2 Bulwer Street
PERTH WA 6000
T: (+61) 8 9227 2600
F (+61) 8 9227 2699
www.auroraenvironmental.com.au

SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA BEACH

Prepared For:	Nufarm Australia Ltd
	PO Box 198 KWINANA WA 6167
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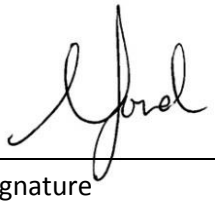
Author:	Nicole Ford Project Environmental Scientist		24 August 2018
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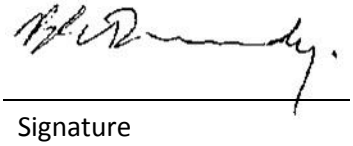
Reviewed by:	Brad Dermody Associate Environmental Scientist (Director)		24 August 2018
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ACM	Asbestos Containing Material
AHD	Australian Height Datum
CDD	Chlorinated dibenzo-p-dioxins
CDF	Chlorinated dibenzo-p-furans
CIK	Chemical Industries Kwinana
COPC	Chemical of Potential Concern
DER	Department of Environment Regulation
DWER	Department of Water and Environmental Regulation
DSI	Detailed Site Investigation
EMP	Environmental Management Plan
GME	Groundwater Monitoring Event
HRA	Health Risk Assessment
HSL	Health Screening Level
IBC	Intermediate Bulk Container
JSA	Job Safety Analysis
KPI	Key Performance Indicator
m bgl	metres below ground level
NPUG	Non-Potable Use Groundwater
OCP	Organochlorine Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PPE	Personal Protective Equipment
PSI	Preliminary Site Investigation
QA	Quality Assurance
QC	Quality Control
SAP	Sampling and Analysis Plan
SBS	Safety Bay Sand
SMP	Site Management Plan
SSP	Site Safety Plan
SWMS	Safe Work Method Statement
TRH	Total Recoverable Hydrocarbons

1 INTRODUCTION

Aurora Environmental (Aurora) was engaged by Nufarm Australia Ltd (Nufarm) to update the Sub-surface Management Plan (SMP) for Lot 51 Mason Road, Kwinana beach (the Site). Aurora has previously conducted a Preliminary Site Investigation (PSI), Detailed Site Investigation (DSI) over three stages, prepared a Preliminary Risk Assessment and completed a Chlorinated Phenol Groundwater Plume Investigation including a Plume Stability Assessment (PSA) (CyMod, 2017).

1.1 BACKGROUND

Nufarm operations at the Site comprise formulation, storage and distribution of agricultural chemicals. Operations are generally limited to the western portion of the Site which has been developed with the construction of numerous plant and storage buildings. The operational area is predominantly covered with asphalt hardstand.

The Site is classified by the Department of Water and Environmental Regulation (DWER), formerly the Department of Environment Regulation (DER), under the *Contaminated Sites Act 2003* as "Possibly Contaminated – Investigation Required". Investigations conducted at the Site by Aurora and others have identified the presence of impacted soils within the operational area. Soils have been impacted by a variety of chemicals with different areas being impacted by different chemicals. It is considered that the majority of sources of impacts are related to historical practices (prior to Nufarm's acquisition of the Site in 1985) before the placement of hardstand which may have included uncontrolled filling, disposal of wastes to ground and inappropriate storage and handling of chemicals. A Health Risk Assessment (HRA) prepared by Coffey Environments (2011) and the Preliminary Risk Assessment (Aurora, 2015a) found that there were no unacceptable health risks posed by identified soil impacts, provided that there were no direct access/exposure. The hardstand over the operational area of the Site primarily fulfils this function. This document details the management controls required to ensure that impacted soils remain contained and if accessed, do not pose unacceptable health or environmental risks.

Groundwater beneath the Site is also known to be impacted by hydrocarbons and chlorinated phenol compounds and associated salts resulting from the breakdown of the chlorinated phenols. Like the soils, the impacts to groundwater have been assessed to not pose unacceptable health risks where there is no direct exposure and groundwater beneath the Site is not extracted.

1.2 OBJECTIVES

The objectives of this SMP were to:

1) describe the location and nature of sub-surface impacts at the Site (including soil and groundwater);
2) describe the physical measures to control access and potential exposure to sub-surface impacts by people conducting work at the Site;
3) provide management advice to prevent unacceptable risks to human health or the environment being realised if impacted soils or groundwater are brought to the surface;
4) provide practical and complete management in the context of Nufarm's planned ongoing operations at the Site;

5) include a plan to undertaken limited groundwater monitoring to assess groundwater quality and the stability of the plume with triggers for further actions if required; and

6) be satisfactory to the Contaminated Sites Auditor and the DWER when considering potential reclassification of the Site.

1.3 SCOPE OF WORK

This SMP comprises the following information.

- A summary of the Site, activities undertaken onsite and previous investigations.
- Identification of the duties and responsibilities of Site users in implementing the SMP.
- A plan to monitor groundwater and the stability of the plume with triggers for further actions (if required) for a defined period of time.
- Establishment of performance indicators to evaluate the effectiveness of the SMP in meeting its objectives and as a tool for monitoring areas of potential future SMP applicability.
- Identification of potential hazards associated with intrusive subsurface works that may intersect contamination so that appropriate safe working procedures and environmental management protocols can be developed and implemented.
- Suggested contingency measures in the instance that people are incidentally exposed to subsurface contamination.

2 BACKGROUND

2.1 SITE IDENTIFICATION AND GENERAL INFORMATION

Salient site identification features and general information are presented in Table A whist Figures 1 and 2 present the location and layout of the Site.

TABLE A: SITE IDENTIFICATION

ITEM	DETAILS
Certificate of Title (see Appendix 1)	Lot 51 on Diagram 46722, Volume 1505 Folio 166
Address	Lot 51 Mason Road, Kwinana Beach
Site Ownership	Nufarm Australia Ltd
Site Area	8.257 ha
Local Government	City of Kwinana
Zoning	General Industrial under Town Planning Scheme No. 2
Current Site Use	Agricultural chemical formulation, storage and distribution
Proposed Site Use	Agricultural chemical formulation, storage and distribution
Surrounding Land Uses	Light and heavy industrial
Classification under Contaminated Sites Act	Possibly Contaminated – Investigation Required
Contaminated Sites Auditor	Phillip Hitchcock – Australian Environmental Auditors

Nufarm's current operations at the Site are predominantly located in the western half of the Site. This portion of the Site is mainly covered with hardstand and is occupied with numerous plant and storage buildings. The Site's water treatment and infiltration systems are located along the southern site boundary. The eastern half of the Site is mainly vegetated with grasses and shrubs and has not been previously developed. The northeastern portion of the Site has been cleared and was previously used as a temporary laydown area (for structural steel and equipment not considered to potentially contaminate the Site) leased from Nufarm. The Site's main access is from Mason Rd, near the southwestern corner of the Site, with administration, gatehouse, ablutions, laboratory and break areas located nearby.

The Site is surrounded by industrial land in all directions. Rockingham Road runs along the southern boundary and is main road. Over Rockingham Road, various small to medium light industries occupy land. Larger industrial sites are located to the southwest (CSBP), to the west (Tronox and BP) and to the north (BOC gases). Mason Road to the west of the Site provides access to properties to the north and west. A railway corridor also runs north-south west of the Site between the Kwinana Beach area and the Fremantle Port. There are several key underground assets in the vicinity of the Site, including the Dampier to Bunbury Natural Gas Pipeline.

2.2 PURPOSE OF THIS MANAGEMENT PLAN

The overall management objective of this SMP is the protection of human health of people working on the Site during Nufarm's routine ongoing operations. As such, the key stakeholders include Nufarm management, employees and contractors.

This SMP has been prepared on the basis of management being required to mitigate potentially unacceptable health risks from the Preliminary Risk Assessment (Aurora, 2015a). Following the completion of the three DSI stages (Aurora, 2013, Aurora, 2015b and Aurora, 2016) and the Chlorinated Phenol Groundwater Plume Investigation Report (Aurora, 2017) including the PSA (CyMod, 2017) the Preliminary Risk Assessment completed by Aurora (Aurora, 2015a) is still considered to be applicable for the Site; no material changes have occurred that would affect the risk assessment or require it to be updated.

The SMP largely formalises existing management measures to demonstrate that these are consistent with existing guidance and suitable in the context of the Site's use and the identified impacts for protecting human health. The central approach to management of identified impacts outlined in this SMP is to short-circuit the source-pathway-receptor relationship by removing the pathway connection. Therefore successful implementation of this SMP will be demonstrated by the ongoing prevention of an exposure pathway to sub-surface impacts.

This SMP is a working document which sets out how that risk will be managed and provides a framework for integrating good risk management practice into the organisational structure and operations.

3 PREVIOUS ENVIRONMENTAL ASSESSMENTS

3.1 HEALTH RISK ASSESSMENT (HRA) COFFEY ENVIRONMENTS (2011)

The HRA concluded that previously identified soil and groundwater impacts on the Site are unlikely to represent an unacceptable risk to the health of current workers at the Site. Notably, the HRA included an assessment of risk from indirect exposure comprising vapour intrusion and possible indoor inhalation which did not identify any significant health risk issue. However, the potential for further and as yet undiscovered sources remained and as such, further risk assessment was recommended to be conducted on any additional sources, following their investigation.

3.2 PRELIMINARY SITE INVESTIGATION AND SAMPLING AND ANALYSIS PLAN (AURORA, 2012)

Analysis of previous soil investigations conducted by various other parties over a period of time, historical records, and documented interviews with personnel who worked on the Site identified some 26 potential sources of contamination across the site, with Chemicals of Potential Concern (COPC) being identified for each.

In order to adequately classify the contamination status of the site, further investigations into the nature of soil and groundwater quality were deemed necessary. In particular, 11 data gaps relating to environmental setting, sources, and pathways were identified with plans for further investigation in these areas included in a Sampling and Analysis Plan (SAP) as part of a staged DSI.

3.3 STAGE 1 DSI (AURORA, 2013)

The first stage of the DSI focused on shallow soil investigation, with investigation at 101 locations on the Site. Additionally, a GME utilising the existing network of onsite and offsite groundwater monitoring wells deemed to be suitably constructed was conducted.

The main findings of this first stage of this DSI are summarised below.

- Five key source areas of soil were identified (Area A to Area E) with various COPCs in each. These areas were defined by exceedance of Tier 1 assessment criteria, warranting further investigations.
- Asbestos Containing Material (ACM) was found in three locations, and given documented historical practices; it was assumed that previously disturbed soils may contain ACM.
- Impacts were primarily located in site operational areas, and given these impacts extended to groundwater beneath the site, it was concluded that the sources were predominantly derived from historical operations on site, prior to acquisition by Nufarm.
- Due to substantial hardstand cover across the site and the health and safety procedures in place, none of the identified soil impacts posed a significant health threat to personnel on Site.

As a result of these findings, the following recommendations were made:

- approaches to addressing the presence of chlorinated dibenzo-p-dioxins (CDD) and chlorinated dibenzo-p-furans (CDF) be evaluated to ensure additional investigations, management and/or remediation are conducted in such a way as to ensure potential health risks to human health are acceptable; and

- Nufarm maintains awareness of the potential for ACM to be present in soils across the Site. An Asbestos Management Plan (AMP) to ensure appropriate controls are in place has been developed and is included in Appendix 2.

3.4 STAGE 2 DSI (AURORA, 2015B)

The main focus of Stage 2 of the DSI was to further address data gaps previously identified by delineating the vertical and lateral extent of groundwater impacts resulting from historical site activities, as well as refining the assessment of risks posed to potential receptors from identified soil and groundwater impacts. This was subdivided into Stage 2A and Stage 2B.

Stage 2A comprised delineation of soil impacts identified in Stage 1 and assessment of groundwater quality from temporary sampling points for the purpose of designing an effective permanent groundwater monitoring well network. Stage 2B comprised installation of additional permanent groundwater network for the assessment of a shallow hydrocarbon plume and deeper chlorinated phenol plume.

Groundwater and shallow soil impacts were found to be at levels that do not pose unacceptable risks to human health and as such no immediate remediation was concluded to be required.

The main recommendations arising from the Stage 2 DSI included:

- installation of additional groundwater wells to further delineate the chlorinated phenol plume;
- further assessment of physical and chemical groundwater conditions to understand hydrogeological processes affecting the plume;
- further assessment of potential indoor air inhalation risks in the Synthesis 2 building;
- conducting additional groundwater monitoring approximately every six months to assess any seasonal changes in groundwater conditions and quality as well as plume stability/biodegradation; and
- the development of a sub-surface management plan for soils at the Site.

3.5 STAGE 3 DSI (AURORA, 2016)

The main focus of the Stage 3 DSI was to finish establishing a permanent tailored groundwater monitoring well network (the 'tailored network') which enabled a consistent, systematic approach to accurately monitoring the chlorinated phenol plume in groundwater. This objective was primarily achieved with the installation of four additional monitoring wells screened in the deep portion of the SBS aquifer and three monitoring wells installed into the upper section of the Tamala Limestone aquifer. The installation of groundwater monitoring wells to the east of the plume, however could not be completed due to access constraints. The plume extent to the east was therefore inferred from data obtained from SBS-D2.

Dioxin concentrations identified in three groundwater samples collected from SBS aquifer were very low and considered to be within the same order of magnitude. As samples were collected from locations on the Site as well as up hydraulic gradient and down hydraulic gradient, the results were considered to be representative of background levels. Further sampling for dioxins was recommended to verify these results.

Two rounds of groundwater data was collected from the network of six shallow screened SBS aquifer monitoring wells did not identify the presence of TRH or BTEXN concentrations. This data was considered to provide adequate confidence that the hydrocarbon plume in the shallow SBS aquifer has been delineated, is stable and no longer needs to be monitored. The hydrocarbon plume is not considered to pose a potentially unacceptable risk to human health or the environment where groundwater is not abstracted.

From the additional data obtained from the Tamala Limestone aquifer it appeared that there may be some seepage into the Tamala Limestone aquifer at or around a monitoring well located in the non-operational portion of the Nufarm Site due to the elevated concentration of chlorinated phenols present in the groundwater sample collected at this location. The low level of impact detected in other Tamala Limestone monitoring wells located further away from the Site suggests that the lateral extent of chlorinated phenols in the Tamala Limestone aquifer are largely understood, however further data from this location were required to confirm.

Two rounds of indoor air quality monitoring were completed in the Synthesis 2 building during the Stage 3 DSI. The results of the indoor air quality assessment indicate that concentrations of NEPM TRH fractions and BTEX compounds inside the Synthesis 2 Building are very low and do not pose an unacceptable heath risk. As a result it was concluded that there was no need to consider indoor air quality further.

Further groundwater investigation and assessment is recommended comprising:

- two additional GMEs, including further collection of data from TL6 and for dioxins in groundwater; and
- the completion of a PSA.

