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Epuron Projects Pty Ltd

Former South Fremantle Landfill Site

Solar Farm Development - Site Management Plan

January 2018

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Executive summary

Background

Epuron Projects Pty Ltd (Epuron) engaged GHD Pty Ltd (GHD) to prepare a Site Management Plan (SMP) with respect to pre-existing site contamination, for a proposed solar farm to be developed on a portion of the larger Former South Fremantle Landfill Site (SFLS), Western Australia (WA), which is owned by the City of Fremantle (CoF).

The portion of the SFLS which is to be developed as a solar farm comprises Lot 1 on Plan 2513, Lot 8 on Diagram 2492, Lot 9 on Diagram 2492, and Lot 10 on Diagram 2492, and is referred to in this SMP as 'the Site' hereafter (Figure 1). The Basic Summary of Records (BSR) for the Site is provided in Appendix A. All other lots within the SFLS are anticipated to remain in an undeveloped condition.

Environmental assessment at the Site completed by GHD (and others) for the City of Fremantle (CoF) identified the following sources of contamination:

- Landfill gas (LFG) and vapours.
- Inorganic and organic substances and pathogens within waste/fill materials, including asbestos containing material (ACM) in sand capping material.
- Mobile contaminants within groundwater.

The respective BSRs for existing lots proposed for the solar farm development (Appendix A) indicate that any future development of the Site must consider and manage the potential risks associated with these sources of contamination

Therefore, the purpose of the SMP is to inform the design of the solar farm to:

- Avoid, mitigate or manage potential negative impacts on the migration of existing contamination (primarily focused on landfill gas) associated with the development and operation of the solar farm.
- Avoid, mitigate or manage potential risks to solar farm operation and maintenance workers associated with existing site contamination.

Contaminated site status (CS Act, 2003)

Under the *Contaminated Sites Act* (CS Act, 2003), the Site has been classified by the Department of Water and Environmental Regulation (DWER; formerly the Department of Environment Regulation [DER]) as '*Contaminated – remediation required*' as a result of the former use of the Site for landfill.

Contamination investigations, management and reporting for the Site are subject to review by DWER and an accredited Contaminated Sites Auditor (CSA), Mr Jason Clay of Senversa Pty Ltd (Senversa).

Management objectives and targets

Site management objectives and targets proposed have been developed (in the context of site development) on the basis of ensuring:

- No significant change (increase) in the risk profile of the Site.
- No unacceptable risk posed to on- and off-site receptors.

The objective of the SMP is to provide the framework for the management and monitoring of:

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- Risk of negative impacts to operation and maintenance workers due to exposure to soil contamination, including chemical exposure risk, ACM, and aesthetics.
- Risk of negative impacts to operation and maintenance workers due to LFG accumulation in enclosed spaces on-site.
- Risk of negative impact on LFG migration off-site.
- Risk of negative impact on groundwater and surface water quality.

Scope of work

The site management strategy describes the overall management framework for the Site to address potential risks associated with the proposed development. Specifically, the management strategy addresses:

- Timeframes required for implementation of the SMP.
- Stakeholder roles and responsibilities.
- Section 5: Development of a Sampling and Analysis Quality Plan (SAQP) to appropriately guide the monitoring requirements to be implemented as part of the development works, which comprise:
  - Section 6: Pre-development management requirements
  - Section 7: Management during development
  - Section 8: Post-construction validation monitoring and ongoing operational controls
  - Section 9: Quality assurance (QA) and quality control (QC) requirements to be implemented for the duration of the monitoring program
- Section 10: Circumstances and events requiring contingency actions and the associated procedures to be adopted.
- Section 11: Reporting requirements of the SMP, including the circumstances under which a revision to the SMP is warranted.

Conclusions

GHD is of the opinion that the Site will be suitable for the proposed solar farm by implementing this SMP to ensure:

- No significant change (increase) in the risk profile of the Site.
- No unacceptable risk posed to on- and off-site receptors.

Implementation of the SMP will therefore render the Site suitable for the proposed use.

Recommendations

GHD provides the following recommendations:

- The status of solar farm design proposals is preliminary at the time of preparing this SMP. This SMP does not address the design or development of LFG management measures for solar farm infrastructure or for provision of advice concerning geotechnical/civil works. The SMP is therefore subject to review and possible amendment when solar farm development proposals are progressed to detailed design stage.
- Review of the SMP if the proposed form of the solar farm development is amended, particularly in relation to management action concerning groundwater if considered to be necessary.

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This report is subject to, and must be read on conjunction with, the limitations set out in Section 1.9 and the assumptions and qualifications contained throughout the report.

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1. Introduction

Epuron Projects Pty Ltd (Epuron) engaged GHD Pty Ltd (GHD) to prepare a Site Management Plan (SMP) with respect to pre-existing site contamination, for a proposed solar farm to be developed on a portion of the larger Former South Fremantle Landfill Site (SFLS), Western Australia (WA), which is owned by the City of Fremantle (CoF).

The portion of the SFLS which is to be developed as a solar farm comprises Lot 1 on Plan 2513, Lot 8 on Diagram 2492, Lot 9 on Diagram 2492, and Lot 10 on Diagram 2492, and is referred to in this SMP as 'the Site' hereafter (Figure 1). The Basic Summary of Records (BSR) for the Site is provided in Appendix A. All other lots within the SFLS are anticipated to remain in an undeveloped condition.

This report is subject to, and must be read on conjunction with, the limitations set out in Section 1.9 and the assumptions and qualifications contained throughout the report.

1.1 Background

SFLS, including the Site, was subject to quarrying/sand mining activities prior to the 1930s and was subsequently used for waste disposal in varying phases until the closure of the landfill in 1991. The Site currently comprises vacant and undeveloped land with limited public access.

Under the *Contaminated Sites Act* (CS Act, 2003), the Site has been classified by the Department of Water and Environmental Regulation (DWER; formerly the Department of Environment Regulation [DER]) as '*Contaminated – remediation required*' as a result of the former use of the Site for landfill. Contamination investigations, management and reporting for the Site are subject to review by DWER and an accredited Contaminated Sites Auditor (CSA), Mr Jason Clay of Senversa Pty Ltd (Senversa).

Environmental assessment at the Site completed by GHD (and others) for the City of Fremantle (CoF) identified the following sources of contamination:

- Landfill gas (LFG) and vapours.
- Inorganic and organic substances and pathogens within waste/fill materials, including asbestos containing material (ACM) in sand capping material.
- Mobile contaminants within groundwater.

Further information pertaining to previous site assessment is provided in Section 1.7.

The respective BSRs for existing lots proposed for the solar farm development (Appendix A) indicate that any future development of the Site must consider and manage the potential risks associated with these sources of contamination.

1.1.1 Interim site management plan

It is important to note that CoF previously commissioned an Interim Site Management Plan (I-SMP; GHD, 2013) for the Site, to allow the CoF to continue to meet its obligations with respect to addressing contamination issues at the Site.

The I-SMP sets out a programme for interim actions to be implemented (including, *inter alia*, monitoring of ground gas and groundwater) to address identified data gaps assuming the Site use remains in its current, undeveloped form.

Recent off-site landfill gas investigation (GHD, 2017) has addressed data gaps pertaining to landfill gas with respect to the Site in its current, undeveloped use; however, as part of the I-SMP, further groundwater assessment is required to characterise groundwater risk with respect

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to potential impacts to receptors. The requirement for groundwater monitoring and associated management with respect to the proposed solar farm development is considered and evaluated within this SMP (refer to Section 2.4.1).

For the above reasons, the status of I-SMP remains 'live' with remaining relevant actions to be implemented by CoF. Further information concerning the I-SMP is provided in Section 1.7.5.

1.2 Project understanding

GHD understands that Epuron has not finalised its proposed development plans for the Site; however, current plans comprise a proposal for a portion of the Former South Fremantle Landfill (known as Sandown Park and part of Hollis Park) to be developed as a solar farm. The proposed development is anticipated to encompass Lot 1 (referred to in design drawings as Area 1) and Lot 8, Lot 9, and Lot 10 (Area 2). All other lots within the larger SFLS are anticipated to remain in an undeveloped condition.

The proposed solar farm is understood to comprise above ground fixed array solar panels and supporting infrastructure including cabling, transformers and inverters, which will connect into the existing power line located in the northern portion of Sandown Park or to the east on Cockburn Road. The majority of the ground surface will be unsealed, with shallow ground screws required for solar panel arrays, substation infrastructure at the point of connection (switch gear, transformers, etc.), inverters and other minor infrastructure (subject to confirmation based on design considerations). An existing earth bund at the Site may be disturbed to accommodate the maximum footprint of the proposed solar farm (Option 1 in Appendix B). The quality of the existing earth bund material is not known.

It is further understood that CoF will maintain ownership of the Site and Epuron, as the solar farm operator, will hold a long-term lease of the Site.

Solar farm proposals (current at the time of reporting) are provided in Appendix B and are discussed further (in the context of site management requirements) in Section 2.

1.3 Purpose

The purpose of the SMP is to inform the design of the solar farm to:

- Avoid, mitigate or manage potential negative impacts on the migration of existing contamination (primarily focused on landfill gas) associated with the development and operation of the solar farm.
- Avoid, mitigate or manage potential risks to solar farm operation and maintenance workers associated with existing site contamination.

It is important to note that this SMP does not address construction phase risk management measures; a separate Construction Environmental Management Plan (CEMP) will be required for this purpose. However, information contained in this SMP may prove useful for inclusion in a CEMP.

1.4 Objectives

The objective of the SMP is to provide the framework for the management and monitoring of:

- Risk of negative impacts to operation and maintenance workers due to exposure to soil contamination, including chemical exposure risk, ACM, and aesthetics.
- Risk of negative impacts to operation and maintenance workers due to LFG accumulation in enclosed spaces on-site.
- Risk of negative impact on LFG migration off-site.

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- Risk of negative impact on groundwater and surface water quality.

The SMP also includes requirements for monitoring/inspection actions to seek to ensure effectiveness of the management measures implemented in relation to the above risks.

1.5 Site identification

SFLS is situated on 19.4 ha of land, approximately 18 km south-west of the Perth Central Business District (CBD). SFLS is separated into three areas, which are commonly referred to as 'Daly Street', 'Hollis Park' and 'Sandown Park'. A high pressure gas pipeline dissects the SFLS in an east-west direction.

The Site comprises approximately 8.0 ha of land within Sandown Park and a portion of Hollis Park. The Site is not currently in formal use and has no infrastructure present with the exception of small drains leading to open soak well type structures at the southern boundary of Sandown Park. The Site is generally covered by grass/scrub vegetation and a large earth bund is also present on the Sandown Park portion of the Site.

A locality plan showing the Site, in the context of its surrounds, is provided in Figure 1. The legal identification of the Site is reported in Table 1 below.

Table 1 Site identification details

Site identification details	
Common Name of Site	South Fremantle Landfill Site
Local Government Authority	City of Fremantle
Coordinates of the Site Boundary[1]	Lot 1: North-west corner: -32.078189, 115.757817 North-east corner: -32.078398, 115.761102 South-east corner: -32.08022, 115.761109 South-west corner -32.080228, 115.757809 Lot 8,9,10: North-west corner: - 32.077083, 115.756439 North-east corner: -32.077079, 115.758658 South-east corner: -32.07759, 115.758645 South-west corner: -32.077805, 115.756443

[1] Coordinates are provided in Longitude / Latitude.

The Site is currently split across a number of legal identification areas, the details of which are summarised in Table 2.

Table 2 Legal identification details

Lot on plan address	Vol - Folio	Street address
Lot 1 on plan 2513	1745-017	1 Cockburn Rd South Fremantle WA 6162
Lot 8 on diagram 2492	1226-104	8 Island Street, South Fremantle WA 6162
Lot 9 on diagram 2492	1226-104	9 Island Street, South Fremantle WA 6162
Lot 10 on diagram 2492	1226-104	10 Island Street, South Fremantle WA 6162

1.5.1 Surrounding land use

The surrounding land use of the Site and the SFLS is summarised in Table 3 below.

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Table 3 Surrounding land use

Direction relative to the Site	Description
North	The Site (both Sandown Park and Hollis Park area) is bound to the north by scrubland and vegetation. SFLS is bound to the north-east by commercial (Fremantle Market Place) and office premises (Geodis Wilson) and to the north-west by residential properties.
South	The Site and SFLS is bound to the south by the Fremantle Chalet Village and residential properties. Within the Hollis Park area, the Site is bound to the south by vegetation.
East	The Site is bound to the east by Hampton Road and Cockburn Road. The SFLS is bound by commercial / industrial properties. The portion of the Site within the Hollis Park area is bound by vegetation.
West	The Site and the SFLS is bound to the west by residential land. for residential purposes. The portion of the Site within the Hollis Park area is bound by vegetation.

1.6 Contamination status of the site

Under the CS Act (2003), DWER has classified the Site as '*Contaminated - Remediation Required*'. This classification is a result of the former use of the Site as a landfill and restricts any occupation or use of the Site until appropriate remedial measures have been implemented such that potential risks to human health have been appropriately mitigated.

Contamination investigations, management and reporting for the Site are subject to review by DWER and the accredited CSA, Mr Jason Clay of Senversa.

1.7 Summary of previous work

A number of previous investigations have been undertaken to seek to assess the contamination status of the SFLS prior to and following classification by DWER. A Detailed Site Review (DSR: GHD, 2012) of available reports was undertaken to improve conceptual understanding of the Site and develop a robust Conceptual Site Model (CSM) to assist in taking the SFLS forward to a conclusion. The DSR contains a summary of earlier investigation work by others.

The DSR identified a number of data gaps to be addressed. Recommended actions to address these gaps were then documented in an I-SMP (GHD, 2013). The I-SMP set out a strategy for implementation of recommended actions for the above, as well as other data gaps identified as part of a staged and risk based approach to management. The purpose of this was to enable CoF to continue to meet its obligations in regard to the management of contamination issues posed by the SFLS. The data gaps identified, and corresponding actions recommended in the DSR with respect to current undeveloped open space 'use', were as follows:

- Sources of contamination associated with the Site were not adequately considered. Further assessment of possible sources was recommended to assist establishing a representative assessment of risk.
- Pathways that may exist to allow the above sources to impact relevant receptors were not appropriately considered. Further assessment of possible contamination pathways was recommended to develop a representative CSM.

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- Local background groundwater quality characteristics (including possible diffuse contamination from other up-gradient anthropogenic sources unrelated to the SFLS) had not been appropriately established. Additional monitoring was recommended to characterise up-gradient conditions.

A summary of the SFLS contamination status based on the DSR (GHD, 2012) and actions subsequently implemented is provided below, with particular emphasis on landfill gas and vapour, which were subject of the most recent assessment (GHD, 2017).

1.7.1 Soil

Previous assessment (GHD, 2012) reported concentrations of substances to vary greatly over the SFLS, as would be expected for a highly heterogeneous fill consisting of waste materials. In some instances, these exceeded published screening assessment criteria (Ecological Investigation Levels - EIL, Health Investigation Levels - HIL A) with respect to metals, metalloids, and total petroleum hydrocarbons. Due to the nature of materials at the SFLS, the presence of other contaminants at the SFLS could not be precluded.

1.7.2 Groundwater

With respect to groundwater contamination, review of available information (GHD, 2012) indicated:

- On-site impact to groundwater, which broadly corresponds with the indicated extent of shallow and deep landfill activity (with the possible exception of nitrate as N and chloride) and to the established overall groundwater flow direction.
- Significant variation in groundwater quality characteristics between monitoring wells across the SFLS (as would be expected for a highly heterogeneous fill consisting of waste materials) and potentially indicative of localised rather than diffuse scale impacts for some substances (e.g. chloride; a useful tracer species given its conservative behaviour in groundwater).
- The impacts recorded to date are of a relatively low order of magnitude compared to that which may be anticipated from the reported history and circumstances of the SFLS.
- Nitrate is likely to be entering groundwater from the SFLS; however, the pattern and extent of impact is unclear. Impacts may also be present from other urban sources in the locality and a regional/local background component, which are likely to contribute to the concentrations observed but are difficult to specifically identify.
- Petroleum hydrocarbons appear to be the most common form of non-aqueous phase liquids (NAPL) to be encountered within groundwater. However, available information does not indicate the likelihood of substances being present as a separate phase.

It was considered that the pattern evident from such data may be reflective of limited magnitude impacts to groundwater due to diffuse or localised sources at the SFLS that have relatively inefficient pathways to groundwater as a result of:

- Limited infiltration of surface waters (i.e. through flow) and resultant leachate generation associated with climatic conditions (i.e. low and seasonal rainfall).
- Limited direct contact of waste materials with groundwater (groundwater is slightly below or above the base of the deeper waste masses at Daly Street and Sandown Park due to seasonal variation).

However, whilst groundwater impact appears to be of limited magnitude based on available data, GHD (2012) advised that some uncertainty remains as there does not appear to be sufficient data to conclusively support this apparent trend as being definitive. A number of

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primary and secondary contaminants of concern and possible other substances of interest were therefore identified.

1.7.3 Landfill Gases and Vapours

Previous assessments pertaining to landfill gas and vapour are listed below:

- CSIRO (1986) *Investigation of the Concentration of Methane Gas within the Landfill, Corner of Rollinson and Cockburn Roads, S. Fremantle, W.A.*
- CSIRO (1989) *Investigation of Concentration of Methane Gas within the South Fremantle Landfill Site.*
- GHD (2010a) *South Fremantle Landfill Site Sampling and Analysis Plan.*
- GHD (2010b) *South Fremantle Landfill – Interim Assessment of Landfill Gas/Vapour Assessment.*
- GHD (2012) *South Fremantle Landfill Site Detailed Site Review.*
- GHD (2013) *South Fremantle Landfill Site Interim Site Management Plan. Rev.1.*
- GHD (2015) *2015 South Fremantle Landfill Site Offsite Landfill Gas and Vapour Investigation.*
- GHD (2017) *2016 South Fremantle Landfill Site Offsite Landfill Gas and Vapour Investigation.*

Relevant information from the above assessment are summarised in the following sections.

1.7.4 Detailed Site Review (GHD, 2012)

GHD (2012) included review of earlier reports pertaining to landfill gases and vapours. GHD (2012) stated that overall, the gas regime indicated biological and/or chemical degradation processes to be occurring within the waste mass at the Daly Street (predominantly aerobic) and Sandown Park areas of the SFLS (anaerobic) and to be reasonably consistent with the history of landfill development at the Site. The corresponding lack of detected gases at the Hollis Park area was also considered to be consistent with the history of waste disposal (i.e. limited) at that area of the SFLS.

