Rio Tinto Iron Ore Mine

Nammuldi Agriculture Project

Environment Management Plan

RTIO-HSE-0210490

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1 SUMMARY

This Environmental Management Plan (E**MP**) is submitted in accordance with Ministerial Statement 1246 Conditions 8 and 9 for the Brockman Syncline Proposal (in particular, the Nammuldi Agriculture Project (**NAP**)) by Hamersley Iron Pty Limited.

Table 1-1 below presents the key environmental factors and the Environmental Protection Authority's (**EPA**) environmental objectives identified during the environmental review process, and the environmental criteria to measure achievement of the environmental outcome that must be met through implementation of this NAP EMP.

Table 1-1: Environmental criteria to measure achievement of the environmental outcome associated with the NAP

Title of proposal	Brockman Syncline Proposal
Proponent	Hamersley Iron Pty. Limited
Ministerial Statement Number	1246
Purpose of this EMP	The NAP EMP is submitted to fulfil the requirements of conditions B7 and B9 of the above Statement
EPA's environmental objective for the key environmental factor/s	**Flora and vegetation (introduced crop species):** To maintain the abundance, diversity, geographic distribution and productivity of flora and vegetation communities at species and ecosystem levels, through the avoidance or management of adverse impacts and improvement in knowledge **Surface water flows and groundwater (soil saturation and water quality):** To maintain the quality and quantity of surface water and groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected
Environmental outcome	**Flora and vegetation (introduced crop species):** • Prevent establishment of introduced crop species outside of the approved area[1] surrounding the agricultural pivots **Surface water flows and groundwater (soil saturation and water quality):** • Prevent adverse impacts to the environment downstream of the agricultural pivots due to waterlogging • Prevent adverse impacts to water quality downstream of the agricultural pivots as a result of irrigation water and nutrient application
Environmental Criteria	
Trigger Criteria	**Flora and vegetation (introduced crop species):** • Introduced crop species identified outside the sown area **Surface water flows and groundwater (soil saturation and water quality):** • Soil moisture within irrigation areas showing trends approaching saturation at all measured depths, taking into account rainfall and upstream control sites • Soil electrical conductivity (EC) ≥ 8.0 dS/m within irrigation areas; or ≥ 4.0 dS/m at downstream sites and increased significantly from baseline taking into account upstream sites • Soil quality; increasing trend from baseline, taking into account upstream (background) sites • Concentrations of nutrients (fertilisers) from runoff entering surface water bodies are above that of baseline levels taking into account background concentrations, or concentrations of herbicides and pesticides are above guideline levels for ecological risk.

[1] Approved area beyond which the introduced crop species should not spread, as defined in Ministerial Statement

	• Irrigation water quality shows exceedance of ANZECC/ARMCANZ (2000) irrigation water guidelines including sodium adsorption ratio (SAR) index for soil degradation • Significant rising trend in groundwater level is evident beneath the NAP area, taking into account upstream control (background) levels, regional changes and rainfall • Groundwater quality exceeding baseline and/or guideline levels for ecological risk, taking upstream control (background) sites into consideration
Threshold Criteria	**Flora and vegetation (introduced crop species):** • Introduced crop species detected outside the approved area **Surface water flows and groundwater (soil saturation and water quality):** • Soil moisture within irrigation areas and downstream sites showing trends indicative of saturation at all measured depths, taking into account rainfall and upstream control sites • Concentrations of nutrients (fertilisers) from runoff entering surface water bodies are above that of baseline levels taking into account background concentrations, or concentrations of herbicides and pesticides are above guideline levels for ecological risk, for more than one sampling event within a given wet season (when creeks are flowing) and are reasonably attributable to NAP operations

2 CONTEXT AND SCOPE

2.1 NAMMULDI AGRICULTURE PROJECT

Rio Tinto, on behalf of Hamersley Iron Pty. Limited (**the Proponent)**, is progressing with the development of the Nammuldi-Silvergrass Expansion Project (the **Proposal**), located approximately 65 km north-west of Tom Price in the western Pilbara region of Western Australia (Figure 1). The Minister for Environment authorised the Proposal on 11 January 2013 via Ministerial Statement 925 (**MS925**). A key component of the Proposal is increased volume of dewatering and a surplus water management strategy, including the transfer of water for irrigated agriculture at the Nammuldi Agriculture Project (**NAP**)[2] on Hamersley Station (operated by the Proponent under pastoral lease L3114/1277). On the 2 February 2026, MS925 was superseded by the Brockman Syncline Proposal, MS1246, which includes aspect of the original proposal and components that make up the significant amendment.

The NAP is expected to be approximately 2,500 ha in area, of which up to 2,000 ha may be cleared to support up to 40 pivots[3] (each up to 50 ha in size) and up to 500 ha for associated infrastructure over the life of the Proposal. The crops are watered by rotating spray pivots either containing a controlled supply of water and essential nutrients or just water, with controlled nutrients added as granular fertilizer when sowing and then as required. The crop is cut and baled on a rotational basis and currently delivered to the Hamersley Station and other nearby stations for stock feed. The NAP has been in care and maintenance since November 2023 and since this time no crop species have been sowed and no irrigation applied.

2.2 KEY ENVIRONMENTAL FACTORS

The NAP Environmental Monitoring and Management Plan (**NAP EMP**) addresses management of environmental factors identified in the EPA report 1457 and 1774; flora and vegetation (introduced crop species) and surface water flows and groundwater (soil saturation and water quality). Closure, decommissioning and rehabilitation were also recognised as key environmental factors in EPA report 1457 and 1774; specifically with respect to the NAP, the potential for introduced crop species to become an invasive weed. Management of introduced crop species is addressed in the NAP EMP, while other aspects of closure, decommissioning and rehabilitation are addressed in the Brockman Syncline Proposal Closure Plan (Rio Tinto 2025), which will be reviewed and updated on a 5-yearly basis.

The NAP EMP is designed to ensure that the EPA environmental objectives associated with the key environmental factors identified in EPA report 1457 and 1774 are met:

Flora and vegetation (introduced crop species)

- "*To maintain the abundance, diversity, geographic distribution and productivity of flora and vegetation communities at species and ecosystem levels, through the avoidance or management of adverse impacts and improvement in knowledge*";

Surface water flows and groundwater (soil saturation and water quality)

- "*To maintain the quality and quantity of surface water and groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected";*

2.3 KEY REGULATORY REQUIREMENTS

The EPA evaluated the Proposal under the Environmental Protection Act 1986 (**EP Act**) and the Minister for Environment authorised the Proposal on 11 January 2013 via MS925. This was superseded by MS1246 on the 2 February 2025. The authorisation is subject to implementation conditions including Condition B 7 specifying requirements for

[2] Referred to in Ministerial Statement 1246 as the Irrigated Agriculture Area (IAA) and since renamed the NAP by the Proponent

[3] 40 pivots is the capacity expected to be required to manage 643 GL of surplus water over the combined life of the mines, as modelled for the Public Environmental Review document. This was based on the mine plan at that time and the use of *Chloris gayana* as a crop. Pivots will be constructed in phases and, ultimately, fewer than 40 pivots may be required according to actual peak volumes of surplus water produced.

management of water quality and quantity at NAP and Condition B9 stipulating requirements for the selection, monitoring and control of all introduced crop species to be cultivated at NAP. Details on the implementation conditions and procedures addressed by this NAP EMP are identified in Section 3.

