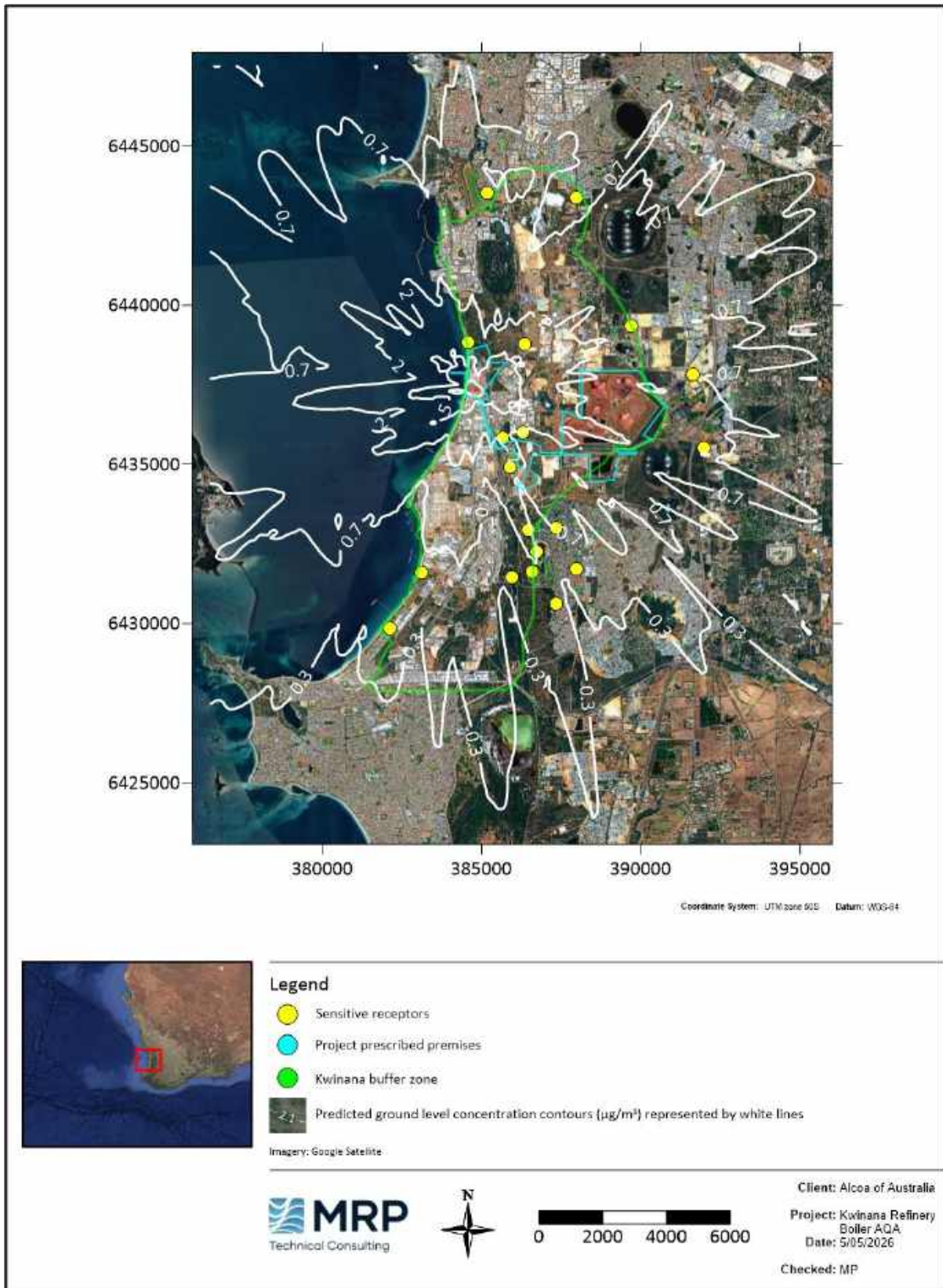


Figure 5-60: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-61: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-62: Predicted maximum 1-hour average GLCs of CO (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-63: Predicted maximum 1-hour average GLCs of CO (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

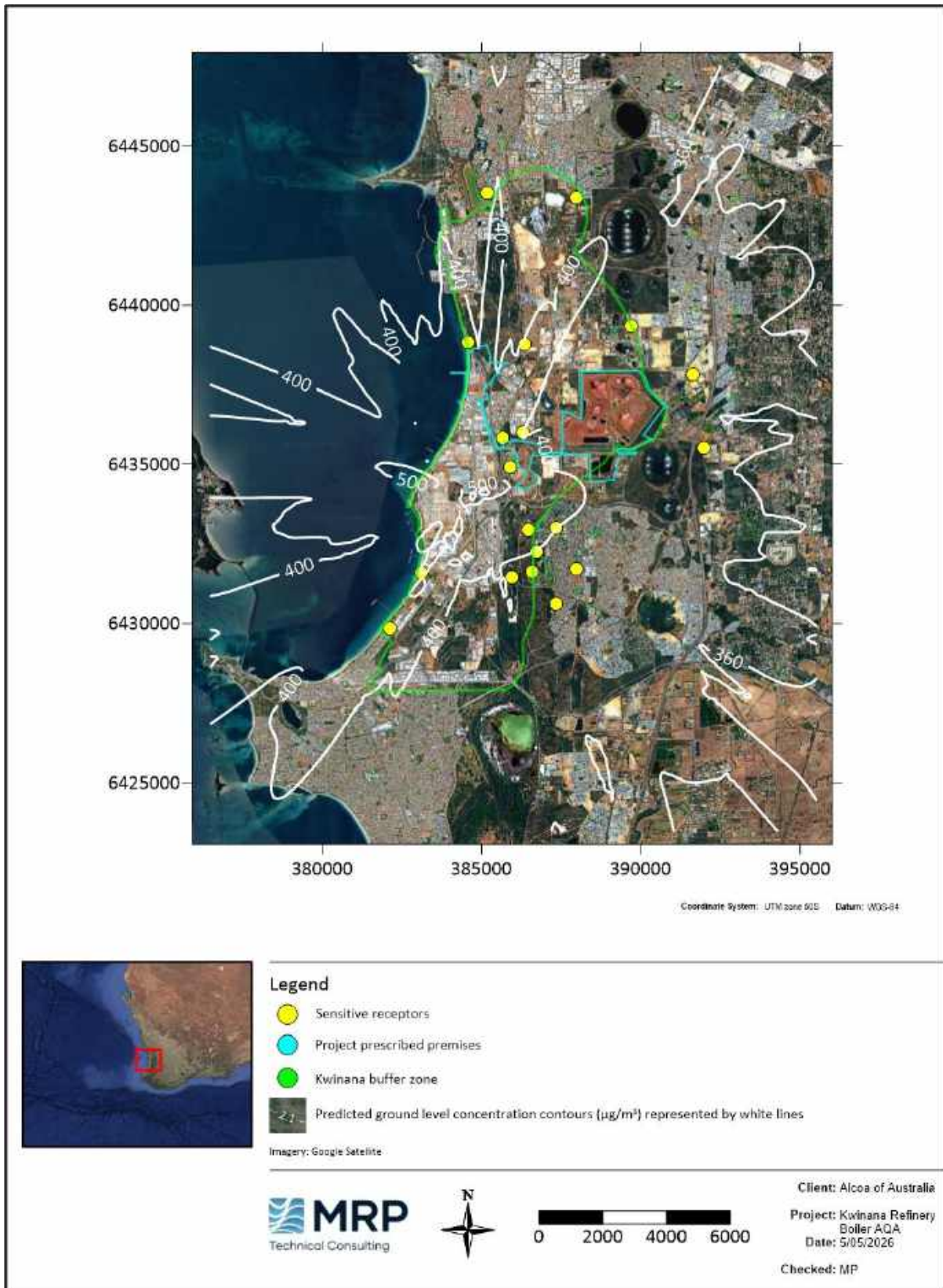


Figure 5-64: Predicted maximum 8-hour average GLCs of CO (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative

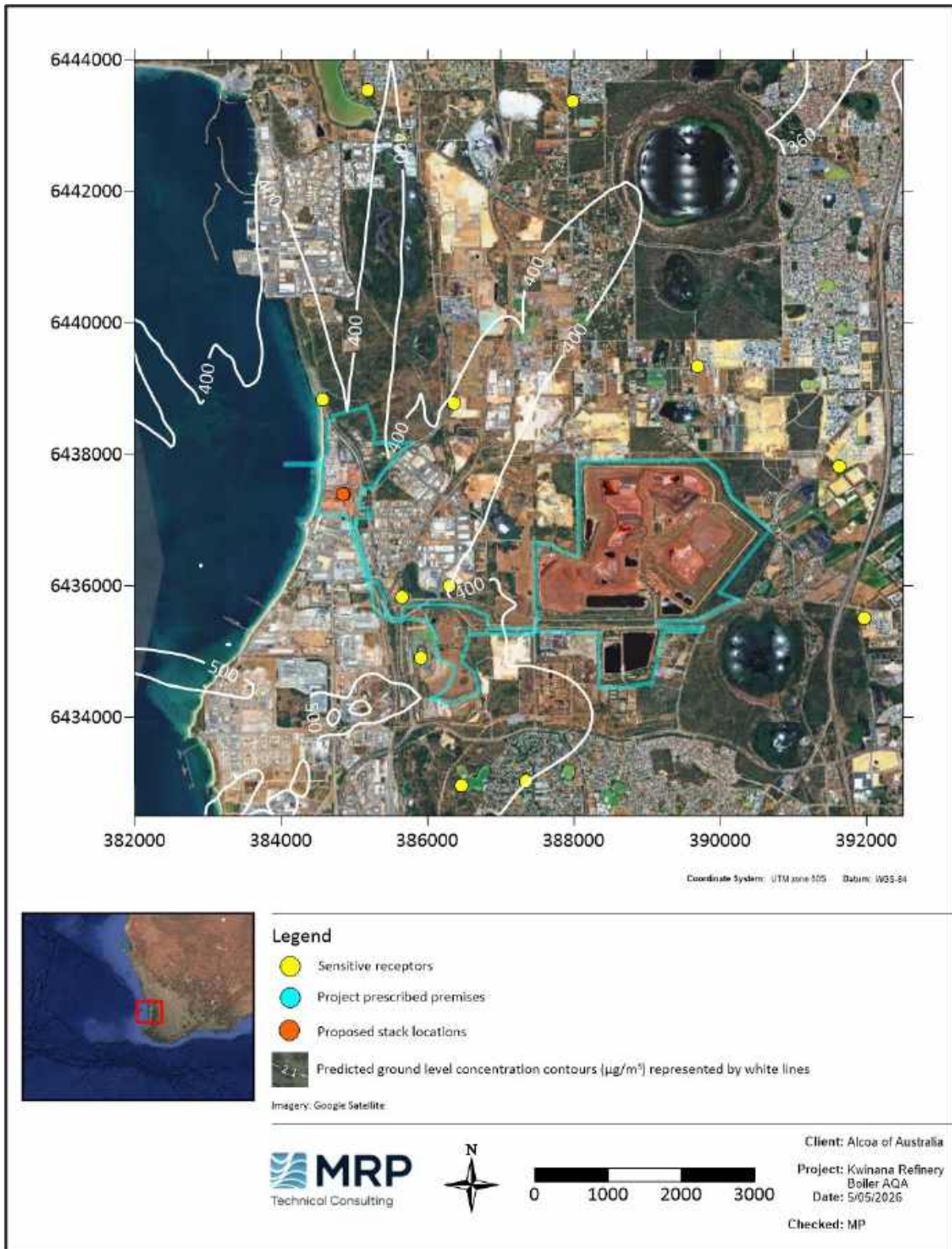


Figure 5-65: Predicted maximum 8-hour average GLCs of CO (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

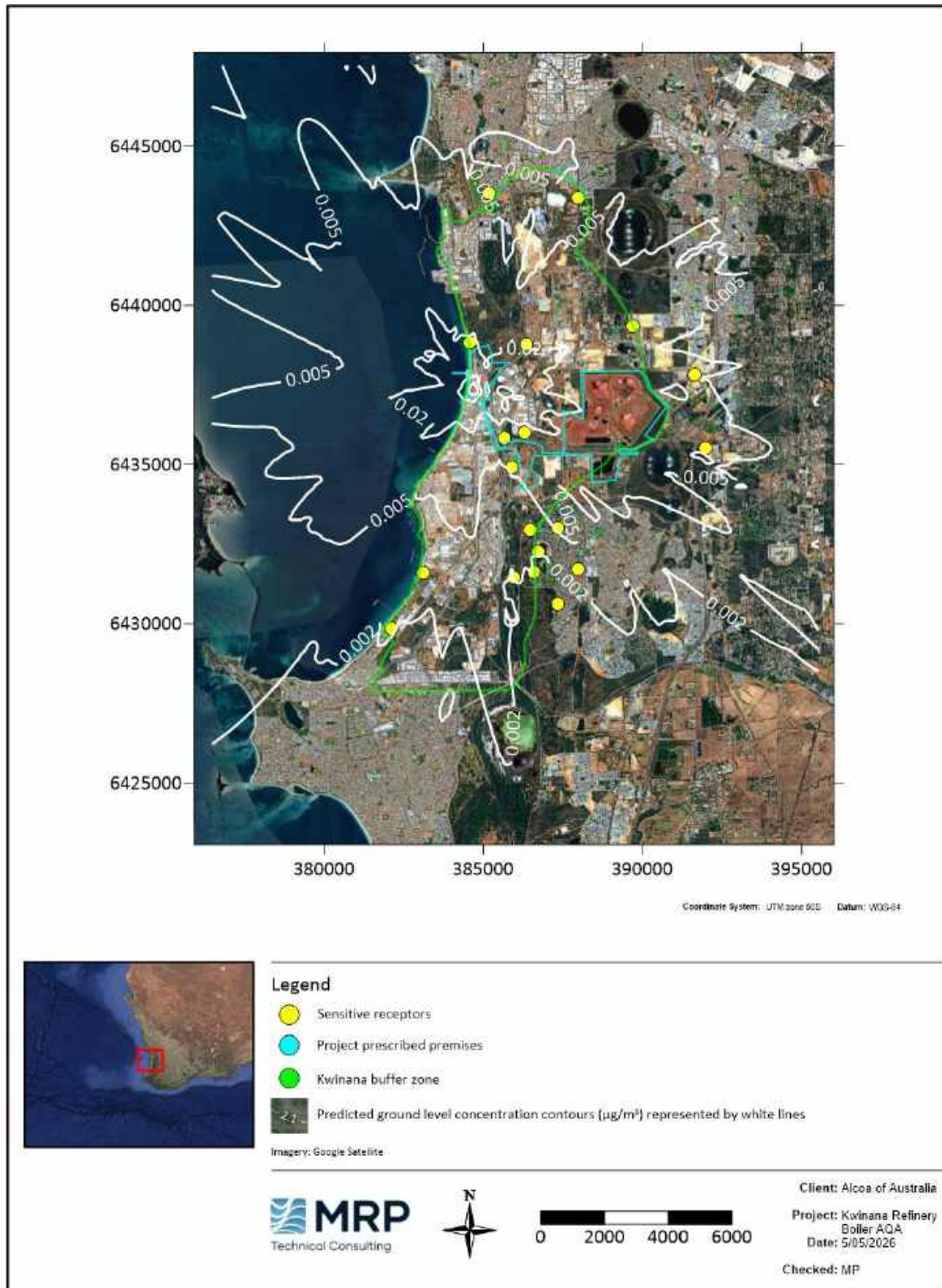


Figure 5-66: Predicted maximum 24-hour average GLCs of PM₁₀ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