Degradation processes did not appear to be inhibited by the presence of any chemical wastes that may have also been deposited at the SFLS. However, GHD (2012) stated that if the future moisture content of the wastes is lower than historically has been the case, generation rates may be lower with a longer overall time period taken for degradation to decline to residual levels.

Based on available information, GHD (2012) considered that migration of methane in groundwater was generally unlikely to occur given the unconfined nature of the groundwater and the very permeable strata at the site and adjacent sites. However, data concerning methane and carbon dioxide concentrations in groundwater was stated to be required to confirm this.

Derivation of Gas Screening Values (GSV) based on data from the SFLS (GHD 2010b, 2012), for comparison with generic criteria presented in CIRIA (2007) with respect to hazards from ground gases and vapours, indicated the following on-site risks for SFLS in its undeveloped condition:

- Daly Street area: Characteristic Situation 2, i.e. 'low' risk (CIRIA, 2007).
- Hollis Park area: Characteristic Situation 1, i.e. 'very low' risk (CIRIA, 2007).
- Sandown Park area: Characteristic Situation 2, i.e. 'low' risk (CIRIA, 2007).

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However, the presence of elevated ground gases and vapours at the SFLS was considered likely to be a significant hazard to future development at the SFLS, as development may introduce additional pathways (e.g. vertical migration via deep foundations) and receptors (e.g. future site users) to the SFLS, as well as potentially enhance the viability of existing pathways, such as greater lateral migration due to low permeability surfacing (subject to the actual development proposed).

1.7.5 Interim Site Management Plan (GHD, 2013)

Of the data gaps identified in the I-SMP (GHD, 2013), the following were considered to be the highest priority for action due to the implications for resultant risks that may be posed to relevant receptors:

- Uncertainties concerning the extent of landfill, and potential for gases and/or vapours to migrate from the Daly Street area of the SFLS and impact existing adjacent residents/site users, were considered to be the highest priority for action.
- Install gas/vapour monitoring wells beyond the western and eastern boundaries of the Sandown Park area of the SFLS to reinforce the existing perimeter bore monitoring network, confirm the indicated gas regime in this area, and to support the overall assessment.

An off-site landfill gas and vapour investigation was subsequently undertaken to assess these data gaps, as summarised below.

1.7.6 Offsite Landfill Gas and Vapour Investigation (GHD, 2015)

Findings from the assessment are summarised below.

On-site wells

Results for on-site wells were consistent with those in previous investigations (GHD, 2010b, 2012: refer to Section 1.7.4). The results were considered to indicate fairly stable landfill gas and vapour conditions with concentrations on-site not varying significantly between each monitoring round, thereby indicating that any landfill gases and vapour off-site should also be relatively stable in concentration.

Risks posed to relevant on-site receptors under the current SFLS condition were characterised as follows:

- Workers undertaking below ground maintenance works: Determined by site-specific factors, particularly, which area of the SFLS the workers would be operating in. Risk was considered to be 'moderate' in the Daly Street area, 'low to moderate' in the Hollis Park area, and 'high' in the Sandown Park area at the time of assessment.
- Existing Site visitors (fenced footpath): Due to a lack of credible exposure pathways in this outdoor environment with respect to gases and vapours and limited duration of presence at the Site for a typical footpath user, no significant risk was considered to be present for footpath users at the time of assessment.

Consideration of future development was not included in the assessment. It was considered that if development at the SFLS were contemplated, then further assessment would be required. In particular:

- The presence of elevated ground gases and vapours at the Site to present a hazard to future development at the Site as this may introduce additional pathways (e.g. vertical migration via deep foundations) and receptors (e.g. future site users) to the Site.

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- Potentially enhance the viability of existing pathways such as greater lateral migration due to low permeability surfacing.

As a result of the above, development at the SFLS without appropriate mitigation measures was considered to increase risks to relevant receptors provisionally to Characteristic Situation 3 (i.e. moderate risk) or higher.

In the context of the proposed development plans, which form the basis of this SMP, the recommendation for further assessment with respect to landfill gases and vapours (as described above) has been evaluated in Section 2.2.

Off-site wells

Overall, all off-site wells consistently reported low to negligible concentrations of landfill gases and vapour, with the exception of the locality of monitoring well POB08. Findings in relation to particular boundaries are summarised below in Table 4.

Table 4 OLGV (GHD, 2015) summary of findings for off-site wells

Relevant boundary	Details	Conclusions/Recommendations
Off-site land west of Daly Street Site area and east of Daly Street/Hollis Park Site areas (excluding POB08)	Risk to receptors west of Daly Street and industrial properties east of Daly Street (BellVista and Backpacker Car Rentals) considered to be Characteristic Situation 1 conditions i.e. 'very low risk.	No specific further action required with respect to risks posed by ground and vapours (for current Site condition) to offsite receptors at these Site boundaries, except: - Limited further work to confirm very low risk rating with respect to hydrogen sulphide detected at POB01 (data gap GV1.2A). - City of Fremantle to undertake a review of records for any indications of complaints that may be related to the presence of hydrogen sulphide odours. Also, review of records for any indication of drainage/sewer problems should be undertaken at the land immediately north of the Daly Street Site area where subsidence to hard standing and the western end of a building has been noted. - *Further action at POB 08 locality (see below).*
Off-site land at POB08 locality east of Daly Street Site area (to the east of Daly Street, located near the Geodis Wilson buildings)	Waste constituents present within fill at POB08 in very close proximity to Geodis Wilson buildings likely related to gas characteristics recorded (particularly elevated carbon dioxide and carbon monoxide) indicative of Characteristic Situation 2 conditions, i.e. 'low risk' to offsite receptors.	Potential for gas migration and accumulation within the Geodis Wilson warehouse building appeared sufficiently limited that absence of membrane protection or passive venting in conjunction with the existing floor slab was not considered likely to increase the risk rating. In the absence of specific details concerning building construction and services penetrations/entry points, limited further action recommended to confirm the risk rating, if access can be provided by the building users (data gap GV1.2B/AA1.2)
Daly Street area- north western boundary (South Fremantle Marketplace Shopping Centre)	No access was granted by the South Fremantle Marketplace Shopping Centre owners to allow assessment of gas/vapour migration risks. Was not possible to fully resolve previously identified uncertainty concerning risk posed to relevant receptors at this Site boundary. Further information concerning ground conditions at the adjacent shopping centre was however obtained which allowed limited refinement of current understanding (informed by results from offsite monitoring at the eastern and western boundaries of the Daly Street Site area).	Provisional risk rating of 'very low' considered applicable to South Fremantle Marketplace Shopping Centre receptors located north and north east of the Daly Street area of the Site (i.e. north and east of MBD1), subject to: - Confirmation in future interim monitoring to address other remaining data gaps (GV 1.2C). - City of Fremantle to communicate OLGV findings to site owners to seek an opportunity for access for confirmatory investigation.

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Relevant boundary	Details	Conclusions/Recommendations
Hollis Park Area northern, western and southern boundaries	Risk to receptors considered to be Characteristic Situation 1 conditions i.e. 'very low risk'.	No further action was considered to be required.
Sandown Park Area, western and eastern boundaries	Access to land beyond these boundaries was not possible for inclusion of these boundaries to assess previously identified Characteristic Situation 2 'low risk' rating for relevant receptors. Further information concerning ground conditions beyond the western boundary did however allow limited refinement of current understanding. In particular, the significant volume of fill material comprising the development platform at this land was identified as a credible source of carbon dioxide detected in historical gas investigation. A source of this nature was not be expected to be associated with significant flows.	Further action as per the I-SMP (GHD 2013) was considered appropriate to confirm gas/vapour characteristics at the western and eastern boundaries the Sandown Park area (data gaps GV8.1 and 8.2).
Sandown Park Area, Southern boundary with Fremantle Village	Risk rating for this area is unchanged from previous assessment (moderate to low risk GHD 2010, GHD DSR 2012) for receptors in the form of site users/property.	Due to the presence of landfill wastes present beneath Fremantle Village and assuming management measures understood to be in force at the Fremantle Village are being implemented in an appropriate manner, no further action proposed whilst the Sandown Park area of the Site and adjacent Fremantle Village remain in their current condition.
All boundaries (also on site)	Reinforce the current dataset (and understanding) of gas characteristics for the Site as a whole.	Recommended monitoring of the Site as a whole be continued as an interim measure (I-SMP data gap GV1.3/GV8.3: GHD 2013) until the assessment of remaining boundaries has been completed (i.e. when access to land beyond those boundaries is available).
	Workers undertaking below ground maintenance works would potentially be exposed to increased risk if entry into a confined space was to occur without appropriate management measures necessary for such work. However, uncontrolled entry into a confined space containing a hazardous atmosphere considered unlikely to occur. Subject to suitable control measures risk to offsite workers considered to be low.	As a precautionary measure, City of Fremantle to confirm that suitable administrative controls are in place with relevant utilities companies to consider risks associated with hazardous gases and vapours in infrastructure maintenance works at land adjacent to the Site.
	Consideration of future development of the Site (data gap GV5) was not included in the assessment. However development at the Site without appropriate mitigation measures was considered likely to increase risks to relevant receptors, (i.e. including offsite receptors).	If development at the Site were contemplated then further assessment would be required.

1.7.1 Offsite Landfill Gas and Vapour Investigation (GHD, 2017)

Site in undeveloped condition

With respect to the SFLS in its undeveloped condition, no further action was considered to be required with respect to the risks posed by landfill gases and vapours to offsite receptors at the Site boundaries. As a precautionary measure, it was recommended that the CoF confirm suitable administrative controls are in place with relevant utilities companies to consider risks associated with hazardous gases and vapours in infrastructure maintenance works at land adjacent to the SFLS.

With respect to on-site receptors, potential risks in the SFLS current, undeveloped condition were unchanged from the previous assessment (GHD, 2014), as summarised below:

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- Existing site visitors (fenced footpath): no significant risk identified.
- Maintenance workers undertaking below ground works (ATCO gas main): 'low' risk (with appropriate control measures in accordance with current legislated health and safety requirements for implementation of management measures relating to such work).

It is understood that surface maintenance works comprising periodic short duration vegetation clearance for fire management purposes takes place at the SFLS. Based on gas characteristics identified at the SFLS and the open environment in which the works take place, it was considered that potential risks posed to maintenance workers undertaking such works with respect to landfill gases and vapours are not significant for the Site in current undeveloped condition.

Future development

Future development of the SFLS was not specifically considered in the assessment. However, the assessment concluded that development at the SFLS without appropriate mitigation measures is considered likely to increase risks to relevant on site and off site receptors. In particular:

- The presence of elevated ground gases and vapours on-site present a hazard to future development at the Site as this would introduce additional pathways (e.g. vertical migration via deep foundations) and receptors (e.g. future site users) to the Site.
- Development potentially enhances the viability of existing pathways such as greater lateral migration due to the introduction of buildings, infrastructure and low permeability surfacing which restrict surface venting of landfill gases and vapours.

The assessment concluded that if redevelopment of the SFLS is to be undertaken, the Characteristic Situation should be provisionally raised to 3 (i.e. 'moderate' risk) and further assessment with respect to landfill gases and vapours will therefore be required. Such assessment would also be required for redevelopment of the Geodis Wilson Buildings, should this be contemplated in the future, to determine requirements (if any) for appropriate mitigation measures.

In the context of the proposed development plans which form the basis of this SMP, the recommendation for further assessment with respect to landfill gases and vapours (as described above) has been evaluated in Section 2.2.

1.8 Conceptual site model

1.8.1 Undeveloped condition (current)

A CSM was previously developed (GHD, 2012) and subsequently updated with outcomes from the previous OLGV (GHD, 2014). The CSM was further refined (where relevant) with reference to the outcomes of the most recent offsite landfill gas and vapour investigation (GHD, 2017). The current CSM (site in undeveloped condition) is presented in Table 5 below.

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Table 5 Conceptual site model (undeveloped condition) (GHD, 2017)

Sources	Pathways	Receptors	Risk to receptors
Inorganic and organic substances and pathogens within waste/fill materials; Mobile contaminants within groundwater (primary and secondary groundwater contaminants of concern and possible other substances of interest. Ground gases and vapours.	Vertical migration of gases/vapours via permeable materials and surface emission. Lateral migration of gases/vapours via permeable strata fill/waste/ natural strata (or via groundwater) Vertical migration of gases/vapours to buildings and intrusion (asphyxiation and/or explosion hazard). Also accumulation within and migration via services (asphyxiation and/or explosion hazard). Direct contact with contaminants (in soil). Wind borne dust. Migration of mobile contaminants via groundwater abstraction bore (non-potable use).	Human health (offsite): Existing adjacent site users/residents Maintenance workers undertaking below ground works Human health (onsite): Existing site visitors (fenced footpath) Maintenance workers (surface maintenance works onsite) Maintenance workers undertaking below ground works Future Site Users (public open space users, residents, commercial users) – not considered in assessments conducted to date	Offsite receptors: Daly Street, Hollis Park Site areas, Sandown Park western and eastern boundaries No further action is considered to be required at this time with respect to 'very low' risks posed by ground gases and vapours (for the Site and Geodis Wilson Buildings) in current undeveloped condition) to relevant offsite receptors in the form of existing adjacent site users/residents and maintenance workers undertaking below ground works. Offsite receptors Sandown Park Southern boundary:' The risk rating for this area unchanged from previous assessment ('moderate to 'low' risk for existing adjacent site users/residents (GHD, 2010; GHD, 2012). No further action is proposed at this time whilst the Sandown Park area of the Site and adjacent Fremantle Village remain in their current condition. Existing Site visitors (fenced footpath) and Maintenance workers (surface maintenance works onsite): No significant risk identified at this time for current site condition. Onsite/offsite Maintenance workers undertaking below ground works: Workers undertaking below ground maintenance works would potentially be exposed to increased risk if entry into a confined space was to occur without appropriate management measures necessary for such work. However, given current legislated health and safety requirements for management measures relating to such work, it is considered that uncontrolled entry into a confined space containing a hazardous atmosphere would in practice be unlikely to occur. On this basis, risks are considered to be 'low' with the implementation of appropriate control measures. As a precautionary measure, it is recommended City of Fremantle confirm that suitable administrative controls are in place with relevant utilities companies to consider risks associated with hazardous gases and vapours in infrastructure maintenance works at land adjacent to the Site. Future Site Users: Future development of the Site (data gap GV5) was not specifically considered in the assessment. However, redevelopment at the Site without appropriate mitigation measures is considered likely to increase risks to relevant on site and off site receptors, provisionally to Characteristic Situation 3 (i.e. 'moderate' risk). If redevelopment of the Site is to be undertaken, further assessment with respect to landfill gases and vapours will therefore be required. Such assessment would also be required for redevelopment of the Geodis Wilson Buildings, should this be contemplated in the future, to determine requirements (if any) for appropriate mitigation measures.
	Direct contact with contaminants (in soil or groundwater). Wind borne dust. Lateral migration of dissolved contaminants via groundwater flow	Environment: Groundwater Indian Ocean Flora and Fauna (on site) Flora and Fauna (off site)	-
	Lateral migration of gases/vapours via permeable strata fill/waste/ natural strata. Vertical migration of gases/vapours to buildings and intrusion via cracks/construction joints and openings in concrete ground slab and accumulation in indoor air (explosion hazard). Also accumulation within and migration via services pipes/ducts/drains/bores (explosion hazard). Direct contact with contaminants (in soil). Irrigated vegetation contact with bore water.	Property: Existing on site below ground infrastructure (gas pipeline) Existing off site buildings and below ground infrastructure Future Site Uses (buildings, hard standing, below ground infrastructure, introduced vegetation/landscaping)	Offsite property: as for human receptors above.

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1.8.2 Developed condition

A refined CSM, reflective of the proposed solar farm and specific to this SMP, is provided in Table 6 below. Further information on extent of management required (based on the proposed solar farm development) is provided in Section 2.

It is pertinent to note that the refined CSM also incorporates (where relevant) existing activities potentially impacted by the solar farm where appropriate management measures are not in place. Management of other potential risks not associated with the solar farm should continue to be managed by the CoF in accordance with the existing I-SMP, detailed further in Section 2.4).

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Table 6 Refined conceptual site model (developed condition)

Source	Transport mechanisms	Exposure routes	Receptor	Summary of potential risk
ACM in existing surface soils (landfill capping material)	Damage during excavation / wind-blown dust	Inhalation of fibres	Site workers during construction	Potentially complete exposure pathway and unacceptable risk. Requires appropriate management in accordance with this SMP.
Ground gases and vapours (landfill waste mass)	Vertical migration of gases/vapours via permeable materials and surface emission. Lateral migration of gases/vapours via permeable strata fill/waste/ natural strata (or via groundwater) Vertical migration of gases/vapours to buildings and intrusion Accumulation within and migration via services	Asphyxiation and/or explosion hazard.	Site workers during construction Ongoing maintenance staff (Epuron and CoF) Below ground maintenance staff (CoF) Offsite adjacent residents	
ACM and other contaminants (bund material quality not known)	Wind-blown dust	Direct contact and inhalation	Site workers during construction Ongoing maintenance staff (if bund material reused)	
ACM and other contaminants (Imported fill material)	Wind-blown dust	Direct contact and inhalation	Site workers during construction Ongoing maintenance staff (if bund material reused)	

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1.9 Limitations

This report has been prepared by GHD for Epuron Projects Pty Ltd and may only be used and relied on by Epuron Projects Pty Ltd and the CSA for the purpose agreed between GHD and the Epuron Projects Pty Ltd as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Epuron Projects Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (Section 1.10). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Epuron Projects Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Management activities identified in the I-SMP (GHD, 2013) which are unrelated to solar farm development and not the responsibility of Epuron to implement in relation to the larger SFLS comprise:

- Groundwater monitoring and management requirements.
- Existing users of the SFLS (excluding the solar farm area).
- Other management/monitoring requirements as stipulated by the I-SMP (GHD, 2013).

These are to be addressed separately by CoF. Items excluded from this SMP are detailed further in 2.4.

1.10 Assumptions

The SMP has been developed based on the following assumptions:

- This SMP does not address construction phase risk management measures or provide a construction environmental management plan as part of these works.
- The status of solar farm design proposals is preliminary at the time of preparing this SMP. This SMP does not address the design or development of LFG management measures for solar farm infrastructure or for provision of advice concerning geotechnical/civil works. The SMP is therefore subject to review and possible amendment when solar farm development proposals are progressed to detailed design stage.
- It is assumed that all necessary community consultation will be undertaken by Epuron.
- The current status of the Site with respect to the *CS Act* (2003) does not preclude solar farm development at the site.

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2. Extent of management required

Solar farm characteristics and the extent of management required for such development are presented in the following sections.