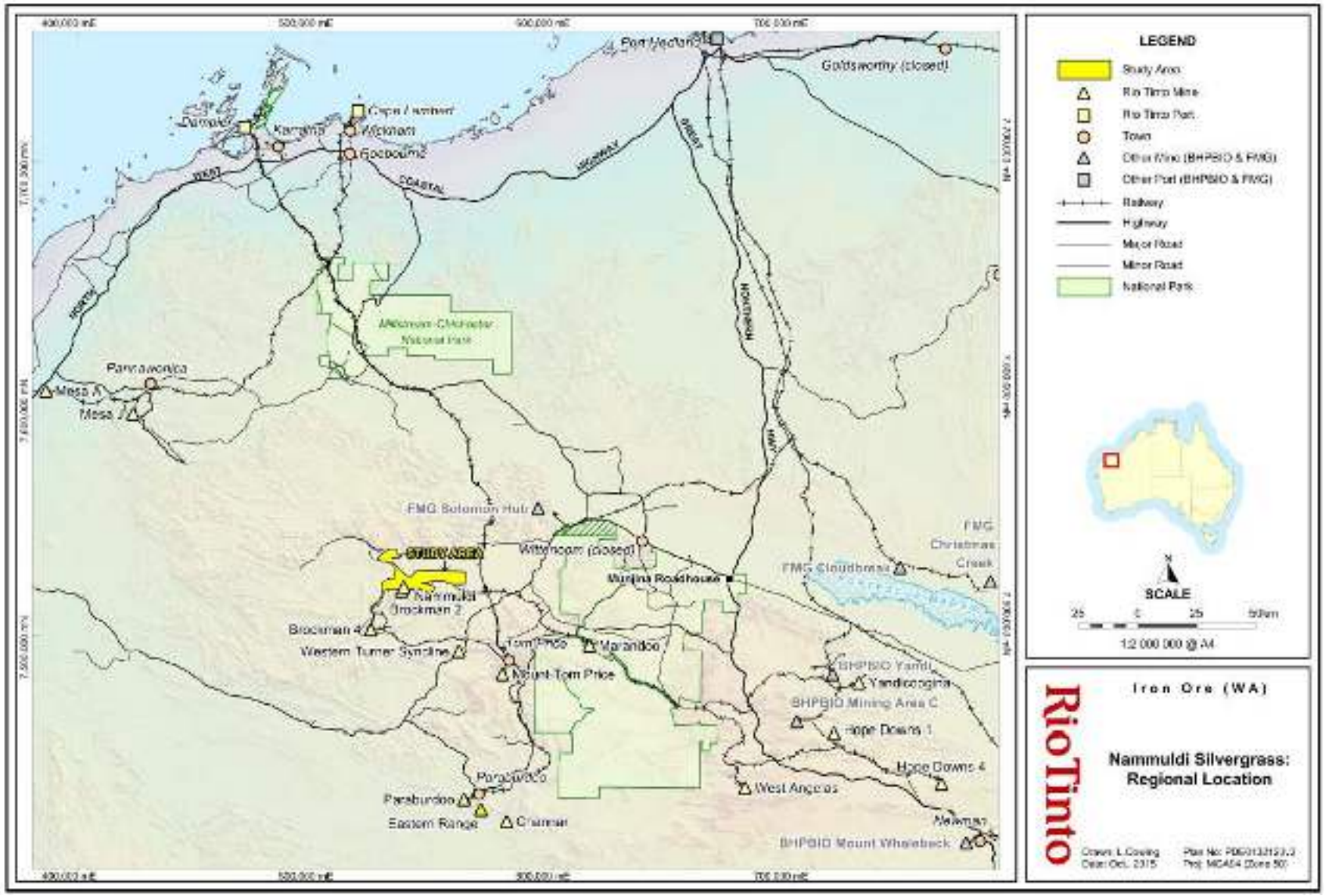

Figure 2-1 Regional location of the Nammuldi Silvergrass Expansion, including the Nammuldi Agriculture Project

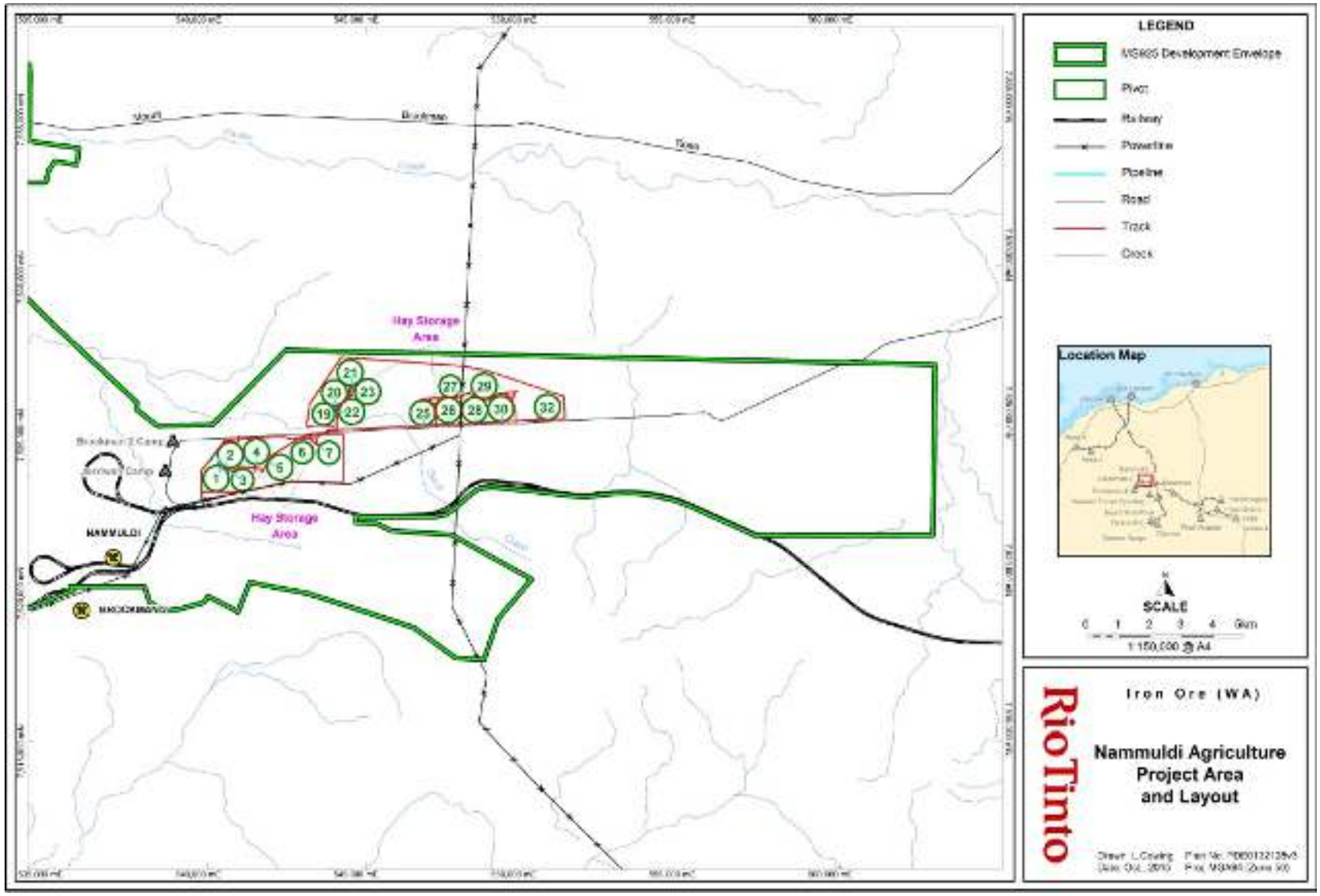

Figure 2-2 Nammuldi Agriculture Project area and current layout

3 CONDITION EMP PROVISIONS

The NAP EMP identifies the measures that the Proponent implements to:

1. Prevent establishment of introduced crop species outside the approved area[4] surrounding the agricultural pivots;
2. Prevent adverse impacts to the environment downstream of the agricultural pivots due to waterlogging; and
3. Prevent adverse impacts to water quality downstream of the agricultural pivots as a result of irrigation water and nutrient application.

It describes the environmental criteria (trigger and threshold) that the Proponent uses to measure performance of the measures proposed to address Conditions B7 and B9 of MS925 and to achieve the environmental outcomes. Finally, it defines the trigger level actions and threshold contingency actions that the Proponent will undertake if the environmental criteria are exceeded. These provisions aim to fulfil the requirements of Conditions B7 and B9 of MS925 (Appendix 1).

3.1 ENVIRONMENTAL CRITERIA

This section identifies the environmental criteria that will be used to measure performance relative to the environmental outcomes and implementation conditions. It also describes the rationale for the criteria that the Proponent has selected.

Two levels of criteria, which vary in function, have been developed for the NAP EMP:

- Trigger criteria - measures set at a conservative level to ensure management actions are implemented well in advance of the environmental outcome being compromised. Thus, trigger criteria are set at a level below threshold criteria to signal the need to focus and investigate and where applicable, mitigate the impact further or increase the level of protection or rehabilitation.
- Threshold criteria - are framed to measure achievement of the environmental outcome. A failure to meet threshold criteria, if attributable to the implementation of the NAP, signals the environmental outcome may not be met.

3.1.1 Rationale for choice of environmental criteria

A precautionary and adaptive approach, based on current best available knowledge and ongoing monitoring, has been adopted in regards to establishment and interpretation of trigger and threshold criteria. Several monitoring parameters help to inform risk of environmental outcomes not being met but do not provide a direct measure of this; these parameters therefore only have a trigger criteria assigned. Other monitoring that directly informs whether an environmental outcome has been met have a trigger and threshold criteria assigned. The rationale for assignment of threshold criteria is presented below.

All trigger and threshold criteria are shown in Tables 3.1 to 3.4. Baseline data for soil, surface water and groundwater quality are provided in Appendix 3.

3.1.1.1 Flora and vegetation (introduced crop species)

The spread of introduced crop species is the monitored parameter upon which the threshold criterion is based. This has been developed from the perspective of an approved area beyond which the crop species should not spread, as defined in MS1246. Un-sown areas adjacent to the sown pivots will be monitored for introduced crop species (Figure 3-1). This will ensure that any crop species growing adjacent to the sown pivots are identified and managed, ensuring minimal spread of crops species outside of the NAP area. Locations outside of the approved area will also be monitored to detect any potential outside spread of crop species

[4] Approved area beyond which the introduced crop species should not spread, as defined in Ministerial Statement

(Figure 3-2).

Furthermore, the riparian vegetation monitoring program implemented as part of the Brockman Syncline Proposal Environmental Management Plan will detect and manage any occurrence of introduced crop species on Duck and Caves Creek (Figure 3-3).

The threshold criterion to be applied to flora and vegetation (introduced crop species) environmental outcome:

- Introduced crop species detected outside the approved area.

The response to a detection of threshold criterion requires the identification of the extent of spread, the potential source and eradication of crop species from the area including increased monitoring extent of search area and frequency. Locations will be mapped and a review will determine if spread of crop species is linked to natural environmental conditions (e.g. rainfall).

3.1.1.2 Surface water flows and groundwater (soil saturation and water quality)

Soil saturation and irrigation water runoff are the monitored parameters upon which threshold criteria are based. The criteria have been developed from the perspective of the management of irrigation water and nutrient application and aim to ensure these inputs are well matched to the plant growth cycle, thus preventing runoff and / or contaminants leaching into groundwater and downstream creeks.

Two sets of threshold criteria have been applied:

A) Waterlogging

- Soil moisture within irrigation areas and downstream sites showing trends indicative of saturation at all measured depths, taking into account rainfall and upstream control sites.

A trend of increasing soil moisture or saturation at depth, or increasing soil moisture downstream of the NAP, may indicate that irrigation is in excess of crop requirements, and could lead to runoff or leaching and possible contamination of the downstream environment. Irrigation will cease during high rainfall events. Irrigation volumes will be calculated based on soil moisture levels, plant requirements, and predicted evaporation and transpiration rates.