3.6 CHLORINATED PHENOL GROUNDWATER PLUME INVESTIGATION REPORT (AURORA, 2017)

The Chlorinated Phenol Groundwater Plume Investigation encompassed the following summarised scope of work.

- Two additional GMEs were completed of the tailored network between November 2014 and November 2016 to complement the previous two GMEs completed as part of the Stage 3 DSI (Aurora, 2016).
- A PSA completed by CyMod Systems (CyMod, 2017).

The main findings/conclusions following the completion and assessment of the four GMEs are summarised below.

- The plume is well delineated in the SBS aquifer both vertically and laterally, noting that the eastern extents have been inferred (using multiple lines of evidence) where investigation access was constrained.
- The plume extents in the Tamala Limestone aquifer are relatively well understood and it is considered that the installation of additional Tamala Limestone aquifer monitoring wells will not be beneficial given the high hydraulic conductivities and low risk to human health and the environment.

- Human health risks are considered to be low and acceptable where there is no direct contact, due to the low toxicity of chlorinated phenols and the industrial land use of the area. However, direct exposure requires management through restrictions on groundwater extraction and use to mitigate potential aesthetic issues and health risks.
- The plume is stable and has not moved in several decades, with only relatively minor variations observed over time.
- The PSA (CyMod, 2017) used groundwater data collected by Aurora between 2014 and 2016, and concluded that the similarity in spatial distribution in 1990 to that measured in 2016 strongly indicates that the plume in the SBS aquifer is effectively stable.
- Dioxin concentrations identified in groundwater at three locations were very low and considered to be within the same order of magnitude over two sampling rounds. As samples were collected from onsite as well as up hydraulic and down hydraulic gradient, the results were considered to be representative of background levels and no further dioxin assessment is considered to be warranted.

4 ENVIRONMENTAL SETTING

The environmental setting of the Site and its surrounds were initially described in the PSI and SAP (Aurora, 2012) as well as in Stages 1, 2 and 3 of the DSI (Aurora 2013, 2015b, 2016 and 2017). A summarised version of the environmental setting is presented below.

4.1 TOPOGRAPHY

Topography at the Site and its surrounds gently undulates with an elevation of 5-10 m Australian Height Datum (AHD) sloping upwards towards the eastern portion of the Site occupied by Nufarm.

4.2 GEOLOGY

The 1:50,000 Environmental Geology map sheet for Fremantle (Gozzard, 1983) indicates the Site's surface geology is characterised by the Quaternary-aged Safety Bay Sand. This unit is described as calcareous sand which comprises white, medium grained and well sorted, rounded quartz grains and shell debris which is of eolian origin. According to Davidson (1995), the Safety Bay Sand in the vicinity of the Site is underlain conformably by the Tamala Limestone. The Tamala Limestone is a variably lithified calcareous eolianite which appears as creamy yellow to light grey, moderately sorted fine to coarse grained, sub-angular to rounded quartz and fine to medium grained shell fragments (Davidson, 1995).

The reported thickness of the Safety Bay Sand beneath the Site ranges between 10m and 18m (CSIRO, 2005). ERM (2004) considered that the Safety Bay Sand is only 2m thick and is underlain by the Becher Sand (up to 16m thick), a unit with similar characteristics and appearance. Aurora identified that the most distinct differences between the SBS and Becher Sand Units was the colour and grainsize, with the SBS being pale cream to cream and being coarser grained and the Becher Sand being grey to dark grey and being finer grained.

Field observations during drilling activities over the three DSI stages have generally been consistent with the published data and historical reports. The primary difference was the presence of an aquitard. Aurora concluded, from information obtained through grain size analysis and a geophysical survey undertaken as part of the Stage 2 DSI, that the aquitard was considered too coarse to act as an effective aquitard between the SBS and Tamala Limestone aquifers. The aquitard was therefore referred to as a 'basal layer' as there is evidence that basal layer has limited the vertical migration of phenolic impacted groundwater and therefore is at least partially effective in the vicinity of the Site.

4.3 HYDROLOGY

Across the majority of the eastern portion of the Site where surfaces are unsealed, water will infiltrate the sandy soils readily without inundating the surface. On the western portion of the Site, stormwater is collected from sealed surfaces and managed through a dedicated system. Storm water is treated onsite prior to infiltration in a dedicated vegetated basin located on the southern site boundary. It is anticipated that a minor amount of stormwater will directly infiltrate the areas without sealed surfaces.

It is expected that surrounding sites will have a similar hydrological regime, with storm water captured from hard stand surfaces subject to onsite treatment and infiltration. Water is stored in ponds by Tronox and the Water Corporation's Kwinana Water Recycling Plant to the west of the Site and in the general vicinity of the groundwater plume emanating from the Site. These are understood

to be lined and maintained but these, along with other unidentified features including infiltration points, may affect groundwater by mounding of the water table locally if they leak.

4.4 HYDROGEOLOGY

A shallow unconfined aquifer is hosted by the SBS aquifer beneath the Site and its surrounds. The depth to groundwater of the SBS aquifer beneath the Site varies between approximately 3.5m and 4.5m below ground surface (bgs) largely in response to changes in surface topography. The groundwater surface for the SBS aquifer is shallower off-site to the west (ranging between 2 to 3mbgs) with groundwater flow being westward towards Cockburn Sound.

ERM (2004) discussed a southerly flow direction of the SBS aquifer immediately down hydraulic gradient of the Site. It was postulated by ERM that remnant depressions in the SBS may have affected lateral water flow. CSIRO (2005) considered that drawdown from extraction bores may have been responsible and reported a general north-northwest flow direction further down hydraulic gradient from the Site. CSIRO (2005) also discussed possible groundwater mounding beneath the Site as did WRC (1982) which also presented a plan showing groundwater elevations with steep gradients reducing away from the central portion of the then CIK operational area on the Site. The cause of this mounding is understood to be the release of large volumes of waste process water into the main CIK soak, i.e. the main source of groundwater impact. This was understood to be a 10m x 17m hole extending to the water table. The shape and extent of the mounding was discussed in further detail and compared to the extent of the chlorinated phenol plume in the Stage 2 DSI (Aurora, 2015b).

The thin silty basal layer identified to underlie the Safety Bay Sand at approximately 15 to 20mbgs has been considered historically to act as an aquitard to the Tamala Limestone. The Tamala Limestone aquifer which underlies this thin layer has been found to have historical elevations lower than the SBS aquifer (CSIRO, 2005). This indicates a possible downward vertical flow direction of the SBS aquifer into the Tamala Limestone aquifer, depending on connectivity and retardation of the aquitard and differences in hydraulic gradient. In the Tamala Limestone aquifer, the CyMod PSA (CyMod, 2017) concludes that the plume is an attenuated version of the plume in the SBS aquifer, with the aquitard ('basal layer') between the two aquifers limiting downward movement of phenol contaminated groundwater. The downward seepage of phenolic impacted groundwater is diluted in the Tamala Limestone aquifer, where groundwater velocities are higher due to the higher average hydraulic conductivity of the aquifer. The shape of the plume is consistent with the direction of regional groundwater flow, as well as the effects of possible abstraction to the south-west, which results in groundwater flow towards the abstraction bore(s).

The inferred groundwater contours based on gauging data is predominantly to the west across the Site, with a north-west vector towards the Toxfree Site (Aurora, 2016). The westerly inferred groundwater flow correlates with the November 2015 GME (GME2) data (Aurora, 2015b) and other historical investigations. Variability in groundwater flow directions was evident during the gauging events for both the SBS and Tamala Limestone aquifers. It is considered likely that the aquifers are influenced by external factors such as recharge effects (in the SBS aquifer) and extraction effects (predominantly in the Tamala Limestone aquifer) (Aurora, 2017). It is considered likely that the Tamala Limestone aquifer ultimately discharges to Cockburn Sound based on review of the 1:50,000 Environmental Geology map sheet for Fremantle (Gozzard, 1983).

5 CONCEPTUAL SITE MODEL

5.1 SOURCES (SUB-SURFACE IMPACTS)

5.1.1 Soil

Following the Stage 2 DSI (Aurora, 2015b), the 10 remaining source areas from the original 26 identified in the PSI and SAP (Aurora, 2012) were consolidated into four areas of impact (Areas A, B, C and D shown on Figure 2). Further investigation into each area has provided more confident delineation. These areas are generally located where former production, storage or waste disposal operations occurred. The status of each area and the relevant COPCs are described below on the basis of identified concentrations of these chemicals exceeding Tier 1 assessment criteria.

5.1.1.1 Area A

Known CDD/CDF impacts in soil are presented as Area A on Figure 3. The potential areas of impact have been inferred from an evaluation of potential source areas of CDD/CDF in the PSI and from previous investigation analytical results. It is proposed that any soil to be disposed offsite from these areas is assessed for dioxin concentrations.

5.1.1.2 Area B

The COPCs for Area B were identified as trifluralin, chlorinated phenols and OCPs. Delineation efforts have identified appreciably lower concentrations in soil around the originally described Area B extents (Aurora, 2013). The inferred extent of Area B is presented on Figure 4.

5.1.1.3 Area C

The COPCs for Area C have been identified as toluene, ethyl benzene, xylenes, Polycyclic Aromatic Hydrocarbons (PAHs) and chlorinated phenols. Shallow soil impact has been delineated to the north, east and south of Area C. Samples from a soil bore location in the Bulk Fill Out Store containing elevated concentration of chlorinated phenols and pungent olfactory impact indicate an additional source for Area C beneath the Bulk Fill Out Store. This location overlaps with Area D (due to hydrocarbon impact) and may just be representative of impact from this area. Concentrations of petroleum hydrocarbons and principally toluene and xylenes in soil below the Synthesis 2 Building have been identified at concentrations in excess of applicable Health Screening Levels (HSLs) with further vapour assessment currently being undertaken. The inferred extent of Area C is presented on Figure 5.

5.1.1.4 Area D

Area D is associated with the presence of Total Recoverable Hydrocarbons (TRH) in soil (as TRH C_{10}-C_{36}) believed to have originated diesel fuel leaks and/or spills from the boiler house. Area D is well delineated to the west and some portions of the south. It is not well delineated to the north due to the presence of buildings. However, there is reasonable confidence that the maximum or near maximum TRH C_{10}-C_{36} concentrations within Area D have been identified and investigated. The inferred extent of Area D is presented on Figure 6.

5.1.1.5 Asbestos

In addition to the COPCs identified in soil in Areas A-D at the Site, it is considered likely that soils across the operational area of the Site and possibly in the non-operational area in the northern

portion of the Site contain varying levels of asbestos in the form of ACM. ACM fragments have been discovered in small (60 mm) diameter soil bores drilled at several locations and within a stockpile of spoil removed from a shallow on-site excavation. Given this, the presence of many buildings onsite constructed from ACM products, their age and the number of alterations and repairs which may have occurred over time, ACM may possibly be present in soil beneath hardstand at numerous locations across the operational area. Known locations where ACM fragments have been observed are presented on Figure 7. An AMP is presented in Appendix 2 which provides management options if ACM fragments in soil are encountered onsite.

5.1.2 Groundwater

Groundwater originating from the onsite operational area has been identified as impacted by petroleum hydrocarbons and chlorinated phenols.

5.1.2.1 Hydrocarbon Plume

The petroleum hydrocarbon groundwater impacts are inferred to be related to a wide spread spill around the boiler house, which historically impacted soils and subsequently groundwater. The petroleum hydrocarbon plume has apparently migrated beyond the Nufarm site boundaries but is delineated based on a samples from group of monitoring wells (SBS-S1 to SBS-S6 on Figure 8) surrounding the Site not containing detectable hydrocarbon concentrations.

Groundwater samples were collected from long screened onsite monitoring well NB8 on two occasions; September 2012 and June 2016. Direct comparison of the data is limited as the original sample collected in September 2012 was analysed for Total Petroleum Hydrocarbons (TPH) rather than Total Recoverable Hydrocarbons (TRH). However, given the relatively low hydrocarbon concentrations overall, the hydrocarbon plume margin is expected to be not far from the Nufarm Site boundary with Mason Road and Rockingham Road as previously inferred and therefore unlikely to be present beneath any offsite buildings.

5.1.2.2 Chlorinated Phenol Plume

It is considered most likely that the majority of chlorinated phenol groundwater impacts originated from the disposal of liquid waste in the former CIK soak. The impacts have migrated vertically through the SBS aquifer to its base and to a limited degree have impacted the underlying Tamala Limestone aquifer (noting no groundwater samples have been collected in Tamala Limestone aquifer directly beneath the former CIK soak due to the risk that a monitoring well in this location may act as a preferred migration pathway between the two aquifers). The plume in the SBS aquifer extends laterally in a radial pattern away from the location of the former CIK infiltration basin, probably due to mounding of the water table caused by the disposal of wastewater. The plume geometry has also been influenced by the regional groundwater flow direction to the south-west.

The establishment of a permanent tailored groundwater monitoring well network (the 'tailored network') was achieved in the Stage 3 DSI (see Figure 9). This enabled a consistent, systematic approach to accurately monitor the plume.

The most recent inferred extent of the chlorinated phenol plume in the SBS aquifer is shown in Figure 10.

5.2 RECEPTORS

5.2.1 Human Health

Onsite

It is understood that Nufarm will continue, in the foreseeable future, to use the Site for the manufacture, storage and distribution of agricultural chemicals. As such adult full-time workers are the most sensitive potential onsite receptors.

A distinction (in terms of the likely extent of exposure) can be made between people who work inside commercial buildings constructed as slab-on-grade and people who conduct sub-surface maintenance activities, such as in service trenches up to 1 m deep or those which produce spoil from the sub-surface.

Offsite

Adult full-time workers at nearby industrial sites affected by the extent of groundwater impacts are also identified as potentially sensitive receptors. There are various parcels of land considered to be affected.

Previously, it was considered that if impacted groundwater migrates from the Site and discharges into Cockburn Sound, then recreational users and consumers of fish may be additional potentially sensitive receptors. However, given that the plume's extent down gradient and to the west of the Site is delineated, that the plume was considered stable (Aurora, 2016, Aurora, 2017 and CyMod, 2017) and is located approximately 1.5km from Cockburn Sound, these receptor types are not likely to manifest. Subsequent groundwater monitoring data and the PSA further supports this finding.

It is understood that groundwater extraction wells in the vicinity of the Site are only used as sources of industrial process water and not for other more sensitive uses (e.g. drinking water and irrigation). If groundwater is extracted for industrial use from within the plume or near the plume's extent from the nominated affected parcels of land, further consideration of management or assessment of risks may be required for these parcels of land. It is not currently understood if groundwater is extracted from neighbouring parcels of land, however it is known that some are affected by other groundwater plumes, classified as contaminated and may have restrictions on groundwater use.

5.2.2 Environment

The aquatic ecology of Cockburn Sound was considered to be the only environmental receptor for possible contamination from the Site in the PSI (Aurora, 2012). Now that groundwater impacts in the SBS aquifer down gradient and to the west of Site have been delineated and the plume is currently considered stable, the aquatic ecology of Cockburn Sound is no longer considered to be a potential receptor.