2.1 Solar farm characteristics

2.1.1 Solar farm development

Based on current development proposals and additional information provided by Epuron (Appendix B), the solar farm development will likely encompass the following:

- Possible minor site preparation works (i.e. vegetation removal) to allow for even placement of the solar farm.
- The proposed solar farm footprint (maximum extent; shown as Option 1 in Appendix B) will extend into an existing earth bund at the Site (bund material to be re-used subject to suitability). Where additional fill is required, material may be imported to the Site. No significant re-grading of the Site is therefore proposed and surface water will therefore infiltrate the site surface in a similar manner to the current circumstances. Subject to suitability of bund material for reuse, Option 2 (Appendix B) will not disturb the existing bund.
- Deployment of a pre-fabricated, continuous solar arrays (pre-ballasted using ground beams to address wind loadings).
- Subject to ground conditions, solar arrays are anchored via ground screws (to 0.5 m below ground level: BGL) at the end of each row. Ground screws are a minimal displacement anchoring solution in which soil is displaced rather than removed in the installation process. If ground conditions are deemed not suitable for use of ground screws, an alternative solution comprising larger ground beams (with a larger footprint area to minimise ground bearing pressures) at the end of each row will be utilised.
- Other ground beams are connected together and do not require anchoring as these achieve stability requirements through the mass of ground beams alone. The arrays are essentially lightweight structures, which do not impose significant bearing pressures upon underlying soils.
- Possible use of rubber pads to level each unit and ensure ground clearance underneath each beam (each beam has 3 points of contact to the ground). Allowance for air flow beneath each unit (0.6 m) and between each solar module (set of panels).
- Continuous array format to circumvent the requirement of trenching for direct current (DC) cables (DC cables are ground-mounted via cable trays or similar) between modules.
- Inclusion of passive venting measures within ground-mounted cable trays and cabinets.
- Outdoor operation cabinet for switchboards, transformer, metering and associated equipment.
- Installation of a site perimeter fence and associated post footings (depth to be confirmed, but likely no deeper than 1-2 mBGL).
- On-site tracks (unsealed) to allow access for ongoing maintenance.
- No significant formal alteration to drainage characteristics of the Site is proposed. Run-off from each solar panel is shed onto the ground surface at the location of each panel. Infiltration will therefore remain consistent across the Site surface and will not be

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concentrated to particular areas; however, existing soak wells in the southern portion of Sandown Park may be disturbed.

2.1.2 Solar farm operation and maintenance

Based on information provided by Epuron, minimal requirements for on-site presence during operation and maintenance of the solar farm are expected. It is understood that at this time, this is likely to comprise:

- Two scheduled visits per year (maximum four contractors using a vehicle) for routine maintenance purposes.
- Maintenance of vegetation by Epuron (approximately two to three times yearly pending rainfall and other climatic factors). Vegetation maintenance may undertaken using mechanical equipment.
- Possible unscheduled maintenance for the purpose of replacement of components in the event of damage (e.g. such as damage to panels, cables or inverter components).
- Operation of the plant via remote Supervisory control and data acquisition (SCADA) monitoring.

2.2 Solar farm sensitivity to site conditions

Future development of the Site was not specifically considered in previous site assessment. GHD (2017) determined that that the presence of elevated ground gases and vapours onsite present a hazard to future development as this may introduce additional pathways (e.g. vertical migration via deep foundations) and receptors (e.g. future site users) to the Site.

Additionally, it was noted that future development potentially enhances the viability of existing pathways such as greater lateral migration due to the introduction of buildings, infrastructure and low permeability surfacing which restrict surface venting of landfill gases and vapours. It was further concluded that if redevelopment of the Site is to be undertaken, the Characteristic Situation should be provisionally raised to 3 (i.e. 'moderate' risk) and further assessment with respect to landfill gases and vapours will therefore be required.

However, as identified in Section 2.1, the solar farm is essentially a light-weight form of development with limited infrastructure requirements and significant tolerance of ground settlement. In particular:

- Development is unlikely to significantly influence surface venting of landfill gases and vapours from the Site, as the proposed development does not comprise the introduction of buildings, underground infrastructure and/or hardstand areas/ low permeability surfacing.
- Ground bearing pressures imposed by solar arrays and minor regrading of the ground surface are not expected to be significant due to the small mass of the structures and limited ground-contact footprint areas (i.e. with increased bearing pressures dissipated within very shallow zone of influence only).
- No significant formal alteration to drainage characteristics of the Site is proposed. Infiltration is expected to remain consistent across the Site surface.
- The deployment of the solar farm arrays include voids for airflow beneath each unit; therefore, the enhancement of landfill gas migration as a result of the deployment is not anticipated (i.e. in the absence of introducing low permeability surfacing).
- Foundation excavations are not generally proposed with the possible limited exception of shallow footings required for the installation of fence infrastructure. Installation of such footings is not considered to present a management issue with respect to landfill gas and/or

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vapour, however appropriate soil management is expected to be required for excavation arisings.

- The presence of site workers associated with the development and operation of the solar farm is not expected to differ significantly from the risk profile established previously (GHD, 2017) for CoF staff undertaking maintenance work at the Site (subject to implementation of appropriate management measures for reuse of bund material on-site).

In these respects, the proposed solar farm development is:

- Of relatively low sensitivity to issues presented to more conventional forms of development at former landfill sites.
- Involves significantly less ground disturbance than more conventional forms of development.

Due to these characteristics, the risk profile of the Site is not expected to materially alter as a result of low sensitivity solar farm development. On this basis, the previous recommendation (GHD, 2017) for further assessment with respect to landfill gases and vapours is not considered necessary prior to formulating a suitable management approach for the Site (i.e. in the context of the proposed development).

Notwithstanding this, a number of development activities (both during and post-construction) will require management to mitigate potential risks to human health and the environment. These form the basis of this SMP and are presented below in Section 2.3.

2.3 Summary of development activities requiring management

The following activities will require specific site management to ensure no unacceptable risks to receptors and to ensure no increase in site risk profile. These are summarised in Table 7 below.

Table 7 Extent of management required for solar farm

Development activity or characteristic requiring management	Rationale for appropriate management requirement (risk to be mitigated)
During development	
Site preparation	Minor land disturbance of surface soils during site preparation may be undertaken. Potential for disturbance of asbestos containing material (ACM) within surficial soils (i.e. landfill capping material) including possible exposure/presence within top 0.1 m of soil. Site preparation activities should not significantly alter site drainage characteristics from current conditions. Removal of existing earth bund (and adjacent stockpiles to the east) to generate flat surface and accommodate maximum potential footprint (area) of solar farm (Option 1 in Appendix B). The quality of the bund material is not known. Therefore, this will also require appropriate management (if disturbed) to ensure no unacceptable risk during disturbance and ongoing use of the Site from potentially hazardous or otherwise undesirable constituents that may be present (e.g. ACM and/or refuse constituents).
Deployment of solar farm	Periodic monitoring of landfill gas and vapour concentrations to confirm no significant change in risk profile of the Site. Contingency measures for unexpected changes landfill gas and vapour concentrations
Installation of footings	Footings for fence installation may trigger appropriate soil management with respect to ACM contamination and/or

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Development activity or characteristic requiring management	Rationale for appropriate management requirement (risk to be mitigated)
	presence of otherwise undesirable constituents (e.g. refuse material). Note; grounds screws to 0.5 mBGL for anchoring solar array (if used) are unlikely to disturb soil and/or landfill gas through installation process and use a minimal displacement installation method to minimise generation of arisings.
Importation of fill material	Fill material imported to site (if required) must be of suitable quality to ensure no ongoing risk to receptors and use of the Site as a solar farm.
Post-construction (ongoing)	
Migration into and accumulation of landfill gases (and possibly vapours) within: ground-mounted cable trays and cabinets.	Appropriate venting measures to mitigate development of hazardous atmospheres within infrastructure which are or may contain enclosed spaces. Spark and/or electrical arc suppression measures to control ignition sources associated with electrical equipment such as switches/relays for switchboards, transformer, metering and associated equipment.
Future disturbance of soil	Potential disturbance of soil during maintenance (future underground infrastructure – if required, repairs to existing fencing, etc.) may trigger soil management requirement, particularly with respect to ACM.

Where activities are identified in Section 2.10 but are not specified above, no specific management (under this SMP) is at this time determined to be required.

2.4 Site management for solar farm – excluded items

Management activities identified in the I-SMP (GHD, 2013) which are unrelated to solar farm development and not the responsibility of Epuron to implement in relation to the larger SFLS, are identified below.

2.4.1 Groundwater monitoring and management requirements

The I-SMP (GHD, 2013) for the Site identified that off-site groundwater impacts appeared to be of limited magnitude but require confirmation. The following data gaps were identified:

- Hydrogeological regime
- Background (up gradient) water quality
- Scale of groundwater impacts
- Down-gradient groundwater quality characteristics
- Groundwater impact upon marine water quality
- Groundwater impact from the Fremantle Village site
- Validity of data from down gradient private bores
- Presence of non-aqueous phase liquids (NAPL - hydrocarbons) in groundwater
- Impact from possible future development on groundwater regime

With respect to the above data gaps, the I-SMP identified that future development of the Site may significantly affect the groundwater regime at the Site. However, it is important to note that the nature of future of development was not defined at the time of I-SMP preparation and did not include consideration of a low-sensitivity form of development such as a solar farm (i.e.

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which does not involve construction of structures with significant foundation loadings or substantial areas of sealed surfacing).

As noted in Sections 2.1 and 2.2 above, no significant formal alteration to drainage characteristics of the Site is proposed. In particular, there is unlikely to be any adverse impact on groundwater as:

- Infiltration is not expected to differ significantly to that of the Site in its current undeveloped condition, except locally at the existing bund if removed as part of site preparation; however, given the footprint area of this and generally permeable nature of site, it is not at this time expected that bund removal would be capable of significantly influencing landfill gas or leachate characteristics.
- The proposed solar farm development does not incorporate the entirety of the former SFLS (approximately 40 % will be utilised for the solar farm). Infiltration rates (and potential leachate generation) are unlikely to alter significantly from the Site in its current undeveloped condition.

Therefore, risks posed to groundwater are not at this time expected to be significantly influenced by the proposed solar farm development and no management action is considered to be required specifically in relation to the solar farm development. Management action in relation to addressing data gaps, as already identified in the I-SMP, will therefore be progressed separately by CoF. If the proposed form of solar farm development is amended, then this matter should be reviewed and this SMP updated to include any management action concerning groundwater that is considered to be necessary.

2.4.2 Existing users of the SFLS (excluding the solar farm area)

As noted in Section 1.8, existing activities are currently undertaken at the larger SFLS which are not related to the proposed solar farm and not undertaken by Epuron. Such activities are excluded from the SMP and shall continue to be managed by the existing I-SMP (GHD 2013) or as otherwise recommended in subsequent reporting, as summarised below:

- Site visits by an Environmental Consultant to undertake ongoing monitoring requirements as per the existing I-SMP (GHD, 2017).
- Surface and below ground maintenance and servicing of existing assets (not related to the Solar Farm).
- Maintenance and operation of other areas of the SFLS that are not within the Site.

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3. Management objectives

3.1 Site management objectives and targets

It is important to note that remediation of the Site (*sensu stricto*) has not been undertaken, and is not proposed as part of this SMP; as noted previously (Section 1.1), the Site is a former landfill site and any future development of the Site must consider and manage the potential risks associated with contamination.

On this basis, site management objectives and targets proposed have been developed (in the context of site development) on the basis of ensuring:

- No significant change (increase) in the risk profile of the Site.
- No unacceptable risk posed to on- and off-site receptors.

Management objectives and targets (including derivation details) are provided in Table 8.

Table 8 Management targets for site management

Environmental media	Management objective	Management target and derivation detail
Ground gas: landfill gas and vapour	No significant increasing concentrations in landfill gas and/or vapours that would constitute an unacceptable risk to relevant receptors (i.e. maintenance personnel and/or off-site residents).	No change in site risk classification above 'low risk' (CIRIA C665). Modelling (using most conservative outcomes from the Ferguson Krylov Mcgrath method as used in the 2016 landfill gas investigation) indicates maximum tolerable CO_2 concentration along western boundary wells (identified in Table 14) should be no greater than 12.5 %. This is based on not exceeding 0.125% in indoor air (CIRIA C665) in adjacent properties along western boundary. No significant increase in flow rate i.e. > 0.5 l/hr. For consistency, methods to calculate gas screening value (GSV) and risk classification will be adopted from the 2016 off-site landfill gas investigation (GHD, 2017).
Site surface soils	No unacceptable risk to relevant receptors (site workers during development related land disturbance and ongoing use).	Remove visible surface ACM as per contingency plan (Section 10) and with reference *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Site in Western Australia* (DoH, 2009), and disposal at licenced landfill facility.
	No visible asbestos within the top 0.1 m of soil at the Site.	
	No other undesirable materials exposed at site surface (e.g. refuse materials that may be aesthetically undesirable	Document and removal of chemically discoloured and/or odoriferous soils at surface level (i.e. top 0.1 m) to licenced landfill facility.

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Environmental media	Management objective	Management target and detailed detail
	and/or result in public concern).	Management with reference to Section 3.6 of the *ASC NEPM* Schedule B1 and as per contingency plan (Section 10).
Earth bund material (and adjacent stockpiles to the east)	If re-used, no unacceptable risk to relevant receptors (site workers during development related land disturbance and ongoing operational use).	All soil results below relevant assessment levels as defined in the *ASC NEPM* (HIL/HSL and EIL/ESL).
	No visible asbestos within the top 0.1 m of soil at the Site.	Remove visible surface ACM as per contingency plan (Section 10) and with reference *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Site in Western Australia* (DoH, 2009), and disposal at licenced landfill facility.
	No other undesirable materials exposed at site surface (e.g. refuse materials that may be aesthetically undesirable and/or result in site workers or public concern).	Document and removal of chemically discoloured and/or odoriferous soils at surface level (i.e. top 0.1 m) to licenced landfill facility. Management with reference to Section 3.6 of the *ASC NEPM* Schedule B1 and as per contingency plan (Section 10).
Imported fill material	No unacceptable risk to relevant receptors (site workers during development related land disturbance and ongoing operational use).	All soil results below relevant assessment levels as defined in the *ASC NEPM* (HIL/HSL and EIL/ESL).
Excavation arisings (e.g. perimeter fence posts)	No unacceptable risk to site users during development related land disturbing activities.	Remove visible surface ACM as per contingency plan (Section 10) and with reference *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Site in Western Australia* (DoH, 2009), and disposal at licenced landfill facility.

Validation of remedial targets will be undertaken through implementation of a site-specific monitoring program proposed as part of this SMP (refer to Section 4).

3.2 Landfill classification for off-site disposal

Where material is excavated from the Site requiring off-site disposal, the excavated material shall be classified in accordance with *Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009)* (DEC 2009) which provides criteria for assessing the appropriate waste classification and subsequent disposal location for contaminated soil.

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4. Site management strategy

4.1 Site management measures

The site management strategy describes the overall management framework for the Site to address potential risks associated with the proposed development. Specifically, the management strategy addresses:

- Timeframes required for implementation of the SMP.
- Stakeholder roles and responsibilities.
- Section 5: Development of a Sampling and Analysis Quality Plan (SAQP) to appropriately guide the monitoring requirements to be implemented as part of the development works, which comprise:
  - Section 6: Pre-development management requirements
  - Section 7: Management during development
  - Section 8: Post-construction validation monitoring and ongoing operational controls
  - Section 9: Quality assurance (QA) and quality control (QC) requirements to be implemented for the duration of the monitoring program
- Section 10: Circumstances and events requiring contingency actions and the associated procedures to be adopted.
- Section 11: Reporting requirements of the SMP, including the circumstances under which a revision to the SMP is warranted.

4.2 Timeframe for site management

This SMP will be in operation over the lifetime of the solar farm; the SMP should be reviewed following the specified landfill gas and vapour monitoring events to confirm the frequency and duration of events are applicable or requirements for amendment.

4.3 Stakeholder identification

GHD notes the *ASC NEPM Schedule B8 – Guideline on Community Engagement and Risk Communication* (NEPC 1999). The community consultation process is being addressed directly by Epuron.

Identified stakeholders and their associated roles and responsibilities as relevant to the SMP are summarised in Table 9.

Table 9 Stakeholder roles and responsibilities

Role and name of stakeholder	Responsibility
Principal (Epuron)	Fulfil the requirements of the SMP and reporting / notification requirements. Implement the SMP and undertake the required monitoring in accordance with this governing document (if they are suitably experienced competent person/s [see below]). Responsible for appointment of relevant organisations to undertake the works and stakeholder management.
Superintendent (Epuron)	Responsible for contract document preparation and procurement. Review and approval of contractor plans such as Environmental Management Plans and Occupational Health and Safety Management Plans.

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Role and name of stakeholder	Responsibility
Contractor (to be appointed)	The company contracted to construct the Solar Farm. The Contractor is responsible for all required civil works including all measures required to protect workers and public health and the environment during the works system and provision of 'As Constructed' information to the relevant parties
Suitably experienced competent person (if appointed)	This is defined by the National Occupational Health and Safety Commission (NOHSC) as a "*Person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill, for the safe performance of the specific work*." (NOHSC, 2005a)". For the purpose of this SMP, this will include persons capable of undertaking ACM assessment/management actions, or landfill gas and vapour assessment and/or management actions, and/or annual inspections. This may be the Principal or an Environmental Consultant engaged by the Principal.
Environmental Consultant (GHD)	Appointed by Epuron and responsible for updating the SMP, as required. Completion of technical work such as ACM and/or landfill gas and vapour assessment and management actions on behalf of the Principal, if required.
Contaminated Sites Auditor (Mr Jason Clay, of Senversa)	Audit the implementation of this SMP and report on its compliance to DWER. As required, review and provide comment on information relating to contamination for incorporation into future revisions of this SMP (if required). As required, provide approval to cease or vary any component of the SMP, which will form part of the ongoing MAR for the Site. Update and revise the MAR.
Regulatory body (DWER Contaminated Sites Branch)	Review and provide approval of the MAR.
Site owner (City of Fremantle)	Endorse the SMP and continue to implement the I-SMP for the Site (GHD, 2017) and undertake stakeholder consultation.
Long-term lease operator (Epuron)	The company or other entity that is leasing or carrying out operations or otherwise using the Solar Farm.

The requirements for notification of stakeholders in response to outcomes from identified site management measures are identified in Section 10.9.

4.4 Site-specific health and safety management

Health, safety and environmental management requirements will be addressed separately within a CEMP, or similar. Where required, the CEMP should provide risk mitigation and management measures for a range of situations that may occur on the Site during development, including, *inter alia*, confined space management, vapour risk, water management, trenching works, excavation and waste management, noise, odour and dust.