The potential for the threshold criterion to be detected due to natural variability (e.g. rainfall events) must be accounted for in the management response and therefore requires identification of cause. Should natural causes be excluded, irrigation water quantities will be revised.

B) Quality of runoff

- Concentrations of nutrients (fertilisers) from runoff entering surface water bodies are above that of baseline levels taking into account background concentrations, or concentrations of herbicides and pesticides are above guideline levels for ecological risk, for more than one sampling event within a given wet season (when creeks are flowing) and are reasonably attributable to NAP operations.

Analytes to be monitored were selected based on applied nutrients, pesticides and herbicides, as well as analytes in the Nammuldi Below Water Table dewatering water that are considered to pose potential risk to aquatic fauna (WRM 2014a).

Baseline levels have been determined from water quality data collected from the Nammuldi and Silvergrass creek systems over seven seasons between 2009 and 2013, as well as a regional Pilbara creek dataset, used to develop interim operational site specific trigger values (**SSTVs**, WRM 2014b). The 80th percentile value for analytes was calculated and compared against the ANZECC/ARMCANZ Guidelines for Fresh and Marine Water Quality (2000) trigger values (**TVs**) for 95% species protection, and the higher of the local baseline or ANZECC/ARMCANZ default value used as the SSTV.

However, the Nammuldi-Silvergrass baseline data included water quality of ephemeral, semi-permanent and permanent pools, and is not representative of transient runoff events, typical of the tributaries adjacent to the NAP, which flow rarely and then for only a short time. Therefore, further baseline data was collected in these tributaries during the wet season of 2014 prior to the clearing and sowing of the NAP pivots. Further information on background (upstream) water quality was collected during 2014 and 2015 after implementation of the NAP. Concentrations of nutrients during runoff events will be compared to the Nammuldi-Silvergrass SSTVs (WRM 2014b), the 2014 local NAP baseline data and background (upstream) water quality (Appendix 3).

As there was no potential source of pesticides or herbicides in the local creeklines prior to the establishment of the NAP, it is not possible to use baseline levels in the threshold criterion. Therefore, published guidelines will be referred to; the ANZECC/ARMCANZ (2000) guidelines in the first instance, or if no guideline is provided for the chemical in question, the Canadian Environmental Quality guidelines (CCME 2015), USEPA (2015) National Recommended Water Quality Criteria or toxicological literature will be referred to.

To determine if the surface water quality in downstream creeks has declined as a result of NAP, it will be important to assess transient runoff events following significant rainfall. If it is not possible to sample directly from the creek, (as access may be difficult following rain events), water will be collected by rising stage samplers situated downstream and control (background) sites upstream of the NAP.

To maintain the quality of surface water in watercourses downstream of the NAP, application of nutrients or other chemicals will cease in the event that soils are found to be waterlogged and when significant rain is forecast.

Given the high degree of variability in water quality observed during baseline measurements, the potential for the threshold criterion to be detected due to natural variability must be accounted for in the management response. Therefore, baseline water quality and the range observed at upstream control sites will be taken into account. If elevated concentrations are observed for more than one sampling event in a given wet season that could reasonably be attributable to the Proposal, then it may be deemed that the threshold criterion is reached. The contingency actions will include reducing the application of fertiliser, irrigation volumes (if runoff has occurred) and/or pesticide application rates. Monitoring frequencies will be reviewed to ensure remedial measures are successful.

3.2 MONITORING

The purpose of the monitoring is to inform, through the environmental criteria, whether or not the environmental outcome is being achieved and when trigger-level management actions or threshold contingency actions need to occur. This section describes how the Proponent will monitor the performance indicators for the environmental criteria. Refer to Tables 3-1 and 3-2 for monitoring to manage introduced crop species and Tables 3-3 and 3-4 for the monitoring to manage water quality and quantity.

3.3 IMPLEMENTATION OF TRIGGER LEVEL ACTIONS

The Proponent has developed trigger level actions that would be implemented if the associated trigger criterion signals the need for increased mitigation or protection (Tables 3-1 and Table 3-3). If implemented, these management actions will mitigate and manage impacts so they once again meet trigger criteria and safeguard threshold criteria.

3.4 IMPLEMENTATION OF THRESHOLD CONTINGENCY ACTIONS

The Proponent has developed threshold contingency actions that would be implemented if the associated threshold criterion signals that the environmental outcome is not being achieved (Table 3-2 and Table 3-4). The threshold contingency actions will be implemented to manage aspects of the Proposal and achieve the environmental outcome and manage the impact to below threshold and trigger criteria again.

Table 3-1 Monitoring to evaluate environmental performance against flora (introduced crop species) trigger criteria

Monitoring	Location	Frequency	Trigger criteria	Management actions
Quarterly surveillance transects	Transects outside of sown pivot areas but within the approved area (Figure 3-1)	Quarterly[5]	Introduced crop species identified outside the sown area	1. Identify extent of spread 2. Identify potential source 3. Implement control methods 4. Incorporate GPS locations into GIS system 5. Monitor site to confirm eradication is achieved
Annual transects: NAP	Transects within and outside the approved area (Figure 3-2)	Annually (post-wet season)[6]	Introduced crop species identified outside the sown area	
Opportunistic inspections	High risk areas including locations where crop species have been previously recorded outside of the sown area	Opportunistically	Introduced crop species identified outside the sown area	
Occurrence of other exotic (introduced) species	Transects within and outside the approved area (Figure 3-2)	Annually (post-wet season)[6]	Significant increase in number of other exotic (introduced) species (as a result of NAP operations)	1. Investigate cause 2. Consider whether weed control / removal is required 3. Revise procedures as required to prevent re-occurrence

[5] As per condition B9-5, monitoring will reduce to yearly if no crop species are identified outside of the approved area for five continuous years.
[6] As per condition B9-5, monitoring will reduce to three yearly if no crop species are identified outside of the approved area for five continuous years.

Table 3-2 Monitoring to evaluate environmental performance against flora (introduced crop species) threshold criteria

Parameter	Location	Frequency	Threshold criteria	Contingency Actions
Annual transects: NAP	Transects within and outside the approved area (Figure 3-2)	Annually (post-wet season)[6]	Introduced crop species detected outside the approved area	1. Identify extent of spread 2. Identify potential source 3. Implement control methods 4. Notification to the OEPA within 7 days of non-compliance being known 5. Incorporate GPS locations into GIS system 6. Monitor site to confirm eradication is achieved
Annual transects: riparian vegetation	Representative riparian vegetation transects on Duck and Caves Creek (Figure 3-3)	Annually (post-wet season)[7]	Introduced crop species detected outside the approved area	

[7] In accordance with the Brockman Syncline Proposal Environmental Management Plan, any subsequent updates to the BSP EMP take precedence over the requirements set out in this EMP.