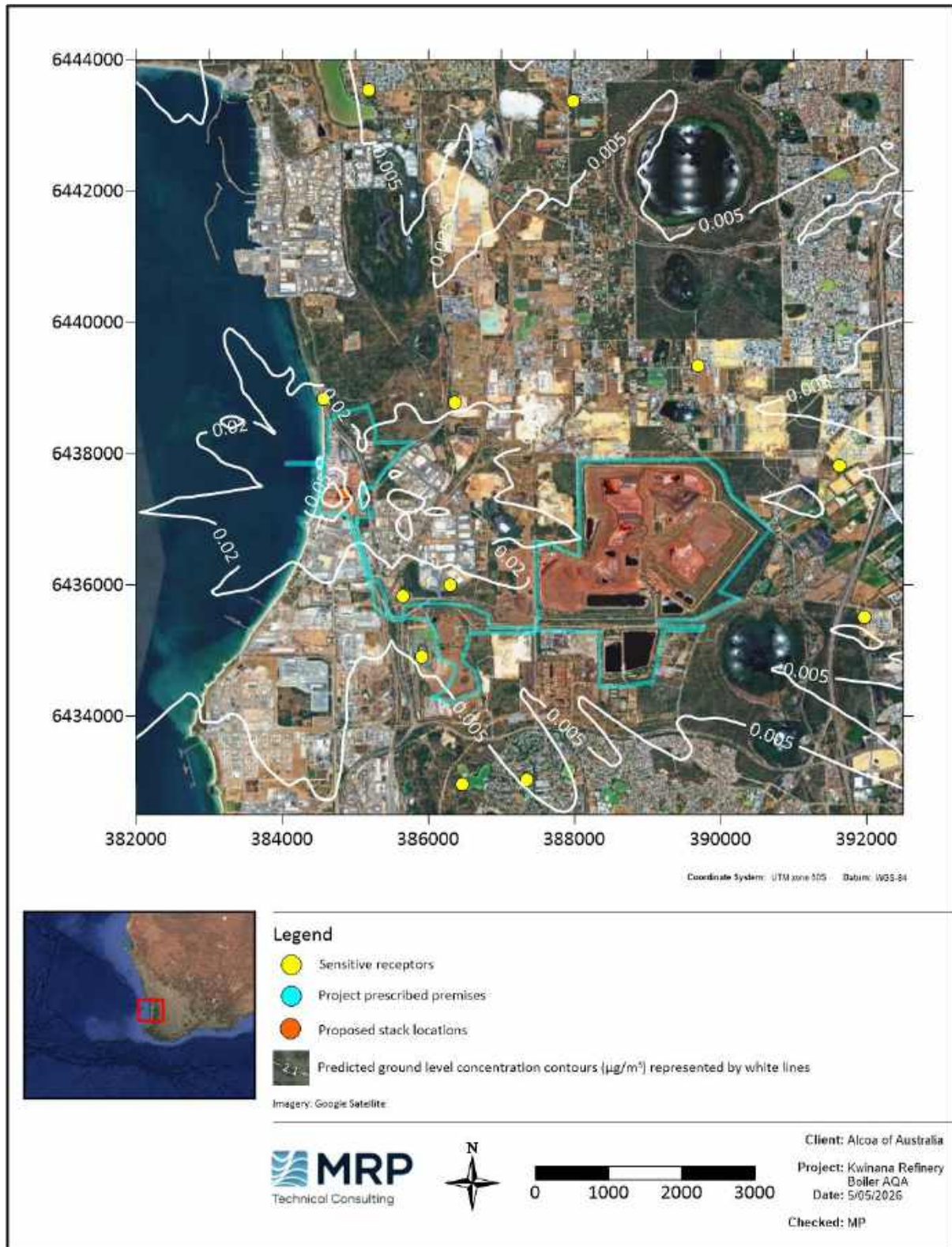


Figure 5-67: Predicted maximum 24-hour average GLCs of PM_{10} (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

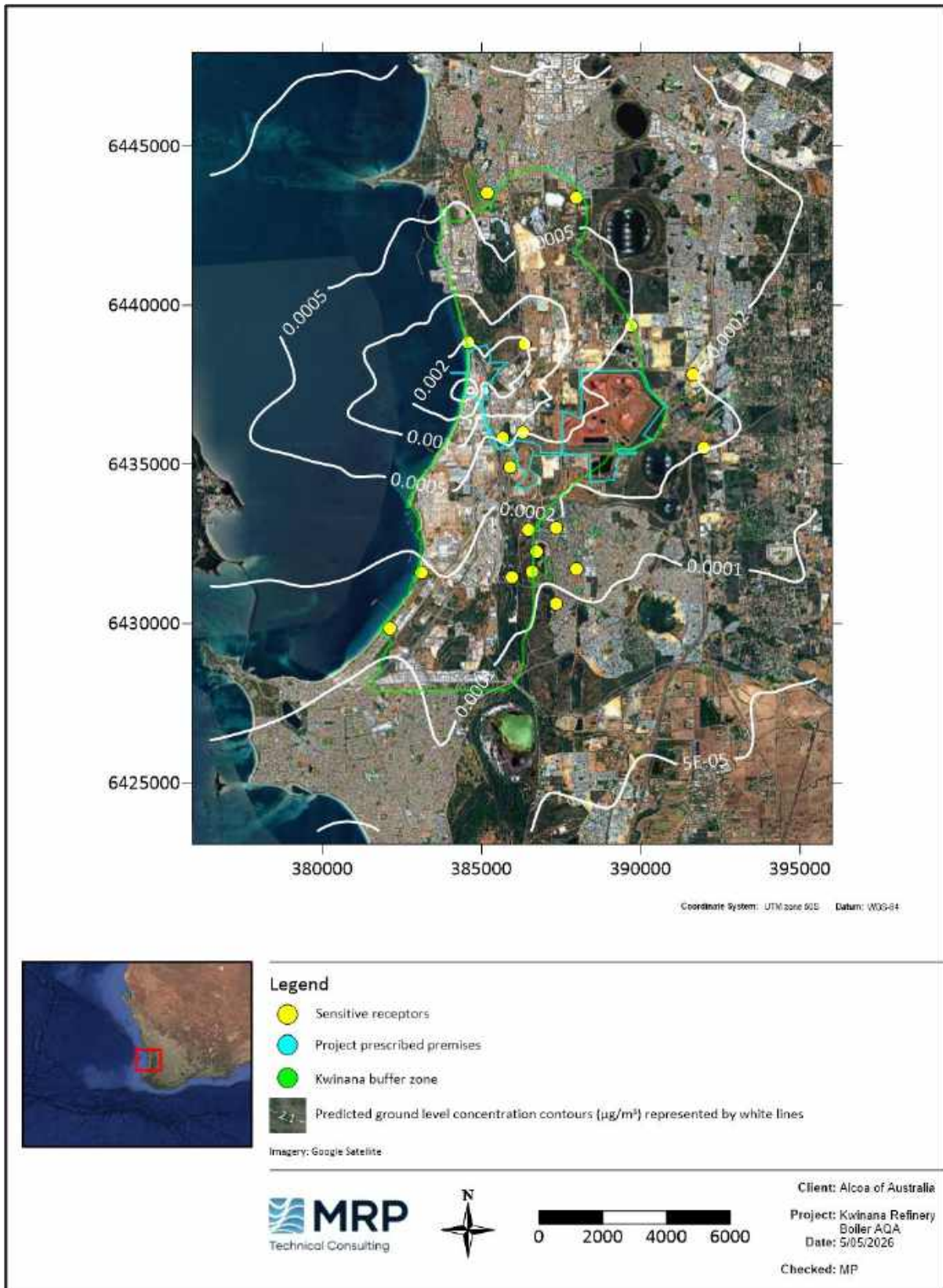


Figure 5-68: Predicted annual average GLCs of PM₁₀ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation



Figure 5-69: Predicted annual average GLCs of PM₁₀ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

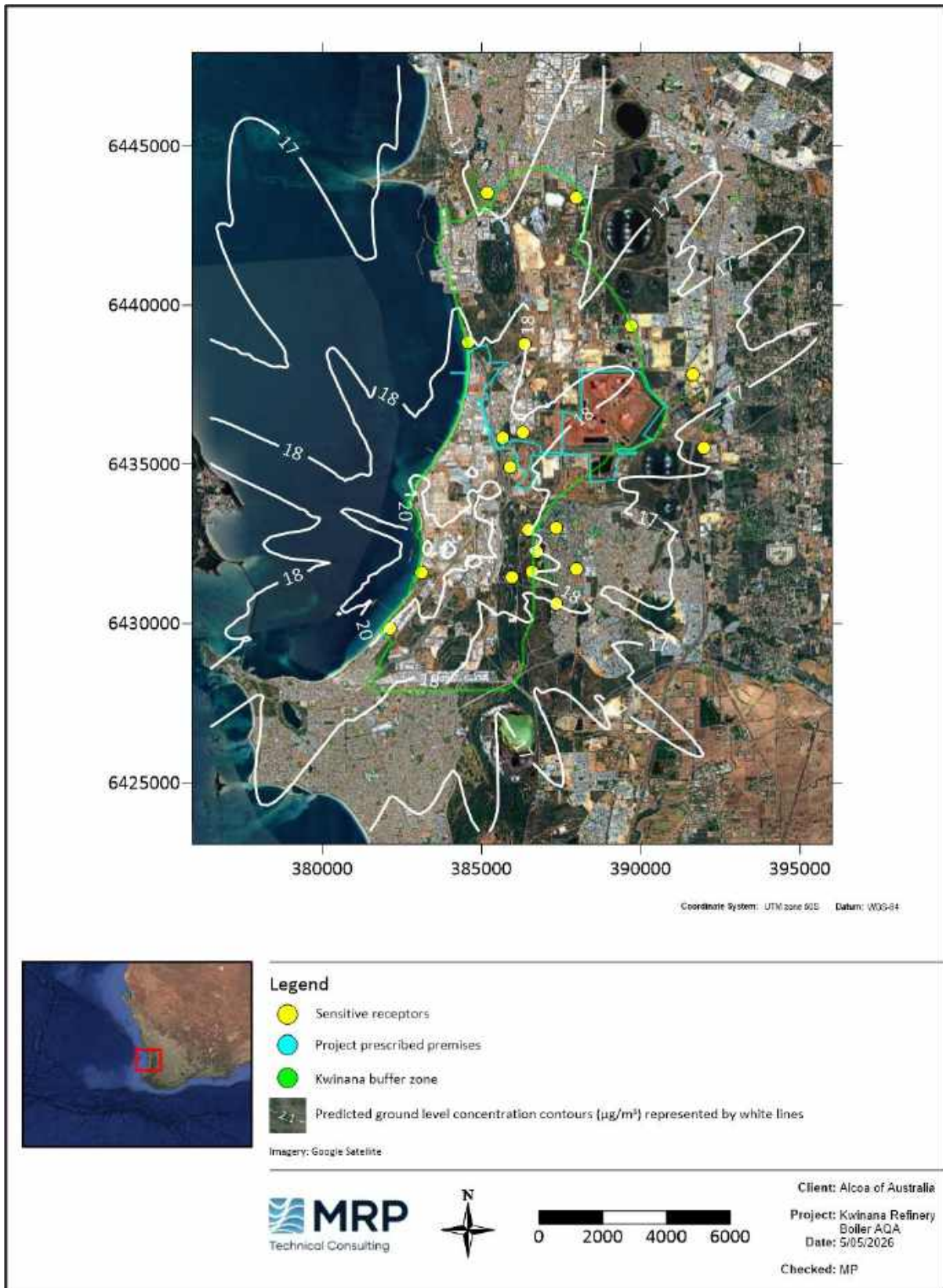


Figure 5-70: Predicted maximum 24-hour average GLCs of PM_{10} (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