There is no ecology within the operational area of the Site. The non-operational area of the Site (in the eastern portion) is generally well vegetated with native flora (albeit some of it degraded and with weedy species) and is expected to support ecology to some degree. It is understood that there is no specific protection requirements for this vegetation. Notwithstanding this, the identified shallow soil impacts are limited to the operational area and on this basis, the ecology in the non-operational area of the Site is not considered a sensitive ecological receptor to potential contamination.

5.2.3 Environmental Value

The *Environmental Protection Act 1986* and subsequently the *Contaminated Sites Act 2003* define environmental value as:

- a beneficial use (including public benefit, public amenity, public safety, public health or aesthetic enjoyment); or
- an ecosystem health condition (including maintenance of ecological structure, ecological function or ecological process).

Impacts to soils identified in the operational area of the Site are not considered to represent loss of environment value in terms of the above definition beyond the Site's development for heavy industrial land use.

In terms of groundwater impacts, the only beneficial use potentially affected is the extraction of groundwater for the use as industrial (process) water. It is noted that chlorinated phenols are highly odorous and even low concentrations can pose aesthetic impacts and which may affect individuals differently. Groundwater highly impacted with chlorinated phenols generally also contains high levels of total dissolved solids (TDS) which may influence suitability of groundwater for industrial process use.

5.3 PATHWAYS

Onsite workers may potentially be exposed to the identified COPCs in soils via direct pathways (i.e. ingestion and dermal contact) and indirect pathways (i.e. inhalation of vapours and dust) where these soils are not contained beneath hardstand. Onsite workers conducting subsurface works may be at risk of direct exposure to COPCs in soil and asbestos where ACM is disturbed and asbestos fibres become airborne.

Direct exposure to impacted groundwater is not considered very likely given all onsite groundwater extraction is limited to sampling. As previously described, indirect exposure to COPCs in groundwater is not considered significant.

Management of the pathways, more specifically ensuring that exposure pathways are not realised, is the focus of this SMP.

5.4 POTENTIAL EXPOSURE TO SUB-SURFACE IMPACTS

The types of scenarios where onsite receptors may be exposed to identified sub-surface impacts include (but may not necessarily be limited to):

- reconfiguration of hardstand surface for example replacement of bitumen, construction of new car parking area;
- removal of underground infrastructure such as a storage tank, drainage sump, building footings, etc;
- relevelling of the Site's surface;
- installation of additional or re-alignment underground services
- construction of foundations and floor slabs for new structures and buildings; and

- extraction of groundwater for another purpose other than sampling.

These sorts of activities and others which may result in impacted soils (from Areas A, B, C or D) being exposed or groundwater being brought to the surface will be managed as described in the following sections.

It is understood that Nufarm has a standard operating procedure for groundwater sampling for licence monitoring.

A schematic conceptual site model is presented on Figure 11.

6 GROUNDWATER MONITORING PROGRAM

6.1 MONITORING PROGRAM

Two additional GMEs will be implemented over a biennial period (once every two years) for two events (i.e. two GMEs over four years). The GMEs will be undertaken in October / November and will include ten selected monitoring wells screened in the deep portion of the SBS aquifer comprising; SBS-D3, SBS-D4, TI8, TI16, TI49, SBS-D5, SBS-D15, SBS-D2, SBS-D14 and SBS-D12 and three selected monitoring wells screened at the top of the Tamala Limestone aquifer comprising TL2, TL5 and TL6. These monitoring wells are located on the fringe of the plume and will therefore provide an indication if there is any unexpected expansion of the plume.

Table B below summarises the two GMEs for the limited groundwater monitoring program. The proposed groundwater monitoring wells to be sampled are shown in Figure 12.

TABLE B: PROPOSED GROUNDWATER MONITORING PROGRAM SUMMARY

EVENT	WELLS	ANALYTES	TIMEFRAME
GME 1	Deep Screened SBS Monitoring Wells: SBS-D3, SBS-D4, TI8, TI16, TI49, SBS-D5, SBS-D15, SBS-D2, SBS-D14 and SBS-D12 Tamala Limestone Monitoring Wells: TL2, TL5 and TL6	Speciated phenols and major ions	October / November 2018
GME 2	Deep Screened SBS Monitoring Wells: SBS-D3, SBS-D4, TI8, TI16, TI49, SBS-D5, SBS-D15, SBS-D2, SBS-D14 and SBS-D12 Tamala Limestone Monitoring Wells: TL2, TL5 and TL6		October / November 2020

6.2 METHODOLOGY

The following methodology will be adopted for the groundwater monitoring program and implemented by a qualified environmental consultant.

6.2.1 Groundwater Elevation Gauging

Groundwater monitoring wells will be gauged using a water level meter to record the depth to water and total well depth. The water level meter will be cleaned between locations using phosphate-free detergent and scheme water. The groundwater gauging measurements will be recorded on standard field sheets.

6.2.2 Sample Collection

Groundwater samples will be collected using low-flow sampling techniques, whereby water is pumped into a flow-through cell connected to a recently-calibrated water quality meter. The pumping rate will be such that less than 10cm drawdown occurs, providing confidence that groundwater is drawn discretely from the aquifer adjacent to the pump inlet.

Given that chlorinated phenols are denser than water, the screens for the selected monitoring wells are positioned at the base of the SBS aquifer and are only 1m long, with the exception of the three

deep SBS aquifer monitoring wells located at Tronox (Ti8, Ti16 and Ti49). The screen lengths for these monitoring wells are 3m long; however they are still positioned at the base of the SBS aquifer. The Tamala Limestone monitoring well screens are also 1m long and positioned between 2m and 3m below the basal layer. The pump inlet will be set at the approximate half-way point of the screened interval for each monitoring well.

Water quality parameters (temperature, pH, dissolved oxygen, oxidation/reduction potential (Eh) and electrical conductivity, EC) will be measured approximately every two minutes during purging. Once conditions stabilised (i.e. three consecutive parameter measurements within approximately 10%) indicating confidence that a representative sample can be taken, groundwater samples will be collected. Excess groundwater will be placed back down the monitoring well it was purged from.

Samples will be collected into laboratory supplied bottles and stored on ice in insulated coolers until transport to the primary laboratory under chain of custody.

Dedicated disposable tubing and low flow bladders will be used to reduce potential cross-contamination and samples will be collected directly into laboratory supplied containers. New nitrile gloves will be worn at each groundwater monitoring location.

6.2.3 Laboratory Analysis

All groundwater samples will be analysed for speciated phenols, as these are the identified COPCs, and major ions. All samples will be submitted to and analysed by laboratories which are National Association of Testing Authorities (NATA) accredited for the analyses to be performed.

6.2.4 Quality Assurance and Quality Control

Table C below outlines the Quality Assurances (QA) procedures and Quality Control (QC) indicators to be used.

TABLE C: SUMMARY OF QA PROCEDURES AND QC INDICATORS

QA PROCEDURE OR QC INDICATOR	DESCRIPTION
Record Keeping	Detailed records of all field activities including, sample collection, water description will be maintained on standard field and purge sheets. Equipment calibration certificates will be retained.
Sample Labelling	Unique sample numbers will be used for each groundwater sample to clearly specify the sample origin (source, date and sample type code), preservation techniques used and accepting custody of samples.
Chain of Custody	Chain of custody documentation will be used for all sample transfers. Custody forms to include sample numbers, description, sample date and signatures of persons transferring and accepting custody of the samples.
Sample Storage	Groundwater samples will be transferred in appropriate approved sampling containers with appropriate preservation as required and placed in cool storage prior to transfer to the laboratory.
Decontamination	Groundwater elevation measuring and water purging equipment used in the sampling process will be decontaminated between monitoring well locations (as required) using a phosphate free detergent followed by rinsing with potable water.

TABLE C: SUMMARY OF QA PROCEDURES AND QC INDICATORS

QA PROCEDURE OR QC INDICATOR	DESCRIPTION
Sample Duplicates and Blanks	In addition to the analysis of primary samples, one field duplicate and one triplicate sample will be collected per GME. Rinsate samples will also be collected from the water level meter (following decontamination) to assess the thoroughness of the decontamination procedures and potential for cross-contamination between equipment (once per day). A combined field and transport blank sample will be collected (once per day). Equipment rinsate and field/transport blank samples will be analysed for COPCs.
Laboratory Internal QA/QC	Where appropriate, the laboratory will use internal standards to check the consistency of the analytical processes (e.g. injection volumes, instrument sensitivity and retention times for chromatographic systems). Sample splits and method validation processes will be used as part of their internal QA/QC procedures. The laboratories and the methods employed for sample analysis will be NATA accredited.

6.3 ASSESSMENT CRITERIA

Groundwater assessment criteria nominated for both GMEs are consistent with those previously adopted. These comprise:

- Non-potable use groundwater guideline (NPUG) values (DER, 2014); and
- Marine water assessment levels (DER, 2014).

Although identified potential receptors are industrial workers and are unlikely to have direct exposure to groundwater, the DoH Non-Potable Groundwater Use (NPUG) criteria (DoH, 2014) were adopted as human health assessment criteria, as presented in the 'Assessment and Management of Contaminated Sites (DER, 2014).

To continue to assess potential risks to the ecology of Cockburn Sound (identified sensitive ecological receptor), the DWER's marine waters assessment levels (DER, 2014) following "Australian Water Quality Guidelines for Fresh and Marine Waters" ANZECC & ARMCANZ (2000), trigger values for slightly moderately disturbed ecosystems were adopted, as presented in the 'Assessment and Management of Contaminated Sites (DER, 2014).

6.4 REPORTING AND CONSULTATION

A single groundwater monitoring report will be prepared following the completion of the second GME. This report will be submitted to the Auditor for review and subsequently to the DWER.

If chlorinated phenol concentrations are less than, equal to or only marginally above the laboratory limit of reporting (LOR) for all monitoring wells, with the exception of SBS-D2 (where detectable concentrations are expected given its position within the plume but close to its margin) then it will be considered that the plume remains stable. If however, detections of chlorinated phenols are identified significantly above the laboratory LOR and/or previous results for any particular location, then the plume's stability will be reconsidered. This might include further investigation or assessment in consultation with the Contaminated Sites Auditor.

The appropriate contingency actions are difficult to predict, as they would be based on the measured result and the affected monitoring well and possibly other factors. However, the following contingency actions are considered appropriate and the SMP has been updated to include them:

- Verify the monitoring result(s) by resampling if necessary.
- Investigate possible reasons why the plume behaviour is varying from what was predicted e.g. a new extraction bore / production bore, changes in stormwater management in the vicinity of the plume, resulting in a change in stormwater recharge rates, dewatering associated with construction works or an unusual rainfall event or weather pattern.
- Sampling of nearby monitoring well/s to determine the spatial extent of any change in plume behaviour.
- On completion of any additional investigation and confirmation that the anomalous result is repeatable and of significance, then further modelling may be undertaken or additional monitoring wells installed.
- Finally, if warranted, appropriate management measures will be developed and implemented if there is evidence that the detected change in the plume is resulting in unacceptable environmental risks.

7 OVERARCHING MANAGEMENT PROCESSES

7.1 ROLES AND RESPONSIBILITIES

As the application of this SMP is restricted to the Site, Nufarm will have sole responsibility for its implementation. Table D below outlines roles and responsibilities.

TABLE D: ROLES AND RESPONSIBILITIES

ROLE	RESPONSIBILITY
Nufarm Manufacturing Manager	All site operations and oversight of the SMP including ensuring appropriate resources and process are in place, more specifically: • maintain control over access to the site and ensure no unauthorised access to site; • maintain records and documentation relevant to the SMP; • ensure any personnel required to conduct sub-surface activities are provided with current version of SMP and are appropriately briefed; • training and awareness for all relevant internal staff, contractors and site visitors; • ensure SMP performance is monitored against nominated Key Performance Indicators (KPIs) (see Table E) and consider rectification works where required; • inform surrounding land occupiers/owners of any disruptions that may impact them and respond to any queries or complaints; and • approve consultants and contractors for undertaking sub-surface works and ensure task specific documentation (e.g. Job Safety Analysis (JSA)/ Safe Work Method Statement (SWMS)) is reviewed and approved prior to works commencing.
Onsite workers - Nufarm staff	All workers have a duty of care to take reasonable care for their own safety and that of others who may be affected by their acts or omissions. The responsibilities of all staff (permanent, temporary, casual and contract) include: • ensuring they are familiar with the SMP for their work area as necessary; • compliance with policies, procedures and reasonable instructions by Nufarm; • refrain from any act which could put them or any other occupant at risk of exposure to impacted soils or groundwater; and • report any incident involving the disturbance of impacted soil or groundwater to the responsible person for the area.
Onsite workers - contractors/consultants	Consultants and contractors are to work under the specific directions of the relevant Nufarm Manager for their work on site. They should read all information provided to them in relation to impacted soil and groundwater at the Site. Specific duties also include: • compliance with policies, procedures and reasonable instructions by Nufarm; • refrain from any act which could put them or any other occupant at risk of exposure to impacted soils or groundwater; • provide task-specific JSA or SWMS documents which incorporate SMP control procedures; • Use the Nufarm permit to work system for any excavation work involving the potential disturbance of impacted soils; and • report any incident involving the disturbance of impacted soil or groundwater to the responsible person for the area.

7.2 NOTIFICATION

The Nufarm Manufacturing Manager or other delegated internal manager is to be notified of any proposed or planned work activities which may disturb impacted soils or groundwater. It is expected that this will occur through Nufarm's permit to work system.

Any non-compliances or unexpected finds are to be reported to the Nufarm Manufacturing manager, so that corrective actions can be considered.

7.3 SITE INDUCTION

Prior to intrusive works on the site, all personnel involved with site works shall be given the Nufarm site induction by a suitably qualified person and read and understood this SMP and the associated risks at the Site.

7.4 PLAN PREPARATION

Prior to any potentially disturbing activities the method of works shall be pre-planned so that risks to people and the environment are minimised. Appropriate site preparations will include, at a minimum, the development of a JSA/SWMS by the person responsible for implementing the potentially disturbing activities. Depending on the scale of potentially disturbing activities, it may also be appropriate for a task-specific Environmental Management Plan (EMP) to be prepared in consultation with a qualified environmental consultant. Although not expected, remediation of soil and/or groundwater would be an example of works requiring a specific EMP.

The JSA or SWMS shall discuss the objectives and order of the potentially disturbing activities, the equipment and procedures to be adopted and the potential for exposure by documenting the locations, depths and volumes of the activities. The JSA/SWMS shall also document the minimum requirements of appropriate personal protective equipment (PPE) for personnel undertaking the potentially disturbing activities (see Section 8.2) and include adequate dust control measures (see Section 7.3.1). All personnel involved in the potentially disturbing activities should read, understand and sign the JSA/SWMS or relevant safety documentation prior to undertaking activities.