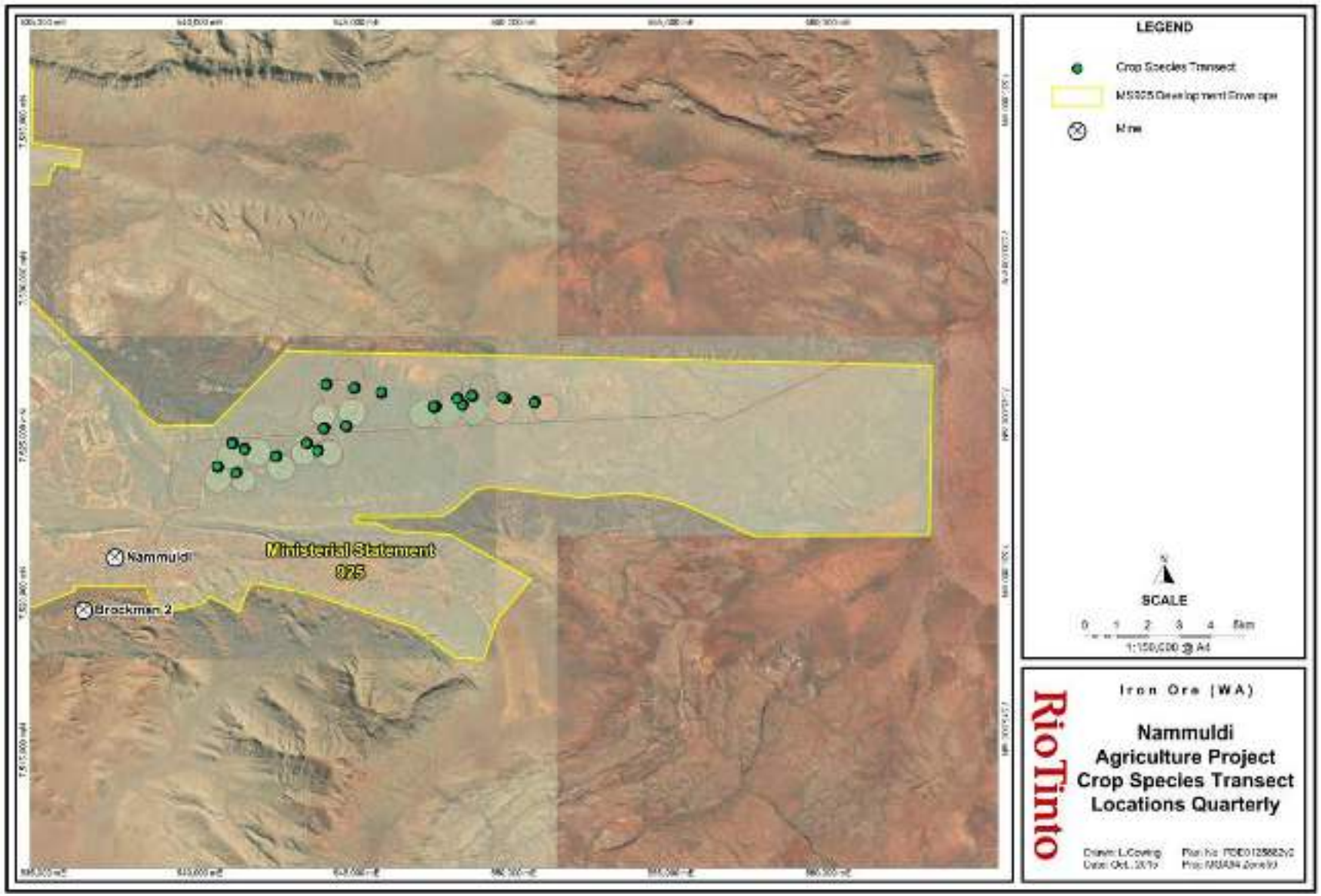

Figure 3-1 NAP quarterly crop species surveillance transect locations

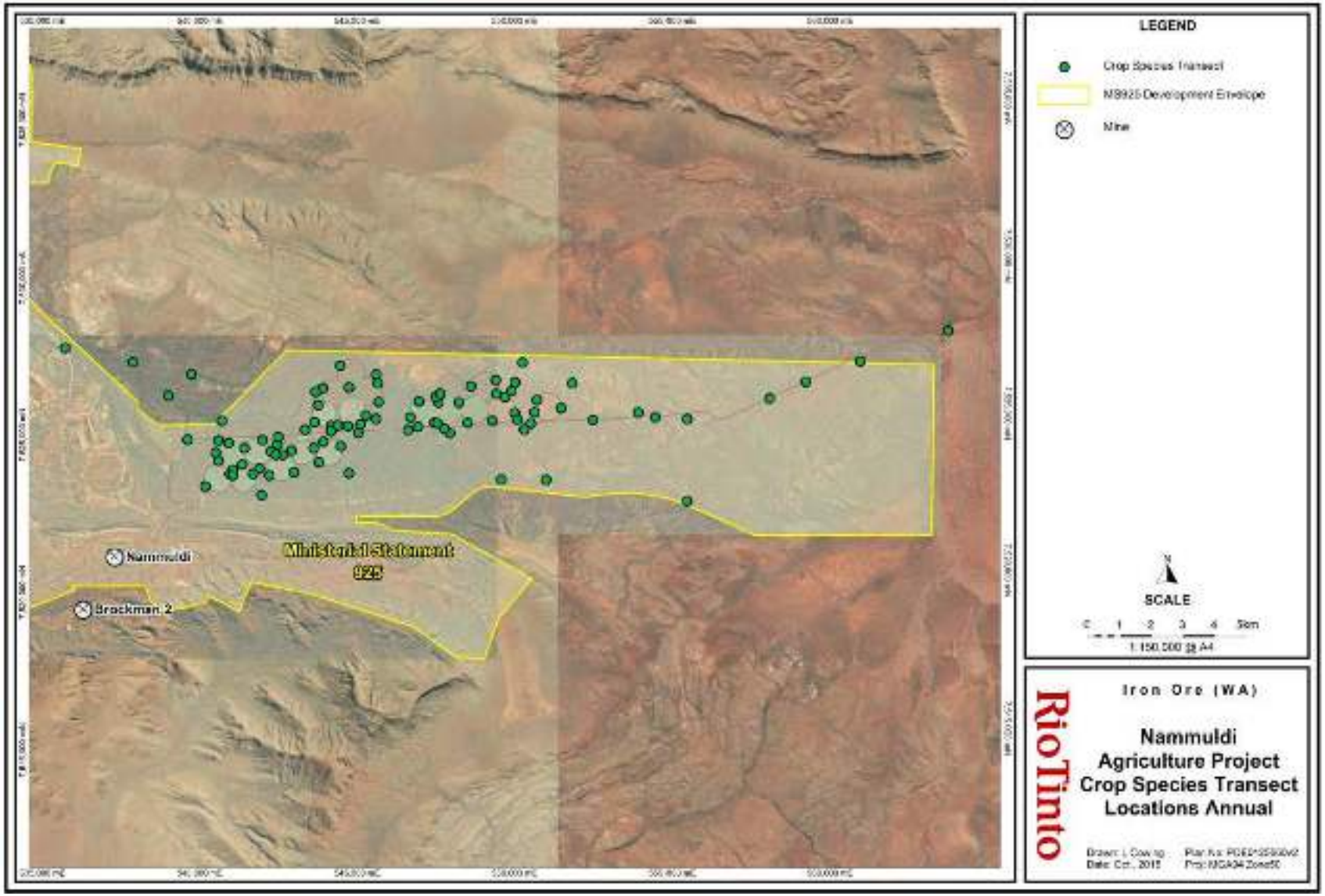

Figure 3-2 NAP annual crop species surveillance transect locations

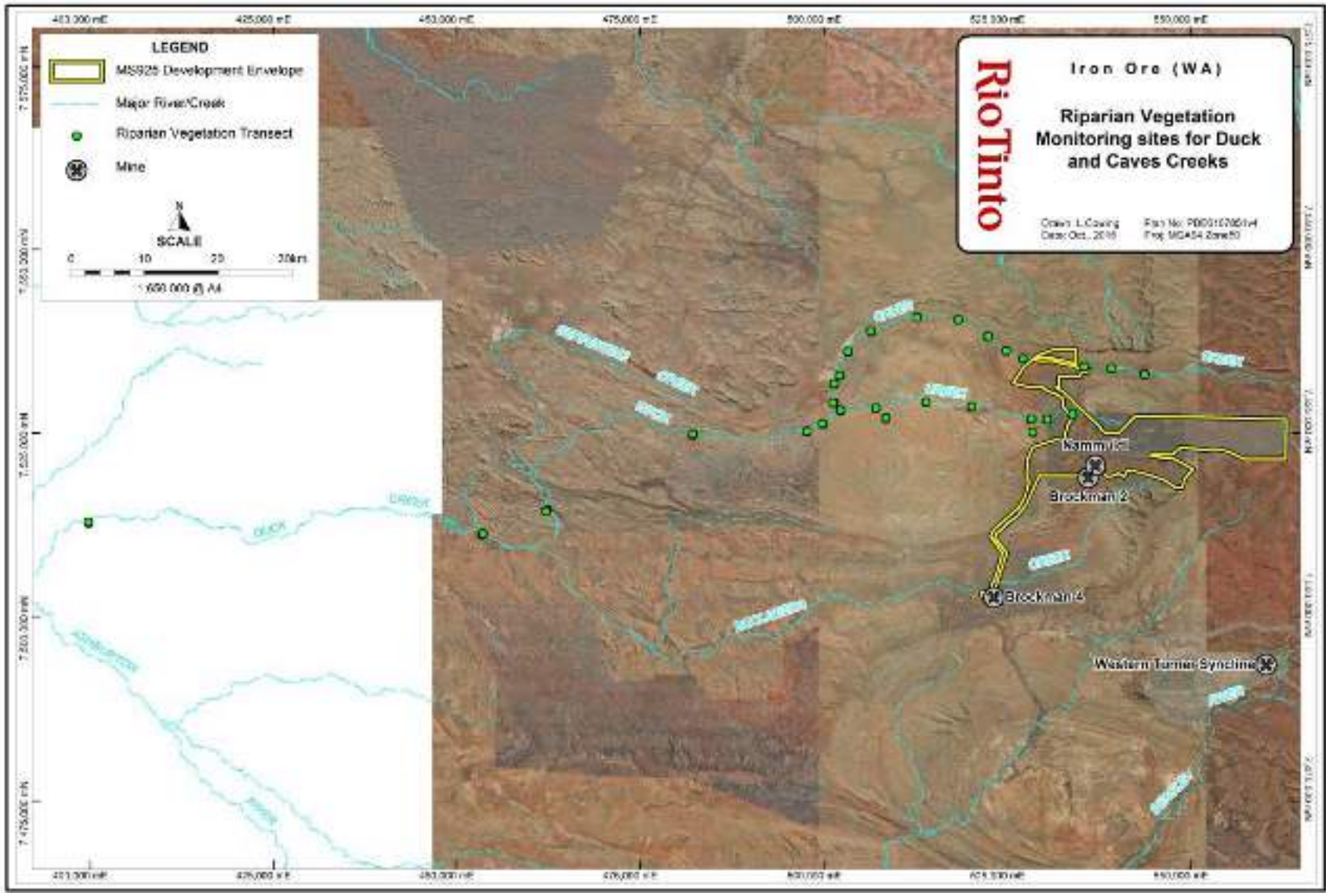

Figure 3-3 Riparian vegetation annual monitoring locations on Duck and Caves Creek

Table 3-3 Monitoring to evaluate environmental performance against water (soil saturation and water quality) trigger criteria

Parameter	Location	Frequency	Trigger criteria	Management actions
Soil moisture	Irrigation areas, upstream and downstream (Figure 3-4)	Daily (automated logging)[8]	Soil moisture within irrigation areas showing trends approaching saturation at all measured depths, taking into account rainfall and upstream control sites	1. Re-analyse test parameters and data statistics 2. Resample soil quality as soon as practicable to confirm trend 3. Revise nutrient applications (if deemed appropriate) 4. Monitor to confirm actions are successful
Soil electrical conductivity	Irrigation areas, upstream and downstream (Figure 3-4)	Daily (automated logging)[8]	Within Irrigation areas:[9] EC_{se} ≥ 8.0 dS/m Downstream sites: EC_{se} ≥ 4.0 dS/m and increased significantly from baseline, taking into account upstream sites	
Soil quality: pH, EC, Al, As, K, Ca, Na, Cl, Cr, Cu, Fe, Mg, N_NO_3, N_NO_2, NH_3, P(total), N(total), SO_4_S, Se, Zn, applied pesticides and herbicides (within irrigated areas and downstream)	Representative irrigation areas, upstream and downstream (Figure 3-6)	Bi-annually (post-wet and post-dry season)[8]	Increasing trend from baseline, taking into account upstream (background) sites.	
Surface water runoff: pH, EC, Hardness($CaCO_3$), TDS, TSS, Al, As, K, Ca, Na, Cl, Cr, Cu, Fe, Mg, N_NO_3, N_NO_2, NH_3, P(total), N(total), SO_4_S, Se, Zn, applied pesticides and herbicides (downstream of pivots)	Drainage lines and creek tributaries upstream and downstream of the NAP area (Figure 3-5)	Following significant rainfall events when creeks are flowing[8]	Concentrations of nutrients (fertilisers) from runoff entering surface water bodies are above that of baseline levels taking into account background concentrations, or concentrations of herbicides and pesticides are above guideline levels for ecological risk.	1. Re-sample if possible 2. If deemed necessary, revise nutrient and/or irrigation applications 3. Monitor to confirm actions are successful

[8] Monitoring is confined to the period of active operations and up to six months post-operations, after which monitoring will cease.