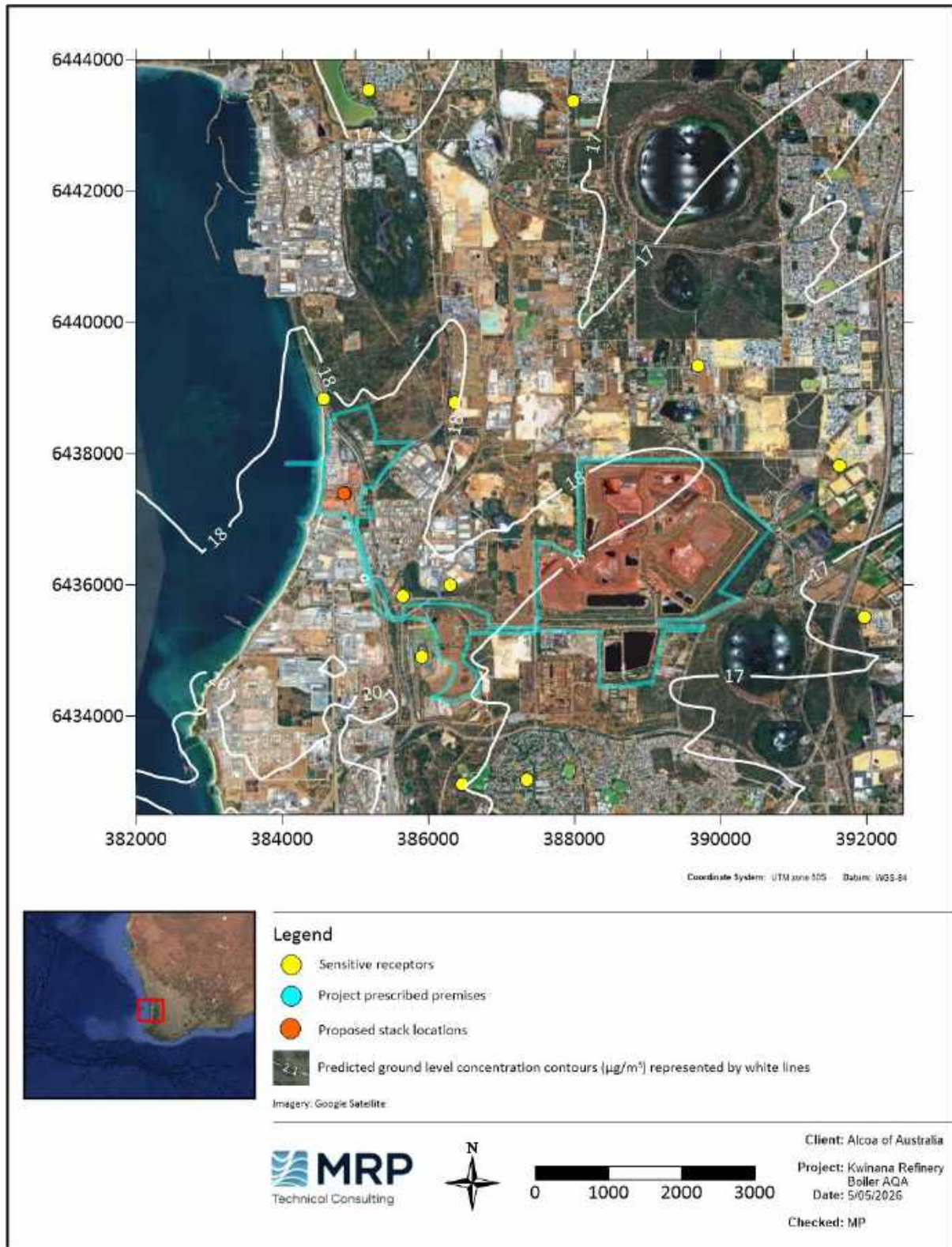


Figure 5-71: Predicted maximum 24-hour average GLCs of PM_{10} (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

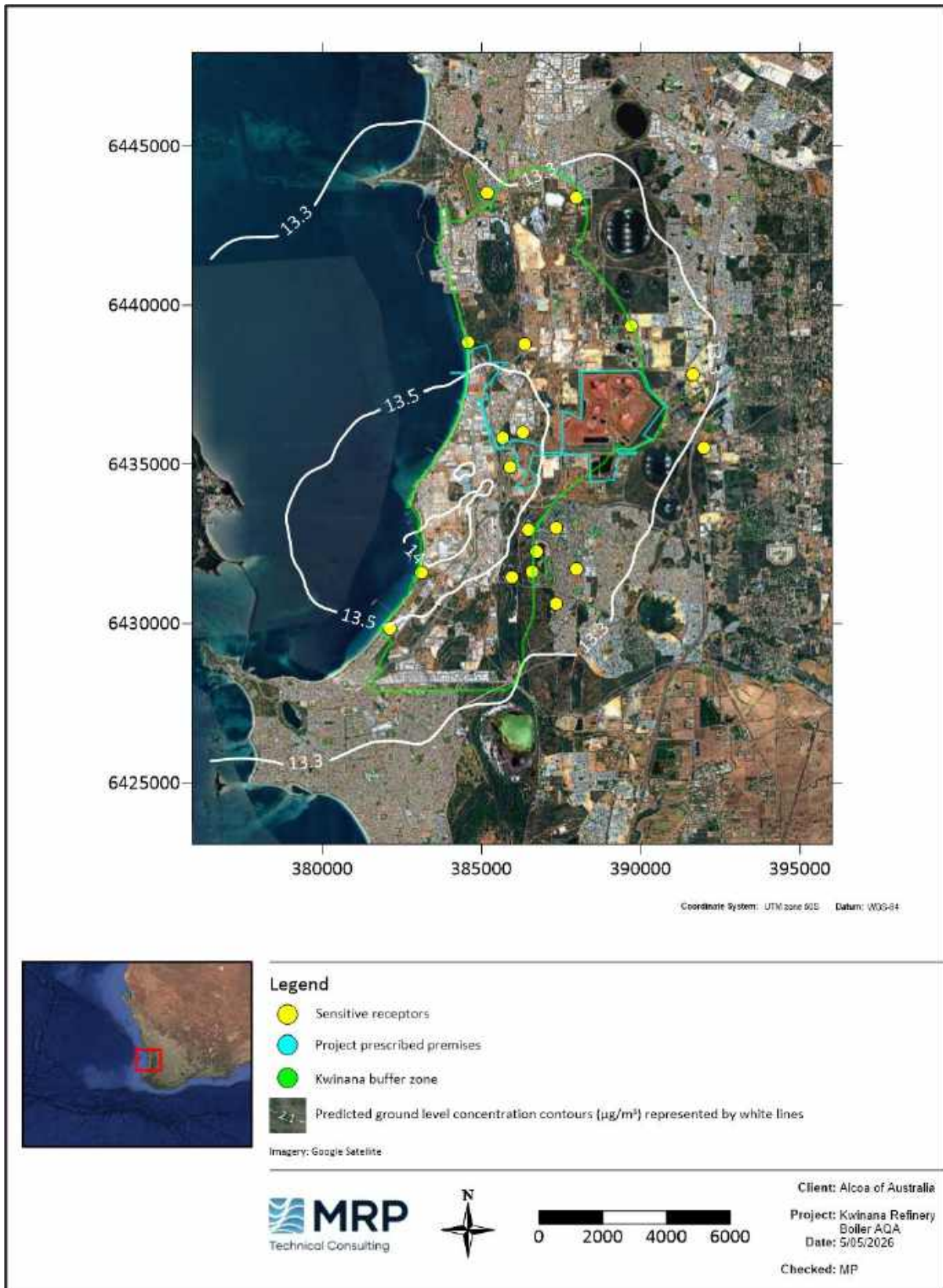


Figure 5-72: Predicted annual average GLCs of PM_{10} (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

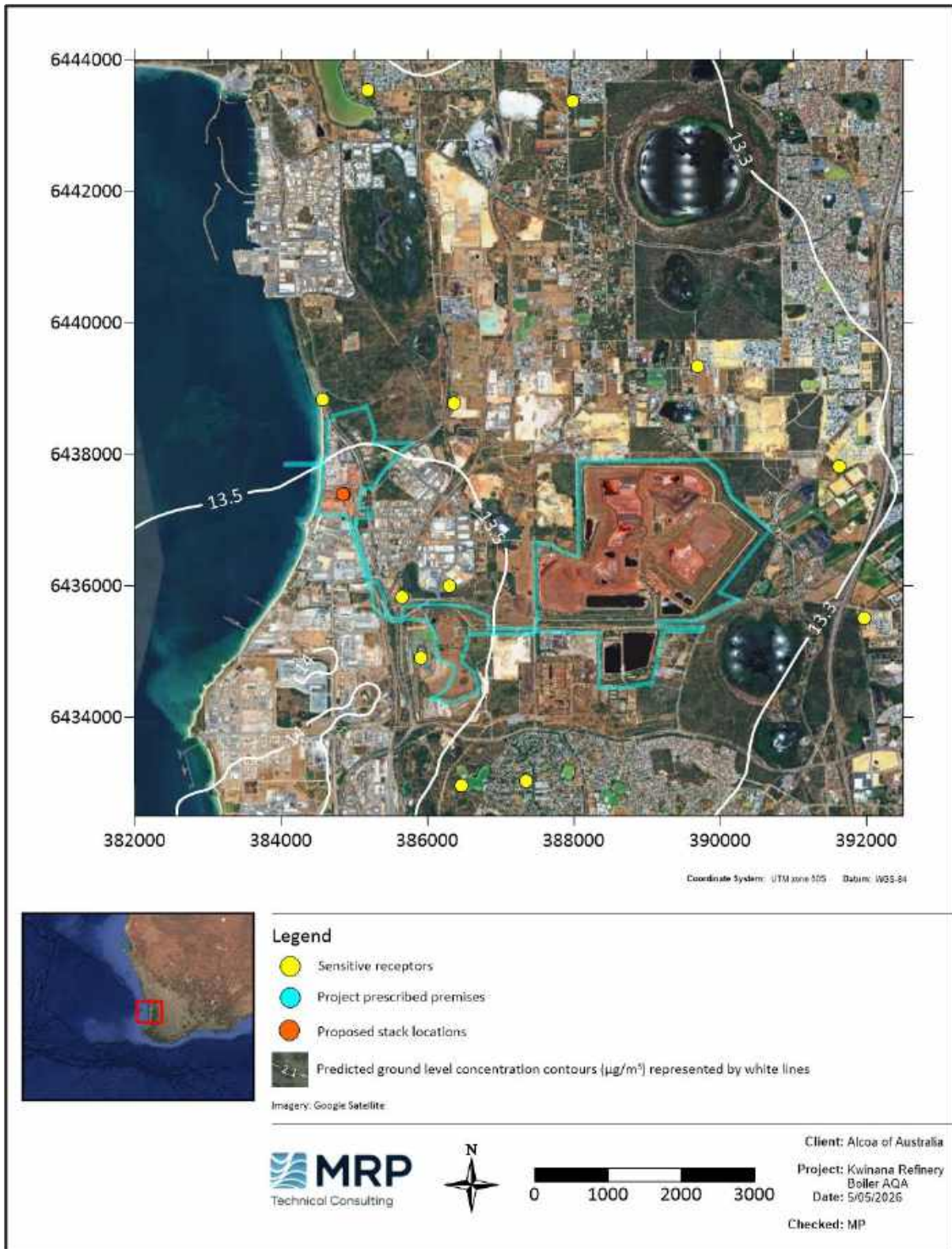


Figure 5-73: Predicted annual average GLCs of PM₁₀ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative



Figure 5-75: Predicted maximum 24-hour average GLCs of PM₁₀ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

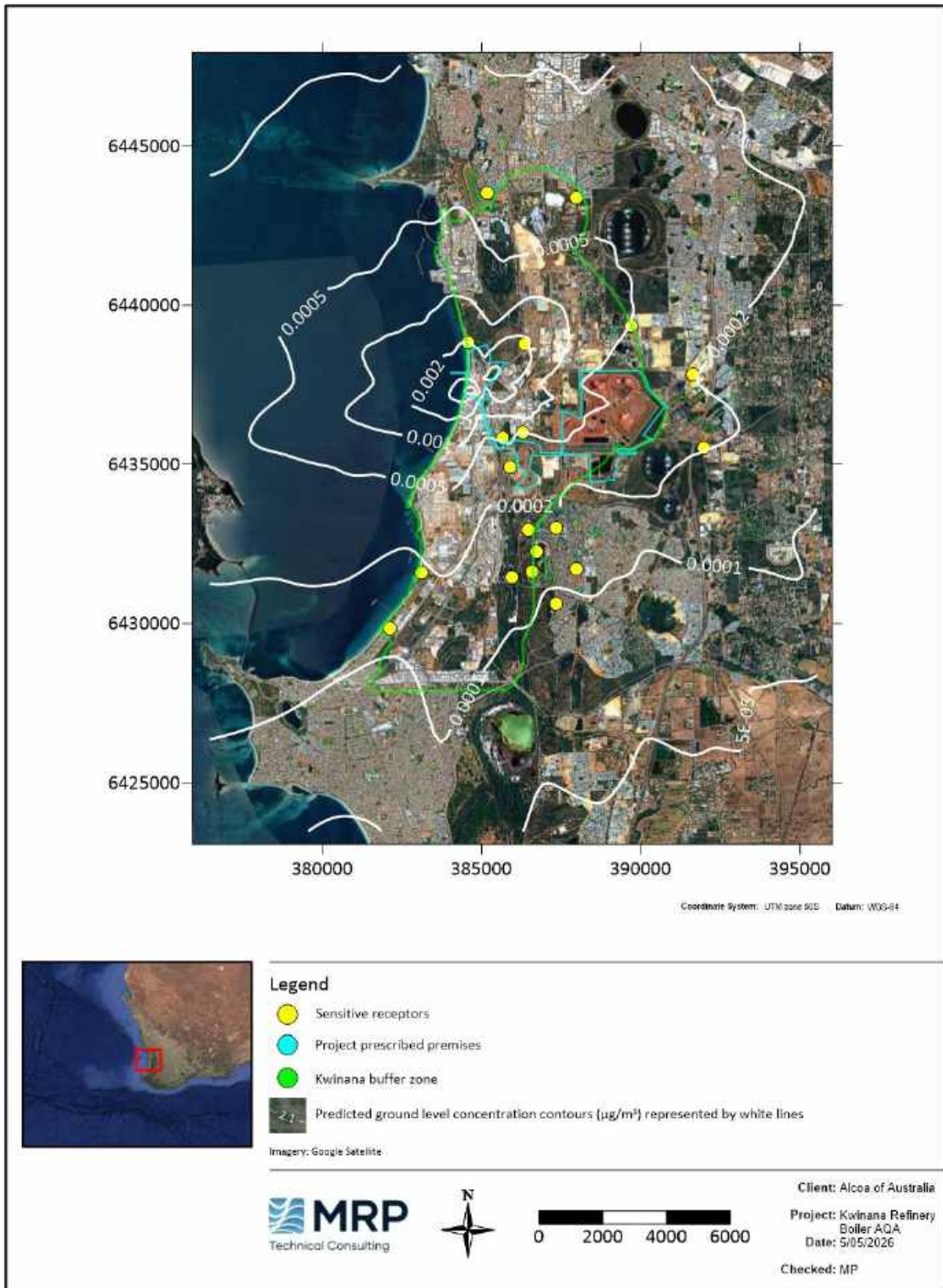


Figure 5-76: Predicted annual average GLCs of PM_{10} (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-77: Predicted annual average GLCs of PM₁₀ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