Any EMP should also include a JSA/SWMS and in addition, soil, water, waste, noise and dust management, monitoring and emergency response actions.

The above documents should be consistent with the minimum requirements for hazard controls described in Section 8 of this SMP.

7.5 KEY PERFORMANCE INDICATORS

To evaluate the effectiveness of the SMP in meeting its objectives and as a tool for monitoring future areas of potential SMP applicability, Table E outlines KPIs that shall be integrated into activities involving excavations. Consistent with roles and responsibilities outlined in Section 7.1, it is the responsibility of Nufarm to ensure the SMP performance is monitored against the nominated KPIs.

TABLE E: KEY PERFORMANCE INDICATORS

NO.	PERFORMANCE INDICATOR	VERIFICATION	RESPONSIBLE PARTY
1.	All site visitors, contractors and workers involved in excavation work are aware of the SMP and associated procedures.	Maintain record of visitor notifications. No incidents of uncontrolled exposure.	Nufarm
2.	No unregistered subsurface disturbances within the site boundaries (excludes nature strip bordering the Site to the west and south).	Maintain a subsurface disturbance register. No incidents or uncontrolled exposure.	Nufarm
3.	Appropriate health and safety precautions are taken in performing works.	Task-specific JSA/SWMS and safety documents are prepared and incorporate SMP control procedures. PPE is being worn as required.	Approved contractors/consultants
4.	Area of disturbance is appropriately reinstated and a 'clean' surface cover is maintained.	Recorded inspection of surface cover reinstatement / compaction. Inspection of surface cover by Nufarm and spot treatments as required.	Approved contractor Nufarm
5.	Appropriate environmental management precautions are taken in performing works.	Where warranted, a task specific EMP is prepared and incorporates SMP control procedures. No environmental incidents (see below).	Approved contractor/consultant (Expert advice shall be sought where environmental monitoring is required)
6.	No unacceptable discharges or emissions or other environmental incidents*.	Qualitatively verified through an inspection of the works during and at the completion of works. In some cases environmental monitoring may be used to evaluate the performance of this KPI, as prescribed in the SMP. Record any community complaints.	Approved contractor/consultant (Expert advice shall be sought where environmental monitoring is required).
7.	If any works detailed in Section 7.4 (or the like) are required, works to be undertaken in accordance with the SMP. All surplus contaminated soil appropriately disposed of in accordance with the SMP and air monitoring is undertaken as necessary (see Section 8.6).	Provision of waste transfer and disposal dockets or other verification documentation as applicable.	Approved contractor/consultant (Expert advice shall be sought where off-site disposal of contaminated material is required).
8.	SMP remains suitable to the needs of subsurface disturbance work and Site conditions.	Works are implemented in accordance with the SMP. SMP is updated as necessary.	Nufarm (Expert advice shall be sought where the SMP requires updating).

**Examples of an unacceptable discharge or emission at this site may include visible dust extending beyond site boundaries, uncontrolled off-site disposal of contaminated soil, or an unacceptable discharge or emission determined by other qualitative and/or quantitative means.*

7.6 CONTINGENCIES

With the presence of identified soil and groundwater impacts in mind, the following constitute an incident whereby actions may be required to prevent exposure and valuable information can be obtained through the process of reporting and investigation, and then used to reduce future risk:

- uncontrolled disturbance, stockpiling or disposal of impacted soils;
- dust emissions or sediment runoff from impacted soils;
- discharge of impacted groundwater either on the Site or across site boundary; or
- other non-conformance with a requirement of the SMP.

Incidents of the nature listed immediately above must be reported to the Nufarm Manufacturing Manager as soon as possible in order to:

- isolate and contain the area, where necessary, to prevent spread of and exposure to impacted media;
- conduct an investigation into the causes;
- determine what immediate actions are necessary; and
- make recommendations for improvements to prevent similar or related incidents.

The minimum environmental incident response measures are summarised in Table F. Additional corrective actions may be necessary depending on the exact nature of the incident.

TABLE F: INCIDENT RESPONSE MEASURES

INCIDENT	RESPONSE
Unregistered subsurface disturbance occurs.	1. Stop work immediately. 2. Where the SMP control measures are confirmed as applicable, ensure such control measures are implemented prior to proceeding with works. 3. Document the unregistered subsurface disturbance through the completion of a report to Nufarm manager and identify and rectify root cause factors.
Identification of unexpected contamination or type of contamination.	1. Stop work immediately. 2. Obtain advice from the relevant Nufarm manager prior to proceeding with works. 3. Document the subsurface condition inconsistency through amendment of this SMP.
Subsurface contamination becomes incidentally exposed.	1. Notify the relevant Nufarm manager. 2. Engage a Contractor (if deemed necessary) to repair the area of subsurface contamination in accordance with the SMP. 3. An assessment should be undertaken to identify why subsurface contamination has become exposed and the root cause rectified.
Non-conformance with SMP control measures.	1. Stop work immediately. Confirm worker is aware of the SMP and its requirements. 2. Ensure worker completes work in accordance with the SMP or engage an alternative Contractor to complete works. 3. In consultation with the relevant Nufarm manager, identify whether additional work is necessary as a result of the non-conformance. 4. Undertake an assessment to identify why the SMP non-conformance occurred and identify whether SMP improvement is warranted.

TABLE F: INCIDENT RESPONSE MEASURES

INCIDENT	RESPONSE
Unacceptable site emission/discharge event*	1. Stop work immediately and contain site discharge or emission where possible. 2. Where the site emission or discharge represents an immediate and significant environmental hazard, immediately notify the relevant emergency departments. 3. Document the unacceptable emission/discharge through the completion of a report to the Nufarm Manufacturing Manager. 4. Undertake an assessment to identify why the SMP non-conformance occurred and identify whether SMP improvement is warranted.
The SMP does not appear to address the type of work proposed (and associated contamination risks) or other subsurface restrictions that may arise.	1. Notify the relevant Nufarm manager for advice prior to completing the works. Task-specific procedures may need to be developed and ultimately the SMP may need to be revised.
Community complaint	1. Document the community complaint through the completion of a report to the Nufarm Manufacturing Manager. 2. Investigate the community complaint and whether works are being completed in accordance with the SMP. 3. Undertake an assessment to identify why the community member(s) was distressed and identify whether SMP improvement is warranted.

** Examples of an unacceptable discharge or emission at this site may include visible dust extending beyond site boundaries, uncontrolled offsite disposal of contaminated soil, or an unacceptable discharge or emission determined by other qualitative and/or quantitative means.*

7.7 PERFORMANCE MONITORING AND REPORTING

The following minimum performance monitoring and reporting mechanisms should be implemented at the Site indefinitely:

- A register shall be maintained by Nufarm documenting visitor notifications, registration/induction of workers conducting subsurface works and any subsurface disturbance works that take place.
- All subsurface disturbance works shall be inspected by the relevant Nufarm manager to ensure site works are implemented in accordance with the SMP control measures.
- The SMP shall be updated to reflect any changes in the nature and extent of contamination in the subsurface and associated physical barriers and future revisions to the document shall be approved by a contaminated sites Auditor.
- All waste management documentation which may include for example waste transfer dockets and landfill receipts, shall be reviewed for completeness and consistency and retained on file.
- All environmental sampling and monitoring works, as applicable, shall be formally documented and a report provided to Nufarm and other stakeholders deemed relevant.
- Where an environmental incident occurs, a report shall be completed and lodged to the Nufarm Manufacturing Manager. Each incident should be investigated and where the control

measures defined in the SMP are found to be inadequate or no longer appropriate, the SMP shall be revised by the relevant Nufarm Manager.

The suitability and performance of the SMP against the nominated KPIs should be reviewed after a period of no more than five years following implementation by the relevant Nufarm Manager. The SMP may be revised earlier than this date if, for example, the SMP is found to not adequately address site conditions.

8 SPECIFIC MANAGEMENT CONTROLS

This section describes the management measures to control potential exposure and hazards to people and/or the environment from the identified sub-surface impacts.

8.1 WORK AREAS

The work area shall be cordoned-off if there is a risk to other onsite personnel from entering the site. As a minimum, unauthorised personnel must be restricted from entering the boundaries of the intrusive work area and any temporary stockpiles of contaminated soil where applicable. All barriers are to remain in place until intrusive works have been completed and all contaminated soil has been reinstated or removed off site and containment/capping has been completed. Where possible, the number of personnel working in an impacted area shall be kept to a minimum.

8.2 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

All personnel within the cordoned-off work site must wear the appropriate PPE as prescribed by the JSA and/or safety plan. It is envisaged that PPE will be worn in all situations where there is a potential risk of exposure to contaminated soil or groundwater. The typical minimum PPE requirements include:

- appropriate protective gloves;
- coveralls/long pants and long sleeved and shirt;
- safety glasses;
- high visibility clothing; and
- steel-toed boots.

8.3 MATERIAL HANDLING

The procedures listed below should be considered the minimum measures to be implemented during potentially disturbing works. Consideration should be given to further investigation of soils and additional measures on a case by case basis. It is emphasised that avoiding the disturbance of impacted sub-surface media is recommended as the primary control measure.

8.3.1 Soil

1. Careful removal of hardstand or overlying clean fill sand. Excavations should be designed to consider preventing the mixing of materials.
2. Stockpile impacted soils material separately to other materials on hardstand or heavy plastic so that all impacted soils can be managed later. If impacted soils are stored on surface soils, grass or other surfaces which they may become contaminated then it is recommended that these surfaces are also removed and then validated as clean.
3. Control dust from any stockpiles of impacted soils by covering with heavy plastic/tarpaulins for small stockpiles or lightly wetting down larger stockpiles and not allowing stockpile surfaces to dry out. It is recommended that a stockpile of impacted soils is not stored on the surface for longer than necessary and that if possible it should be removed from the surface on the same day it was created.

4. If impacted soils are to be removed and disposed offsite to landfill, then dust control measures during loading and transport should be implemented. The materials should be lightly wetted before and during loading. Loads should be securely covered with heavy plastic/tarpaulin.
5. Any surface water which may runoff stockpiles should be captured as it may entrain and transport COPCs on sediments. Sediments from the captured runoff should be filtered (and managed as if they contain asbestos unless laboratory analysis demonstrates they do not) before the water is removed.

8.3.2 Groundwater

Extracted groundwater should be immediately contained (e.g. in drums, IBCs, etc.) and not allowed to collect or run across the Site's surface. The container requirements will be dependent on the expected volume of groundwater to be extracted and so a suitable containment method should be planned prior to commencing work.

8.4 RE-INSTATEMENT OF HARDSTAND

The primary exposure control to impacted sub-surface soil is the presence of hardstand across the majority of the operational area of the Site. Hardstand materials should be replaced as soon as practicable following completion of sub-surface works. Hardstand re-instatement should utilise equivalent performing material as that was in place previously and constructed to avoid subsidence, cracking or other failure which may lead to sub-surface materials being exposed. A suitable Nufarm representative should inspect the re-instatement of hardstand before signing off work completed either internally or approved contractors.

8.5 WASTE MANAGEMENT

8.5.1 Soil

Impacted soils that cannot or will not be replaced beneath the hardstand will either need to be safely stored at the Site or disposed of at an appropriately licenced landfill as waste under the DWER's "Landfill Waste Classifications and Waste Definitions 1996 (as amended 2018)" (DWER, 2018).

Given the impacted soils are known to contain elevated concentrations of COPCs and possibly asbestos, they will require transport and disposal as contaminated waste to an approved landfill facility under the appropriate regulatory requirements. Sampling and analysis of chemical testing of stockpiled material will need to be undertaken to determine the waste classification and establish an appropriate landfill facility. Results of chemical testing of materials across the Site conducted during the DSI provide an indication of likely waste classification, however further assessment will be required to quantify the bulk properties of the excavated material including potential for COPCs to leach from soils.

Sampling and analysis of surfaces which are not hardstand and used to store stockpiled material or will not be covered with hardstand should also be conducted to validate the complete removal of impacted soils. It is recommended that a qualified environmental consultant undertake sampling and analysis of impacted soils consistent with DWER guidelines.

8.5.2 Groundwater

Effluent disposal is to be undertaken in accordance with direction from the Nufarm Manufacturing Manager with options including treatment in onsite waste water system (preferred option) or offsite disposal. Offsite disposal will require sampling and analysis of the effluent and transport by a suitably licensed operator to a licensed facility approved to accept the effluent.

8.6 DUST AND AIR QUALITY

Dust control measures previously outlined above should be considered prior to any potentially disturbing works. Consideration should also be given to implementing dust and air quality monitoring, particularly for more complex-type works such as those (but not limited to):

- involving the disturbance of more than 100m^3 of impacted soils; or
- which will take longer than five days (or a period over which sub-surface soils may dry out and generate dust and affect people onsite or leave the Site).

A dust and air quality monitoring plan which is fit for purpose (using guidance such as by the DWER, 2011) should be prepared by a qualified environmental or occupational hygiene consultant if monitoring is considered required.

8.7 RESTRICTION ON GROUNDWATER EXTRACTION

Groundwater is not currently extracted from beneath the Site for any purpose other than for sampling for licence monitoring and contaminated site assessment. It is understood that this is not expected to change under Nufarm's tenure/operation of the Site. A restriction on the extraction of groundwater from beneath the Site and the affected sites is expected to be emplaced by the DWER during re-classification of the Site.

8.8 ASBESTOS MANAGEMENT PLAN

An AMP is presented in Appendix 2 of this SMP. The AMP offers guidance and management for when ACM is encountered in soil on the Site.