[9] Guidelines for risk of salinity and sodicity provided in Moore, G (2001). Soilguide. A handbook for understanding and managing agricultural soils. Agriculture Western Australia Bulletin No. 4343.

Irrigation water quality (post-fertigation, if applicable): pH, EC, Hardness($CaCO_3$), TDS, TSS, Al, As, K, Ca, Na, Cl, Cr, Cu, Fe, Mg, N_NO_3, N_NO_2, NH_3, P(total), N(total), SO_4_S, Se, Zn	Representative irrigation areas	Quarterly[8]	Exceedance of ANZECC/ARMCANZ (2000) irrigation water guidelines including SAR index for soil degradation^	1. Re-test irrigation water 2. Revise nutrient application should exceedances still occur and / or SAR showing trend of soil degradation 3. Monitor to confirm actions are successful
Groundwater level	Representative groundwater bores within the NAP area, upstream and downstream (Figure 3-7)	Monthly[8]	Significant rising trend in groundwater level is evident beneath the NAP area, taking into account upstream control (background) levels, regional changes and rainfall	1. Investigate cause 2. If increase is due to irrigation in excess of requirements adjust irrigation volumes 3. Monitor to confirm actions are successful
Groundwater quality: pH, EC, Hardness($CaCO_3$), TDS, TSS, Al, As, K, Ca, Na, Cl, Cr, Cu, Fe, Mg, N_NO_3, N_NO_2, NH_3, P(total), N(total), SO_4_S, Se, Zn, applied pesticides and herbicides (downstream of pivots)	Representative groundwater bores within the NAP area, upstream and downstream (Figure 3-7)	Bi-annually[8]	Parameters exceeding baseline and/or guideline levels for ecological risk, taking upstream control (background) sites into consideration	1. Re-analyse test parameters and data statistics 2. Revise nutrient applications (should natural causes be excluded) 3. Monitor to confirm actions are successful

^ ANZECC/ARMCANZ (2000) Guidelines for Fresh and Marine Water Quality; Section 4.2 Water Quality for irrigation and general use, specifically short term trigger values in Tables 4.2.10 and 4.2.11 and Figure 4.2.2 for SAR index

Table 3-4 Monitoring to evaluate environmental performance against water (soil saturation and water quality) threshold criteria

Parameter	Location	Frequency	Threshold criteria	Contingency actions
Soil moisture	Irrigation areas, upstream and downstream (Figure 3-4)	Daily (automated logging)[8]	Soil moisture within irrigation areas and downstream sites showing trends indicative of saturation at all measured depths, taking into account rainfall and upstream control sites	Should other causes be excluded: 1. Notify the OEPA within 7 days of that non-compliance being known 2. Review and revise nutrient and/or irrigation quantities 3. Re-analyse data 4. Monitor to confirm contingency actions are successful
Surface water runoff: pH, EC, Hardness($CaCO_3$), TDS, TSS, Al, As, K, Ca, Na, Cl, Cr, Cu, Fe, Mg, N_NO_3, N_NO_2, NH_3, P(total), N(total), S, Se, Zn, applied pesticides and herbicides (downstream of pivots)	Drainage lines and creek tributaries upstream and downstream of the NAP area (Figure 3-5)	Following significant rainfall events when creeks are flowing[8]	Concentrations of nutrients (fertilisers) from runoff entering surface water bodies are above that of baseline levels taking into account background concentrations, or concentrations of herbicides and pesticides are above guideline levels for ecological risk, for more than one sampling event within a given wet season (when creeks are flowing) and are reasonably attributable to NAP operations	