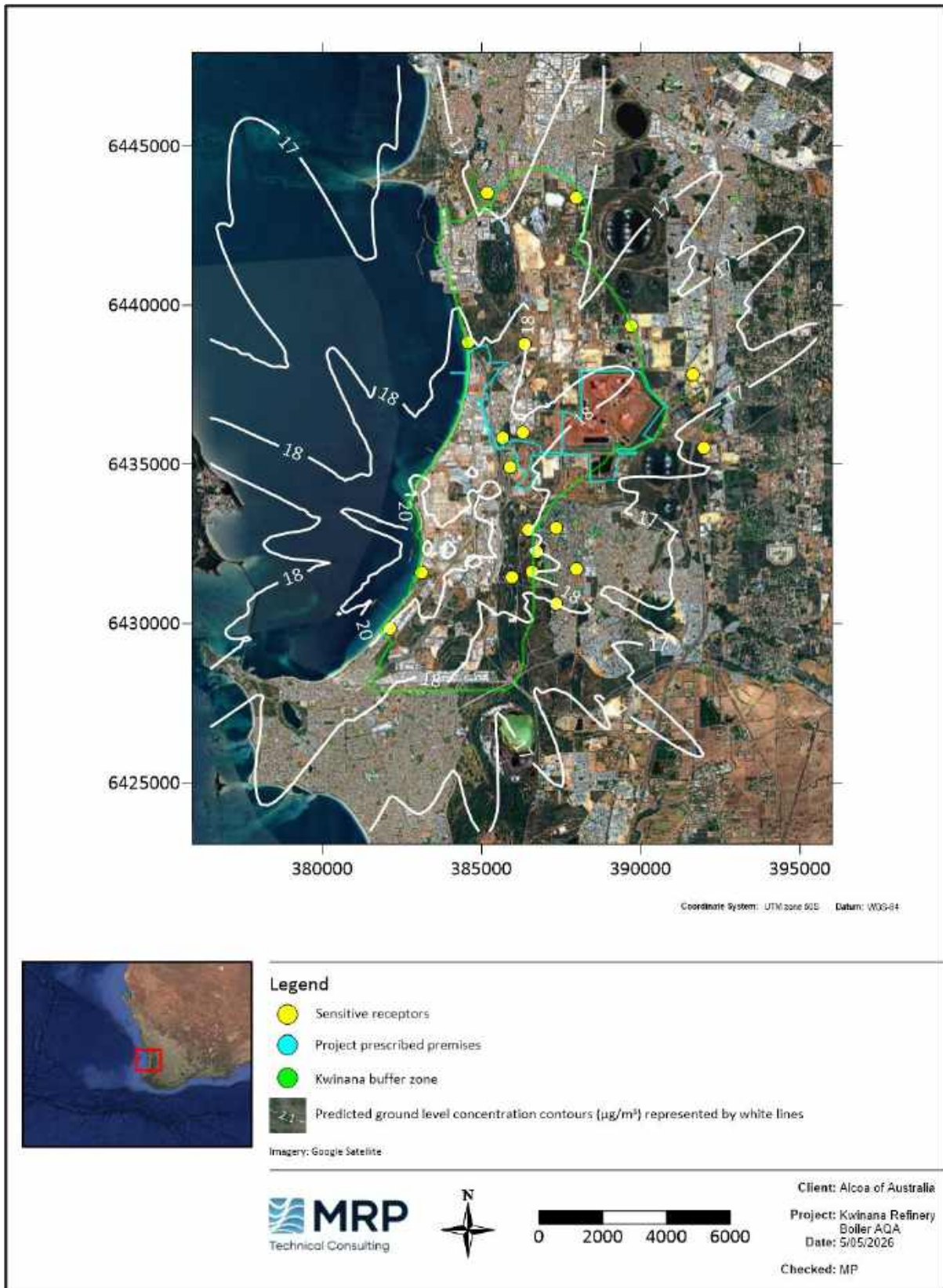


Figure 5-78: Predicted maximum 24-hour average GLCs of PM_{10} (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative

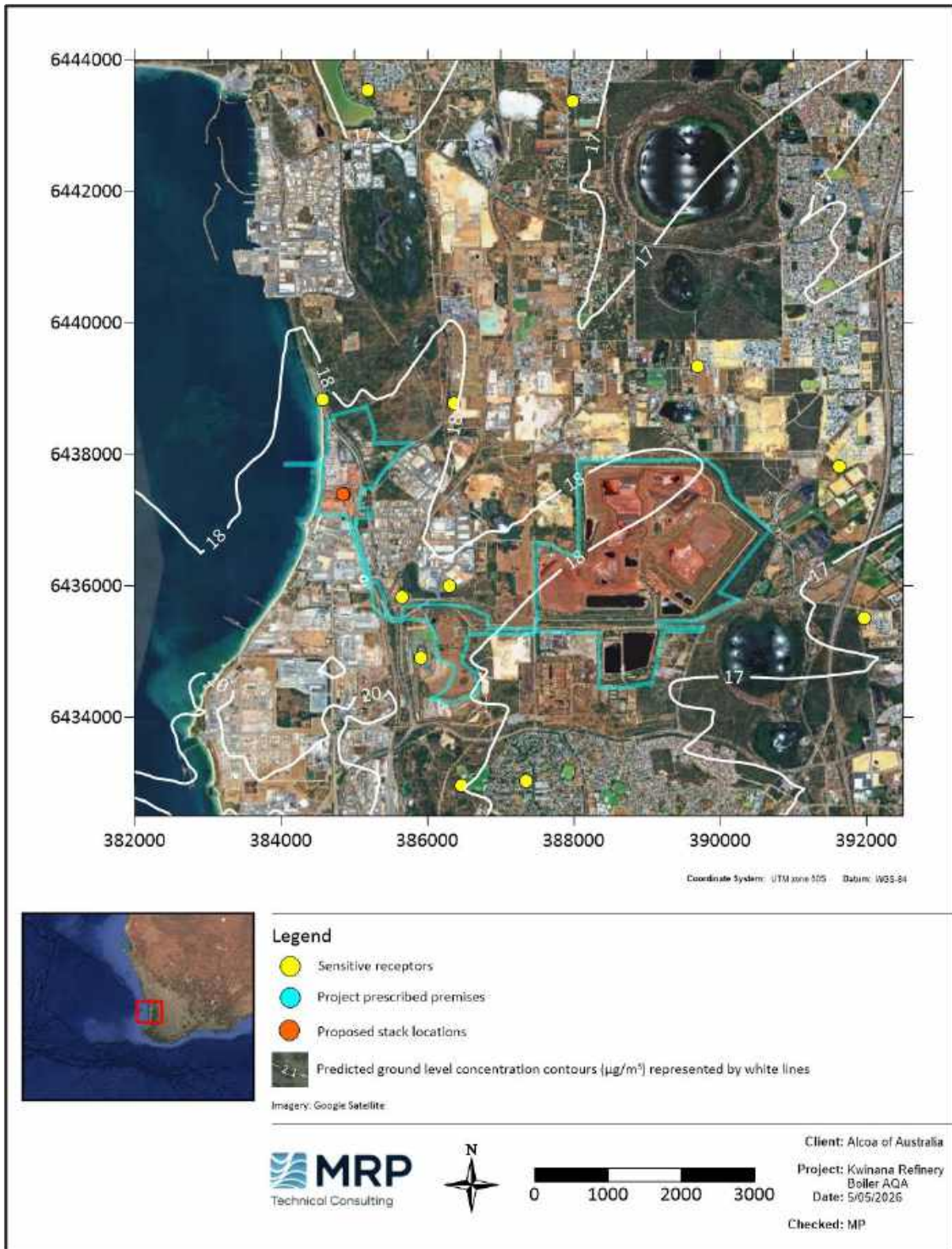


Figure 5-79: Predicted maximum 24-hour average GLCs of PM_{10} (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

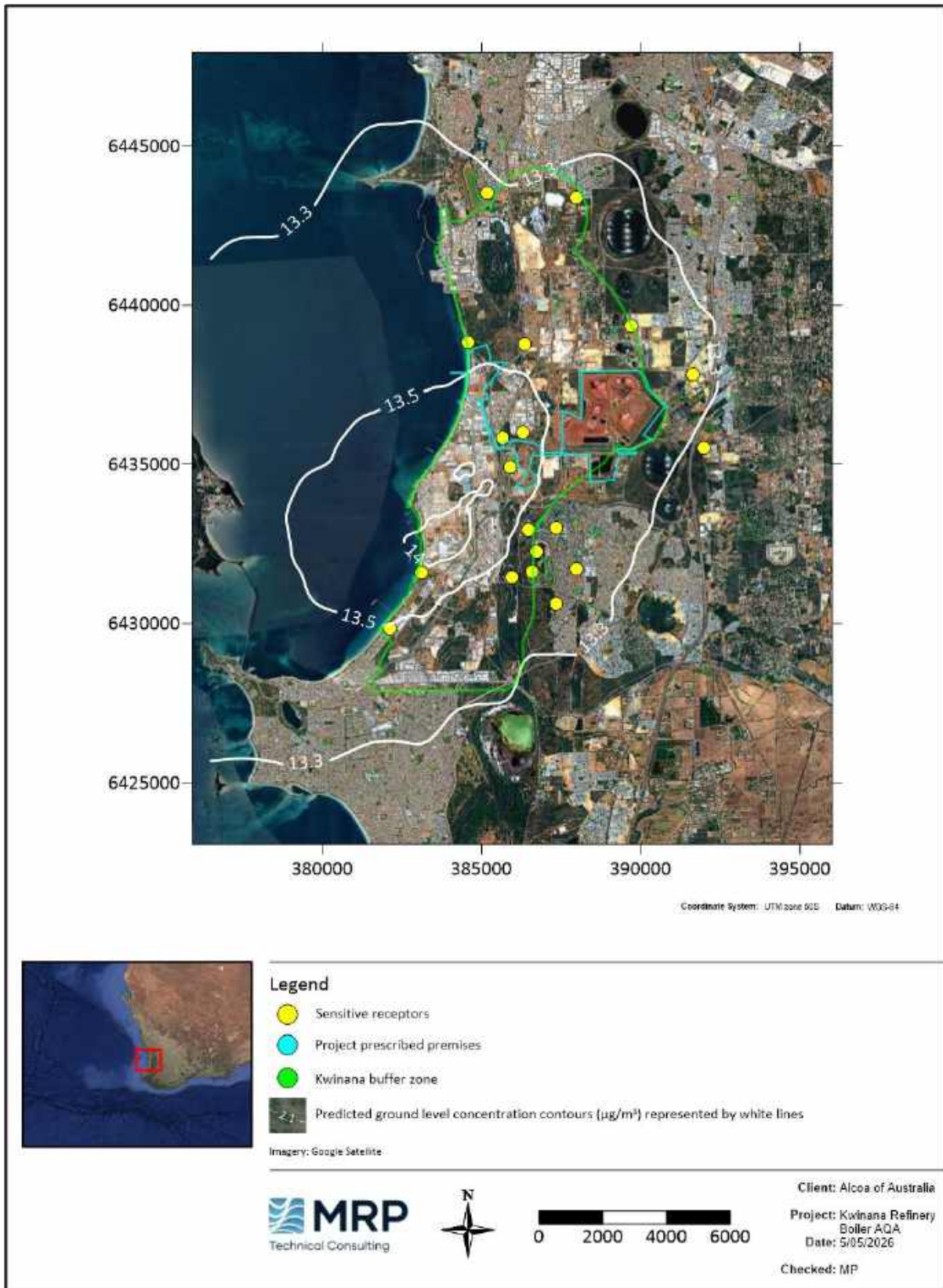


Figure 5-80: Predicted annual average GLCs of PM_{10} (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-81: Predicted annual average GLCs of PM₁₀ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