4.5 Protection of monitoring infrastructure

Prior to development commencing, adequate protection measures shall be implemented (where not already in place) to preserve the integrity of existing monitoring infrastructure at the Site. Infrastructure includes:

- Groundwater monitoring wells
- Landfill gas/vapour monitoring wells

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In the event of damage, contingency measures shall be employed as detailed in the contingency plan (Section 10).

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5. Sampling and analysis quality plan

Monitoring requirements at the Site will be addressed through implementation of a SMP-specific Sampling and Analysis Quality Plan (SAQP). The purpose of the SAQP is to outline the proposed sampling approach and methodologies in order to appropriately validate the appropriateness and effectiveness of the proposed management measures.

The SAQP provides:

- The Data Quality Objectives (DQOs) for the SMP monitoring program.
- The monitoring and sampling methodologies to be adopted.
- The field and laboratory analytical schedule.

Additional pertinent information in relation to the SAQP (such as proposed monitoring locations and frequency of sampling), is provided in each relevant stage of management requirement (Section 6, Section 7, and Section 8). The QA/QC program is provided in Section 9.

5.1 SAQP guideline framework

The SAQP has been prepared with reference to relevant guideline documents concerning contaminated sites and ground gas, as outlined below:

- Construction Industry Research and Information Association (CIRIA) *Assessing risks posed by hazardous ground gases to buildings C665* (CIRIA, 2007).
- DWER *Contaminated Sites Guidelines: Assessment and management of contaminated sites* (DER, 2014).
- Department of Health (DoH) *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Site in Western Australia* (DoH, 2009).
- Environmental Protection Agency (EPA) Victoria, *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines, Publication 1416, September 2011* (EPA Victoria, 2011).
- *NEPC National Environment Protection (Assessment of Site Contamination) Measure*, (*ASC NEPM*) NEPM Amendment 2013 No. 1 (NEPC, 1999).
- NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (NSW EPA, 2012).

5.2 Data quality objectives

Development of DQOs for the SMP monitoring requirements is based on guidance presented in the *ASC NEPM*.

The DQO process comprises the following seven steps:

- Step 1: State the problem.
- Step 2: Identify the principal study question.
- Step 3: Inputs to the decision.
- Step 4: Boundaries of the study.
- Step 5: Decision rules.
- Step 6: Tolerable limits on decision errors.
- Step 7: Optimisation of the data collection process.

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A summary of the DQO process for this investigation is presented below in Table 10.

Table 10 Data quality objectives

DQO	Sub-item	Description
Step 1: State the Problem	Problem description	The Site is a former landfill and is currently classified as '*Contaminated – remediation required*' under the CS Act (2003). No further action is considered to be required with respect to the risks posed by landfill gases and vapours to offsite receptors at the Site boundaries whilst the Site remains in its current, undeveloped condition. However, future development of the Site must consider and manage the potential risks associated sources of contamination. Development of the Site as a solar farm (if not managed appropriately) may increase the site risk profile and pose an unacceptable risk to identified receptors. Appropriate site management during development (and post-construction) is therefore required to: • Avoid, mitigate or manage potential negative impacts on the migration of existing contamination (primarily focused on landfill gas) associated with the development and operation of the solar farm. • Avoid, mitigate or manage potential risks to operation and maintenance workers associated with existing site contamination.
	Identify members of the planning team	The project team structure is outlined below: Client: Epuron Projects Pty Ltd (Epuron) Environmental Consultant: GHD Pty Ltd Contaminated Sites Auditor: Jason Clay (Senversa Pty Ltd) Solar farm designer: Complete Power Solutions Pty Ltd (CPS National)
	Develop the conceptual site model (CSM)	The CSM (with respect to the Site in both current [undeveloped] and proposed [developed] condition) is provided in Section 1.8. The CSM will be updated as required, as additional data and information becomes available.
	Specify available resources and constraints	Resources: GHD provide and/or contract the necessary resources and suppliers for the work as specified in a proposal. Constraints: Potential constraints comprise: • High pressure gas main and narrow ditch crossing the SFLS from west to east. • Serviceability and accessibility of existing monitoring installations, some of which lie in land accessible to or in use by other parties or otherwise have uncontrolled access. • Logistical issues associated with undertaking monitoring events under representative weather conditions.

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DQO	Sub-item	Description
Step 2: Identify the Decision	Identify the principal study question	Are the management measures sufficient to manage potential impacts of the solar farm development and risks to receptors.
	Identify alternative actions that could result from resolving the principal study question	Management measures are sufficient at managing the development. No further action required. Management measures are not sufficient, indicating a potentially unacceptable risk to identified receptors. Further action may be necessary and comprise: • Implementing contingency measures: e.g. short-term management actions and/or undertake additional assessment (including monitoring and/or quantitative risk assessment). • Implementing additional management measures (longer term).
Step 3: Identify the Inputs to the Decision	Identify the information that will be required to resolve the decision	The following inputs are required: • Background information from previous investigations; • Understanding of the geology, hydrogeology and topography of the Site. • Solar farm development information. • Field landfill gas and vapour data, targeting methane, carbon dioxide, oxygen, hydrogen sulphide, carbon monoxide, atmospheric pressure, gas flow; and volatile organic compounds. • Field conditions (visual observations) relating to ACM and presence of refuse. • Chemical concentrations of targeted analytes.
	Determine the sources for each item of identified information	The following sources of information will be required: • Previous site investigation reports and then I-SMP (GHD, 2013). • Field and laboratory data, as defined in this SMP. • Proposed development plans (drawings, etc) for the solar farm, to the extent known at this time. • Composition and characteristics of bund material • Visual assessment of ACM in surface soils.
	Identify the information needed to establish the assessment level	Baseline (pre-construction) monitoring data for landfill gases and vapours Monitoring data (field and laboratory) collected during, and post, the construction program concerning soil (ACM and contaminants) and gas.
	Confirm that appropriate analytical methods exist to provide the necessary data	Ground gas: Laboratory analytical methodologies are not required for the ground gas monitoring components, unless the field screening indicates a sample for laboratory analysis is required to address an uncertainty concerning field monitoring data. Soil: National Association of Testing Authorities (NATA) accreditation is available for the proposed analysis from the nominated laboratories. Nominated groundwater laboratory limits of reporting will be below the relevant *ASC NEPM* investigation levels.

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DQO	Sub-item	Description
		Visual inspection of soils for ACM and subsequent laboratory confirmation (if required). Validation criteria as provided in Section 5.4.3.
Step 4: Define the Study Boundaries	Specify the characteristics that define the population of interest	The population of interest comprises landfill gases and vapours, atmospheric pressure conditions and soil conditions, including the composition of the bund material. Ground gas: The most commonly occurring contaminants of concern for this former landfill site include methane, carbon dioxide, oxygen, hydrogen sulphide, carbon monoxide and volatile organic compounds. Gas flow also is a characteristic that will be used to determine risk of landfill gases and vapours. Soil: The most commonly occurring contaminants of concern for this former landfill site include ACM and metals / metalloids.
	Define the spatial boundaries of the decision	The lateral extent of the Site is shown in Figure 1 and defined in Section 1.5. The vertical extent of the Site will extend from surface soils to the base of the landfill waste mass.
	Define the temporal boundaries of the decision	Assessment relates to the site in its current condition with data to be obtained over a period of monitoring which is suitable for assessment purposes, i.e.: • Sufficient to allow prediction of worst case conditions with rising, falling and stable atmospheric pressure being taken into account in the decision process; and • Such that it is unlikely that additional data will change the interpretation of the data, the outcome of the risk assessment and proposed management actions. With respect to soil and ACM, the temporal boundaries are contingent on the proposed construction program and use of the bund material (if disturbed). The temporal boundary is restricted to the Site in its developed condition and qualitative consideration of potential for short term disturbance during development works and ongoing maintenance.
	Define the scale of decision making	The scale of the decision making is limited to the Site boundaries (Figure 1) and identified adjacent offsite receptors.
	Identify Any Practical Constraints on Data Collection	Constraints on data collection are set out in Step 1 of this table.
Step 5: Develop a Decision Rule	Specify the statistical parameter that characterises the population of interest	Landfill gases: CIRIA 2007 GSVs Vapours: qualitative assessment of PID readings Soil: The decision rules for the project will be based on an analysis of land use and the identified receptors, which will in turn lead to the selection of appropriate assessment criteria for the Site. The assessment levels should take into account the future land use within the Site. Management targets are provided in Section 3.

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DQO	Sub-item	Description
	Specify the Action Level for the Decision	Management targets are provided in Section 3.
	Confirm that the Action Level Exceeds Measurement Detection Limits	Ground gas: Detection limits for the GA5000 are listed below: Landfill gas/vapour — Detection limit range Methane — 0-100% Carbon dioxide — 0-100% Oxygen — 0-25% Carbon monoxide — 0-2,000 ppm Hydrogen sulphide — 0-5,000 ppm or 0-10,000 ppm Methane/ carbon dioxide accuracy — +/- 0.5% after calibration Flow accuracy — +/-0.3 L/hr Detection limits for the PID are listed below: • 0-2000 ppm: +/- 2 ppm or 10% reading • >2000 ppm: +/- 20% of reading Soil: Nominated laboratory limits of reporting (LOR) values will be below the nominated management targets (Section 3). ACM (if encountered) compared against criteria as identified in Section 5.4.3.
	Combine the outputs from the previous DQO steps and develop a decision rule.	If the decision rule parameter presented in the first part of this Step 5, exceeds the action level in this Step 5, then the following actions may be undertaken: • Undertake additional assessment (including monitoring and/or quantitative risk assessment); and/or • Implement management measures.
Step 6: Specify Limits on Decision Errors	Baseline decision	Landfill gases and/or vapour characteristics and/or soil characteristics (ACM, chemical concentrations) do not indicate a potentially unacceptable risk to relevant receptors as a result of the solar farm development.
	Determine the possible range of the parameter of interest	The range of the parameters of interest range from the instrument limits of detection to the maximum concentrations of parameters of interest. ACM to be assessed through presence/absence and concentration (%w/w) in soil, as per Section 5.4.3.
	Define both types of decision errors, consequences and the baseline condition	There are two main types of decision errors likely to result from implementation of the SMP. These are discussed below. Type I: Concluding that the site being assessed is contaminated when it is not. This may result in unnecessary expenditures for further investigation and/or remediation. Type II: Concluding that the site being assessed is not contaminated when it is. This may result in risks to human health and the environment. There are two main components of error that may lead to decision errors (US EPA 2006):

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DQO	Sub-item	Description
		Sampling error: This is influenced by the inherent variability of the population over space and time, the sample collection design, and the number of samples taken. It is usually impractical to measure the entire population space, and limited sampling may miss some features of the natural variation of the measurement of interest. Sampling design error occurs when the data collection design does not capture the complete variability within the population space, to the extent appropriate for making conclusions. Sampling error can lead to random error (i.e., random variability or imprecision) and systematic error (bias) in estimates of population parameters. Measurement error: This is influenced by imperfections in the measurement and analysis system. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, data reduction, transmission, and storage. In general, sampling error is much larger than measurement error and consequently needs a larger proportion of resources to control (US EPA 2006).
	Acceptable Limits on Decision Errors	The magnitude of error from the above and likelihood of making incorrect conclusions is controlled (to within acceptable limits) by selection of an appropriate sampling design and accurate measurement techniques. Acceptable limits on decision errors selected for this assessment are further described in the Data Quality Indicators (DQI) in Section 9.
Step 7: Optimise the Design		To maintain the integrity and reliability of data, the following measures will be adopted: • Use of relevant guidelines. • Review of the field and analytical results obtained during each stage of monitoring • Use of robust field and laboratory quality assurance/quality control protocols as outlined in Section 9. • Use of NATA accredited laboratories and suitable laboratory limits of reporting.

5.3 Ground gas monitoring methodology

5.3.1 Calibration of equipment

Prior to use in the field, all field instruments will be calibrated by the equipment supplier to optimise the accuracy of the measurements taken. If field measurements appear to be inconsistent or incorrect, the equipment supplier shall re-calibrate or provide another instrument.

5.3.2 Leak testing

Basic field leak testing will be undertaken at each monitoring well to confirm the integrity of the monitoring wells and sampling train. This will be undertaken by calibrating the PID to ambient air (0.0 ppm) then connecting the PID to the monitoring well and whilst pumping the well, wiping the exterior of the well head, including around the gas tap seal and connection to the PID, with an isobutylene alcohol wipe. If a leak is present, the PID should detect the alcohol from the wipe and report a reading. Results of this test should be recorded on a field sheet and kept on file.

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5.3.3 Ground gas monitoring methodology

Gas monitoring from gas monitoring wells shall be undertaken with reference to the procedures outlined in NSW EPA (2012) and CIRIA C665 (CIRIA, 2007). Monitoring in the field will be undertaken using a Geotech GA5000 portable infra-red gas analyser with internal flow pod and PID for the following:

- methane
- carbon dioxide
- oxygen
- carbon monoxide
- hydrogen sulphide
- atmospheric pressure
- gas flow
- volatile organic compounds (VOCs)

During the monitoring rounds, the following general procedure will be followed:

- The integrity of the well will be recorded prior to sampling.
- An ambient reading will be undertaken prior to sampling each well (to ensure accuracy of results and no cross contamination occurred).
- Well will be unlocked and brass connector attached.
- The GA5000 will be used to measure atmospheric pressure, relative pressure and flow, followed by landfill gases over a minimum period of ten minutes, as per NSW EPA (2012).
- The PID will then be used to measure the volatile organic compounds in vapour over a minimum period of three minutes.
- For both the GA5000 and PID, all concentrations will be recorded until stabilisation, and a summary of steady state, peak and/or low concentrations will be recorded as per NSW EPA (2012) and CIRIA (2007) requirements.
- Any field observations will be noted e.g. moisture in sampling tubes.

5.4 Soil sampling methodology

Soil sampling (where required) will be undertaken with reference to *Assessment and Management of Contaminated Sites* (DER 2014), *AS 4482.1 – 2005* (Standards Australia 2005) and *AS 4482.2* – 1999 (Standards Australia 1999) and *ASC NEPM*.

At each soil sampling location, the following will apply:

- Sample locations will be recorded on a GPS device and appropriately marked on a site plan.
- Logging of soils will be consistent with the Unified Soil Classification System (USCS) at each sample location, comprising the material description (colour, particle size, roundness and sorting) and a note of the water level/saturation content.
- A photographic log will be taken at each sample location.
- Field screening for VOCs using a PID for each soil sample.

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- Sample collection directly into NATA-accredited laboratory soil containers and placed immediately into pre-chilled eskies. Disposable nitrile gloves will be used at each sample locations to minimise cross-contamination and ensure safety.

Additionally, chain of custody documentation will be completed to accompany all sample containers to the laboratory.

5.4.1 Sampling frequencies for reuse, off-site classification and/or importation of fill material

The number of required samples for the purpose of reuse of existing material, off-site disposal and/or importation of fill material shall be accordance with DWER *Landfill Waste Classification and Waste Definitions* guidelines (DEC 2009), as summarised below in Table 11.

Table 11 Sampling frequencies for purpose of reuse, off-site disposal and/or importation of fill

Volume (m^3)	Number of samples
100 to 200	4
200 to 500	6
500 to 1,000	8
1,000 to 2,000	11
2,000 to 3,000	15
3,000 to 4,000	18
4,000 to 5,000	20
5,000 to 10,000	24
>10,000	24 plus 4 for each additional 10,000 m^3

5.4.2 Laboratory analytical schedule

Samples will be submitted to a NATA-accredited laboratory for the following analysis:

- Metals / metalloids (*ASC NEPM* suite)
- Total recoverable hydrocarbons (TRH)
- Polycyclic aromatic hydrocarbons (PAH)
- Organochlorine pesticides (OCP)
- Organophosphorus pesticides (OPP)
- Polychlorinated biphenyls (PCBs)
- Perfluoroalkyl and polyfluoroalkyl (PFAS) substances
- Asbestos (presence/absence)

5.4.3 Asbestos field assessment and validation

The *ASC NEPM* provides risk-based health soil assessment criteria based on DoH *Guidelines for the Assessment, Management and Remediation of Asbestos- Contaminated Sites in Western Australia* (DoH, 2009). The Health Screening Levels (HSLs) for asbestos in soil have been developed to be protective of human health and are based on an assessment of potential exposure via inhalation for various land uses including residential, recreational and commercial/industrial land uses. The adopted HSL for the soil results will be the HSL-D criteria for "*commercial/industrial, including premises such as shops, offices, factories and industrial sites*", as presented in Table 12.

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Table 12 Asbestos validation criteria

Contaminants of concern	HSL-D
Bonded ACM	<0.05% w/w
AF/FA	<0.001 % w/w
All forms of asbestos	No visible asbestos for surface soil (top 10 cm)

HSL – health screening level; ACM – asbestos containing materials; FA – fibrous asbestos; AF - asbestos fines

Where required during soil investigations, field screening for ACM will be undertaken by collecting a bulk soil sample (10L) and sieving through a ≤ 7 mm with reference to DoH (2009) guidelines.

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6. Pre-development management requirements

6.1 Landfill gases and vapours

Appropriate characterisation of pre-development conditions is required to formulate remedial targets for the Site and allow for future comparative assessment during post-construction monitoring of the solar farm. Baseline conditions concerning ground gas have however been addressed through utilising the existing, available dataset concerning ground gas. These have been considered in the development of management objectives for the Site (Section 3.1) and are previously summarised in Section 1.7. Previous reports relating to ground gas and vapours are identified below:

- CSIRO (1986) Investigation of the Concentration of Methane Gas within the Landfill, Corner of Rollinson and Cockburn Roads, S. Fremantle, W.A.
- CSIRO (1989) Investigation of Concentration of Methane Gas within the South Fremantle Landfill Site.
- GHD (2010a) South Fremantle Landfill Site Sampling and Analysis Plan.
- GHD (2010b) South Fremantle Landfill – Interim Assessment of Landfill Gas/Vapour Assessment.
- GHD (2012) South Fremantle Landfill Site Detailed Site Review.
- GHD (2013) South Fremantle Landfill Site Interim Site Management Plan. Rev.1.
- GHD (2015) 2015 South Fremantle Landfill Site Offsite Landfill Gas and Vapour Investigation.
- GHD (2017) 2016 South Fremantle Landfill Site Offsite Landfill Gas and Vapour Investigation.

As noted in Section 4.5, adequate protection measures shall be implemented (where not already in place) to preserve the integrity of existing monitoring infrastructure at the Site.