9 REFERENCES

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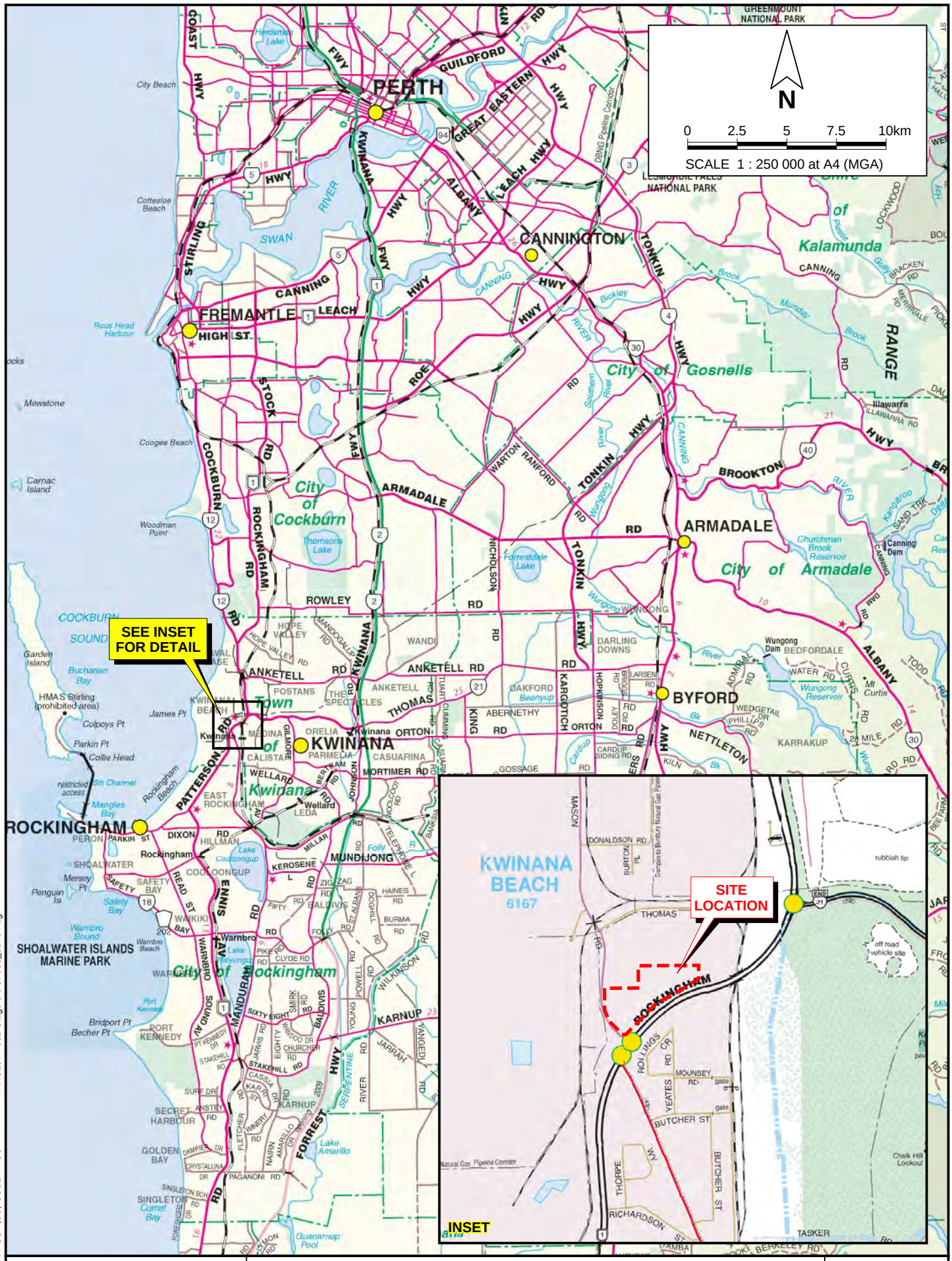
FIGURES



PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f01.dgn

Aurora environmental
ASSESS • ADVISE • APPLY

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

Figure 1

SITE LOCATION

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

N

0 10 20 30 40 50m

SCALE 1 : 1 500 at A3 (MGA)

304.500

112.110

67.330

170.990

23.603

150.25

91.13

112.248

COMPOUND No 1

COMPOUND No5

COMPOUND No6

NEW EFF. PLANT

LI-700 PLANT

DNPA PLANT

SYNTHESIS 1 BUILDING

FORM 1

FORM 2

FLOWABLES

STEAM TRAYS

ELECTRICAL SUB STATION

BOILER ROOM

DEFLUORIDATION TREATMENT TANKS

E1

E2

E3

E4

E5

E6

EXISTING ROAD

STORE 9

POND

GATE 1

GATE 2

STORE 8

STORE 7

BULK FILL OUT STORE

GRANULATION

SYNTHESIS 2 BUILDING

STAFF AMENITIES

LABORATORY

STORE 6

POWDER PLANT

BULK HCL

ADMINISTRATION

STORE 2

MAIN GATE

PRODUCTION OFFICE

STORE 5 (CLASS 3.1)

FORKLIFT DEPOT

ELECTRICAL OFFICE

ENGINEERING OFFICE

SHED

WORKSHOP

STORE ONE BUILDING

STORE No 4

MASON ROAD

ROCKINGHAM ROAD TO PERTH

65.750

14.200

228.430

Nature strip in road reserve and crossing onto the site.

Legend

- Site Boundary
- Area A
- Area B
- Area C
- Area D

BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

Aurora environmental ASSESS • ADVISE • APPLY

Drawn: N. Ford | Date: 1 Aug 2018

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

SITE LAYOUT AND AREAS OF IDENTIFIED ONSITE SOIL IMPACT

Figure 2

Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f02.dgn

N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A3 (MGA)

ANALYTES

Dioxins
TCDD 2,3,7,8-TCDD (level pg/g)

SB113 | Depth 0.5-1.0 | TCDD 2
SB109 | Depth 0.5-1.0 | TCDD 2.5
SB54 | Depth 0.0-0.5 | TCDD 20
SB55 | Depth 0.0-0.5 | TCDD 19
SB56 | Depth 0.0-0.5 | TCDD 58
SB108 | Depth 0.5-1.0 | TCDD 3.8
SB104 | Depth 2.5-3.0 | TCDD 16
SB94 | Depth 3.0-3.5 | TCDD 110
SB105 | Depth 0.5-1.0 | TCDD 520
SB107 | Depth 0-0.5 | TCDD 95
SB59 | Depth 0.5-1.0 | TCDD 41
SB103 | Depth 0.5-1.0 | TCDD 0.38
SB106 | Depth 0-0.5 | TCDD 37
SB41 | Depth 0.0-0.5 | TCDD 28

DSS2 DSS1 SB113 SB109 SB54 SB55 SB56 SB108 SB104 SB105 SB107 SB59 SB103 SB106 SB41

170.990 23.603 112.248 91.13 80.350 85.720 228.430

GATE GATE

POND

COMPOUND No 1 COMPOUND No5 COMPOUND No6 NEW EFF. PLANT SYNTHESIS 1 BUILDING DNPA PLANT ISOTAINER LOCATION DMA 2 DMA 3

FORM 1 FORM 2 FLOWABLES STEAM TRAYS ELECTRICAL SUB STATION BOILER ROOM DEEP WELL BORE

E1 E2 E3 E4 E5 E6 EFFLUENT TREATMENT TANKS

STORE 9 EXISTING ROAD

STAFF AMENITIES BULK FILL OUT GRANULATION STORE 7 SYNTHESIS 2 BUILDING

STORE 5 (CLASS 3.1) STORE 8

LABORATORY STORE 6 POWDER PLANT BULK HCL STORE 2 FORKLIFT DEPOT

ELECTRICAL OFFICE ENGINEERING OFFICE SHED WORKSHOP MAIN GATE PRODUCTION OFFICE STORE ONE BUILDING STORE No 4

DAOR NOSAW

ROCKINGHAM ROAD TO PERTH

Legend

- Site Boundary
- Area A
- Soil Bore Location (Completed July 2012)
- Soil Bore Location (Completed January 2014)
- Concentration Exceeds USEPA RSL Industrial Soil Guideline
- 23 Concentration Exceeds Laboratory LOR
- Stage 1 DSI Soil Bore - Concentration Exceeds US EPA RSL
- Analysed for Dioxins - Results not above US EPA RSL

BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

Aurora environmental ASSESS • ADVISE • APPLY

Drawn: N. Ford | Date: 1 Aug 2018

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

AREA A - DIOXIN ANALYTICAL RESULTS EXCEEDING ADOPTED ASSESSMENT CRITERIA

Figure 3

Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f03.dgn

N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A3 (MGA)

ANALYTES (mg/kg)

Herbicides

Tri	Trifluralin
Sim	Simazine

Chlorinated Phenols

CP	Chlorinated Phenols

OCPs

Ald	Aldrin
Die	Dieldrin
DDE	Dichlorodiphenyldichloroethylene
DDD	Dichlorodiphenyldichloroethane
DDT	dichlorodiphenyltrichloroethane

SB97					
Depth	Tri	Die	DDE	DDD	DDT
0.0-0.5	270	1.5	14	8.4	7
1.0-1.5	3.3	-	-	-	-

SB119								
Depth	Ald	Die	DDE	DDD	DDT	Tri	Sim	CP
3.0-3.5	0.28	0.24	0.76	3	<0.01	<0.2	ND	<LOR
3.9-4.0*	0.05	0.1	0.79	0.03	<0.01	<0.2	ND	<LOR

SB110								
Depth	Ald	Die	DDE	DDD	DDT	Tri	Sim	CP
0.0-0.5	<0.01	<0.01	<0.01	<0.01	<0.01	0.2	<0.1	<LOR
0.5-1.0	<0.01	<0.01	<0.01	<0.01	<0.01	0.2	-	-

SB104								
Depth	Ald	Die	DDE	DDD	DDT	Tri	Sim	CP
3.5-4.0*	0.03	0.11	0.04	0.33	0.07	<0.2	-	<LOR

SB98					
Depth	Tri	Die	DDE	DDD	DDT
0.0-0.5	23	0.8	4.1	0.6	<1
2.5-3.0	1.9	-	-	-	-

SB1			
Depth	Tri	Ald	Die
0.5-1.0	0.9	430	9.1
1.5-2.0	<0.4	14	4

SB99					
Depth	Tri	Die	DDE	DDD	DDT
0.5-1.0	9	0.5	1	0.5	<1
3.0-3.5	0.5	-	-	-	-

SB94					
Depth	Tri	Die	DDE	DDD	DDT
0.5-1.0	290	<0.4	<0.4	<0.4	<1
3.0-3.5	530	0.5	0.9	11	5

SB111							
Depth	Ald	Die	DDE	DDD	DDT	Tri	Sim
0.0-0.5	<0.01	0.04	0.2	<0.01	<0.01	<0.1	<0.1

SB121		
Depth	CP	SVOC Screen
0.5-08	<LOR	<LOR

SB57					
Depth	Tri	Die	DDE	DDT	Sim
0.0-0.5	-	-	-	-	-
2.0-2.5	160	3.2	0.9	1.8	58

SB112							
Depth	Ald	Die	DDE	DDD	DDT	Tri	Sim
0.0-0.5	<0.01	0.02	0.09	<0.01	<0.01	<0.1	<0.1
0.5-1.0	<0.01	0.03	<0.01	<0.01	<0.01	<0.2	-

SB118		
Depth	CP	SVOC Screen
1.5-2.0	<LOR	<LOR
3.5-4.0*	<LOR	<LOR

SB2					
Depth	Tri	Die	DDE	DDD	DDT
0.0-0.5	580	-	<0.4	<0.4	<1
2.0-2.5	140	0.9	1.1	2.7	7

Legend

- Site Boundary
- Soil Bore Location (Completed July 2012)
- Soil Bore Location (Completed January 2014)
- Area B
- 0.4 Concentration Exceeds EIL
- 23 Concentration Exceeds HIL-F
- Concentration Exceeds US EPA RSL
- Concentration Exceeds Laboratory LOR
- ND Not Detected
- - Not Analysed
- * Soil Collected from Smear Zone (3.5-4.0).
- Stage 1 DSI Soil Bore - Concentration Exceeded Adopted Assessment Criteria
- Stage 2 DSI Soil Bore - Concentration Less than the Adopted Assessment Criteria

BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

Aurora environmental ASSESS • ADVISE • APPLY

Drawn: N. Ford | Date: 1 Aug 2018

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

AREA B - TRIFLURALIN, CHLORINATED PHENOLS & OCP ANALYTICAL RESULTS EXCEEDING ADOPTED ASSESSMENT CRITERIA

Figure 4

Job: NAU2011-002

NAU2011-002-Stage 3 DSI-080_bd-f04.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A3 (MGA)

ANALYTES (mg/kg)

TEX

T	Toluene
E	Ethylbenzene
X	Xylenes

Polycyclic Aromatic Hydrocarbons (PAHs)

Nap	Naphthalene
Pyr	Pyrene
Ant	Anthracene
Ben	Benzo(a)pyrene
Phe	Phenanthrene
Flu	Fluoranthene

Chlorinated Phenols

PCP	Pentachlorophenol PCP
2,4-Dic	2,4-Dichlorophenol
2,4,6-Tri	2,4,6-Trichlorophenol

SB121											
Depth	B	T	E	X	Nap	Pyr	Ant	Ben	Phe	Flu	PCP
0.5-0.8	<0.1	<0.1	<0.3	<0.3	<0.1	<0.2	<0.1	<0.2	<0.1	<0.1	<2

SB118											
Depth	B	T	E	X	Nap	Pyr	Ant	Ben	Phe	Flu	PCP
1.5-2.0	<0.1	<0.1	<0.1	<0.3	<0.1	<0.2	<0.1	<0.2	<0.1	<0.1	<2
3.5-4.0*	170	12	26	49	97	<0.2	<0.1	<0.2	<0.1	11	<2

SB115		
Depth	2,4 Di	2,4,6 Tri
1.0-1.5	2300	1700

SB34			
Depth	T	E	X
1.0-1.5	2200	80	370

SB58	
Depth	Nap
3.0-3.5	350

SB59										
Depth	T	E	X	Nap	Pyr	Ant	Ben	Phe	Flu	PCP
0.0-0.5	1100	31	130	5.1	2	0.6	-	2.8	1.7	<2
0.5-1.0	7500	810	3300	700	820	260	240	1200	950	89
1.0-1.5	2000	63	280	5.4	2.3	0.7	-	3	2.7	8
3.0-3.5	61	7	32	7.7	0.2	-	-	-	-	<2

SB103										
Depth	B	T	E	X	Nap	Pyr	Ant	Ben	Phe	Flu
1.5-2.0	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
3.5-4.0*	<0.1	<0.1	0.1	0.8	41	<0.1	<0.1	<0.2	6.5	<0.1

SB120											
Depth	B	T	E	X	Nap	Pyr	Ant	Ben	Phe	Flu	PCP
1.5-2.0	<0.1	<0.1	<0.1	<0.3	<0.1	<0.2	<0.1	<0.2	<0.1	<0.1	<2
3.7-4.0*	<0.1	190	21	52	25	<0.2	<0.1	<0.2	<0.1	3.7	<2

Legend

- Site Boundary
- Soil Bore Location (Completed July 2012)
- Soil Bore Location (Completed January 2014)
- Area C
- 0.4 Concentration Exceeds EIL
- Concentration Exceeds HIL-F
- Concentration Exceeds ESL (New Data)
- Concentration Exceeds US EPA RSL
- 23 Concentration Exceeds Laboratory LOR
- * Soil Collected from Smear Zone (3.5-4.0).
- Stage 1 DSI Soil Bore - Concentration Exceeded Adopted Assessment Criteria
- Stage 2 DSI Soil Bore - Concentration Less than the Adopted Assessment Criteria (with the exception of samples collected from the smear zone)

BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

Aurora environmental ASSESS • ADVISE • APPLY

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

AREA C - TEX, PAHS AND CHLORINATED PHENOLS ANALYTICAL RESULTS EXCEEDING ADOPTED ASSESSMENT CRITERIA

Figure 5

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-l05.dgn

N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A3 (MGA)

ANALYTES (mg/kg)