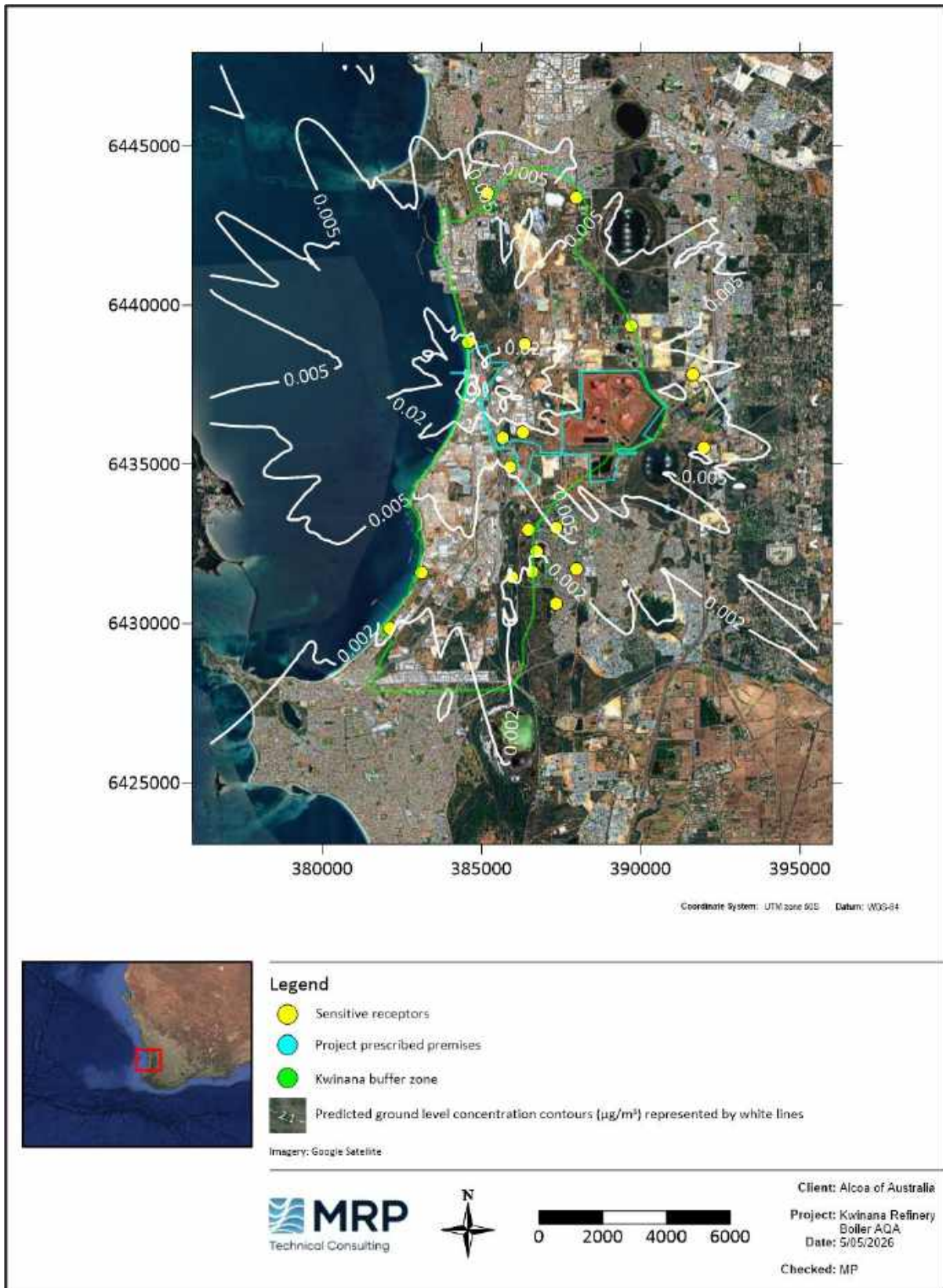


Figure 5-82: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation

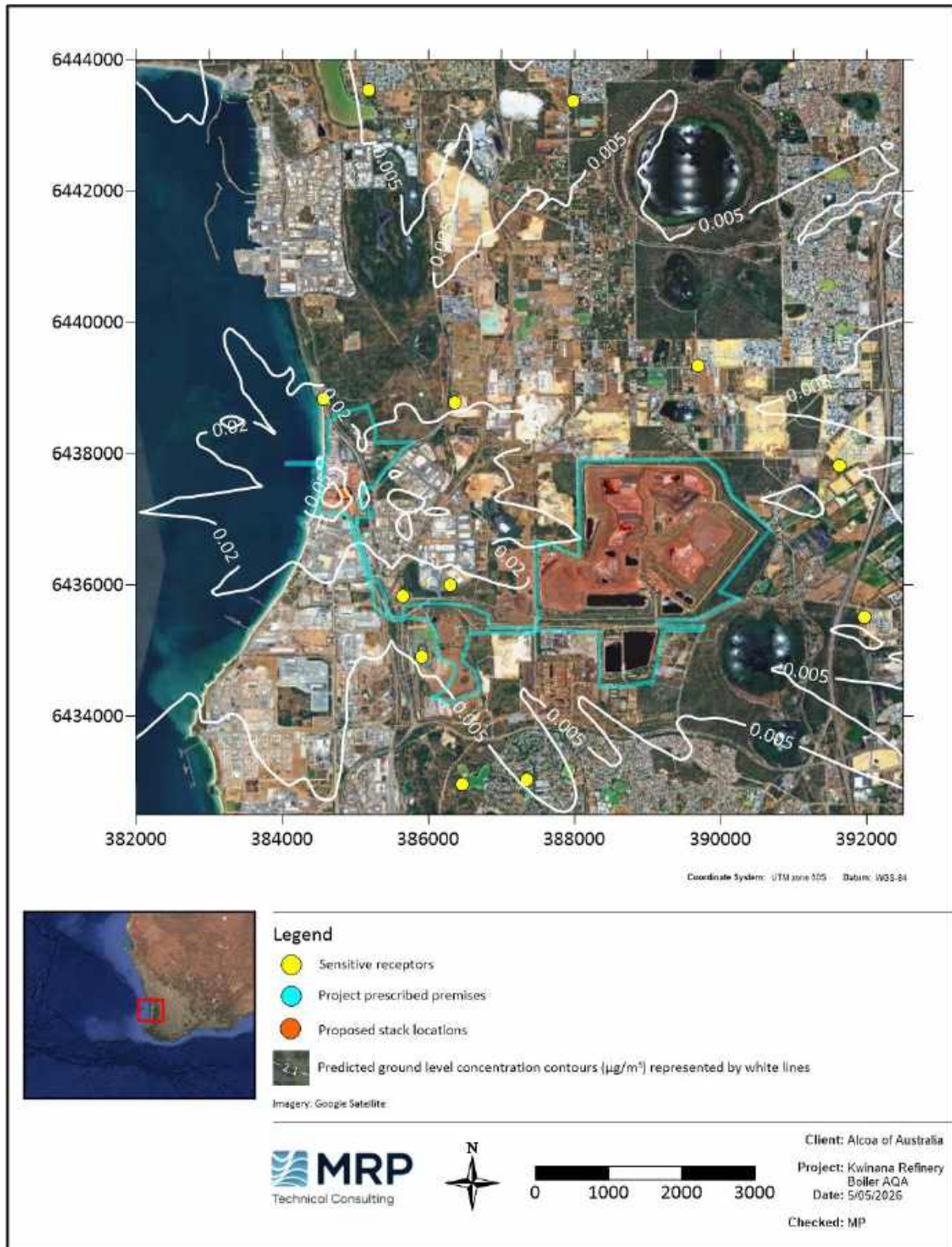


Figure 5-83: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

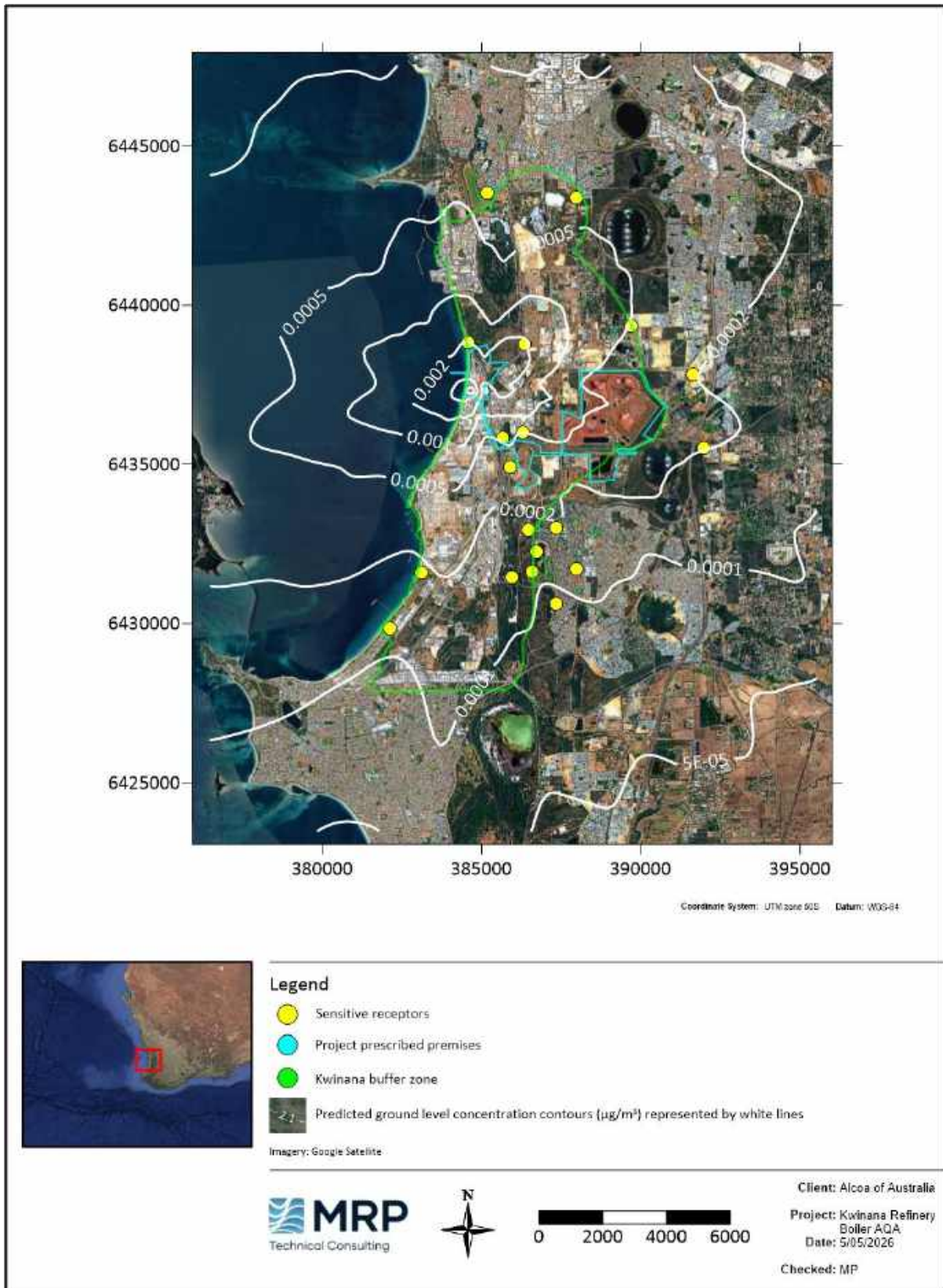


Figure 5-84: Predicted annual average GLCs of PM_{2.5} (Across modelled domain) – Scenario 3a – Boiler combination 1 – Isolation



Figure 5-85: Predicted annual average GLCs of PM_{2.5} (Zoomed in) – Scenario 3a – Boiler combination 1 – Isolation