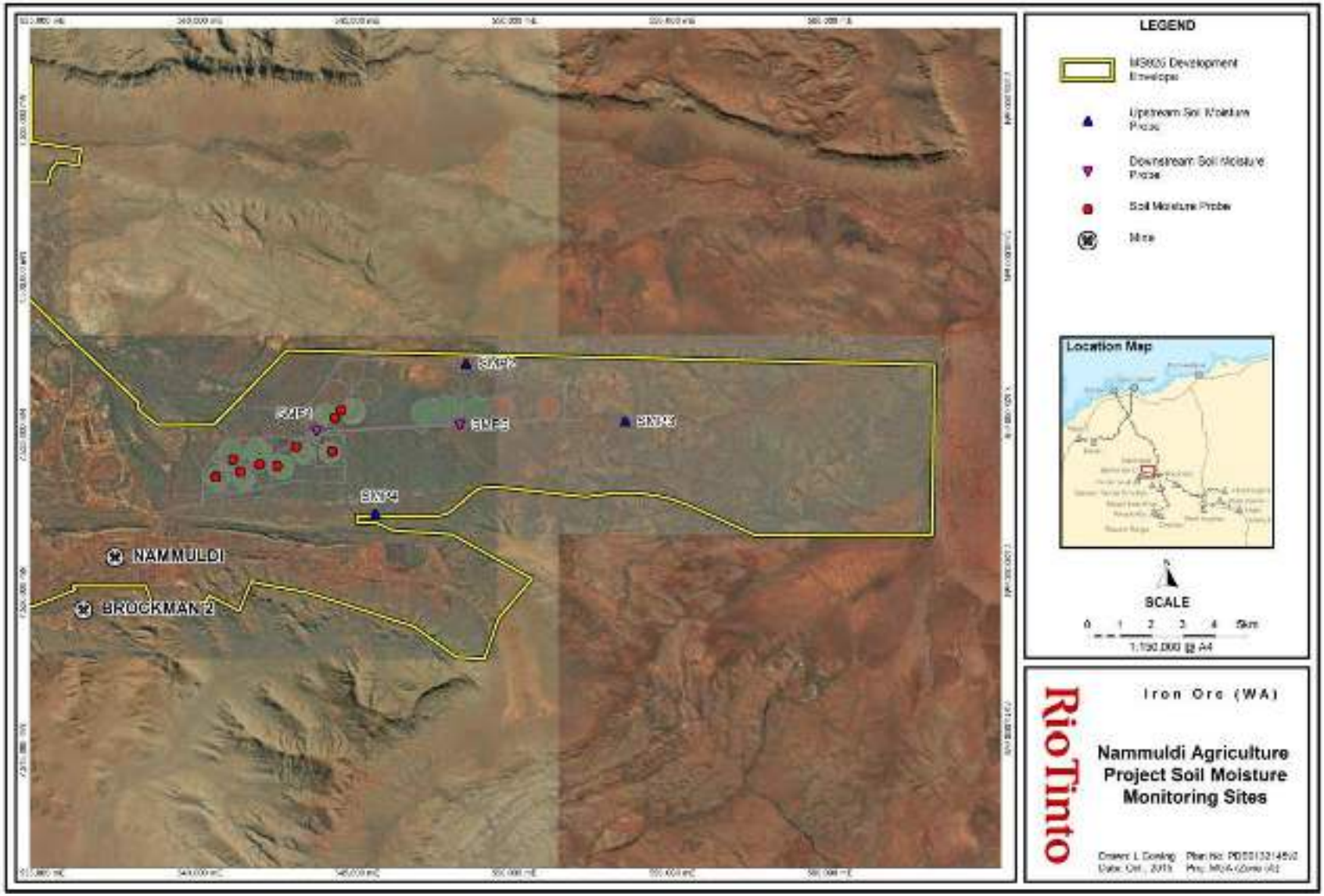

Figure 3-4 NAP soil moisture and electrical conductivity probe locations

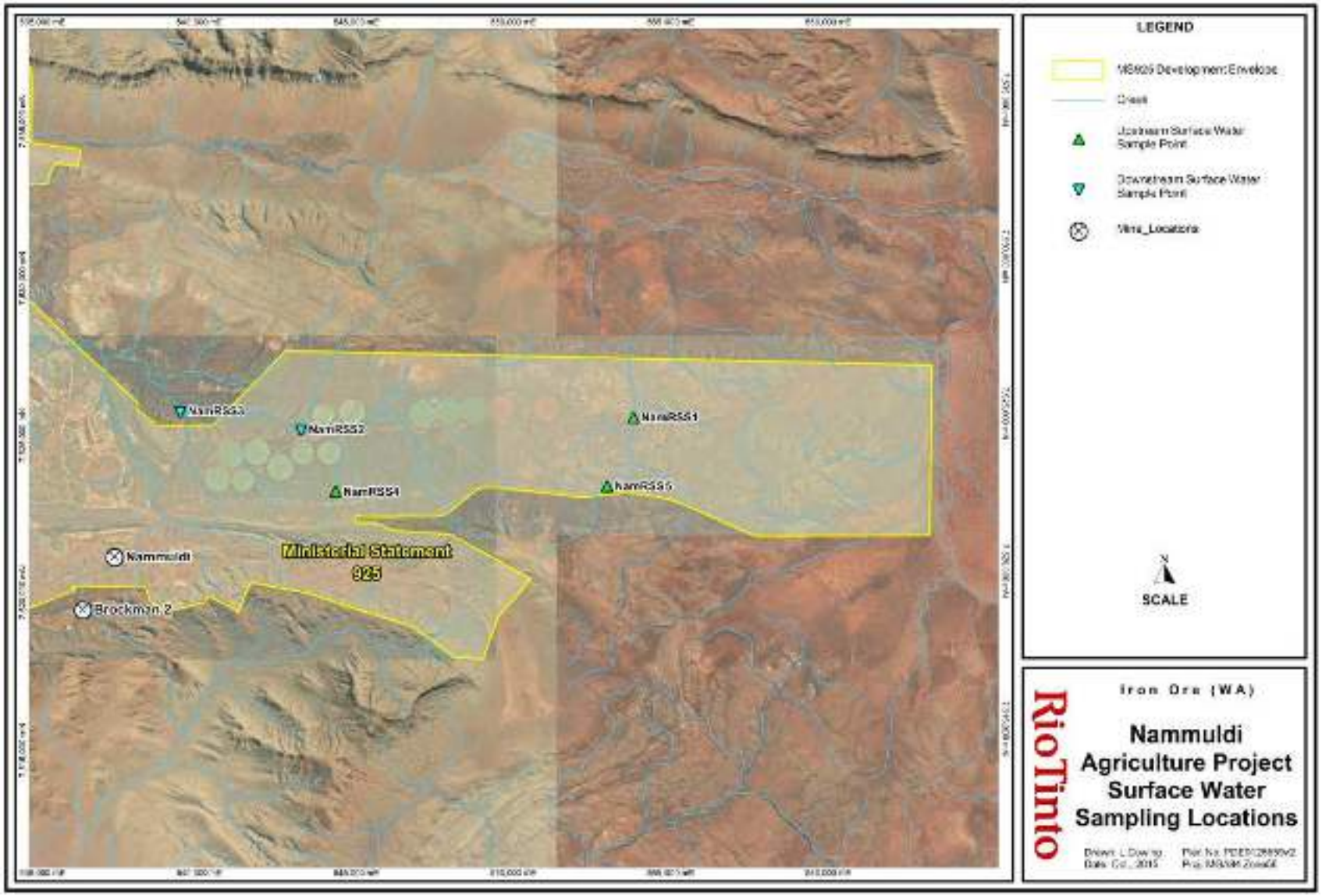

Figure 3-5 NAP surface water runoff monitoring locations

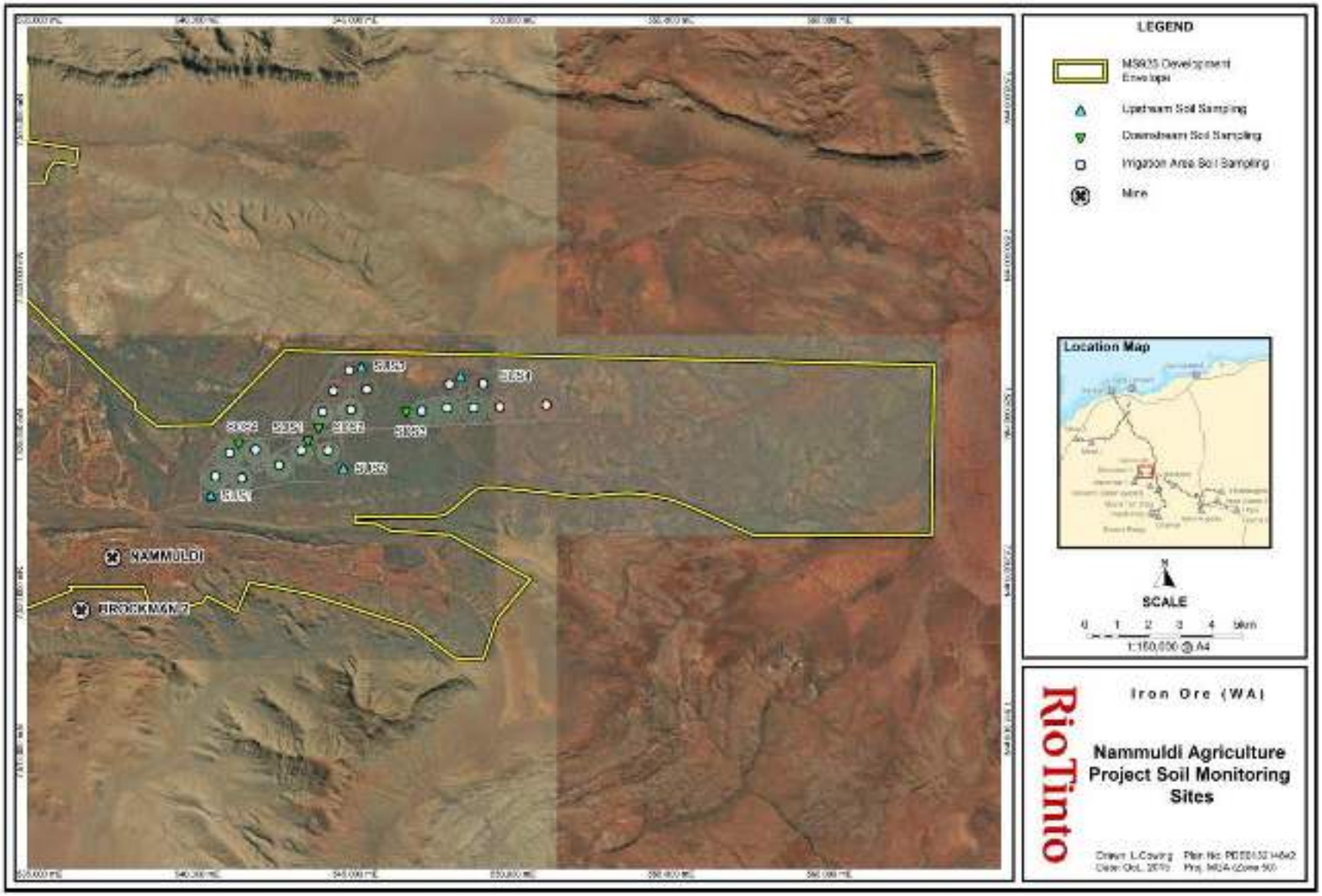

Figure 3-6 NAP soil sample locations (indicative only within irrigation areas)

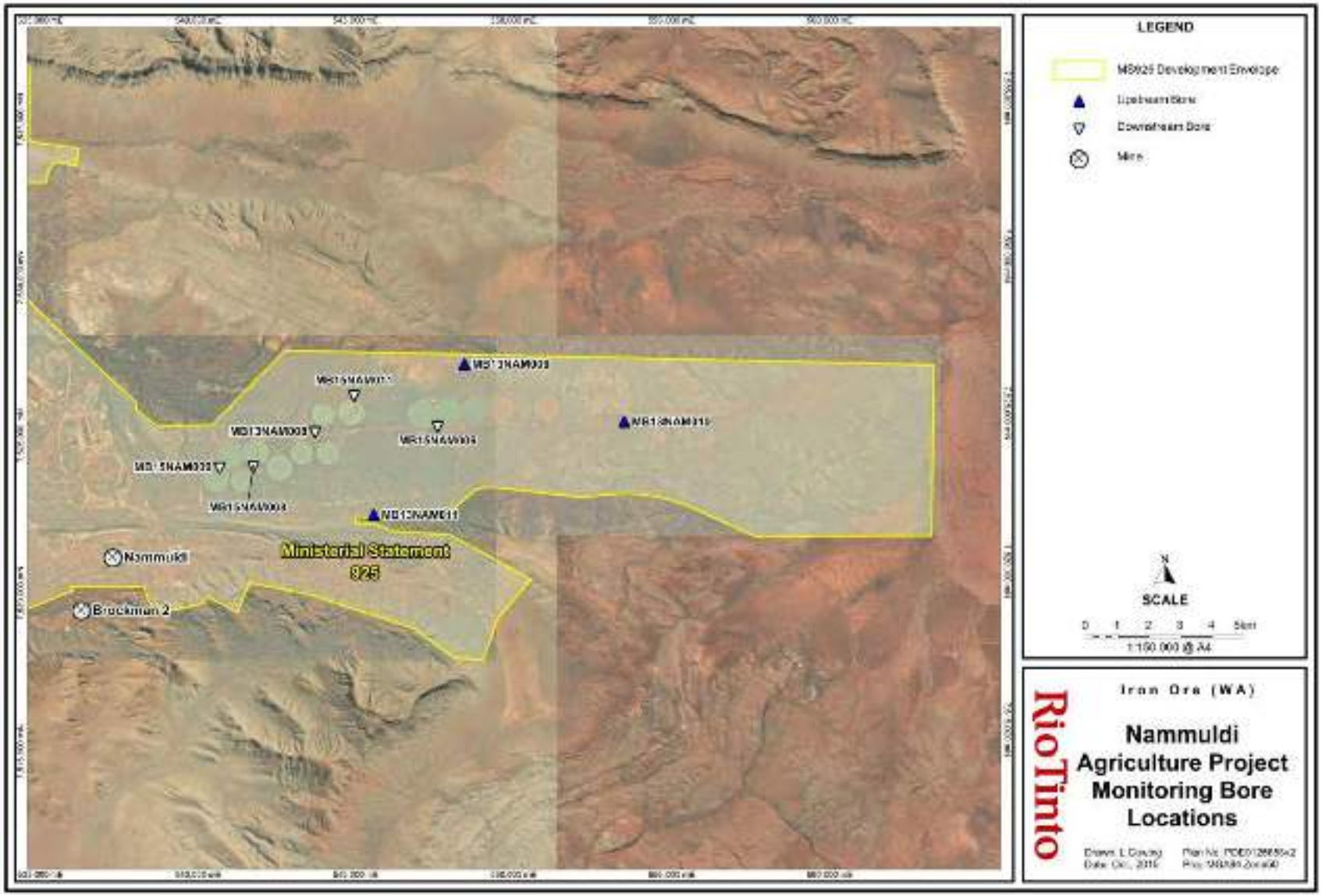

Figure 3-7 NAP groundwater bore locations (indicative and subject to change based on operability)

3.5 REPORTING PROVISIONS

The environmental outcome will be reported against trigger and threshold criteria (Table 1-1) for the calendar year in the annual compliance report for MS1246.