Total Recoverable Hydrocarbons

C_{10}-C_{14}	TRH C_{10}-C_{14}
C_{15}-C_{28}	TRH C_{15}-C_{28}
C_{29}-C_{36}	TRH C_{29}-C_{36}

SB50			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.5-1.0	<0.2	190	280
2.0-2.5	3500	8700	2100

SB51			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	400	6700	1800
2.5-3.0	580	4000	1200

SB52			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	10	670	480
2.0-2.5	<0.2	33	34

SB119			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
3.0-3.5*	46	1800	1020
3.9-4.0*	10000	28000	6400

SB117			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
3.5-4.0*	<0.2	<0.4	<0.4

SB30			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	1130	4860	920
2.5-3.0	2100	4900	610

SB33			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	61	1200	690
1.0-1.5	<0.2	180	140

SB102			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	20	1100	730
1.0-1.5	<0.2	<0.4	<0.4

SB32			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
1.5-2.0	100	1600	330
3.5-4.0*	8500	20000	3600

SB116			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
3.5-4.0*	<0.2	<0.4	<0.4

SB118			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
1.5-2.0	2	9	<0.4
3.5-4.0*	3000	7500	19400

SB87			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	<0.2	<0.4	<0.4
1.5-2.0	3400	12000	2000

SB115			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.0-0.5	4400	150	<0.4
3.5-4.0*	460	3200	671

SB121			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
0.5-0.8	<0.2	<0.4	<0.4

SB120			
Depth	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}
1.5-2.0	2	170	130
3.7-4.0	11000	27000	4500

Legend

- Site Boundary
- Soil Bore Location (Completed July 2012)
- Soil Bore Location (Completed January 2014)
- Area D
- 0.4 Concentration Exceeds EIL
- Concentration Exceeds HIL-F (assuming aromatic species)
- Concentration Exceeds HSL-D (New Data)
- Concentration Exceeds US EPA RSL
- 23 Concentration Exceeds Laboratory LOR
- * Soil Collected from Smear Zone (3.5-4.0).
- Stage 1 DSI Soil Bore - Concentration Exceeded Adopted Assessment Criteria
- Stage 2 DSI Soil Bore - Concentration Less than the Adopted Assessment Criteria (with the exception of samples collected from the smear zone)

BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

Aurora environmental ASSESS • ADVISE • APPLY

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

AREA D - TPH C_{10}-C_{36} - ANALYTICAL RESULTS EXCEEDING ADOPTED ASSESSMENT CRITERIA

Figure 6

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_pd-06.dgn

N

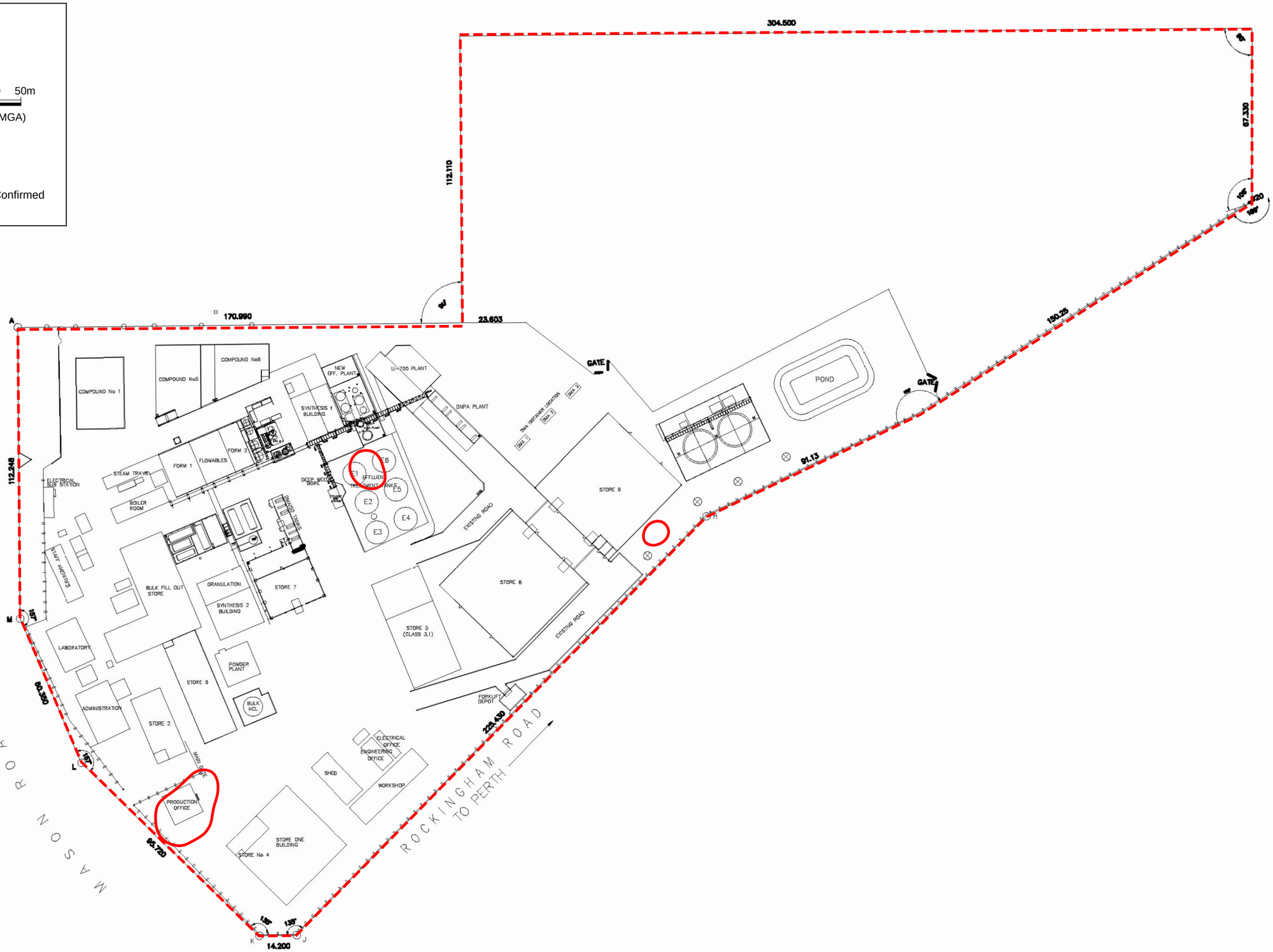
0 10 20 30 40 50m

SCALE 1 : 1 500 at A3 (MGA)

Legend

Site Boundary

Inferred Extents of Confirmed ACM in Fill/Spoil



BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-l07.dgn

Aurora environmental ASSESS • ADVISE • APPLY

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

Figure 7

INFERRED EXTENTS OF CONFIRMED ACM IN SOIL

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f08.dgn

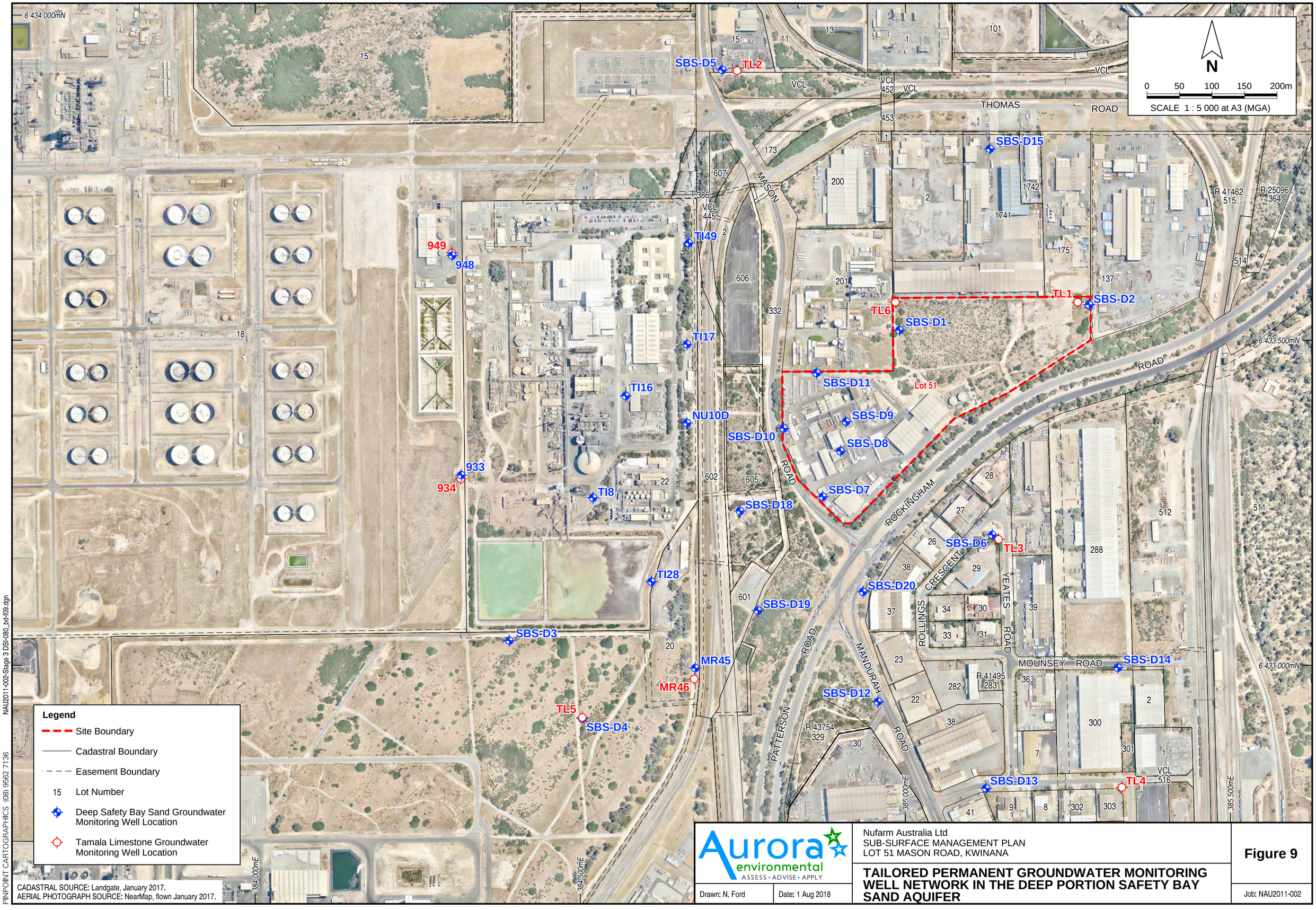
Aurora environmental

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

Figure 8

GROUNDWATER MONITORING WELL LOCATIONS SHALLOW SAFETY BAY SAND AQUIFER (DELINEATING HYDROCARBON PLUME)

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002



Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- 15 Lot Number
- Deep Safety Bay Sand Groundwater Monitoring Well Location
- Tamala Limestone Groundwater Monitoring Well Location

CADASTRAL SOURCE: Landgate, January 2017.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2017.

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f09.dgn

Aurora environmental ASSESS • ADVISE • APPLY

Drawn: N. Ford | Date: 1 Aug 2018

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

TAILORED PERMANENT GROUNDWATER MONITORING WELL NETWORK IN THE DEEP PORTION SAFETY BAY SAND AQUIFER

Figure 9

Job: NAU2011-002

N

0 50 100 150 200m

SCALE 1 : 5 000 at A3 (MGA)

6 434 000mN

6 433 500mN

6 433 000mN

384 000mE

384 500mE

385 000mE

SBS-D5 SBS-D15 SBS-D2 SBS-D1 SBS-D11 SBS-D9 SBS-D10 SBS-D8 SBS-D7 SBS-D6 SBS-D14 SBS-D12 SBS-D13 SBS-D3 SBS-D4

TI49 TI17 TI16 NU10D TI8 TI28 MR45

948 933

Lot 51

THOMAS ROAD

MASON ROAD

ROCKINGHAM ROAD

PATTERSON ROAD

MANDURAH ROAD

CRESCENT

ROLLINGS

YEATES ROAD

MOUNSEY ROAD

VCL

R 41462 515

R 25096 364

R 41495

R 43754 329

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- 15 Lot Number
- 200 Lot Number Within Inferred Plume
- Existing Deep SBS Groundwater Monitoring Well Location
- Less than LOR
- Inferred Extent of Chlorinated Phenol Plume
- ?- Unknown Extent

CADASTRAL SOURCE: Landgate, May 2015.
AERIAL PHOTOGRAPHY SOURCE: NearMap, flown April 2015.

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f10.dgn

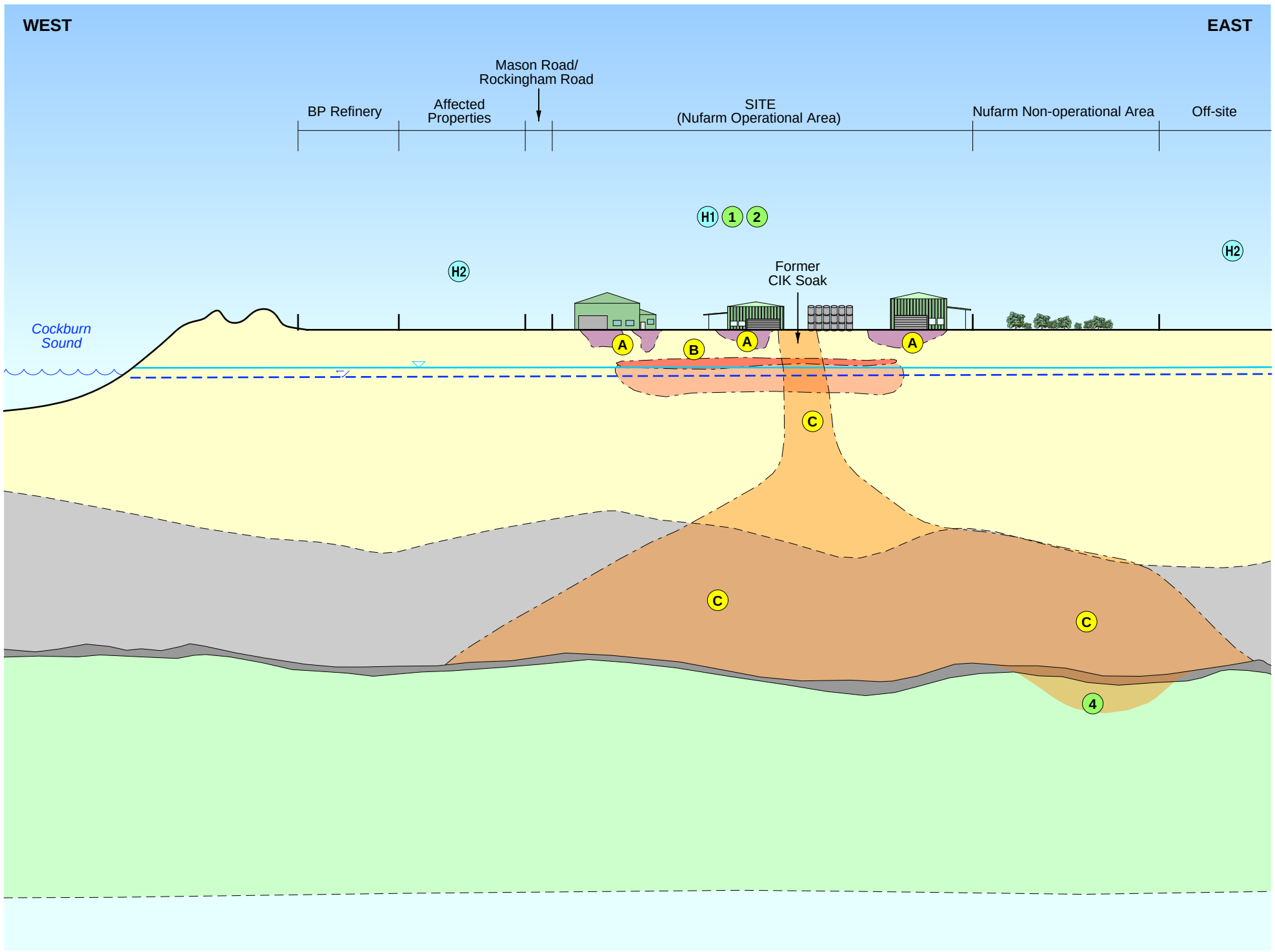
Aurora environmental ASSESS • ADVISE • APPLY