6.2 Bund and stockpile composition

The quality of the existing earth bund material and adjacent stockpiles to the east is not known. It is recommended that the bund material be surveyed prior to disturbance (if undertaken) to determine an accurate area and volume of material that will be disturbed.

Under the proposed development, three possible scenarios for the bund material have been identified:

- **Scenario 1:** Material is disturbed and re-used across the Site
- **Scenario 2:** Material is disturbed and disposed off-site
- **Scenario 3:** Material remains in-situ.

Under scenario 1 and 2 above, the bund material will require an appropriate level of investigation and management to ensure no unacceptable risk to users of the Site and/or to allow for appropriate off-site disposal.

At this time, scenario 2 is unlikely to be economically viable (i.e. disposal of a large quantity). Under this scenario, the solar farm development footprint may revert to Option 2 (Appendix B), with a smaller footprint, which proposes no disturbance of the bund material.

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The investigation of bund material shall be undertaken in accordance with the SAQP (Section 5.3) and the sampling frequencies and methodologies provided in Table 11 and Section 5.4, respectively.

A 4-tonne excavator (or similar) shall be used to generate a limited number (40) of test pits across the bund material (to maximum 3.0 mBGl across all elevations of the bund) to appropriately visually assess the bund composition for ACM (visual) and potentially other undesirable constituents, including a limited number of samples for chemical analysis (refer to Section 5.4).

Field observations and laboratory analytical concentrations shall comply with management objectives and targets for the Site, as provided in Section 3.1.

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7. Management during development

7.1 Management of land disturbing activities

Based on proposed development information provided by Epuron (Appendix B), significant disturbance of existing soil (landfill waste mass or otherwise) is not proposed to facilitate the solar farm redevelopment.

Notwithstanding this, development activities may involve minor disturbance of existing surface soils as part of site preparation works and to allow for appropriate placement of the solar farm. This may involve:

- Minor disturbance of surface soils during site preparation works i.e. such as vegetation removal (if required), and during the installation of footings for fence infrastructure.
- Reuse of an existing earth bund (if suitable, subject to the outcomes of the prescribed investigation approach detailed in Section 6.2).
- The importation of fill material (i.e. if demand for additional material).

On this basis, soil management measures are summarised below in Table 13.

Table 13 Soil management measures during development (summary)

Site activity	Potential risk	Management requirement
Site preparation	ACM in soil	If encountered, manage in accordance with contingency plan (Section 10.3)
Installation of footings	ACM in soil	If encountered, manage in accordance with contingency plan (Section 10.3)
Existing earth bund material and adjacent stockpiles to the east to be disturbed and reused (Option 1 in Appendix B)	Contaminants and ACM in soil	Management of bund in accordance with measures defined in Section 7.2. Management of ACM and other undesirable constituents (if encountered) in accordance with contingency plan (Section 10.3). Validate surface soils after placement of bund material in accordance with Section 5.4.3.
Importation of material (if required)	Contaminants in soil	Undertake sampling at source quarry to confirm acceptable soil quality prior to importing material to the Site. Manage in accordance with Table 11 and Section 5.4

7.2 Management of bund material

7.2.1 Disturbance of bund material (scenario 1 and 2)

The extent of management control required will be contingent on the quality of the bund material once investigated (refer to Section 6). However, the following principles are likely to be required for all excavations:

- No excavation on the Site shall commence until the air quality monitoring and dust suppression program is implemented and site monitors deployed and active (if determined to be required).

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- All contractors involved in excavation activities must comply with regulations for the proper storage, transport and disposal of waste in Western Australia, including Controlled Waste and Environmental Protection Regulations, as appropriate.
- No excavation should be carried out in windy conditions, which are likely to generate significant airborne dust. If the surface soil is dry and dusty then it must be lightly sprayed with water to prevent any dust occurrence. Water supply for dust suppression must be present at all times during soil excavation works.
- An agreed method of excavation shall be defined on-site to minimise exposure of the excavator and truck drivers to dust.
- Excavations shall be undertaken under periodic supervision of the Environmental Consultant during the excavation period.
- All works shall be carried out to minimise the risk of contaminated material being mixed with uncontaminated material.
- All excavations and loading of trucks shall be undertaken in such a manner that ensures no spillage of contaminated material occurs outside nominated areas or outside the Site boundaries. Excavator operators will take care not to overload trucks.
- The excavations shall be carried out in such a manner as to minimise the material excavated to only material that is necessary for the removal.
- Any spillage of contaminated material outside of the remediation area shall be promptly reported to the Principal and cleaned up.
- If reused, undertake validation in accordance with Section 5.4.3 and DoH (2009) guidelines. The top 0.1 m of surface soil should be visually free from ACM.

7.2.2 Disposal of bund material (scenario 3)/other materials

If requiring disposal off-site (Section 6), the transportation of the bund material from the Site shall conform to the appropriate requirements of the DWER, Main Roads WA, local authorities and any other relevant authorities. The transportation procedures and conditions to be followed at all times will include:

- Compliance with the *Environmental Protection (Controlled Waste) Regulations 2004*, where applicable to the materials to be disposed off-site. In particular:
  - The concentrations of contaminants within the existing earth bund are not known, however, it is noted (DER, 2015) that where a controlled waste may be lawfully accepted at a suitably licensed Class I, Class II or Class III landfill site that an exclusion from the *Environmental Protection (Controlled Waste) Regulations 2004* applies to controlled wastes transported on a road.
  - The transportation of asbestos waste is not exempt from the *Environmental Protection (Controlled Waste) Regulations 2004*; however, a controlled waste transport licence and documentation are not required (DER, 2015).
  - If unexpected finds occur, the *Environmental Protection (Controlled Waste) Regulations 2004*, may become applicable to the materials to be disposed off-site. In such a case, a controlled waste permit issued by the DWER and controlled waste permits shall be used for carting and disposal of controlled wastes.
- All trucks transporting contaminated soil will be covered/enclosed to prevent dust emissions.
- Before leaving the Site, trucks transporting contaminated soils will be inspected to ensure that no contaminated soil is adhering to the outside of the truck.

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- Construction vehicles shall travel along specifically designated routes (e.g. on the existing roads) that have been selected to minimise disturbance on other traffic and the community (this will be based on the size of the vehicle).
- If any spillage of contaminated material occurs along the trucking route it is to be reported immediately to the Superintendent and the Contractor will clean it up directly.

Material tracking

Quantities and types of materials moving on- and off-site must be documented on a material register. This will be compared to waste disposal receipts from receiving facilities. Receipts for disposal of materials must be supplied to the Superintendent at the end of each day.

Any change to the disposal location or provider of clean fill must be negotiated with the Superintendent prior to moving the material on- or off-site.

Should material quantities moving off-site not match quantities being received at the recommended disposal facilities, the Superintendent may cease work until material-tracking issues can be corrected.

7.3 Ground gas monitoring during solar farm deployment

Ground gas monitoring is required to ensure no increase in risk profile during deployment of the solar farm. Monitoring requirements (including proposed monitoring locations) are summarised below in Table 14 and provided in Figure 2. Monitoring shall commence 2 months prior to the commencement of construction works for continuity purposes. This may be subject to amendment depending on which season construction is proposed to commence.

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Table 14 Ground gas monitoring requirements during development

Monitoring network area	Location ID	Analytes	Frequency and timing	Rationale for inclusion
Within Site	MBD6, MBD7,MBD9, MBD11	Field parameters: General gases: methane, carbon dioxide, carbon monoxide, oxygen and hydrogen sulphide; VOCs; flow rate	Once weekly during first two weeks of solar farm deployment. Once monthly thereafter.	To determine the concentration and flow rates of landfill gases and/or vapours in the area covered by the solar farm.
Northern boundary	MBD6, POB16, POB17, POB18			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the north of the Site.
Eastern boundary	MBD15, MBD16, MBD17, POB09, POB10			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the east of the Site.
Southern boundary	MBD12, MBD13, MBD14			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the south of the Site.
Western boundary	MBD18, MBS2, MBS6, MBS7, MBD19, MBD20, MBS8, MBS9, MBD21, MBD7, MBD9 1			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the west of the Site.

Table notations:

1 – monitoring location to be used for assessment within site boundary in addition to western boundary.

Pending timing of deployment and construction schedules, remote monitoring devices (e.g. Gas Clam) may be utilised.

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8. Ongoing management (post-construction)

8.1 Ground gas validation monitoring

Post-construction monitoring is required to demonstrate that lateral sub-surface LFG emissions from beneath the Site are not occurring and do not present a risk to receptors as a result of the construction and operation of the Solar Farm. Requirements for post-construction monitoring of existing gas and vapour wells are presented below in Table 15. Monitoring locations are presented in Figure 2.

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Table 15 Post-construction ground gas validation monitoring requirements

Monitoring network area	Location IDs	Analytes	Frequency and timing	Rationale for inclusion
Within Site	MBD6, MBD7,MBD9, MBD11	Field parameters: General gases: methane, carbon dioxide, carbon monoxide, oxygen and hydrogen sulphide; VOCs; flow rate	Fortnightly monitoring over three months immediately following completion of solar farm deployment would provide a reasonable period of monitoring for validation purposes. One monthly monitoring event per month thereafter, for a further 9 months as an additional verification on site risk profile.	To determine the concentration and flow rates of landfill gases and/or vapours in the area covered by the Solar Farm.
Northern boundary	MBD6, POB16, POB17, POB18			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the north of the Site.
Eastern boundary	MBD15, MBD16, MBD17, POB09, POB10			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the east of the Site.
Southern boundary	MBD12, MBD13, MBD14			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the south of the Site.
Western boundary	MBD18, MBS2, MBS6, MBS7, MBD19, MBD20, MBS8, MBS9, MBD21, MBD7, MBD9 1			To determine the concentration and flow rates of landfill gases and/or vapours in the vicinity of properties to the west of the Site.

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8.2 Management of excavation activities

Incidental land disturbance as part of ongoing site use (if undertaken) should be managed in accordance with Section 7.1.

8.3 Other management measures (operational controls)

Operational controls are to be implemented onsite continuously and are to be followed by personnel visiting/working on the Site and are presented in Table 16. The 'responsible party' is provided for guidance as an indication of the people most likely to encounter the particular potential hazard.

Table 16 Operational control measures

Site activity	Hazard to be managed	Responsible party	Management requirement
Driving on the Site	Driving into and compromising monitoring infrastructure	All parties identified in Section 4.3	- Drive slowly onsite (e.g. not exceeding 10 km/hr) - Be cautious and vigilant of monitoring infrastructure - Do not drive or park within 2 m of monitoring infrastructure - Do not place materials upon monitoring well protective covers that may cause damage to the monitoring installations.
Temporary/permanent laydown on the Site	Landfill gases and vapours potentially accumulating in enclosed spaces	Operator, as identified in Section 4.3	- No enclosed spaces/unventilated structures to be placed onsite (e.g.. shipping containers).
Working at the Site	Landfill gases and vapours creating potentially explosive atmospheres	All parties identified in Section 4.3	No ignition sources such as: -Smoking (matches/ cigarette lighters) -Live electrical equipment (other than intrinsically safe equipment) -Hot works (e.g. welding, brazing, metal grinding and cutting) -Petrol powered generators, pressure washers or similar. - Other Maintenance activities
Landfill gas and vapour monitoring	Access restriction to monitoring installations	Operator, as identified in Section 4.3	Provide or otherwise maintain access to monitoring wells for monitoring purposes.

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Site activity	Hazard to be managed	Responsible party	Management requirement
Landfill gas and vapour monitoring	Landfill gases and vapours	Environmental consultant or other suitably experienced competent person appointed by the Principal (as defined in Section 4.3)	- Borehole covers to be replaced at the end of each monitoring event - Borehole integrity to be noted during each monitoring event (cracks/ leaks, etc.)

A record to confirm periodic inspection monitoring and review of this SMP in accordance with the requirements set out in this SMP is to be maintained by the operator.

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9. Quality assurance/quality control requirements

The quality assurance/quality control (QA/QC) procedures are based on *ASC NEPM* and DWER *Assessment and management of contaminated sites* (DER, 2014). The QA/QC program shall be implemented during all monitoring components of the SMP.

QA involves all of the actions, procedures, checks and decisions undertaken to ensure the representativeness and integrity of samples and accuracy and reliability of analytical results (NEPC, 2013). QC involves protocols to monitor and measure the effectiveness of QA procedures.

9.1 Field program

Key requirements of the QA/ QC procedures include:

- Detailed records - records documenting field activities using standardised templates.
- Sample identification and equipment decontamination procedures.
- Sample preservation and analytical holding times - all samples are to be transported/ received by the analytical laboratory in accordance with relevant holding time requirements.
- QC sampling frequency to be collected at required frequencies.
- Use of teflon-free equipment to ensure appropriate collection of PFAS samples (in accordance with Appendix 1 of DWER, 2017).

The *ASC NEPM* outlines the QC sampling protocol which will be adopted for environmental assessments. The QC samples to be collected during the investigation of soil and groundwater are described below:

- Blind (inter-laboratory) duplicates: Blind duplicate samples are used to identify the variation in the analyte concentration between samples from the same sampling point and the repeatability of the laboratory's analysis. Duplicates will be collected at a frequency of one per 20 primary samples for each CoPC.
- Split (intra-laboratory) duplicates: Split duplicate samples provide an indication of the repeatability of the results between laboratories. Duplicates will be collected at a frequency of one per 20 primary samples for each CoPC.
- Rinsate blanks: Rinsate blank samples are water samples collected from decontaminated, re-used field equipment and used primarily to assess whether the decontamination procedure is effective and if cross contamination has led to positive observations in subsequent samples. A rinsate blank will be prepared from the interface meter for each day of groundwater sampling for each CoPC analysed in the batch from the day of sampling.
- Field blanks: Field blank samples are used to estimate contamination of a sample during the collection procedure. A field blank will be prepared for each day that soil and groundwater samples are collected for each CoPC analysed in the batch from the day of sampling.
- Transport blanks: Transport blank samples are used to estimate the amount of contamination introduced during the transport and storage of samples from the time of sampling to the time of analysis. A transport blank will be prepared for all volatile and semi-volatile CoPCs analysed in each batch of groundwater samples collected/ submitted to the laboratory.

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9.1.1 Field quality assurance procedures

- Decontamination procedures - Including the use of new disposable gloves for the collection of each sample, decontamination of the sampling equipment between each sampling location and the use of non-Teflon dedicated sampling containers provided by the primary laboratory (appropriate for PFAS analysis).
- Sample identification procedures - Collected samples are immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers are clearly labelled with a sample number, job number, sample depth and sample date. The sample containers are then transferred to a chilled insulated container (using ice contained in plastic) for sample preservation prior to and during shipment to the analytical laboratory.
- CoC information requirements - A CoC form is completed and forwarded to the testing laboratory with the samples. A CoC form will be used for every batch of samples submitted to the laboratory. Delivery and analysis of samples to the laboratory will need to comply with sample holding times (6 months for PFAS analysis).
- Sample blind/split duplicate and rinsate frequency as per Section 9.2.2.
- Calibration of field equipment: Field equipment (i.e. water quality meter, landfill gas analyser, PID) will be calibrated by the rental supplier to ensure accuracy of measurements taken in the field. If field measurements appear inconsistent, the Consultant will either complete field calibration of the equipment or replace equipment with newly calibrated equipment from the supplier.
- At the commencement of the landfill gas/vapour monitoring event, a leak test will be undertaken at all wells scheduled to be sampled. The leak test will be undertaken using a PID and an isopropyl alcohol impregnated wipe. An initial reading (without the wipe) will be taken, then a reading with a wipe around the sampling train and top of well casing, and lastly a final reading without a wipe again. This will be recorded on field notes and included in the updated DSI.

9.1.2 Sampling and analysis quality control

The NEPC (2013) and DER (2014) guidelines outline a recommended approach to QC sampling. The QC samples to be collected during the investigation are described as follows:

- Blind (inter-laboratory) duplicates: Blind duplicate samples are used to identify the variation in the analyte concentration between samples from the same sampling point and the repeatability of the laboratory's analysis. Duplicates will be collected at a frequency of one per 20 primary samples for each CoPC.
- Split (intra-laboratory) duplicates: Split duplicate samples provide an indication of the repeatability of the results between laboratories. Duplicates will be collected at a frequency of one per 20 primary samples for each CoPC.
- Rinsate blanks: Rinsate blank samples are water samples collected from decontaminated, re-used field equipment and used primarily to assess whether the decontamination procedure is effective and if cross contamination has led to positive observations in subsequent samples. A rinsate blank will be prepared from the low-flow pump for each day of groundwater sampling for each CoPC analysed in the batch from the day of sampling.
- Field blanks: Field blank samples are used to estimate contamination of a sample during the collection procedure. A field blank will be prepared for each day that soil and groundwater samples are collected for each CoPC analysed in the batch from the day of sampling.

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- Transport blanks: Transport blank samples are used to estimate the amount of contamination introduced during the transport and storage of samples from the time of sampling to the time of analysis. A transport blank will be prepared for all volatile and semi-volatile CoPCs analysed in each batch of groundwater samples collected/ submitted to the laboratory.

As no samples are proposed to be collected for the investigation of ground gas, the QA/QC program for ground gas monitoring will include the following:

- Use of appropriately qualified and trained staff to install and monitor each location.
- Leak detection testing.

9.1.3 Relative percentage difference calculations

Blind and split duplicate samples will be assessed by calculating the relative percentage difference (RPD) between the primary, blind and split samples in accordance with the procedure described in AS 4482.1 – 2005 (Standards Australia 2005). Calculation of RPDs provides a quantitative measure of the accuracy of the analytical results reported.

RPD results will be considered acceptable if they are less than or equal to 30%. The exception to this is when concentrations within the primary and blind or split sample are less than ten times the laboratory LOR. In this case, a greater RPD value is considered acceptable.

9.2 Laboratory program

9.2.1 Laboratory analytical program

Laboratory methods to be used by the primary and secondary laboratories will be suitable for environmental contaminant analysis and are based on established internationally recognised procedures. Each of the laboratories is NATA accredited for the proposed analysis.

9.2.2 Laboratory quality control procedures

The laboratories used for the investigation will be NATA accredited and perform internal QC analysis as per the below sample descriptions. During assessment of the laboratory QC, the laboratory adopted acceptable criteria (that are based on the *ASC NEPM* and USEPA method guidance) will be adopted to assess laboratory QC performance.

Laboratory duplicate samples

Laboratory duplicate sample analysis is the analysis of a laboratory derived duplicate sample from the process batch, at a rate equivalent to one in 20 samples per analytical batch, or one sample per batch if less than 20 samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the analytical results.