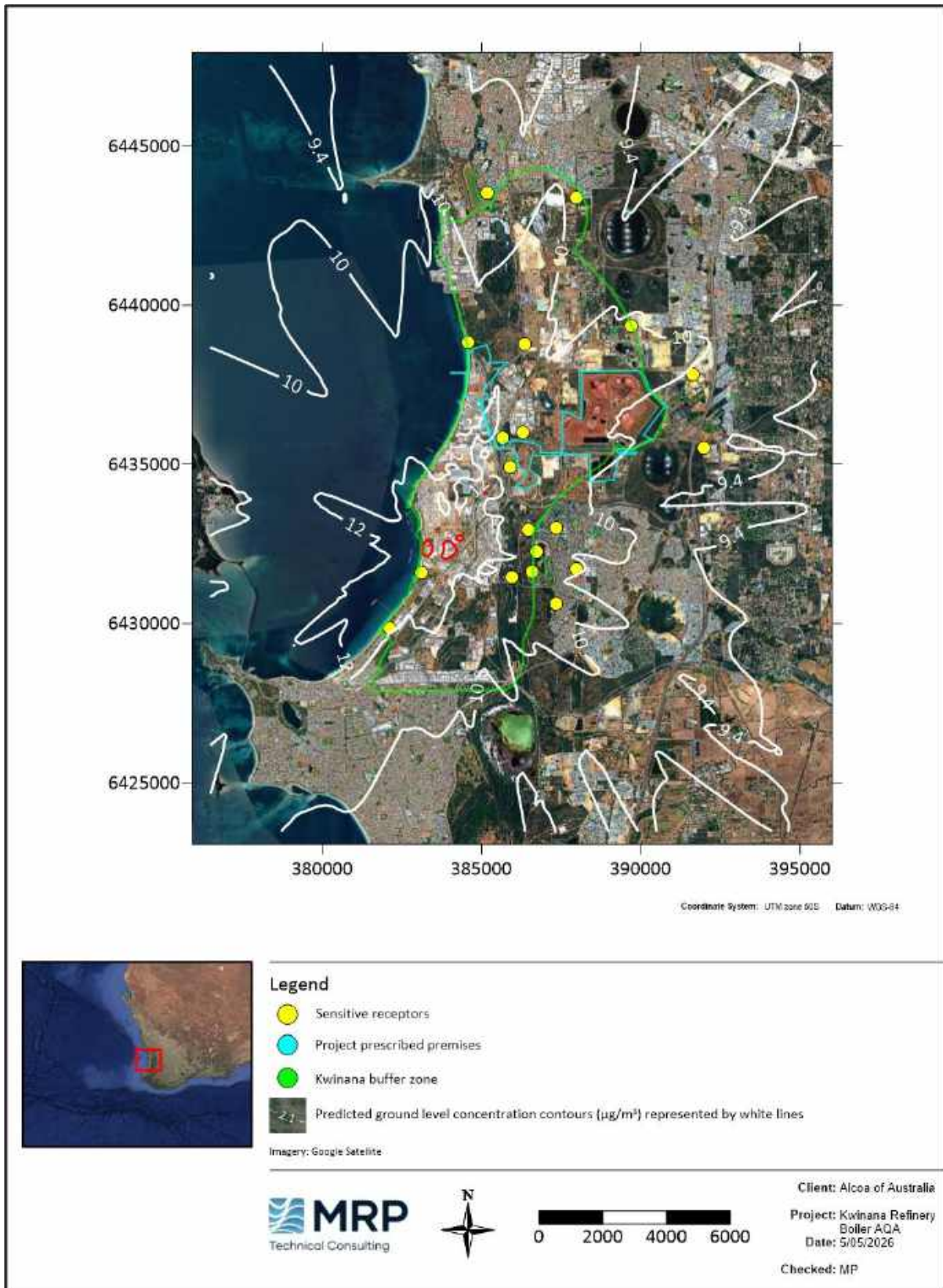


Figure 5-86: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

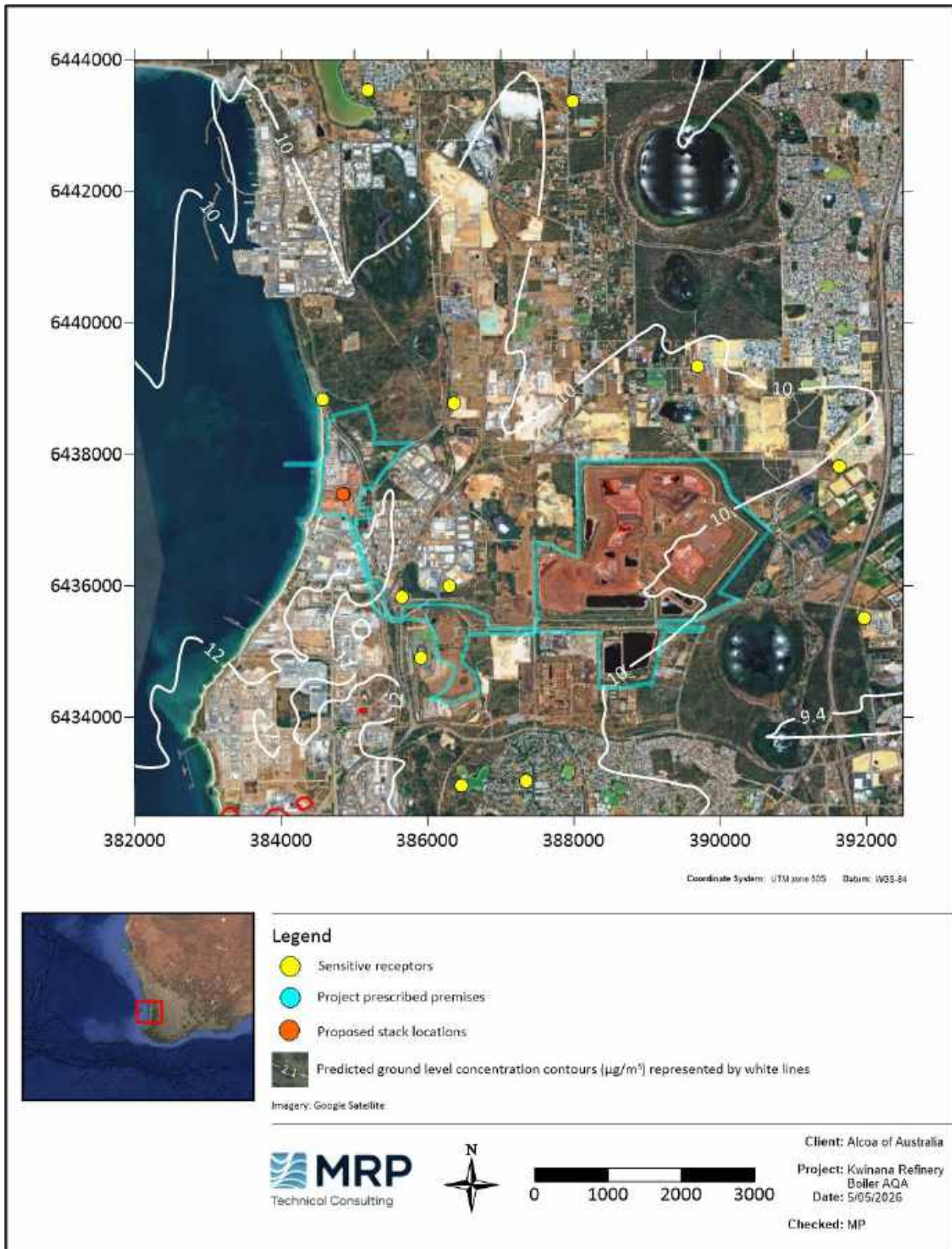


Figure 5-87: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

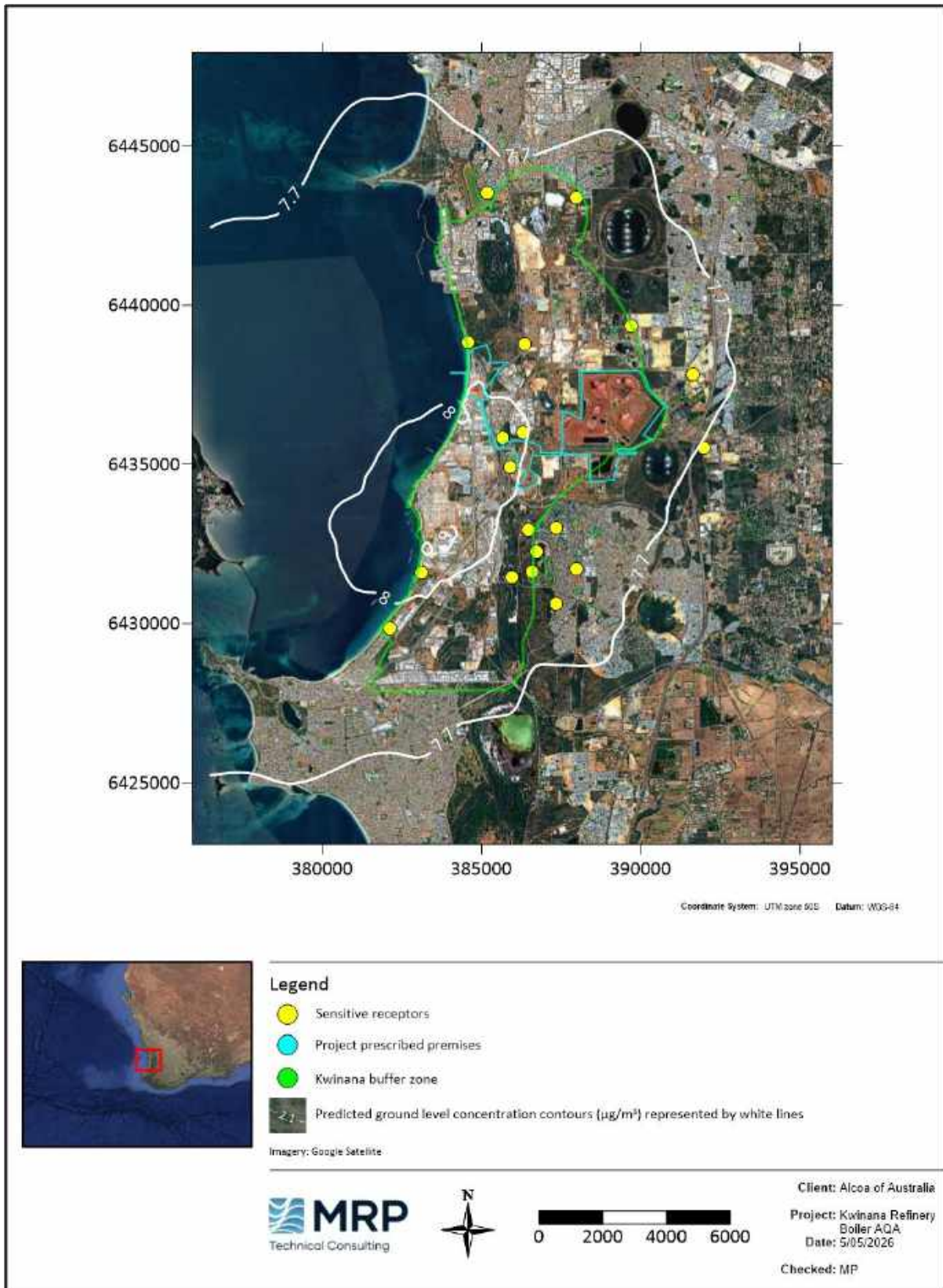


Figure 5-88: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Across modelled domain) – Scenario 3b – Boiler combination 1 – Cumulative

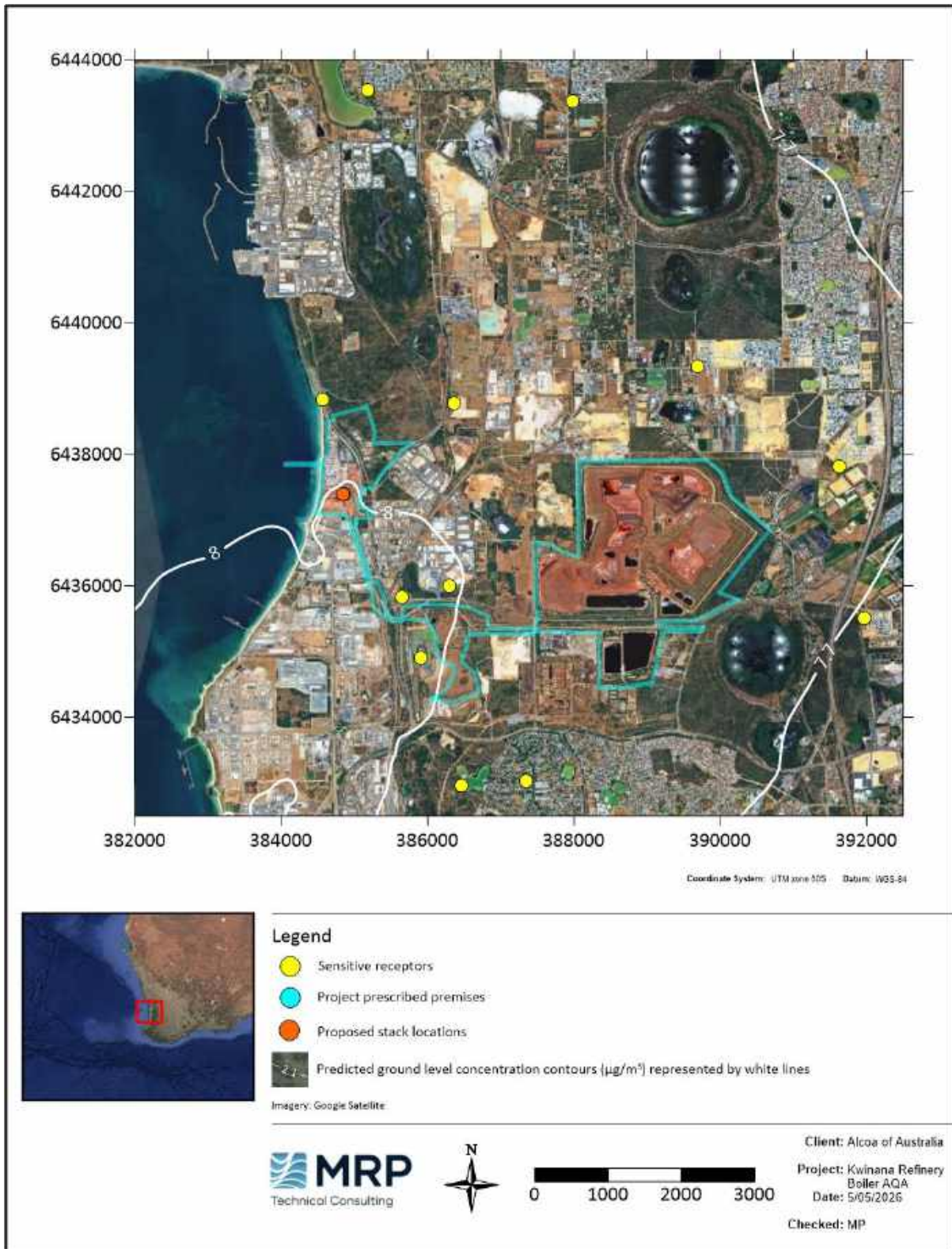


Figure 5-89: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 3b – Boiler combination 1 – Cumulative