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

INFERRED CHLORINATED PHENOL GROUNDWATER PLUME WITH AFFECTED PROPERTIES IN THE SAFETY BAY SAND AQUIFER

Figure 10

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002



Potential Sources

- A — Multiple sources of soil impact (some extend to groundwater, others don't)
- B — LNAPL plume and associated dissolved phase plume
- C — Chlorinated phenolic compound plume(s) dissolved phase in Safety Bay Sand and Tamala Limestone (limited impact)
- D — Release of acidic, basic or high TDS solutions
- E — Offsite sources

Pathways

- 1 — Direct contact with impacted shallow soils
- 2 — Inhalation of vapour and dust from soil
- 3 — Inhalation of vapour from impacted groundwater
- 4 — Vertical Migration of COPCs in groundwater
- 5 — Direct contact with impacted sediments or water of Cockburn Sound
- 6 — Consumption of impacted ecology
- 7 — Uptake by ecology of Cockburn Sound
- 8 — Migration of COPCs into Tamala Limestone

Receptors

- H1 — Onsite workes
- H2 — Offsite workers
- H3 — Recreation users of Cockburn Sound
- H4 — Consumers of Cockburn Sound ecology
- E — Cockburn Sound ecology

Legend

- Safety Bay Sand Aquifer Potentiometric Surface Elevation (unconfined)
- Tamala Limestone Aquifer Potentiometric Surface Elevation (partially confined)
- Safety Bay Sands
- Becher Sands
- 'Basal' Layer
- Tamala Limestone
- Cretaceous-aged Sediments
- Soil Impact Source
- LNAPL Plume
- LNAPL Dissolved Phase Plume
- Chlorinated Phenolic Dissolved Phase Plume

NOTE:
- Not To Scale.
- All shown extents are approximately inferred and/or schematic.
- Greyed out text indicates potential sources, pathways and receptors are no longer considered to be complete linkages after the Stage 2 DSI.

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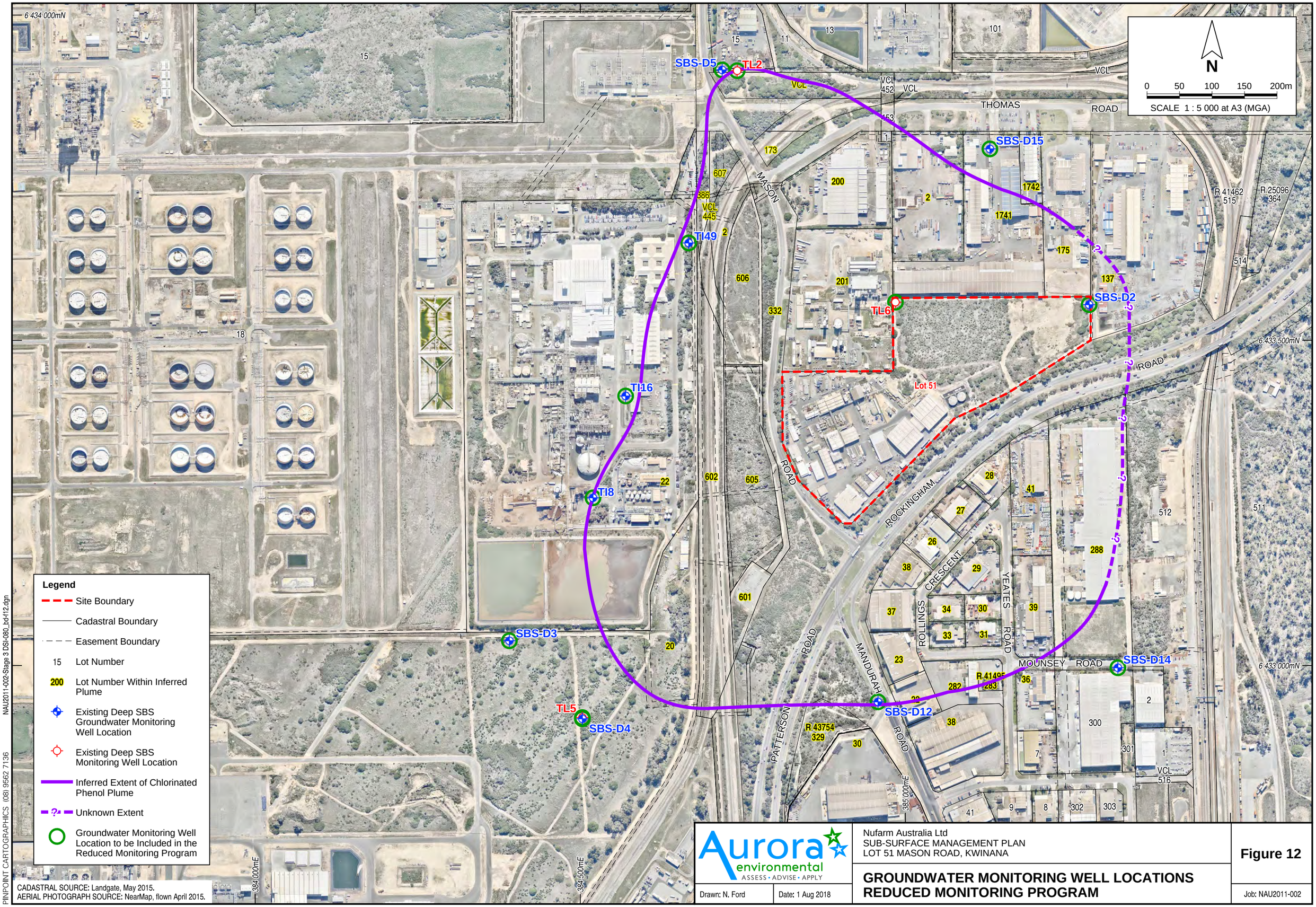
Drawn: N. Ford | Date: 1 Aug 2018

Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

SCHEMATIC CONCEPTUAL SITE MODEL

Figure 11

Job: NAU2011-002



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Nufarm Australia Ltd
SUB-SURFACE MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

GROUNDWATER MONITORING WELL LOCATIONS REDUCED MONITORING PROGRAM

Figure 12

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002-Stage 3 DSI-080_bd-f12.dgn

APPENDIX 1

Certificate of Title

298T

REGISTER NUMBER	
51/D46722	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	15/6/2011

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

VOLUME 1505 FOLIO 166

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 51 ON DIAGRAM 46722

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

NUFARM AUSTRALIA LTD OF 103-105 PIPE ROAD, LAVERTON NORTH, VICTORIA
(AN L598231) REGISTERED 8 APRIL 2011

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1.	*C141783	MEMORIAL. INDUSTRIAL LANDS DEVELOPMENT AUTHORITY ACT 1966/1980. AS TO THE PORTIONS OF KWINANA LOTS 174 AND 175 ONLY. LODGED 20.5.1981.
2.	C589205	EASEMENT TO METROPOLITAN WATER AUTHORITY. SEE SKETCH ON VOL 1505 FOL 166. REGISTERED 22.7.1983.
3.	*L399970	MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 13.8.2010.
4.	L598233	MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 8.4.2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1505-166 (51/D46722).
PREVIOUS TITLE:	1387-140, 91-28A.
PROPERTY STREET ADDRESS:	LOT 51 MASON RD, KWINANA BEACH.
LOCAL GOVERNMENT AREA:	TOWN OF KWINANA.

APPENDIX 2

Asbestos Management Plan

2 Bulwer Street
PERTH WA 6000
T: (+61) 8 9227 2600
F (+61) 8 9227 2699
www.auroraenvironmental.com.au

Asbestos Management Plan
Lot 51 Mason Road, Kwinana Beach

Prepared For:	Nufarm Australia Ltd
	PO Box 198 KWINANA WA 6167
Report Number:	AP2018-161
Report Version:	V1
Report Date:	6 August 2018

DISCLAIMER

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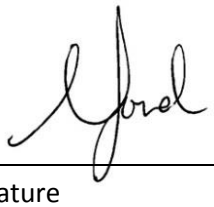
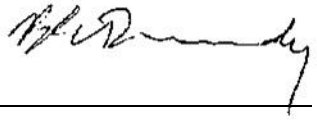
QUALITY ASSURANCE

Aurora Environmental has implemented a comprehensive range of quality control measures on all aspects of the company's operation.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed and signed off by senior members of the consultancy team prior to issue to the client.

Document No: NAU2011-002_AMP_119_NF_V1

Report No: AP2018-161

Author:	Nicole Ford Senior Environmental Scientist		6 August 2018
		Signature	Date
Reviewed by:	Brad Dermody Associate Environmental Scientist (Director)		6 August 2018
		Signature	Date

DISTRIBUTION

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1	NAU2011-002_AMP_119_NF_V1	Final	6 August 2018	Nufarm Australia Ltd	BD
1	NAU2011-002_AMP_119_NF_V1	Final	6 August 2018	Australian Environmental Auditors	BD

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ATTACHMENTS

LIST OF FIGURES

1 INTRODUCTION

Aurora Environmental (Aurora) was engaged by Nufarm Australia Ltd (Nufarm) to prepare an Asbestos Management Plan (AMP) to be appended to the Sub-surface Management Plan (SMP) for Lot 51 Mason Road, Kwinana beach (the Site). The purpose of the AMP is to provide guidance for management of asbestos should it be encountered in soil at the Site. Figure 1 presents the location of the Site.

1.1 BACKGROUND

The background of the Site, including site identification and previous investigations are presented in the SMP (Aurora, 2018). Background information including site identification and general site information is presented in Section 2 of the SMP. Previous environmental assessments are presented in Section 3 of the SMP.

Based on the identification of asbestos fragments during historical site investigations in either soil bores or from observed spoil from a single shallow excavation (Figure 2) and the presence of buildings clad with Asbestos Containing Material (ACM), it is considered likely that asbestos fragments exist in shallow soils at other locations across the Site. It is hypothesised that historical burial of or filling with building demolition waste inadvertently containing ACM could have occurred although there are no specific locations or events of this occurring which are recorded. Given that the current operational areas of the Site are covered with hardstand, it is considered unlikely that asbestos represents a health risk during ongoing operational commercial/industrial activities at the Site. Given that ACM has been discovered at three locations in investigations to date (which have comprised over 100 drilling locations), possible exposure to asbestos can be managed through measures as presented in this AMP.

2 ASBESTOS MANAGEMENT PLAN

2.1 PURPOSE OF THIS PLAN

The purpose of this AMP is to provide a framework for the management of Asbestos Containing Material (ACM) fragments in soil so that the health and safety of site users and visitors, surrounding receptors, and the general environment are protected from adverse impacts that could eventuate from uncontrolled subsurface disturbances and inappropriate management of ACM fragments identified in soil at the Site. Specific objectives of the AMP include:

- Prevention of uncontrolled exposure to asbestos for site workers, surrounding community and environment, during ongoing operational use of the Site; and
- satisfying regulatory requirements for the preparation and implementation of an AMP.

2.2 SCOPE OF THIS MANAGEMENT PLAN

This AMP comprises the following information:

- where ACM has been identified previously;
- identification of the key roles and responsibilities in implementing this AMP.
- Identify potential hazards associated with asbestos that may be encountered during ongoing operational activities as a commercial / industrial site so that appropriate safe working procedures and environmental management protocols can be developed and implemented; and
- contingency measures in the instance that asbestos in the form of bonded ACM is encountered unexpectedly during any potential future earthworks or ongoing operational activities.

2.3 APPLICABILITY OF THIS MANAGEMENT PLAN

The AMP shall be implemented if ACM is encountered during ongoing operational activities, future earthworks or developments on the Site.

In addition, this AMP includes contingency measures if other work beyond that specified above, is required to be undertaken, to ensure all ground disturbance works are managed appropriately with respect to exposure to asbestos.

2.4 CONTROL AND UPDATE OF THE PLAN

This AMP is considered to be a live document and should reflect Site conditions. Consequently this AMP is required to be updated by Nufarm if additional information, relevant to the scope of the AMP, becomes available. This includes updating the locations where ACM is known or likely to be present in soils should further ACM be discovered in soil.

3 HAZARD IDENTIFICATION AND MANAGEMENT

3.1 AREAS WHERE ACM HAS BEEN IDENTIFIED

ACM fragments have been discovered in small (60 mm) diameter soil bores drilled at two locations and within a stockpile of soil from a shallow excavation. Given this, the presence of many buildings onsite constructed from ACM products, their age and the number of alterations and repairs which may have occurred over time, ACM may possibly be present in soil beneath hardstand at numerous locations across the operational area. The confirmed locations of ACM are presented on Figure 2, however as stated, undiscovered ACM fragments could be present in soil elsewhere on the Site.

3.2 ACM HANDLING

If a relatively small number of ACM fragments are encountered on the soil surface or whilst ground disturbing works are taking place and the ACM fragments are in good condition, it is considered that the fragments can be handpicked and placed into asbestos bags. The ACM fragments should be placed into either ziplock bags that are then placed into asbestos specific removal bag, made of high impact LDPE with a thickness of 0.2mm (200µm) and labelled appropriately or double bagged straight into asbestos removal bags. The bags should then be taped up and secured prior to appropriate disposal (see Section 3.1.4).

If the ACM fragments are numerous and distributed through the soil profile, then a dedicated soil assessment and possibly remediation and validation may be required. If this is the case, an appropriately qualified/competent environmental consultant, who is experienced in applying the DoH (2009) guideline requirements should be engaged to provide further advice.