Method blank samples

Method or analysis blank sample analysis are the analysis of a sample that is as free as possible of the analytes of interest, but has been prepared the same as the samples under investigation. The analysis is to ascertain if laboratory reagents, glassware and other laboratory consumables contribute to the observed concentration of analytes in the process batch. If below the maximum acceptable method blank (20% of the practical quantitation limit), the contribution is subtracted from the gross analytical signal for each analysis before calculating the sample analyte concentration. The method blank should return analyte concentrations as 'not detected'.

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Laboratory control samples

Laboratory control spike analysis is the analysis of either a reference material or a control matrix fortified with analytes representative of the analyte class. The purpose of laboratory control spike samples is to monitor method precision and accuracy independent of the sample matrix. Typically, the percentage recovery of the laboratory control spike sample is compared to the dynamic recovery limits based on the statistical analysis of the processed laboratory control spike sample analysis.

Matrix spike samples

Matrix spike sample analysis is the analysis of one or more replicate portions of samples from the batch, after fortifying the additional portion(s) with known quantities of the analyte(s) of interest. The percentage recovery of target analyte(s) from matrix spike samples is used to determine the bias of the method in the specific sample matrix.

Surrogate spike samples

Surrogate spike samples are samples with known additions of known amounts of compounds, which are similar to the analytes of interests in terms of extractability, recovery through clean-up procedures and response to chromatographic or other measurement. Surrogate compounds may be alkylated or halogenated analogues or structural isomers of analytes of interest. The purpose of surrogate spikes, which are added immediately before the sample extraction step, is to provide a check for every analysis that no gross processing errors have occurred, which could have led to significant analyte loss or faulty calculation.

Internal standards

Internal standards are known additions of known amounts of compounds which are not found in real samples, will not interfere with quantification of analytes of interest and may be separately and independently quantified. The purpose of internal standards in instrumental techniques is to provide independent signals, which serve to check the consistency of the analytical step. Internal standards are often used for organic compounds and some inorganic compounds.

9.3 Evaluation of QA/QC program

Data quality indicators (DQIs) of completeness, comparability, representativeness, precision and accuracy will be adopted as an assessment of the reliability of field procedures and analytical results.

Field procedures and laboratory procedures are included in DQIs to provide an overview of the process in which data is collected at the Site. A summary of the adopted DQIs for this assessment is provided in Table 17 below.

Table 17 Data quality indicators

DQI	Evaluation criteria
Completeness	All proposed locations are sampled. Samples analysed according to the SAQP.
	All field documentation is complete and correct, including chain of custody documentation for samples.
	Field forms and documentation capture all relevant important information.
	Samples analysed within appropriate holding times.
	Appropriate laboratory limits of reporting for comparison to relevant assessment criteria.
Comparability	Standardised operating procedure for soil/groundwater sampling adhered to and is in line with relevant guidelines.

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DQI	Evaluation criteria
	Field staff experienced in the sampling of soil/groundwater and appropriately trained.
	Consistent laboratory use with consistent analytical methods adopted.
	Climatic conditions consistent and considered representative of region.
Representativeness	Samples collected in a uniform and consistent manner and representative of the media in the field.
	Monitoring wells target appropriate strata and constructed in accordance with relevant requirements.
Precision	Sufficient quantities of field blind and split duplicates collected to enable comparison within and between laboratories.
	Sufficient quantities of internal laboratory duplicates analysed to enable comparison within laboratories.
	Relative percentage difference calculations indicate duplicate sample concentrations are within defined acceptable difference limits.
	Field equipment calibrated by equipment supplier.
Accuracy	Sufficient quantities of field blanks, rinsate blanks and transport blanks collected and analysed, with no results indicating cross-contamination.
	Sufficient quantities of internal laboratory method blanks, surrogate spikes and laboratory control samples analysed to determine laboratory accuracy, with the large majority of samples within defined limits.

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10. Contingency plan

The purpose of the contingency plan is to identify unexpected situations that could occur during the management of the Site, and to specify procedures that can be implemented to manage such situations and prevent adverse impacts to human health and the environment.

It is also pertinent to note that roles and responsibilities, as outlined in Section 4.3, apply to the contingency plan.

10.1 Contingency response events

Contingency response measures may be triggered by one or more of the following events and/or circumstances:

1. Visual and/or odoriferous indicators of concerns (refer to Section 10.2).
2. In the event of unexpected finds i.e. previously undetected contaminants or hazardous materials are identified in existing surface or subsurface soils (refer to Section 10.3).
3. Complaints from adjacent property (refer to Section 10.4).
4. Remedial targets not met i.e. elevated landfill gas and vapour measurements during monitoring (refer to Section 10.5).
5. Damage to existing monitoring infrastructure (refer to Section 10.6).
6. Other potential nuisances, such as those related from control of dust, and noise and vibration (refer to Section 10.7 and Section 10.8).

Further information is provided below in the following sections, including examples of the procedures (contingency responses) to be adopted in the event of these occurrences.

10.2 Visual and/or odoriferous concerns

During development and/or as part of the ongoing use of the Site as a Solar Farm, the following observations may trigger a contingency response (provided in Section 10.2.1):

- Subsidence of the Solar Farm array.
- Damage to landfill gas monitoring wells.
- Stunted and/or dying flora within the Site due to lack of oxygen (noting that this may also be related to other factors, such as prolonged dry weather events).

Landfill gases are typically colourless and odourless (with the exception of hydrogen sulphide, which has a rotten egg odour at low concentrations <1 ppm, but becomes odourless at concentrations > approx. 50 ppm[1]). However, it is possible that an odour which is considered unusual and/or of concern may be identified.

10.2.1 Contingency response

In the event that visual and/or odoriferous indicators are identified, the following procedure shall be undertaken:

- Contact the Principal. In the first instance, the Principal shall investigate to make observations and seek to determine the source/cause of what has been identified. The

[1] As noted in the Ground Gas Handbook (2009)

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Principal will also determine the need for consultation with third parties including adjacent site users and implement this as required for any further action deemed necessary.

- If the issue is not resolved, appropriate further action is required. Subject to the issue identified and area of concern, this shall comprise one or more of the following:

  (1) Environmental consultant or other suitably experienced competent person (Section 4.3) to carry out visual inspection of the Solar Farm and general site area (if not already carried out above).

  (2) Environmental consultant or other suitably experienced competent person (Section 4.3) to conduct landfill gas and vapour monitoring at the Site for comparative assessment to previous monitoring data (using methods outlined in Section 5.3). Remedial targets (baseline conditions) are provided in Section 3.1.

  (3) Environmental consultant or other suitably experienced competent person (Section 4.3) to conduct a landfill gas and vapour survey of relevant adjacent properties (buildings and infrastructure) for the presence of landfill gas and vapours. This should be conducted using a PID/FID detector, as per the building survey method outlined in Section 9 of the *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011)*.

  (4) Environmental consultant or other suitably experienced competent person (Section 4.3) to conduct a leak detection test to ensure that the gases and vapours are not emanating from the wells (see Section 5.3 for methodology).

  (5) Subject to the concentrations of landfill gas and vapours identified at the Site boundary and/or off-site, additional landfill gas monitoring wells may require installation to appropriately characterise potential risk to adjacent properties. Additional landfill gas monitoring wells shall be installed as per the specifications outlined in Appendix B, Figure B1 of the *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011)*, provided as Diagram 2 in Section 10.6.

  (6) In the event that VOC concentrations are significantly elevated (>100 ppm), a sample should be collected using a thermal desorption tube and analysed in a NATA-accredited laboratory for the TO-15 VOC suite to determine the VOC component breakdown, in order to determine associated risks.

  (7) Review requirements for remedial action such as LFG management measures, partial or complete removal of Solar Farm, installation of monitoring alarms or other measures (e.g. ventilation) in adjacent properties. Such action may be taken as a result of any of the above measures if it is considered that an unacceptable risk exists requiring action.

  (8) In the event that elevated concentrations of landfill gases and vapours are not identified on- and off-site, but an issue still apparent, the additional contingency measure provided in Section 10.2.2 should be undertaken.

  (9) Following implementation of relevant management action, review the measures set out in this SMP for appropriateness and requirements for amendment such as revision of periodic monitoring (e.g. additional/higher frequency monitoring, installation and monitoring of additional wells on/off site).

10.2.2 Additional contingency measure

As noted above, in the event that elevated concentrations of landfill gases and vapours are not identified on- and off-site, but an issue is still apparent, a transect of the surface of the Site should be undertaken using a low concentration methane detector with an extendable probe, as

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per the methodology outline in Section 5 (landfill surface cover areas) of the *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011)*. A summary is provided in Diagram 1 below.

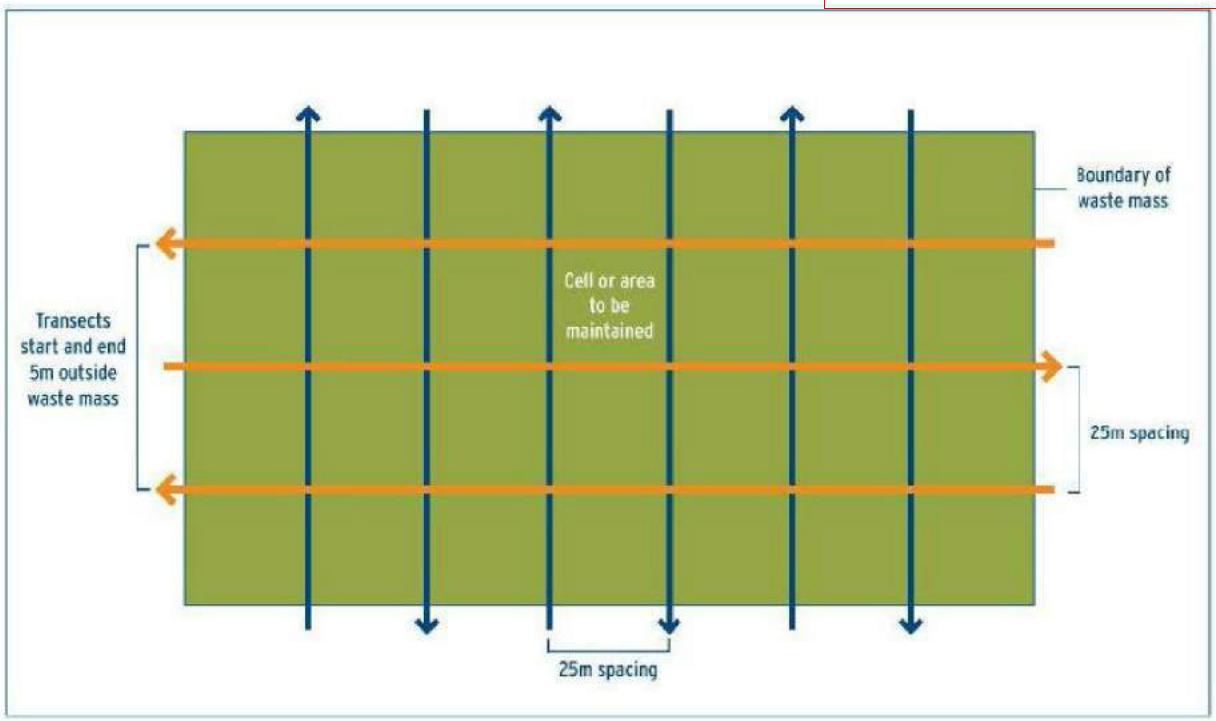

Diagram 1 Example transects of landfill surface cover. Reference: Figure 5.2 of *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011)*

10.3 Previously undetected contaminants or hazardous materials

10.3.1 Unexpected finds protocol

Potential exists for previously undetected contaminants or hazardous materials to be found in existing surface or subsurface soils in the form of domestic refuse materials.

Upon discovery of an unexpected find, the leasee should cease work in the area and restrict access in order to:

- Prevent further disturbance to the area to reduce the spread of potential contamination.
- Mitigate risk to human health and/or environment whilst the unexpected find is being assessed.

The unexpected find shall be reported to the Principal (or Superintendent if related to any works) within 24 hours including any relevant details (e.g. description, digital photographs, location).

The Principal will assess the information provided and determine if an immediate response action and/or a site visit is required to assess the unexpected find. The Principal will then determine appropriate management action to mitigate potential risks to human health and/or the environment. The action may include 'short term' recommended response actions, e.g. cessation of work in the vicinity/further investigation for delineation purposes, depending on the nature of the issue. Management of unexpected finds shall be undertaken in accordance with relevant guidance and legislation.

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Unexpected finds relating to asbestos containing materials (ACM) are discussed further below.

10.3.2 Asbestos in soil

Fragments of ACM may be encountered at the site surface and/or at depth during construction. In the event that ACM is suspected (if identification is in doubt, the suspected ACM should be assumed to be asbestos until confirmed otherwise), the following procedures shall apply:

- All visible pieces of ACM should be hand picked individually and placed in a tear resistant polythene bag no more than half filled, labelled as asbestos and securely closed.
- The bagged ACM should be disposed to an appropriately licensed disposal facility. No ACM is to be disposed of in general workplace disposal bins or at other non-designated temporary locations.

All actions in relation to this matter are to be undertaken by the Principal unless otherwise indicated. Validation shall be undertaken in accordance with Section 5.4.3.

10.4 Complaint from adjacent property

All complaints should be directed to the Principal's nominated representative, as required for further action (refer to Section 10.2.1).

10.5 Management targets not met

In the event that management targets are not met (refer to Section 3.1), procedures outlined in Section 10.2.1 shall be implemented for further action. The level of action shall be commensurate with the level of risk identified.

10.6 Damage to existing monitoring infrastructure

Landfill gas monitoring wells damaged above ground surface should be inspected to identify if the headwork can be replaced (i.e. below ground pipework is still intact and uncompromised).

If required, all monitoring wells should be repaired or replaced to the specifications outlined in Appendix B, Figure B1 of the *Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011)*, as summarised in Diagram 2 below.

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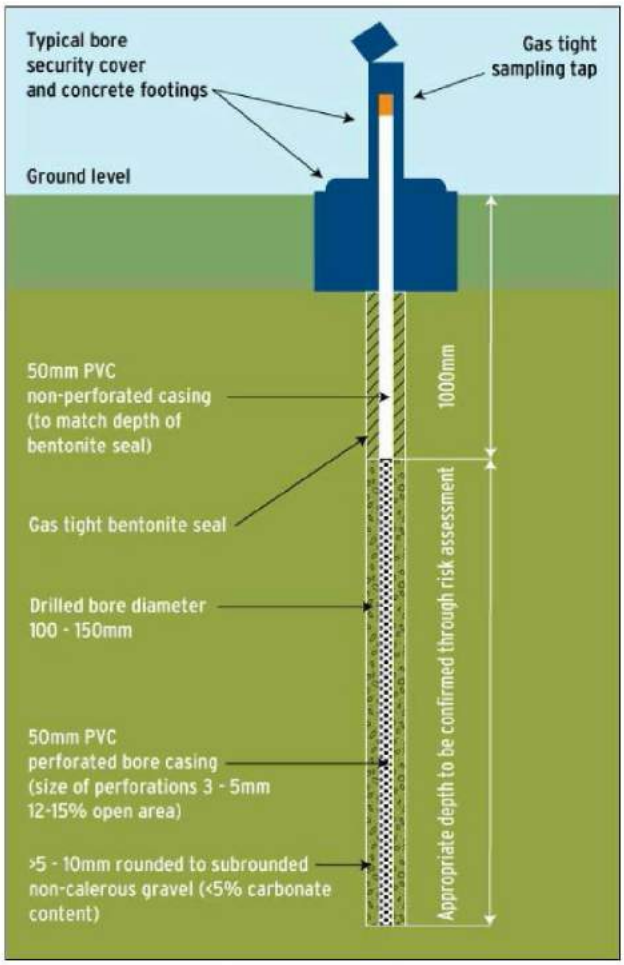

Figure B1: Cross-section of a typical landfill gas monitoring bore.

Diagram 2 Landfill gas bore monitoring design Reference: Appendix B, Figure B1 *of Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (Victoria EPA, 2011).*

10.7 Control of dust

Contingency measures shall be implemented when dust levels are found to exceed acceptable levels (based on observations made on-site or measurements made by calibrated instruments). Where unacceptable dust levels are considered to have been generated, dust shall be suppressed by one or more of the following:

- Water sprays applied by water cart.
- Use of proprietary products.
- Sheeting (or similar) laid over and secured to cover localised exposed areas.
- Changing protocols i.e. avoid work on windy days.

10.8 Noise and vibration

Contingency measures shall be implemented when noise levels are found to be unacceptable. Unacceptable noise levels shall initially be reduced by one or more of the following:

- Modification of the location of equipment and stockpiles.
- Modifying the operation of the equipment.

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- Modifying the type of equipment used.

In the event that additional measures are required, operations shall be further modified to achieve acceptable noise levels. Modifications may include:

- Installing additional noise suppression features on the equipment (e.g. encapsulation of engine chambers, silencers, curtains on feed-openings).
- Construction of noise attenuation measures (e.g. stockpile barriers, enclosures).
- Using different equipment, which generates less noise.

10.9 Notification procedures

Stakeholder notification for incidents, exceedances and other matters will be undertaken directly by Epuron. Where relevant, stakeholders will be provided with information relating to circumstances that constitute a material change to site conditions, such as (but not limited to):

- Potential human health risks and impacts to environmental values, including adverse effects to receptors and where contamination migrating outside of the Site boundary is identified.
- Short-term nuisances (if present), such as noise, odours and dust, potentially generated during development and/or ongoing use of the Site as a Solar Farm.

As part of the notification procedure, the following (at a minimum) shall be undertaken:

- Stakeholder engagement in evaluating contingency response actions and evaluation further actions, such as further work required and revisions to the SMP.
- Re-reporting the Site to DWER if material change in site risk profile.

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11. Reporting requirements

All reporting of site management shall be prepared with reference to *Assessment and Management of Contaminated Sites* (DER, 2014) and *ASC NEPM* guidelines. A report shall be prepared following the completion of each phase of monitoring (i.e. during and post-construction). Reporting requirements are summarised below.

11.1 Review of site management procedures

The Principal shall conduct a periodic review of the SMP to incorporate any changes to the site conditions or regulations. An annual review shall be undertaken for the initial 5 years of SMP implementation, after which the frequency of review shall be re-assessed.

11.2 Interim reporting during development

During development, a monthly memorandum (memo) report shall be prepared. Each memo report shall contain the following:

- Scope of work completed.
- Verification of compliance with the requirements of the SAQP.
- Field observations and measurements.
- Evaluation of the applicability of adopted assessment criteria.
- Comparison of field data with assessment criteria.
- Review of the suitability data for assessment purposes (e.g. QA/ QC evaluation).
- Evaluation of monitoring results against this SMP.
- Conclusions and recommendations.