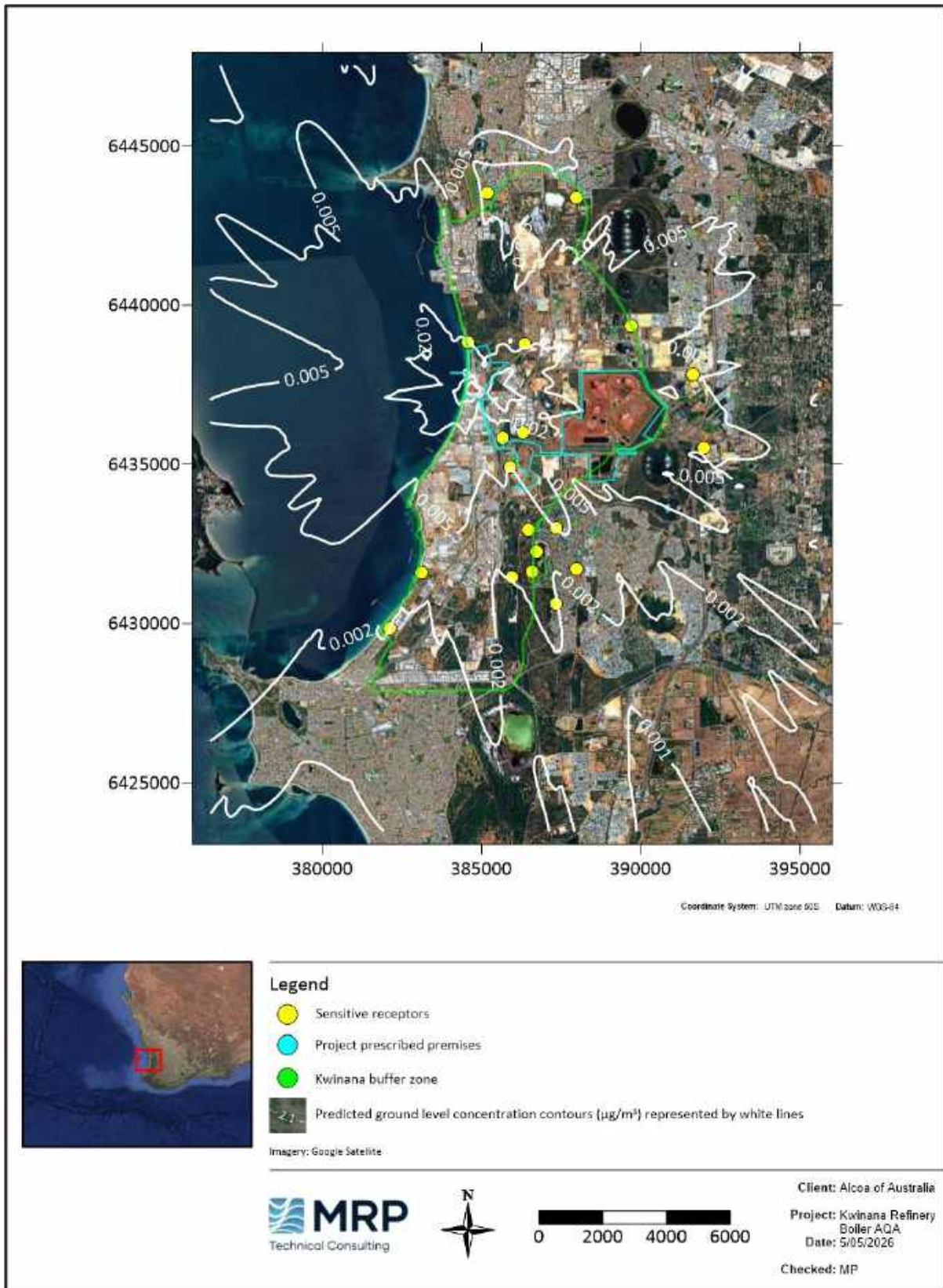


Figure 5-90: Predicted maximum 24-hour average GLCs of PM_{2.5} (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation



Figure 5-91: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

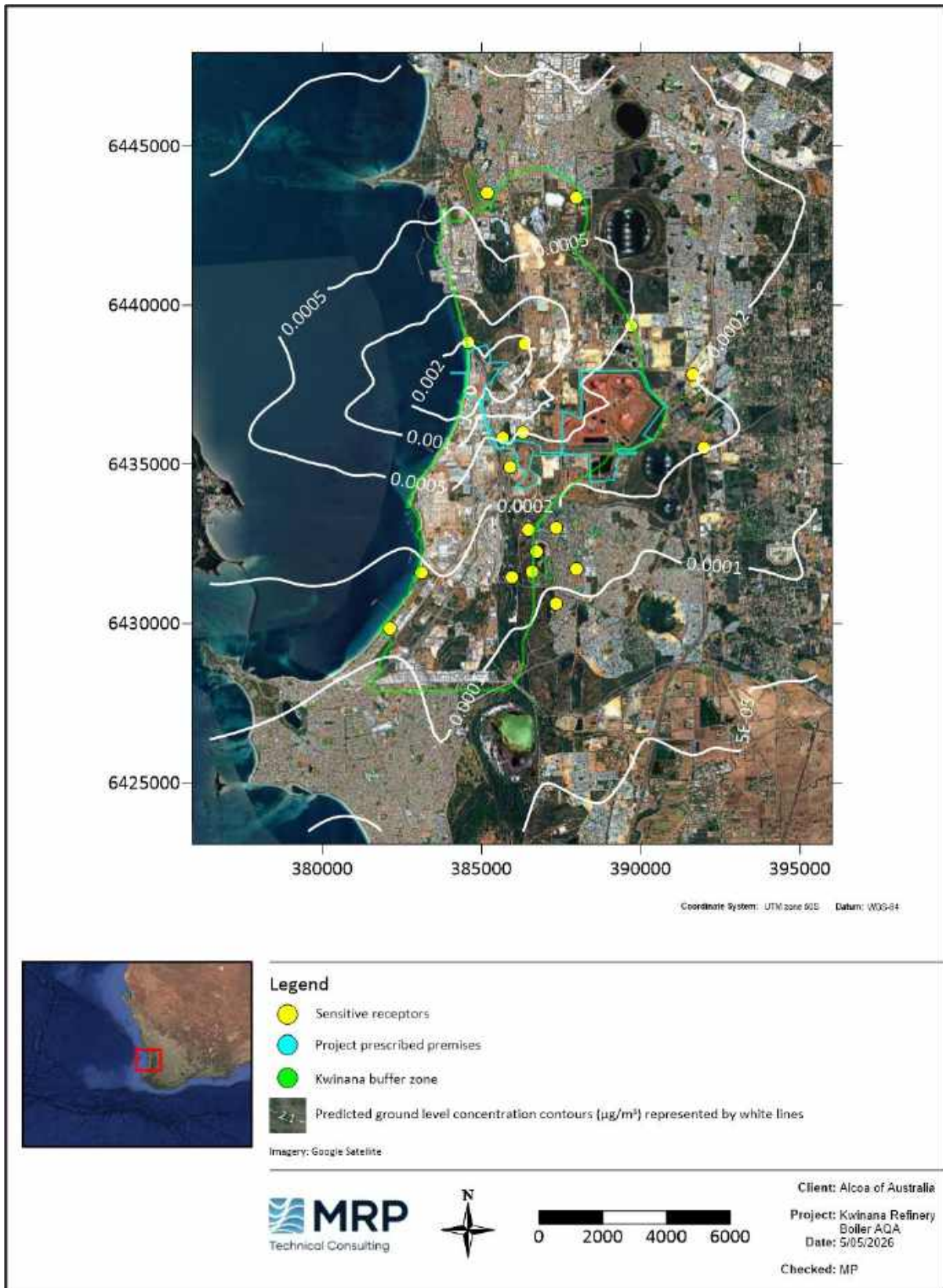


Figure 5-92: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Across modelled domain) – Scenario 4a – Boiler combination 2 – Isolation

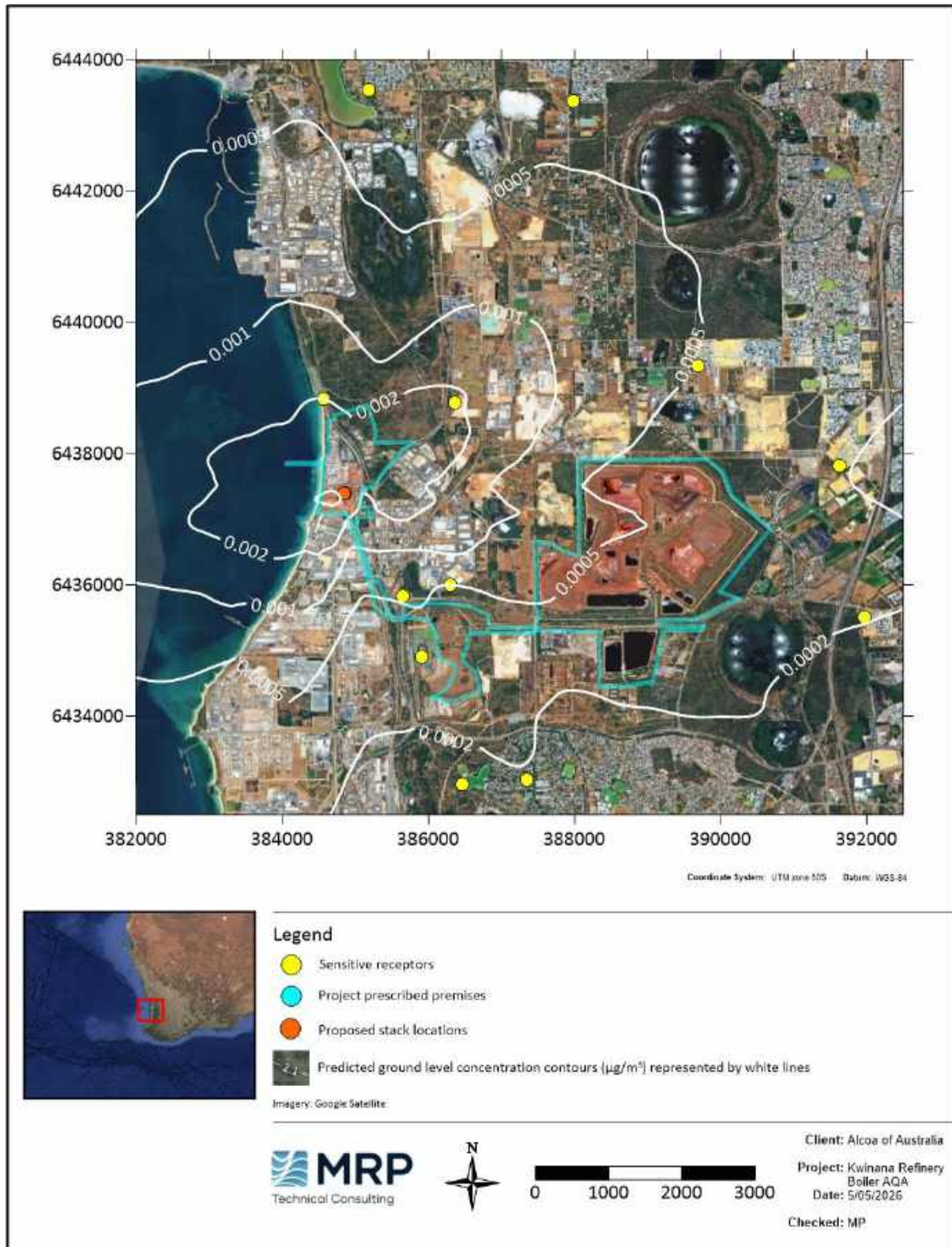


Figure 5-93: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 4a – Boiler combination 2 – Isolation

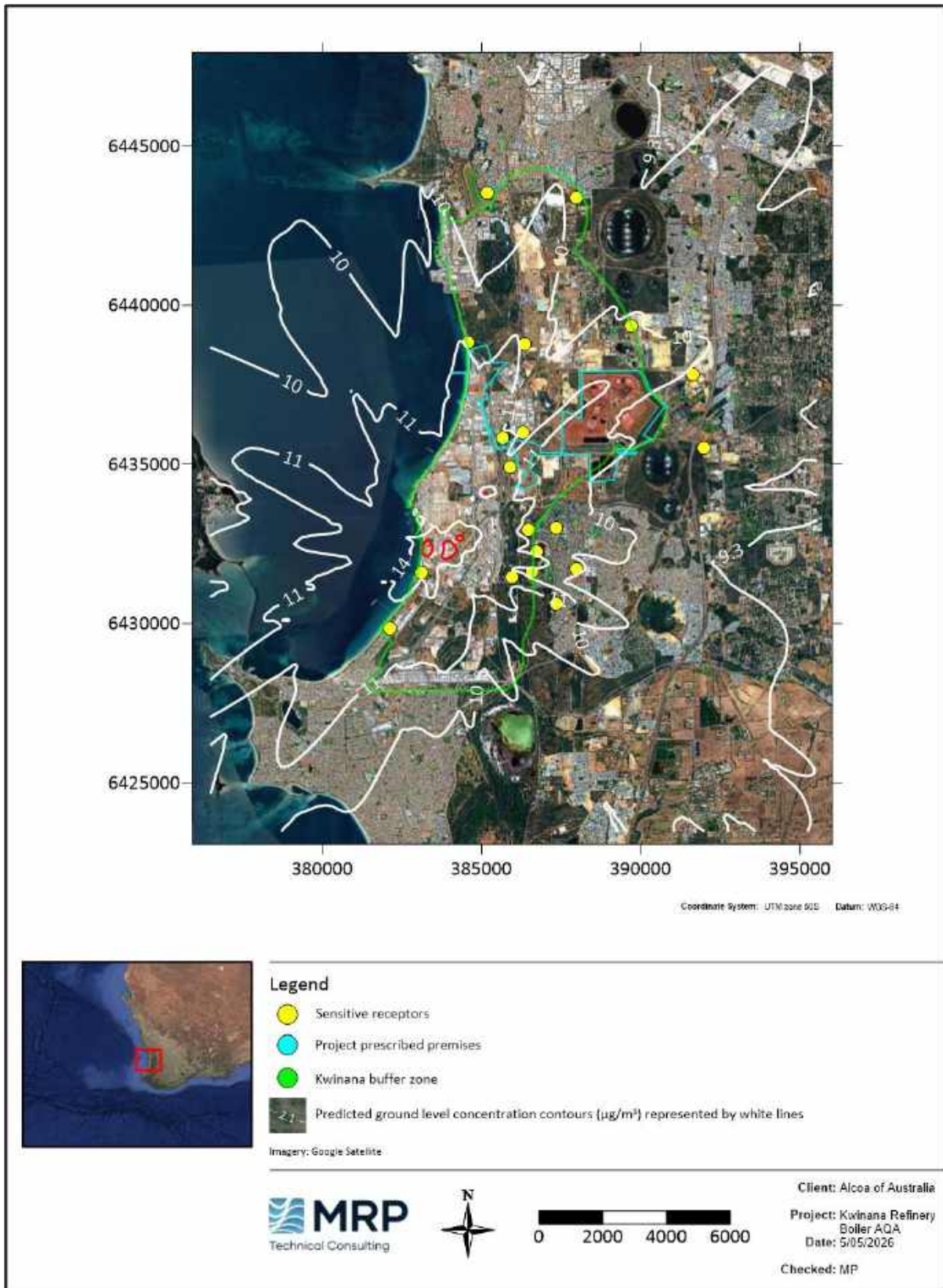


Figure 5-94: Predicted maximum 24-hour average GLCs of PM_{2.5} (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative



Figure 5-95: Predicted maximum 24-hour average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

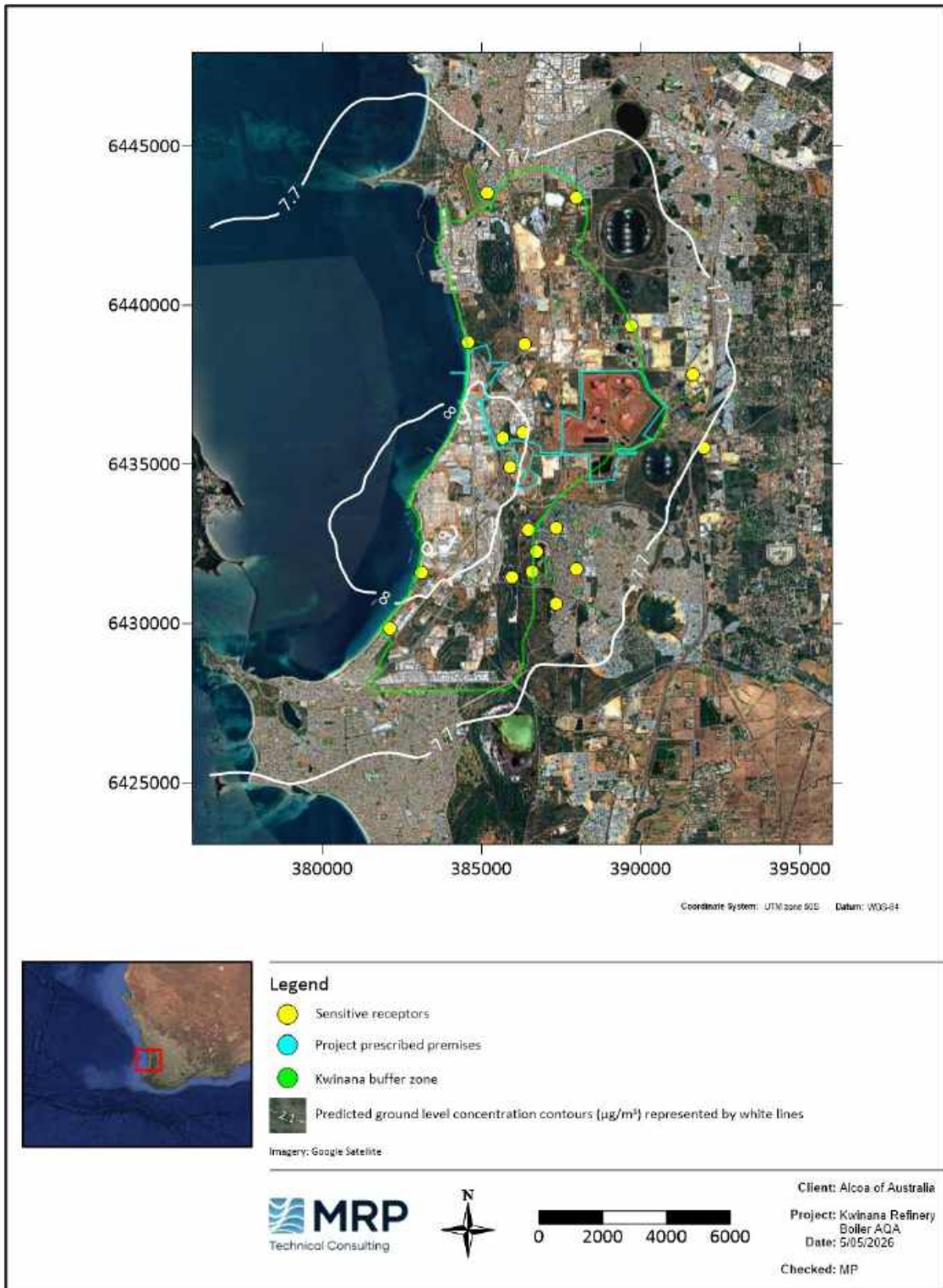


Figure 5-96: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Across modelled domain) – Scenario 4b – Boiler combination 2 – Cumulative

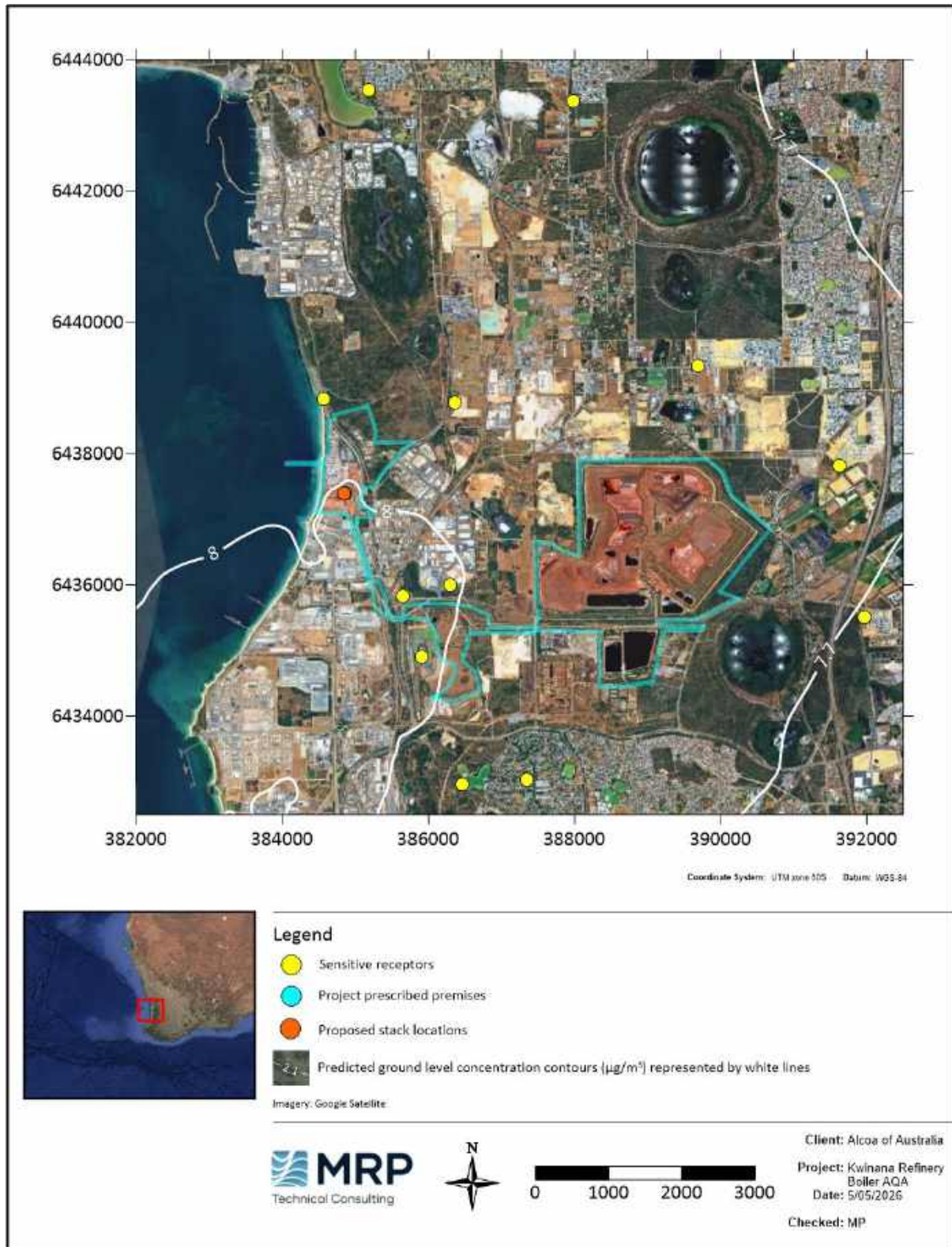


Figure 5-97: Predicted annual average GLCs of $\text{PM}_{2.5}$ (Zoomed in) – Scenario 4b – Boiler combination 2 – Cumulative

6 Summary

This air quality assessment was undertaken to evaluate the potential impacts associated with the installation and operation of two proposed 18 MW boilers at Alcoa's Kwinana Refinery under two potential configurations. The boilers are intended to supply steam to Building 42 to support surplus water management activities during the transition to permanent closure of the refinery. Atmospheric dispersion modelling was conducted to assess emissions of NO₂, SO₂, CO and particulates.

Air dispersion modelling was completed using the CALPUFF modelling system in conjunction with site-specific meteorological data generated using the WRF model. The modelling domain included the KIA and surrounding sensitive receptors, with assessment undertaken for four scenarios representing current and future approved sources, operation of the proposed boilers in isolation, and cumulative impacts with other regional sources.

The modelling results indicate that emissions from the proposed boilers, when assessed in isolation (Scenarios 3a and 4a), result in predicted ground level concentrations that are well below all relevant ambient air quality criteria at all sensitive receptor locations for all pollutants and averaging periods assessed. The contribution of the proposed boilers to regional air quality is minor, with maximum predicted concentrations representing only a small fraction of the applicable criteria. In particular, the maximum predicted contribution of the proposed boilers to annual average PM_{2.5} concentrations at sensitive receptors was negligible.

The cumulative assessment including emissions from the proposed boilers (Scenario 3b and 4b), predicted concentrations of NO₂, SO₂, CO and PM₁₀ at sensitive receptor locations that were below the applicable ambient air quality criteria. Short-term exceedances of the 1-hour SO₂ and 24-hour PM_{2.5} criteria were predicted to occur in limited areas within close proximity to individual industrial sources in the KIA; however, these are consistent with the highly industrialised nature of the region and were not attributable to the proposed boilers alone.

Predicted annual average PM_{2.5} concentrations exceeded the relevant NEPM criterion at all receptor locations under cumulative conditions. However, ambient monitoring data indicate that annual average PM_{2.5} concentrations in the region, particularly at the South Lake monitoring station, already exceeded the NEPM criterion prior to the inclusion of emissions from the proposed boilers. The contribution of the proposed boilers to cumulative PM_{2.5} concentrations was shown to be negligible relative to existing background levels, and the exceedances are considered to be driven primarily by regional background sources, including traffic emissions and other regional sources. It is also noted that the boilers will emit significantly less particulates than the current Alcoa powerhouse.

Overall, the modelling demonstrates that the proposed operation of two 18 MW boilers to support evaporation activities at Building 42 is unlikely to result in unacceptable air quality impacts or materially change the existing air quality environment within the Kwinana region. Based on the results of this assessment, the proposed boilers can be operated in a manner that

is consistent with applicable air quality objectives and protective of human health and the environment.

7 Limitations

MRP prepared this report in accordance with the scope of work as outlined in our proposal to Alcoa dated 13th April 2026 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent MRP's professional judgement based on information made available during the course of this assignment and are true and correct to the best of MRP's knowledge as at the date of the assessment.

MRP did not independently verify all of the written or oral information provided during the course of this investigation. While MRP has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to MRP was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

This report has been prepared for Alcoa and may not be relied upon by any other person or entity without MRP's expressed written permission.

8 References

Cole, H.S. & Summerhays, J.E. (1979). A review of techniques available for estimating short-term NO₂ concentrations. *Journal of the Air Pollution Control Association*, 29(8), pp. 812–817. <https://doi.org/10.1080/00022470.1979.10470866>

Department of Environment and Conservation (DEC) (2012). 2011 Western Australia Air Monitoring Report. Department of Environment and Conservation, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) (2017). 2017 Western Australian Air Monitoring Report. Department of Water and Environmental Regulation, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) (2019). Guideline: Air emissions. Government of Western Australia, Perth.

Emery, C., Tai, E. & Yarwood, G. (2001). Enhanced meteorological modeling and performance evaluation for two Texas ozone episodes. *Journal of Applied Meteorology*, 40(5), pp. 998–1015.

Environment Protection Authority Victoria (EPA Victoria) (2002). Air Monitoring Report 2001. Environment Protection Authority Victoria, Melbourne.

Environmental Protection Authority Western Australia (EPA WA) (1999). Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999. Government of Western Australia, Perth.

Herzbach, M., et al. (2023). Air quality impacts and spatial variability associated with extreme wildfire events. *Atmospheric Environment*, 307, 119903.

Michalakes, J., Dudhia, J., Gill, D., Henderson, T., Klemp, J., Skamarock, W. & Wang, W. (2001). The Weather Research and Forecast model: Software architecture and performance. In: *Proceedings of the 11th ECMWF Workshop on the Use of Parallel Processors in Meteorology*, Reading, UK.

National Environment Protection Council (NEPC) (2021). National Environment Protection (Ambient Air Quality) Measure. NEPC, Adelaide (Compilation incorporating amendments to May 2021).

New South Wales Environment Protection Authority (NSW EPA) (2016). Approved methods for the modelling and assessment of air pollutants in New South Wales. NSW EPA, Sydney.

Tikvart, J.A. (1996). Application of the Ozone Limiting Method (OLM) for estimating annual NO₂ concentrations. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.