3.3 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENT

The following personal protective equipment (PPE) is recommended to be worn if ACM fragments are being handpicked and bagged by Nufarm employees. In lieu of the condition of ACM being unknown, a disposable half face respiratory mask with a P2 or P3 filter should be worn when handling ACM fragments. Preferably disposable nitrile gloves (if available) or alternatively re-useable gloves should be worn to pick up the ACM fragments.

Further PPE should be considered if the ACM fragments are more extensive or are considered to be in a poor condition whereby fibres may be easily released from the ACM and adhere to clothing, equipment or shoes. This includes disposable coveralls and boot covers. All spent PPE should be removed immediately after completion of any ACMN handling and disposed of waste, consistent with Section 3.4.

3.4 WASTE MANAGEMENT

Any ACM fragments (and spent PPE), once appropriately bagged and sealed, will need to be disposed of at an appropriately licenced landfill as Special Waste Type 1 under the DWER's "*Landfill Waste Classifications and Waste Definitions 1996 (as amended 2018)*" (DWER, 2018).

ACM-impacted soils which are surplus to the Site should also be disposed offsite to an appropriately licenced landfill as Special Waste Type 1 under the DWER's "*Landfill Waste Classifications and Waste*

Definitions 1996 (as amended 2018)" (DWER, 2018). Any soils disposed offsite will also be subject to sampling and chemical testing for waste characterisation as required by the SMP (Aurora, 2018).

Any areas from which ACM-impacted soils are removed should be validated to be free of ACM or else identified as areas with known ACM impacts in this AMP. It is appropriate for a qualified competent environmental scientist to undertake such validations.

3.5 INSPECTIONS

The operational areas of the Site should be inspected from time to time by Nufarm for the presence of ACM in soil where it is not covered with hardstand or coarse gravels. Any areas where the hardstand is removed should be inspected before being commissioned for operational use (noting that this circumstance is unlikely to occur at the Site).

Where possible, any areas which will be subjected to sub-surface works or building/plant development works should be inspected for the possible presence of ACM in soil as part of planning the works and before disturbing soils.

All areas of the Site should be free of ACM in soil at the surface, other than the incidental presence of occasional fragments (which are to be removed as per Section 3.2). An inspection of the surface soils in the vicinity of any building/plant development works or sub-surface works should be undertaken at the completion of the works to ensure that the area is free of visible ACM fragments.

4 ROLES AND RESPONSIBILITIES

Roles and responsibilities for the implementation of AMP are outlined below in Table A and mirror those from Section 7.1 of the SMP (Aurora, 2018).

TABLE A: ROLES AND RESPONSIBILITIES

ROLE	RESPONSIBILITY
Nufarm Manufacturing Manager	All site operations and oversight of the AMP including ensuring appropriate resources and process are in place, more specifically: • maintain control over access to the site and ensure no unauthorised access to site; • maintain records and documentation relevant to the AMP; • ensure any personnel required to conduct sub-surface activities are provided with current version of AMP and are appropriately briefed; • training and awareness for all relevant internal staff, contractors and site visitors;; • inform surrounding land occupiers/owners of any disruptions that may impact them and respond to any queries or complaints; and • approve consultants and contractors for undertaking sub-surface works and ensure task specific documentation (e.g. Job Safety Analysis (JSA)/ Safe Work Method Statement (SWMS)) is reviewed and approved prior to works commencing.
Onsite workers - Nufarm staff	All workers have a duty of care to take reasonable care for their own safety and that of others who may be affected by their acts or omissions. The responsibilities of all staff (permanent, temporary, casual and contract) include: • ensuring they are familiar with the AMP for their work area as necessary; • compliance with policies, procedures and reasonable instructions by Nufarm; • refrain from any act which could put them or any other occupant at risk of exposure to asbestos in ACM; and • report any incident involving the disturbance of ACM in soil to the responsible person for the area.
Onsite workers - contractors/consultants	Consultants and contractors are to work under the specific directions of the relevant Nufarm Manager for their work on site. They should read all information provided to them in relation to ACM in soil at the Site. Specific duties also include: • compliance with policies, procedures and reasonable instructions by Nufarm; • refrain from any act which could put them or any other occupant at risk of exposure to impacted soils or groundwater; • provide task-specific JSA or SWMS documents which incorporate AMP control procedures; • Use the Nufarm permit to work system for any excavation work involving the potential disturbance of impacted soils; and • report any incident involving the disturbance of impacted soil or groundwater to the responsible person for the area.

5 CONTINGENCIES

The following constitute an incident whereby actions may be required to prevent exposure and valuable information can be obtained through the process of reporting and investigation, and then used to reduce future risk:

- uncontrolled disturbance, stockpiling or disposal of ACM-impacted soils;
- dust emissions or sediment runoff from ACM-impacted soils; or
- other non-conformance with a requirement of the AMP.

Incidents of the nature listed immediately above must be reported to the Nufarm Manufacturing Manager as soon as possible in order to:

- isolate and contain the area, where necessary, to prevent spread of and exposure to impacted media;
- conduct an investigation into the causes;
- determine what immediate actions are necessary; and
- make recommendations for improvements to prevent similar or related incidents.

6 DOCUMENTATION, REPORTING AND COMMUNICATION

It is important that anyone conducting sub-surface works at the Site is made aware of the potential presence of ACM in soils where they are working and provided with this AMP so that the works can be prepared to adequately manage the potential discovery of ACM. This includes Nufarm personnel, subcontractors or utility providers working on the Site.

All additional discoveries of ACM in soil should be reported to Nufarm. It is recommended that Nufarm or other parties who encounter ACM fragments on the Site document the location and actions that took place to remove the ACM fragments and record how and where they were disposed. This AMP should then be updated to reflect the updated understanding of ACM present in soil on the Site.

If a dedicated ACM in soil assessment is required than this should be documented formally by the engaged suitably qualified environmental consultant as per the DoH (2009) requirements and this AMP updated.

This AMP should be updated if it considered that it no longer reflects the locations and distribution of ACM in soil or is not effective at management potential exposure to asbestos in soil.

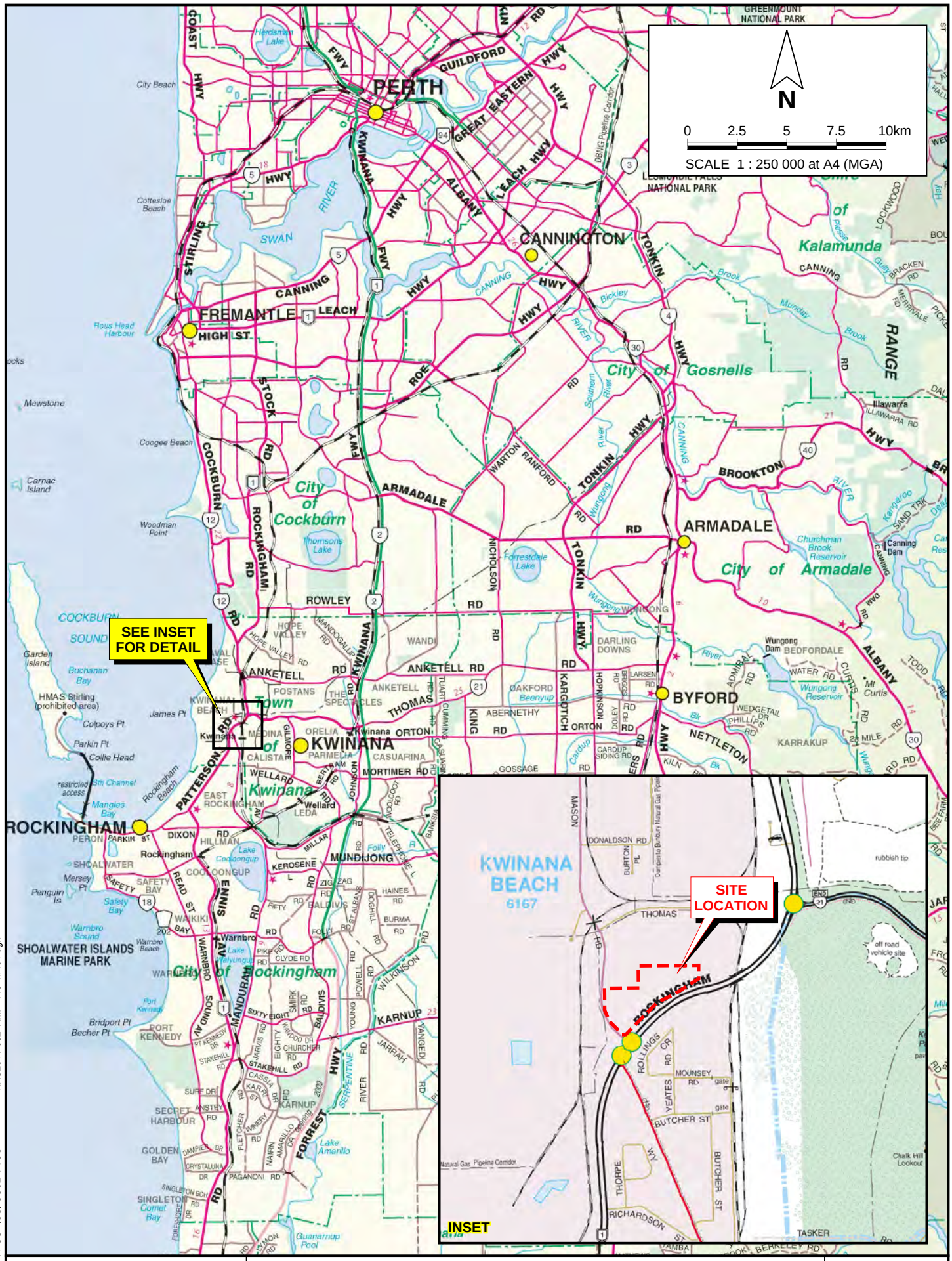
7 REFERENCES

Aurora Environmental (2018) Sub-Surface Management Plan, Lot 51 Mason Road, Kwinana Beach. Prepared for Nufarm Australia Ltd, Version 5 issued on 6 August 2018. Report Number AP2015-181.

Department of Health (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.

Department of Water and Environmental Regulation (DWER) (2018) Landfill Waste Classification and Definitions 1996 (as amended), Department of Water and Environmental Regulation (DWER), Perth, April 2018.

FIGURES



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Nufarm Australia Ltd
ASBESTOS MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

Figure 1

SITE LOCATION

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002

N

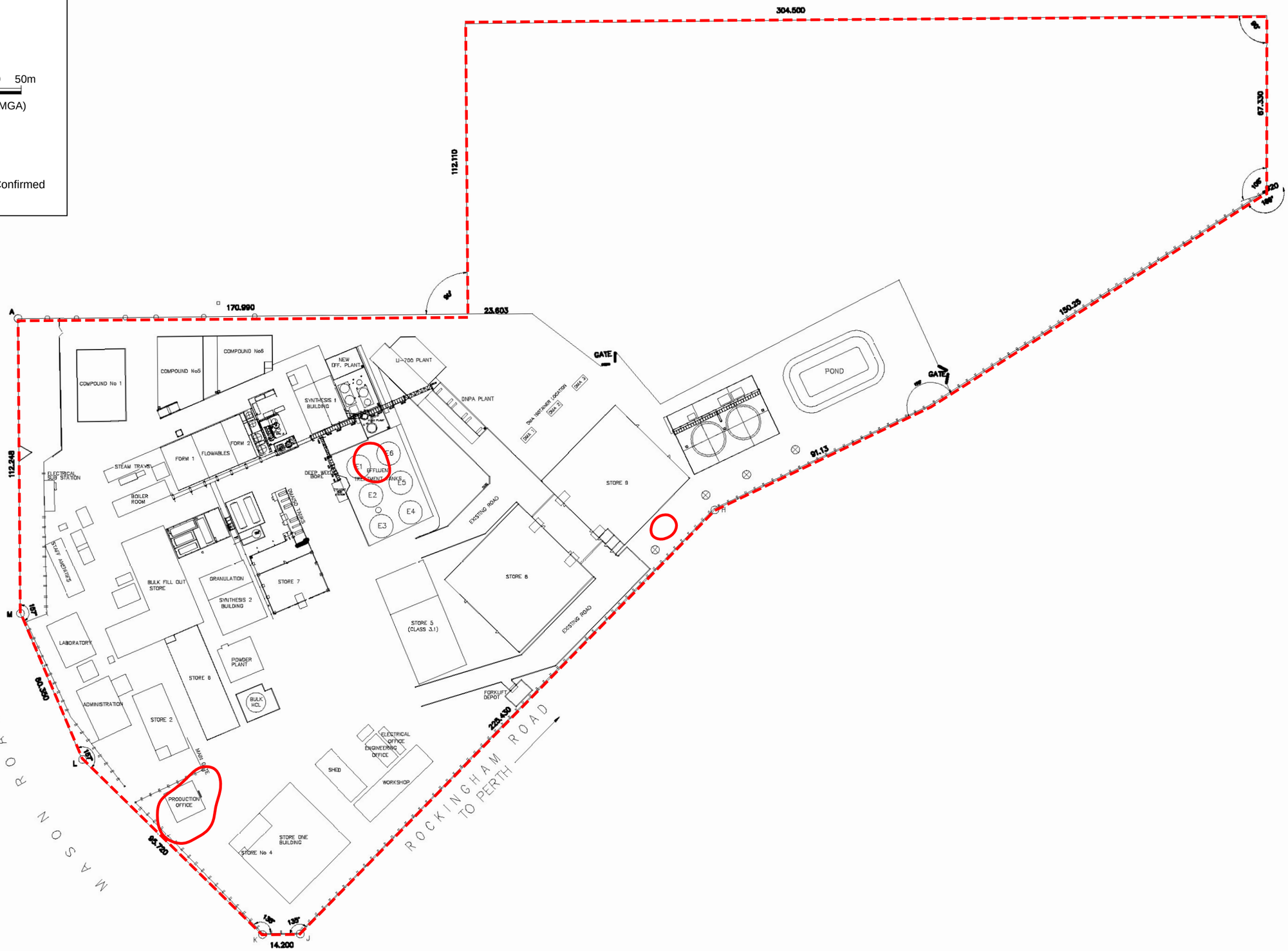
0 10 20 30 40 50m

SCALE 1 : 1 500 at A3 (MGA)

Legend

Site Boundary

Inferred Extents of Confirmed ACM in Fill/Spoil



BASE SOURCE: Nufarm Limited, Dwg No. N6000, 06/02/2008.

PINPOINT CARTOGRAPHICS (08) 9562 7136 NAU2011-002_AMP_119_nf-f02.dgn

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Nufarm Australia Ltd
ASBESTOS MANAGEMENT PLAN
LOT 51 MASON ROAD, KWINANA

Figure 2

INFERRED EXTENTS OF CONFIRMED ACM IN SOIL

Drawn: N. Ford | Date: 1 Aug 2018 | Job: NAU2011-002