In the event of exceedance of any threshold criteria, the Proponent will notify the DWER in writing as stated in Tables 3-2 and 3-4.

4 ADAPTIVE MANAGEMENT AND REVIEW OF THE CONDITION EMP

The Proponent will implement adaptive management to learn from the implementation of mitigation measures, monitoring and evaluation against trigger and threshold criteria, to more effectively meet the environmental outcome. This approach recognises the dynamic nature of ecosystems and adapting management and monitoring based on learning and experience from past actions to meet the environmental outcome. Thus, implementation of the NAP EMP considers uncertainties in the ecosystem and will be evaluated against collected monitoring data on a recurrent basis in a process of continual improvement. Monitoring data will be analysed to evaluate environmental performance relative to trigger and threshold criteria and management adapted to meet environmental outcomes more effectively.

The NAP EMP will be subject to regular reviews and updates based on amendments to the NAP operation, monitoring audits, continuous improvement and changes in regulatory and corporate requirements. Relevant regulatory authorities will be consulted following significant changes to the NAP EMP.

5 REFERENCES

ANZECC/ARMCANZ 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The Guidelines, chapters 1-7. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Australian Premium Seeds (APS) 2015. Product information – Tolgar Rhodes Grass. [Online] Australian Premium Seed Pty Ltd., Wacol, Queensland. [online; http://www.apseeds.com.au/assets/brochures/tolgar_rhodes_grass.pdf], accessed 28 April 2015.

Canadian Council of Ministers of the Environment (CCME) 2015, Canadian Environmental Quality Guidelines and Summary Table, [online; http:/ceqg-rcqe.ccme.ca/], accessed 28 April 2015.

Department of Agriculture and Food 2011. Declared Plants in Western Australia. [online; http://www.agric.wa.gov.au/PC_93088.html?s=1360062146,Topic=PC_93079], accessed viewed 20 April 2011.

Department of Environment and Conservation (DEC) 2011. DEC Pilbara Weed Assessment. [online; http://www.dec.wa.gov.au/component/option,com_docman/task,doc_details/gid,5015/Itemid,99999999/] accessed 17 January 2011.

Department of Environment and Regulation (DER) 2010. Assessment levels for Soil, Sediment and Water. Contaminated Sites Management Series.

Department of Water (DoW) 2006. Nutrient and Irrigation Management Plans: Water quality protection note 33 [online; http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/DOE_ADMIN/GUIDELINE_REPOSITORY/NUTRIENT.PDF]

Halpern Glick Maunsell 1999. Nammuldi/Silvergrass Soils, Vegetation and Flora Survey, unpublished report for Hammersely Iron Pty Ltd. (RTIO-HSE-0108966).

Mattiske Consulting Pty Ltd. (Mattiske) 2011. Flora and Vegetation Survey of the Greater Nammuldi Irrigated Agriculture Survey Area, unpublished report for Rio Tinto (RTIO-HSE-0114959).

Moore G 2001. Soilguide. A handbook for understanding and managing agricultural soils. Agriculture Western Australia Bulleting No. 4343.

Rio Tinto 2014. Greater Nammuldi Closure Plan, unpublished report (RTIO-HSE-0181030).

United States Environmental Protection Agency (USEPA) 2015. National Recommended Water Quality Criteria. <http:/water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm> accessed 28 April 2015.

Wetland Research and Management (WRM) 2014a, Nammuldi Expansion Project – Hazard Analysis for Dewatering Discharge to Duck Creek. Unpublished report to Rio Tinto Iron Ore by Wetland Research & Management (RTIO-HSE-0240130).

Wetland Research and Management (WRM) 2014b, Nammuldi-Silvergrass Project – Interim Operational Water Quality Guidelines for Dewatering Discharge: Revision 2014. Unpublished report to Rio Tinto Iron Ore by Wetland Research & Management (RTIO-HSE-0240129).

Appendix 1 Implementation conditions (MS1246) of the Nammuldi Agriculture Project and section condition addressed in this EMP.

Obligation Number	Obligation	Section addressed in the NAP EMP
B7 Water Quality and Quantity (Irrigated Agriculture Area)		
B7-1	The proponent shall ensure that any irrigation water runoff from the agricultural pivot cells does not exceed whichever is greater of the following: 1. the default trigger for the protection of marine and freshwater ecosystems as per the Australian and New Zealand Environmental and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ (2000)) *Australia Water Quality Guidelines for Fresh and Marine Waters* and its updates; or 2. baseline levels of the receiving environment for the criteria measured under the Australian and New Zealand Environmental and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ (2000)) *Australian Water Quality Guidelines for Fresh and Marine Waters* and its updates.	3.1.1.2 Tables 3.3 and 3.4
B7-2	The proponent shall ensure that changes to hydrological regime, specifically soil saturation, related to the establishment of irrigated pivot cells do not disturb the environment beyond a 30 m buffer around the agricultural pivot cells.	
B7-3	The proponent shall ensure that irrigation water quality is consistent with the requirements for irrigation water as per the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000, *Australian Water Quality Guidelines for Fresh and Marine Waters* and its updates, or take such other in situ measures as approved by the CEO, to prevent the accumulation of toxicants within the soil profile, and to prevent the degradation of soil structure due to sodicity and excessive salinity.	
B7-4	The proponent shall monitor the changes to the hydrological regime, specifically soil saturation, as well as the quality of any run-off from the agricultural pivot cells which enters surface water within the boundary of the Nammuldi-Silvergrass approved proposal area to determine if the requirements of Conditions B7-1 and B7-2 are met. This monitoring is to be carried out using methods detailed in the Nammuldi Agriculture Environmental Management Plan, June 2012, and any subsequent approved revisions, prepared for this proposal and to the satisfaction of the CEO.	
B7-5	The proponent shall commence the water quality and soil saturation monitoring required by condition B74 at least one (1) month prior to the commencement of irrigation.	Baseline monitoring commenced August 2013
B7-6	In the event that monitoring required by condition B7-4 indicates that the requirements of conditions B7-1 and B7-2 are not being met: 1. the proponent shall report such findings to the CEO within twenty-one (21) days, or as otherwise agreed in writing by the CEO of the decline in water quality being identified; 2. the proponent shall provide evidence to the CEO which allows determination of the cause of the decline in water quality; 3. if a decline in water quality is determined by the CEO to be a result of activities undertaken in implementing the proposal, the	3.5

	proponent shall submit to the CEO actions to be taken to remediate the decline in water quality within twenty-one (21) days, or as otherwise agreed in writing by the CEO of the determination being made; and 4. the proponent shall implement the actions to remediate the decline in water quality required by condition B7-6(3) upon approval of the CEO and shall continue to implement such actions until such time as the CEO determines that the remedial actions may cease.	
B9 Management of Introduced Crop Species		
B9-1(1)	The proponent shall demonstrate that the selected crop species does not have the potential to become an invasive weed.	Risk assessment completed, reports submitted to OEPA for *C. gayana* 13 December 2013, for *A. sativa* 18 December 2014 and for *M. sativa* 29 January 2015.
B9-1(2)	To verify that the requirements of condition 9.1 are being met, prior to cultivation, the proponent shall prepare a report to the satisfaction of the CEO on advice of the DBCA which: 1. identifies crop species considered for the Nammuldi Irrigated Area shown in Figure 4 (*of MS1246*). 2. provides evidence based on at least two surveys (one conducted during the wet season and one during the dry season), in a similar environment, that the selected crop species does not have the potential to become invasive; and 3. proposes the crop species to be cultivated.	
B9-2	The proponent shall only plant the selected crop species following receipt of a notice in writing from the CEO that the crop species is acceptable.	OEPA approval received 30 December 2013 for *C. gayana* and 9 March 2015 for *A. sativa* and *M. sativa*.
B9-3	The proponent shall implement the Nammuldi Agriculture Environmental Management Plan (June 202) approved by the CEO, that the acceptable crop species approved in conditions B9-2 does not spread beyond a 30 m buffer surrounding the agricultural pivot cells. The Plan shall include: 1. the location of monitoring sites, monitoring methodology and frequency of monitoring to demonstrate that the acceptable crop species approved in condition B9-2 has not spread; 2. proposed management measures to prevent the propagation and spread of the acceptable crop species approved in condition B9-2 beyond a 30 m buffer surrounding the pivot cells; 3. identification of criteria to measure invasive spread of crop species; and 4. identification of trigger levels and management actions to be implemented should the criteria identified in condition 9-3(2) be exceeded.	3.1.1.1 Tables 3.1 and 3.2
B9-4	The proponent shall implement the monitoring and management plan required by condition 9-3 and any subsequent revisions approved by the CEO within the Irrigated Agriculture Area shown in Figure prior to crop propagules arriving on site.	Baseline monitoring commenced August 2013 Ongoing
B9-5	In the event that the results of monitoring required by condition B9-4 show that over five consecutive years there has been no spread of crop species beyond the indirect impact areas, the proponent may revise the frequency of monitoring required by condition B9-4, as approved by the CEO.	Not required at this stage

B9-6	In the event that monitoring required by condition B9-5 indicates that the requirements of conditions B9-1 and B9-3 are not being met: 1. the proponent shall report such findings to the CEO within twenty-one (21) days of the spread of crop species being identified; 2. the proponent shall provide evidence to the CEO which allows determination of the cause of the spread of crop species; 3. if determined by the CEO to be a result of activities undertaken in implementing the proposal, the proponent shall submit to the CEO within twenty-one (21) days, or as otherwise agreed in writing by the CEO of the determination being made, actions to be taken to remediate the spread of crop species,	3.5
B9-7	The proponent shall implement the actions required by condition 9(3) to control and eradicate the spread of crop species upon approval of the CEO and shall continue to implement such actions until such time as the CEO determines that the remedial actions may cease.	3.5

Appendix 2 NAP design and site information

The location of the NAP was selected based on its current pastoral land use (Hamersley Station), capability to support irrigated agriculture and its proximity to existing infrastructure and resources, including power, road access, communications and water supply. The site is also flat and not located near any significant (named) creek lines or sensitive vegetation.