Following the completion of each round of monitoring, the field results will be provided to Epuron (via email) within 5 days of completion of fieldwork.

11.3 Post-construction monitoring reporting

A validation report will be provided on completion of the required monitoring program and will contain information as described in Section 11.2.

Following the completion of each round of monitoring, the field results will be provided to Epuron (via email) within 5 days of completion of fieldwork.

11.4 Mandatory audit report

The Auditor is required to update the Mandatory Audit Report (MAR) for the Site. The first MAR has already been submitted, with the findings reflected in the current DWER BSR. The MAR shall be submitted directly to DWER.

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12. Conclusions and recommendations

12.1 Conclusions

GHD has prepared a SMP to provide the framework for the management of the proposed solar farm. GHD is of the opinion that the Site will be suitable for the proposed solar farm by implementing this SMP to ensure:

- No significant change (increase) in the risk profile of the Site.
- No unacceptable risk posed to on- and off-site receptors.

Implementation of the SMP will therefore render the Site suitable for the proposed use.

12.2 Recommendations

GHD provides the following recommendations:

- The status of solar farm design proposals is preliminary at the time of preparing this SMP. This SMP does not address the design or development of LFG management measures for solar farm infrastructure or for provision of advice concerning geotechnical/civil works. The SMP is therefore subject to review and possible amendment when solar farm development proposals are progressed to detailed design stage.
- Review of the SMP if the proposed form of the solar farm development is amended, particularly in relation to management action concerning groundwater if considered to be necessary.

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Figure 1 Site location and layout

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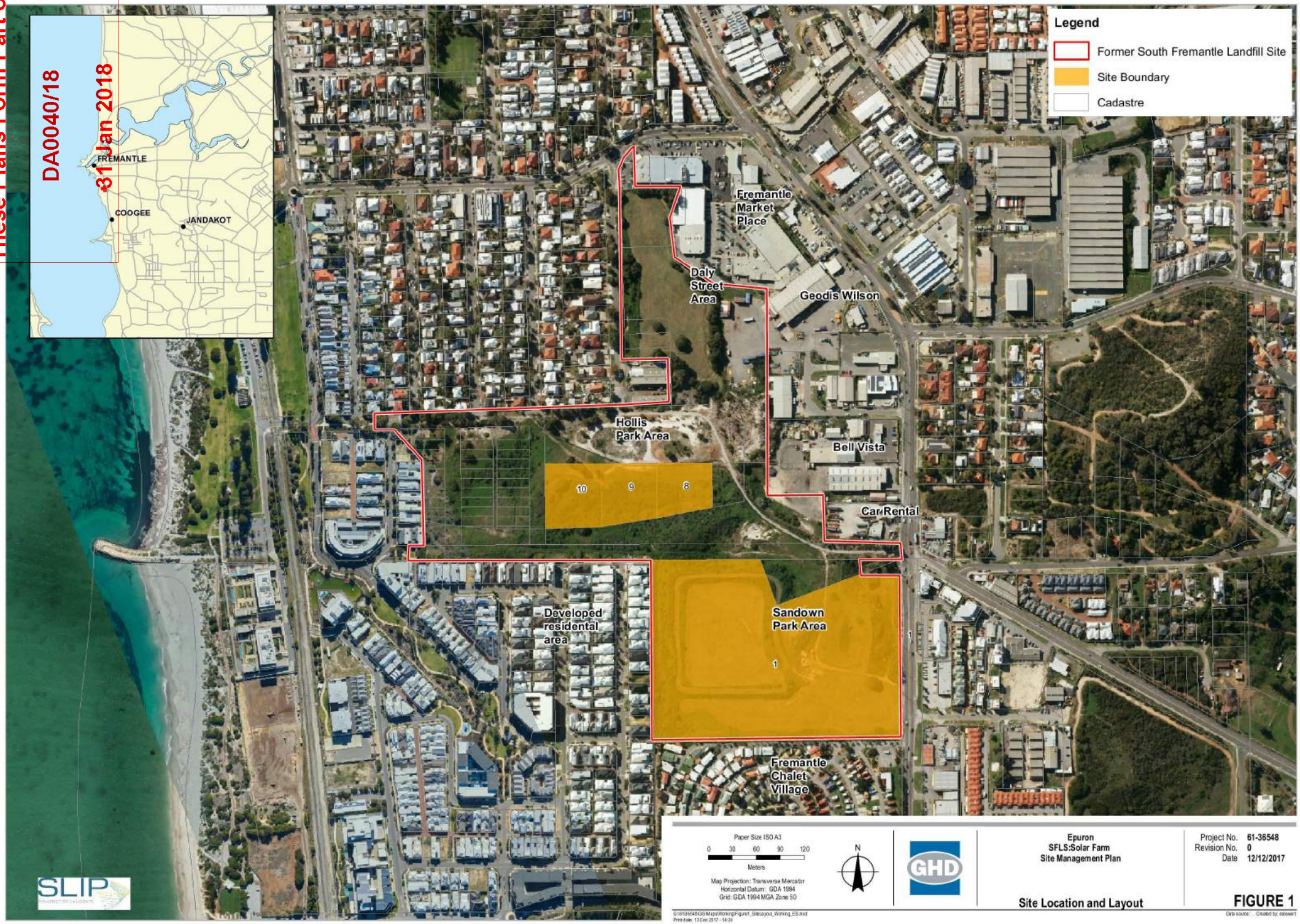

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Figure 2 Ground gas monitoring locations

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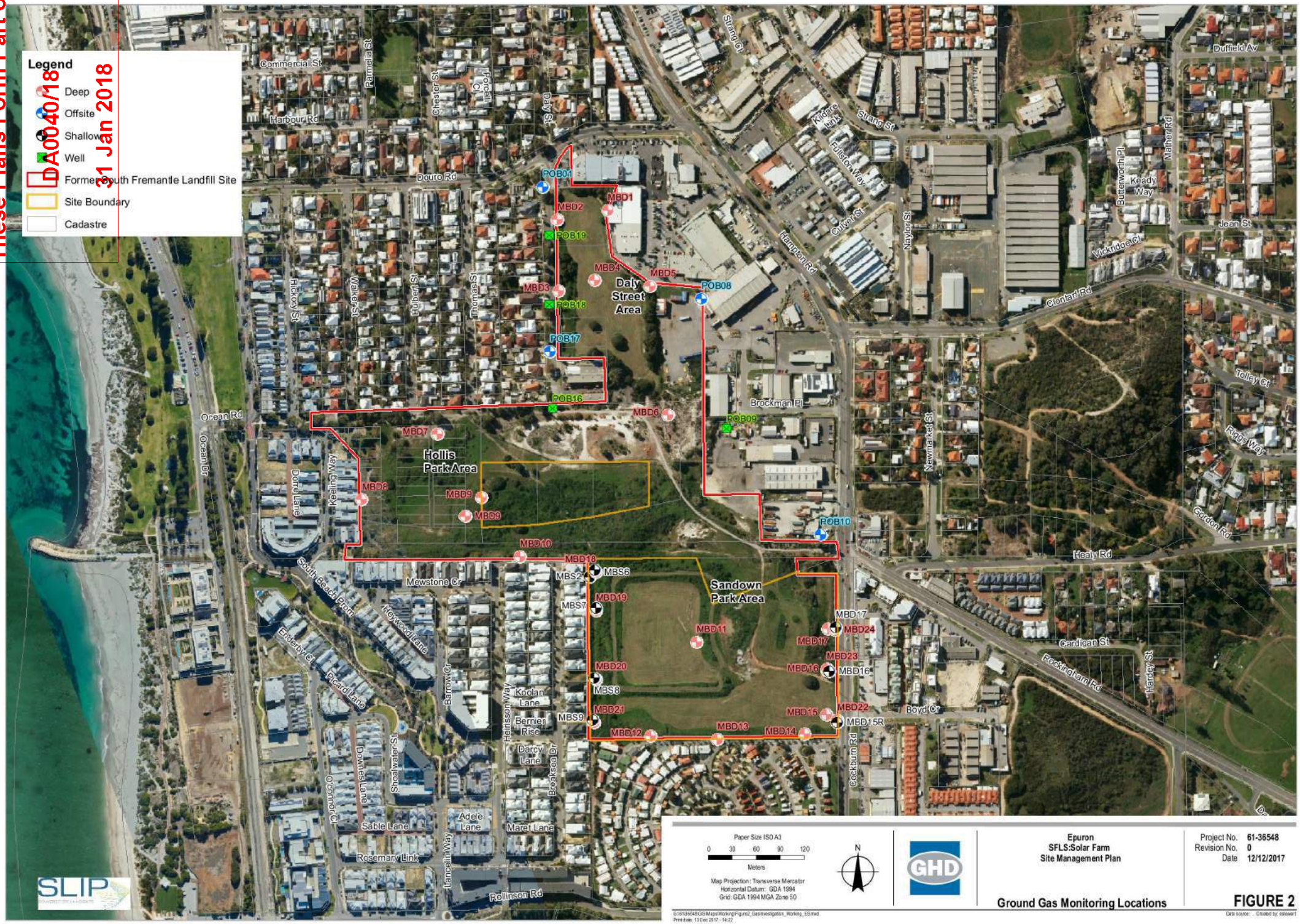

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31 Jan 2018

Appendices

CITY OF FREMANTLE
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Appendix A – Basic summary of records

CITY OF FREMANTLE
These Plans Form Part of
DA0040/18
31 Jan 2018

Government of Western Australia
Department of Water and Environmental Regulation

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 3:40:22PM, 08/12/2017

Search Results

This response relates to a search request received for:

17 Cockburn Rd
South Fremantle WA 6162

This parcel belongs to a site that contains 55 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	17 Cockburn Rd South Fremantle WA 6162
Lot on Plan Address	Lot 1 On Plan 2513
Parcel Status	**Classification:** *12/09/2017 - Contaminated - remediation required* **Nature and Extent of Contamination:** This land parcel is part of the "Sandown Park" portion of the former South Fremantle landfill. Landfill waste is typically present to a depth of 12 to 14 metres below ground in this area. A sand cap (up to 1.5 metres thick) covers the landfill waste. This surface layer may contain building rubble, including asbestos-containing material. The landfill waste beneath "Sandown Park" is decomposing and is producing elevated methane and carbon dioxide gas in soil. Those landfill gases are flowing at a low rate, so they are considered "low risk" under current conditions. Across the former South Fremantle landfill (which covers more than 19 hectares), soil beneath the sand cap contains metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, other contaminants may also be present. Groundwater quality beneath the former South Fremantle landfill is affected by landfill leachate. Nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc), hydrocarbons (such as from petrol, diesel or oil), solvents (benzene and methylene chloride), polychlorinated biphenyls, an organochlorine pesticide (dieldrin), pathogens and salts are present in groundwater. **Restrictions on Use:** The use of the former South Fremantle landfill site (which covers more than 19 hectares) is restricted to its current use, which is passive recreation with most areas fenced to restrict

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

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access. Further assessment and management is required for any change to the site layout; increased public access to currently fenced areas; or for any change in land use.

Excavation or disturbance of soils is restricted, pending the development of a site management plan consistent with the Department of Health's requirements (see Action Required).

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by August 2006. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site comprises the former South Fremantle landfill, which is separated into three portions known as "Daly Street" (northern portion), "Hollis Park" (central) and "Sandown Park" (southern portion).

"Daly Street" is a former quarry that accepted a range of household and industrial waste as landfill, from 1939 to 1957 and again from 1980 to 1991. Landfill waste is typically present to a depth of 5 to 10 metres below ground.

"Hollis Park" accepted solid and liquid waste such as sand rubble, paper and cloth, timber, sawdust and packaging, food wastes and swill, metals and bottles between 1931 and 1956. Sullage (liquid waste) continued to be accepted until 1976. Unlike other areas of the landfill, waste was disposed of in depressions between natural sand dunes. Waste is typically present to a depth of between 1 to 5 metres below ground, deeper in the southern portion of Hollis Park, near Sandown Park. There is minimal waste in the central northern portion. A composting plant also operated on the southern boundary of Hollis Park during the early 1950s, closing in 1956.

"Sandown Park" is a former quarry that accepted waste such as fly ash, wools and skin, marine bilge oil, tyres, sullage and car bodies between 1956 and 1980. Landfill waste is typically present to a depth of 12 to 14 m below ground. A waste transfer station operated here between 1980 and 1991.

Landfill sites and associated activities, and compost manufacturing, are land uses that have the potential to cause contamination, as specified in the guideline 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

The former South Fremantle landfill has been subject to numerous investigations and assessments since 1985. These include soil and groundwater investigations, groundwater monitoring, geotechnical reports, landfill gas assessments, air quality assessments, a site management plan, hydrogeological studies, a health and environmental risk assessment

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and redevelopment option studies.

Based on soil investigations carried out in 2007 or earlier, there is approximately 938,000 cubic metres of waste present beneath the site, across an area of approximately 19.4 hectares in total. Contaminants known to be present in soil, at concentrations exceeding guideline criteria that were relevant at the time of the investigations, include metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, concentrations of contaminants vary greatly and other contaminants may also be present.

A sand cap (up to 1.5 metres thick) covers the landfill waste. This layer has been observed by DWER to contain building rubble (such as bricks, tiles and glass) and asbestos fragments. The Department of Health advises that capping material used prior to the regulatory control of asbestos often included asbestos cement building products.

A children's playground is located in the western-most portion of Hollis Park. The area is mostly grassed, but there is a small area of exposed soils along the eastern fence line. Based on a review of historical information, it is unlikely any landfill material was deposited beneath the playground. However, building rubble and asbestos may wash onto this area from within the sand cap at Hollis Park during high rainfall events.

Historical studies (including soil investigations and groundwater monitoring) were summarised in a Detailed Site Review report completed in 2012. That report identified gaps in the available data and prioritised further investigation based on the potential risk to human health, the environment or environmental values.

Landfill gas investigations carried out in 2010, 2014 and 2016 found that landfill waste beneath Daly Street and Sandown Park is decomposing and producing elevated methane and carbon dioxide gas, and reducing oxygen concentrations, in soil. However, landfill gases are flowing at a low rate, indicating that the landfill poses a "low risk" under current conditions. There is no indication of landfill gas generation in Hollis Park, which was ranked as posing a "very low risk" under current conditions. The risk ranking for landfill gas was determined by comparison with the Gas Screening Values published in the guideline, 'Assessing risks posed by hazardous ground gases to buildings' (CIRIA 2007).

A risk assessment concluded that landfill gas was unlikely to pose a risk to off-site receptors while the site is in its current, undeveloped, land use. Further assessment will be required if the site is proposed for development, or if a change in land use is proposed.

Groundwater quality beneath the former South Fremantle landfill, and off-site, was affected by landfill leachate, as per groundwater monitoring from 2007 and earlier. Groundwater quality improved with distance from the landfill. Criteria below for the assessment of water quality are published in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

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Nutrients (ammonia), metals (arsenic, cadmium, copper, lead, mercury, nickel and zinc), benzene, phenol, polychlorinated biphenyls (PCB) and dieldrin are present in groundwater beneath the former landfill at concentrations exceeding groundwater investigation levels for the protection of marine ecosystems.

Chloride, total dissolved solids, nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, nickel, selenium), benzene, 1,2-dichlorobenzene and methylene chloride are present in groundwater beneath the former landfill at concentrations exceeding groundwater investigation levels for drinking water. Ammonia, metals (arsenic, cadmium, chromium, iron, selenium), benzene, total phenols and 1,2-dichlorobenzene also exceed criteria for the non-potable use of groundwater.

A microbiological indicator of possible pathogens (E.coli) was also present in groundwater beneath the former landfill at a concentration exceeding criteria for the irrigation of urban recreational areas, open spaces, parks and gardens.

An accredited contaminated sites auditor (the auditor) reviewed the investigations and risk assessment for the site. The auditor's findings are documented in a mandatory auditor's report dated 3 August 2017. DWER accepts the auditor's recommendation that the site is suitable for its current use, which is passive recreation with most areas fenced to restrict access, where groundwater is not used for any purpose. However, the auditor found that a site management plan is required to outline ongoing management. Further groundwater assessment is also required to assess the risk to off-site receptors.

The site is contaminated and remediation (such as the development of a site management plan, and further groundwater assessment) is required to reduce risks to human health, the environment and environmental values to acceptable levels. Therefore, the site is classified as 'contaminated - remediation required'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included in this section is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, groundwater contamination present beneath this site has also been identified beyond the site boundary beneath adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or

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remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

Land affected by groundwater contamination originating from beneath this site is classified separately under the Act, with a different classification.

Landfill waste in "Sandown Park" extends off-site to the south onto a property used as a caravan park. That site is classified separately under the Act, with a different classification.

Action Required:

This site is considered to be high priority for action to be taken to address contamination, as described below.

A site management plan is required to outline long-term management measures, including for asbestos and landfill gas. The plan is to be prepared in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia' (Department of Health, May 2009).

The Department of Health requires the site management plan to include regular inspections of all accessible areas, including the footpath and the playground at the western end of Hollis Park, to identify and remove any asbestos-containing materials from the surface. It is to include detailed information on how site inspections will be conducted and how suspect asbestos-containing materials will be handled, removed and disposed. Occupational health and safety requirements should also be included.

Further groundwater monitoring is also required to assess the risk to any off-site bore water users and the marine environment 300 metres to the west. Investigations should be carried out in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'National Environment Protection (Assessment of Site Contamination) Measure 1999'.

A high pressure gas main traverses the boundary between Sandown Park and Hollis Park in an east-west direction. Utility companies carrying out works on the gas main should manage potential health risks to intrusive maintenance workers.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "Contaminated - remediation required". An instrument affecting land which comprises all, or part of, this site will not be registered or accepted for registration, unless the CEO of the Department of Environment & Conservation consents to the registration in writing. For further information on the contamination status of this site, or this restriction, please contact the Contaminated Sites section of the Department of Environment & Conservation.

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Current Regulatory Notice Issued	**Type of Regulatory Notice:** Nil **Date Issued:** Nil
General	No other information relating to this parcel.