Site design

The NAP, as referred and approved by MS925 and superseded by MS1246, incorporates up to forty 50 ha pivots seeded/planted with a crop and irrigated according to soil moisture and plant requirements. Introduced crop species that the Proponent plans to sow at NAP include (but not limited to) *Chloris gayana,* (Rhodes Grass), *Avena sativa* (Oats) and *Medicago sativa* (Lucerne). During June 2014, the first 9 pivots were sown to *C. gayana,* in May 2015 a further 6 pivots were sown to *A. sativa* and in July/August 2015 two pivots were sown to *M. sativa*.

As a result of stakeholder comments from the OEPA and the Department of Parks and Wildlife (**Parks and Wildlife**), and experience in implementation of the Hamersley Agriculture Project (**HAP**) (also on Hamersley Station), the Proponent amended the design of the NAP to include the following:

- Construction of a 5m wide cleared access track around the perimeter of each pivot to:
    - enable access to monitor the development of the crop across a greater area of each pivot and inform the timing of harvesting – in particular this assists in identifying the stages of flowering and seed set;
    - enable access and improve visibility and therefore detection of a) any stoloniferous spread or germinations from the irrigated area; b) water runoff that may have transported seed off the pivot; and/or c) any germination of seed off the pivot; and
    - improve the ease of control of any escapees.
- Modification of the end gun pattern to reduce the volume of irrigation water that reports to surrounding topographic low areas. End gun sprays will not be used to irrigate introduced crops at the NAP.
- Placement of native vegetation stockpiles around the downslope side and in drainage lines downstream of the pivots to assist in trapping any water-borne crop seed in surface runoff.
- Inclusion of an additional native vegetation area around the perimeter of the pivots. These may be irrigated in future to enhance the production of local provenance native seed for use in rehabilitation.

Fertiliser requirements

Total annual nutrient requirement for crop species under irrigation was formulated in order to optimise production, water use and reduce the risk of over fertilising. This information was developed in conjunction with the Department of Agriculture and Food WA (**DAFWA**) and specialist consultants.

Fertiliser application rates are calculated based on the quality and volume of crop to be grown. Estimation of volume of crop helps to define the volume of nutrients which will be removed during harvest. The primary nutrients required are nitrogen, potassium, phosphorus and trace elements. Fertiliser is to be delivered to site and applied as soon as possible after delivery.

Since sowing of the NAP in 2014, the applied fertiliser has been dosed into the water delivery line for the nutrient requirements of the crops. After observing production during this time, it has been highlighted that this method of applying nutrients is technically demanding and does not always achieve optimal results. A risk assessment completed in late 2014 noted that to change the fertiliser application methodology to granular application at regular intervals would not increase the environmental risk. Therefore, commencing from early 2015 a combination of liquid and granular fertiliser has been used to significantly improve matching fertiliser addition to crop species needs, nutrient uptake, and operability and decrease nutrient runoff risks associated with environmental and safety risks.

Soils and hydrology

The dominant soil types at Nammuldi-Silvergrass are coherent, loamy soils with weak pedologic development and a uniform texture (Halpern Glick Maunsell 1999). Soil type "Um 5.52" is a shallow, coherent and porous loamy soil occurring on the lower slopes of hills and stony undulating plains. The "A" horizon is 75 – 100 cm depth, with dark red to red sandy clay loam and a stony, hard setting surface and a low to high coarse fraction. This soil type has a low salinity, low nutrient levels and is slightly acidic.

Groundwater generally flows from east to west along the Nammuldi valley. Groundwater levels are approximately 40 m below the surface, corresponding to 590 m AHD in the east of the valley.

The NAP is located within the Duck Creek and Caves Creek regional catchments. Caves Creek extends 50 km west of the NAP and eventually drains into Duck Creek approximately 35 km west of the Silvergrass mine site. Like all major rivers in the Pilbara, Duck Creek and Caves Creek are ephemeral and flow only occasionally, generally following heavy rain. However, both creek systems contain a number of groundwater fed springs, including Palm Springs located approximately 30 km downstream of the Silvergrass site, which deliver water to sections of the creek all year round, maintaining local pools. There are no permanent pools in the vicinity of the NAP and the closest semi-permanent pools are approximately 15 km downstream.

The agriculture pivots are not located in high energy creek channels or drainage lines, therefore all natural drainage features of the site will be maintained. The 30 m indirect impact area of uncleared vegetation around agriculture pivots will prevent exposure outside of the area to applied water and nutrients and to minimise the potential for erosion to occur (Department of Water (DoW) 2006).

Flora and Vegetation

The majority of vegetation types and flora species recorded within the NAP area are considered to be representative of the Pilbara bioregion. A total of thirteen vegetation communities were defined for the NAP and can be broadly classified as representing four major groups: Low Acacia Woodlands, Triodia Hummock grasslands, Tussock grasslands, and Drainage line vegetation (Mattiske 2011). The majority of vegetation communities were rated as in "Very Good" to "Pristine" condition with two species of conservation significance recorded in the area including:

• *Vigna* sp. central (M.E. Trudgen 1626) (Department of Environment and Conservation (**DEC**) Priority 2)

• *Goodenia nuda* (DEC Priority 4)

No Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) were observed.

A total of 8 introduced (exotic) taxa were recorded within the NAP area during baseline surveys (Mattiske 2011). At the time of the survey, none of these were Declared Plant species pursuant to section 37 of the Agricultural and Related Resources Protection Act 1976 according to the Western Australian Department of Agriculture and Food (2011). Three of these species were rated as having a high ecological impact and a high risk rating according to the Pilbara Weed Assessment (DEC 2011). These were *Cenchrus ciliaris* (Buffel Grass), *Cenchrus setiger* (Birdwood Grass) and *Vachellia farnesiana* (Mimosa Bush).

Appendix 3 Baseline data for soil, surface and ground water quality

Table A3-1: Nammuldi-Silvergrass SSTVs and NAP baseline and background (upstream) surface water quality data

Units are in mg/L except where shown

	Nammuldi-Silvergrass SSTV	NAP baseline 2014	NAP background 2014 to 2015
Al	0.055	0.05	0.084
As	0.013	<0.001	<0.001
Cl	326	2	4
Cr	0.001	0.0012	<0.0005
Cu	0.0019	0.0050	0.0038
EC (uS/cm)	1830	84	113
Fe	0.3	0.04	0.2
Mg	94	2.4	3.2
N_NH_3	0.90	0.05	2.30
N_NO_2	0.04	0.01	0.12
N_NO_3 (eutrophication)	0.04	0.55	4.60
NO_3 (toxicity)	11	2.44	20.38
N_total	0.6	1.4	7.4
P_total	0.02	0.36	0.71
SO_4_S	170	2.4	4.5
Se	0.005	<0.001	<0.001
TDS_calc	1100	52	62
TSS	5	470	110
Zn	0.017	0.044	0.084
pH	7.5-8.5	6.6-8.4	4.4-7.8

Table A3-2: NAP baseline groundwater quality (sampled on 4 occasions between 2013 and 2014)

Units are in mg/L except where shown

	Maximum	Minimum
EC (uS/cm)	3400	
Hardness ($CaCO_3$)	800	
pH	8.1	7.6
Al	0.032	
As	0.001	
Ca	120	
Cl	620	
Cr	0.007	
Cu	0.005	
Fe	0.18	
Mg	130	
NO_3	30	
NO_2	0.55	
N_NH_3	0.78	
N_NO_3	6.7	
N_NO_2	0.17	
N_total	7.3	
P_total	1.6	
K	48	
Se	0.01	
Na	440	
SO_4	520	
Zn	0.12	

Table A3-3: NAP baseline soil quality data (sampled in 2013)

Units are in mg/kg except where shown

soil depth	0-10 cm		10-20 cm	
	max	min	max	min
EC (uS/cm 1:5)	114		83	
pH ($CaCl_2$)	6.0	4.1	5.7	4.2
N_NH_3	8		2	
N_NO_3	45		34	
N_total (%)	1000		700	
P_total	292		229	
S	18		17.8	
DTPA Cu	3.16		3.87	
DTPA Fe	19.22		13.23	
DTPA Zn	2.03		0.94	
Exchangeable Al (meq/100g)	0.52		0.52	
Exchangeable Ca (meq/100g)	9.24		7.20	
Exchangeable Mg (meq/100g)	2.11		2.18	
Exchangeable K (meq/100g)	1.13		0.89	
Exchangeable Na (meq/100g)	0.08		0.09	
ESP(%)	1.89		1.70	
Cl	33.7		18.7	
K (nitric)	672		677	
As	43.2		32.3	
Cr	576		564	
Se	1.50		1.05	