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Department of Water and Environmental Regulation

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 3:41:35PM, 08/12/2017

Search Results

This response relates to a search request received for:

8 Island St
South Fremantle WA 6162

This parcel belongs to a site that contains 55 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	8 Island St South Fremantle WA 6162
Lot on Plan Address	Lot 8 On Diagram 2492
Parcel Status	**Classification:** *12/09/2017 - Contaminated - remediation required* **Nature and Extent of Contamination:** This land parcel is part of the "Hollis Park" portion of the former South Fremantle landfill. Landfill waste is typically present to a depth of between 1 to 5 metres below ground in this area, deeper in the southern area near the boundary with Sandown Park. There is minimal waste in the central northern portion of Hollis Park. A sand cap (up to 1.5 metres thick) covers the landfill waste. This surface layer may contain building rubble, including asbestos. Across the former South Fremantle landfill (which covers an area of more than 19 hectares), soil beneath the sand cap contains metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, other contaminants may also be present. Groundwater quality beneath the former South Fremantle landfill is affected by landfill leachate. Nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc), hydrocarbons (such as from petrol, diesel or oil), solvents (benzene and methylene chloride), polychlorinated biphenyls, an organochlorine pesticide (dieldrin), pathogens and salts are present in groundwater. **Restrictions on Use:** The use of the former South Fremantle landfill site (which covers more than 19 hectares) is restricted to its current use, which is passive recreation with most areas fenced to restrict access. Further assessment and management is required for any change to the site layout; increased public access to currently fenced areas; or for any change in land use.

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Excavation or disturbance of soils is restricted, pending the development of a site management plan consistent with the Department of Health's requirements (see Action Required).

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by August 2006. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site comprises the former South Fremantle landfill, which is separated into three portions known as "Daly Street" (northern portion), "Hollis Park" (central) and "Sandown Park" (southern portion).

"Daly Street" is a former quarry that accepted a range of household and industrial waste as landfill, from 1939 to 1957 and again from 1980 to 1991. Landfill waste is typically present to a depth of 5 to 10 metres below ground.

"Hollis Park" accepted solid and liquid waste such as sand rubble, paper and cloth, timber, sawdust and packaging, food wastes and swill, metals and bottles between 1931 and 1956. Sullage (liquid waste) continued to be accepted until 1976. Unlike other areas of the landfill, waste was disposed of in depressions between natural sand dunes. Waste is typically present to a depth of between 1 to 5 metres below ground, deeper in the southern portion of Hollis Park, near Sandown Park. There is minimal waste in the central northern portion. A composting plant also operated on the southern boundary of Hollis Park during the early 1950s, closing in 1956.

"Sandown Park" is a former quarry that accepted waste such as fly ash, wools and skin, marine bilge oil, tyres, sullage and car bodies between 1956 and 1980. Landfill waste is typically present to a depth of 12 to 14 m below ground. A waste transfer station operated here between 1980 and 1991.

Landfill sites and associated activities, and compost manufacturing, are land uses that have the potential to cause contamination, as specified in the guideline 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

The former South Fremantle landfill has been subject to numerous investigations and assessments since 1985. These include soil and groundwater investigations, groundwater monitoring, geotechnical reports, landfill gas assessments, air quality assessments, a site management plan, hydrogeological studies, a health and environmental risk assessment and redevelopment option studies.

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Based on soil investigations carried out in 2007 or earlier, there is approximately 938,000 cubic metres of waste present beneath the site, across an area of approximately 19.4 hectares in total. Contaminants known to be present in soil, at concentrations exceeding guideline criteria that were relevant at the time of the investigations, include metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, concentrations of contaminants vary greatly and other contaminants may also be present.

A sand cap (up to 1.5 metres thick) covers the landfill waste. This layer has been observed by DWER to contain building rubble (such as bricks, tiles and glass) and asbestos fragments. The Department of Health advises that capping material used prior to the regulatory control of asbestos often included asbestos cement building products.

A children's playground is located in the western-most portion of Hollis Park. The area is mostly grassed, but there is a small area of exposed soils along the eastern fence line. Based on a review of historical information, it is unlikely any landfill material was deposited beneath the playground. However, building rubble and asbestos may wash onto this area from within the sand cap at Hollis Park during high rainfall events.

Historical studies (including soil investigations and groundwater monitoring) were summarised in a Detailed Site Review report completed in 2012. That report identified gaps in the available data and prioritised further investigation based on the potential risk to human health, the environment or environmental values.

Landfill gas investigations carried out in 2010, 2014 and 2016 found that landfill waste beneath Daly Street and Sandown Park is decomposing and producing elevated methane and carbon dioxide gas, and reducing oxygen concentrations, in soil. However, landfill gases are flowing at a low rate, indicating that the landfill poses a "low risk" under current conditions. There is no indication of landfill gas generation in Hollis Park, which was ranked as posing a "very low risk" under current conditions. The risk ranking for landfill gas was determined by comparison with the Gas Screening Values published in the guideline, 'Assessing risks posed by hazardous ground gases to buildings' (CIRIA 2007).

A risk assessment concluded that landfill gas was unlikely to pose a risk to off-site receptors while the site is in its current, undeveloped, land use. Further assessment will be required if the site is proposed for development, or if a change in land use is proposed.

Groundwater quality beneath the former South Fremantle landfill, and off-site, was affected by landfill leachate, as per groundwater monitoring from 2007 and earlier. Groundwater quality improved with distance from the landfill. Criteria below for the assessment of water quality are published in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

Nutrients (ammonia), metals (arsenic, cadmium, copper, lead, mercury, nickel and zinc), benzene, phenol, polychlorinated biphenyls (PCB) and dieldrin are present in groundwater

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beneath the former landfill at concentrations exceeding groundwater investigation levels for the protection of marine ecosystems.

Chloride, total dissolved solids, nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, nickel, selenium), benzene, 1,2-dichlorobenzene and methylene chloride are present in groundwater beneath the former landfill at concentrations exceeding groundwater investigation levels for drinking water. Ammonia, metals (arsenic, cadmium, chromium, iron, selenium), benzene, total phenols and 1,2-dichlorobenzene also exceed criteria for the non-potable use of groundwater.

A microbiological indicator of possible pathogens (E.coli) was also present in groundwater beneath the former landfill at a concentration exceeding criteria for the irrigation of urban recreational areas, open spaces, parks and gardens.

An accredited contaminated sites auditor (the auditor) reviewed the investigations and risk assessment for the site. The auditor's findings are documented in a mandatory auditor's report dated 3 August 2017. DWER accepts the auditor's recommendation that the site is suitable for its current use, which is passive recreation with most areas fenced to restrict access, where groundwater is not used for any purpose. However, the auditor found that a site management plan is required to outline ongoing management. Further groundwater assessment is also required to assess the risk to off-site receptors.

The site is contaminated and remediation (such as the development of a site management plan, and further groundwater assessment) is required to reduce risks to human health, the environment and environmental values to acceptable levels. Therefore, the site is classified as 'contaminated - remediation required'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included in this section is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, groundwater contamination present beneath this site has also been identified beyond the site boundary beneath adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

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Land affected by groundwater contamination originating from beneath this site is classified separately under the Act, with a different classification.

Landfill waste in "Sandown Park" extends off-site to the south onto a property used as a caravan park. That site is classified separately under the Act, with a different classification.

Action Required:

This site is considered to be high priority for action to be taken to address contamination, as described below.

A site management plan is required to outline long-term management measures, including for asbestos and landfill gas. The plan is to be prepared in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia' (Department of Health, May 2009).

The Department of Health requires the site management plan to include regular inspections of all accessible areas, including the footpath and the playground at the western end of Hollis Park, to identify and remove any asbestos-containing materials from the surface. It is to include detailed information on how site inspections will be conducted and how suspect asbestos-containing materials will be handled, removed and disposed. Occupational health and safety requirements should also be included.

Further groundwater monitoring is also required to assess the risk to any off-site bore water users and the marine environment 300 metres to the west. Investigations should be carried out in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'National Environment Protection (Assessment of Site Contamination) Measure 1999'.

A high pressure gas main traverses the boundary between Sandown Park and Hollis Park in an east-west direction. Utility companies carrying out works on the gas main should manage potential health risks to intrusive maintenance workers.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "Contaminated - remediation required". An instrument affecting land which comprises all, or part of, this site will not be registered or accepted for registration, unless the CEO of the Department of Environment & Conservation consents to the registration in writing. For further information on the contamination status of this site, or this restriction, please contact the Contaminated Sites section of the Department of Environment & Conservation.

Current Regulatory Notice Issued

Type of Regulatory Notice: Nil

Date Issued: Nil

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Government of Western Australia
Department of Water and Environmental Regulation

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 3:41:35PM, 08/12/2017

General	No other information relating to this parcel.

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Government of Western Australia
Department of Water and Environmental Regulation

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 3:38:30PM, 08/12/2017

Search Results

This response relates to a search request received for:

9 Island St
South Fremantle WA 6162

This parcel belongs to a site that contains 55 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	9 Island St South Fremantle WA 6162
Lot on Plan Address	Lot 9 On Diagram 2492
Parcel Status	**Classification:** *12/09/2017 - Contaminated - remediation required* **Nature and Extent of Contamination:** This land parcel is part of the "Hollis Park" portion of the former South Fremantle landfill. Landfill waste is typically present to a depth of between 1 to 5 metres below ground in this area, deeper in the southern area near the boundary with Sandown Park. There is minimal waste in the central northern portion of Hollis Park. A sand cap (up to 1.5 metres thick) covers the landfill waste. This surface layer may contain building rubble, including asbestos. Across the former South Fremantle landfill (which covers an area of more than 19 hectares), soil beneath the sand cap contains metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, other contaminants may also be present. Groundwater quality beneath the former South Fremantle landfill is affected by landfill leachate. Nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc), hydrocarbons (such as from petrol, diesel or oil), solvents (benzene and methylene chloride), polychlorinated biphenyls, an organochlorine pesticide (dieldrin), pathogens and salts are present in groundwater. **Restrictions on Use:** The use of the former South Fremantle landfill site (which covers more than 19 hectares) is restricted to its current use, which is passive recreation with most areas fenced to restrict access. Further assessment and management is required for any change to the site layout; increased public access to currently fenced areas; or for any change in land use.

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Excavation or disturbance of soils is restricted, pending the development of a site management plan consistent with the Department of Health's requirements (see Action Required).

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by August 2006. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site comprises the former South Fremantle landfill, which is separated into three portions known as "Daly Street" (northern portion), "Hollis Park" (central) and "Sandown Park" (southern portion).

"Daly Street" is a former quarry that accepted a range of household and industrial waste as landfill, from 1939 to 1957 and again from 1980 to 1991. Landfill waste is typically present to a depth of 5 to 10 metres below ground.

"Hollis Park" accepted solid and liquid waste such as sand rubble, paper and cloth, timber, sawdust and packaging, food wastes and swill, metals and bottles between 1931 and 1956. Sullage (liquid waste) continued to be accepted until 1976. Unlike other areas of the landfill, waste was disposed of in depressions between natural sand dunes. Waste is typically present to a depth of between 1 to 5 metres below ground, deeper in the southern portion of Hollis Park, near Sandown Park. There is minimal waste in the central northern portion. A composting plant also operated on the southern boundary of Hollis Park during the early 1950s, closing in 1956.

"Sandown Park" is a former quarry that accepted waste such as fly ash, wools and skin, marine bilge oil, tyres, sullage and car bodies between 1956 and 1980. Landfill waste is typically present to a depth of 12 to 14 m below ground. A waste transfer station operated here between 1980 and 1991.

Landfill sites and associated activities, and compost manufacturing, are land uses that have the potential to cause contamination, as specified in the guideline 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

The former South Fremantle landfill has been subject to numerous investigations and assessments since 1985. These include soil and groundwater investigations, groundwater monitoring, geotechnical reports, landfill gas assessments, air quality assessments, a site management plan, hydrogeological studies, a health and environmental risk assessment and redevelopment option studies.

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Based on soil investigations carried out in 2007 or earlier, there is approximately 938,000 cubic metres of waste present beneath the site, across an area of approximately 19.4 hectares in total. Contaminants known to be present in soil, at concentrations exceeding guideline criteria that were relevant at the time of the investigations, include metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, concentrations of contaminants vary greatly and other contaminants may also be present.

A sand cap (up to 1.5 metres thick) covers the landfill waste. This layer has been observed by DWER to contain building rubble (such as bricks, tiles and glass) and asbestos fragments. The Department of Health advises that capping material used prior to the regulatory control of asbestos often included asbestos cement building products.

A children's playground is located in the western-most portion of Hollis Park. The area is mostly grassed, but there is a small area of exposed soils along the eastern fence line. Based on a review of historical information, it is unlikely any landfill material was deposited beneath the playground. However, building rubble and asbestos may wash onto this area from within the sand cap at Hollis Park during high rainfall events.

Historical studies (including soil investigations and groundwater monitoring) were summarised in a Detailed Site Review report completed in 2012. That report identified gaps in the available data and prioritised further investigation based on the potential risk to human health, the environment or environmental values.

Landfill gas investigations carried out in 2010, 2014 and 2016 found that landfill waste beneath Daly Street and Sandown Park is decomposing and producing elevated methane and carbon dioxide gas, and reducing oxygen concentrations, in soil. However, landfill gases are flowing at a low rate, indicating that the landfill poses a "low risk" under current conditions. There is no indication of landfill gas generation in Hollis Park, which was ranked as posing a "very low risk" under current conditions. The risk ranking for landfill gas was determined by comparison with the Gas Screening Values published in the guideline, 'Assessing risks posed by hazardous ground gases to buildings' (CIRIA 2007).

A risk assessment concluded that landfill gas was unlikely to pose a risk to off-site receptors while the site is in its current, undeveloped, land use. Further assessment will be required if the site is proposed for development, or if a change in land use is proposed.

Groundwater quality beneath the former South Fremantle landfill, and off-site, was affected by landfill leachate, as per groundwater monitoring from 2007 and earlier. Groundwater quality improved with distance from the landfill. Criteria below for the assessment of water quality are published in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

Nutrients (ammonia), metals (arsenic, cadmium, copper, lead, mercury, nickel and zinc), benzene, phenol, polychlorinated biphenyls (PCB) and dieldrin are present in groundwater

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beneath the former landfill at concentrations exceeding groundwater investigation levels for the protection of marine ecosystems.

Chloride, total dissolved solids, nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, nickel, selenium), benzene, 1,2-dichlorobenzene and methylene chloride are present in groundwater beneath the former landfill at concentrations exceeding groundwater investigation levels for drinking water. Ammonia, metals (arsenic, cadmium, chromium, iron, selenium), benzene, total phenols and 1,2-dichlorobenzene also exceed criteria for the non-potable use of groundwater.

A microbiological indicator of possible pathogens (E.coli) was also present in groundwater beneath the former landfill at a concentration exceeding criteria for the irrigation of urban recreational areas, open spaces, parks and gardens.

An accredited contaminated sites auditor (the auditor) reviewed the investigations and risk assessment for the site. The auditor's findings are documented in a mandatory auditor's report dated 3 August 2017. DWER accepts the auditor's recommendation that the site is suitable for its current use, which is passive recreation with most areas fenced to restrict access, where groundwater is not used for any purpose. However, the auditor found that a site management plan is required to outline ongoing management. Further groundwater assessment is also required to assess the risk to off-site receptors.

The site is contaminated and remediation (such as the development of a site management plan, and further groundwater assessment) is required to reduce risks to human health, the environment and environmental values to acceptable levels. Therefore, the site is classified as 'contaminated - remediation required'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included in this section is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, groundwater contamination present beneath this site has also been identified beyond the site boundary beneath adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

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Land affected by groundwater contamination originating from beneath this site is classified separately under the Act, with a different classification.

Landfill waste in "Sandown Park" extends off-site to the south onto a property used as a caravan park. That site is classified separately under the Act, with a different classification.

Action Required:

This site is considered to be high priority for action to be taken to address contamination, as described below.

A site management plan is required to outline long-term management measures, including for asbestos and landfill gas. The plan is to be prepared in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia' (Department of Health, May 2009).

The Department of Health requires the site management plan to include regular inspections of all accessible areas, including the footpath and the playground at the western end of Hollis Park, to identify and remove any asbestos-containing materials from the surface. It is to include detailed information on how site inspections will be conducted and how suspect asbestos-containing materials will be handled, removed and disposed. Occupational health and safety requirements should also be included.

Further groundwater monitoring is also required to assess the risk to any off-site bore water users and the marine environment 300 metres to the west. Investigations should be carried out in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'National Environment Protection (Assessment of Site Contamination) Measure 1999'.

A high pressure gas main traverses the boundary between Sandown Park and Hollis Park in an east-west direction. Utility companies carrying out works on the gas main should manage potential health risks to intrusive maintenance workers.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "Contaminated - remediation required". An instrument affecting land which comprises all, or part of, this site will not be registered or accepted for registration, unless the CEO of the Department of Environment & Conservation consents to the registration in writing. For further information on the contamination status of this site, or this restriction, please contact the Contaminated Sites section of the Department of Environment & Conservation.

Current Regulatory Notice Issued

Type of Regulatory Notice: Nil

Date Issued: Nil

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Report Generated at: 3:38:30PM, 08/12/2017

General	No other information relating to this parcel.

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Basic Summary of Records Search Response

Report Generated at: 3:39:06PM, 08/12/2017

Search Results

This response relates to a search request received for:

10 Island St
South Fremantle WA 6162

This parcel belongs to a site that contains 55 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	10 Island St South Fremantle WA 6162
Lot on Plan Address	Lot 10 On Diagram 2492
Parcel Status	**Classification:** *12/09/2017 - Contaminated - remediation required* **Nature and Extent of Contamination:** This land parcel is part of the "Hollis Park" portion of the former South Fremantle landfill. Landfill waste is typically present to a depth of between 1 to 5 metres below ground in this area, deeper in the southern area near the boundary with Sandown Park. There is minimal waste in the central northern portion of Hollis Park. A sand cap (up to 1.5 metres thick) covers the landfill waste. This surface layer may contain building rubble, including asbestos. Across the former South Fremantle landfill (which covers an area of more than 19 hectares), soil beneath the sand cap contains metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, other contaminants may also be present. Groundwater quality beneath the former South Fremantle landfill is affected by landfill leachate. Nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc), hydrocarbons (such as from petrol, diesel or oil), solvents (benzene and methylene chloride), polychlorinated biphenyls, an organochlorine pesticide (dieldrin), pathogens and salts are present in groundwater. **Restrictions on Use:** The use of the former South Fremantle landfill site (which covers more than 19 hectares) is restricted to its current use, which is passive recreation with most areas fenced to restrict access. Further assessment and management is required for any change to the site layout; increased public access to currently fenced areas; or for any change in land use.

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Excavation or disturbance of soils is restricted, pending the development of a site management plan consistent with the Department of Health's requirements (see Action Required).

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by August 2006. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site comprises the former South Fremantle landfill, which is separated into three portions known as "Daly Street" (northern portion), "Hollis Park" (central) and "Sandown Park" (southern portion).

"Daly Street" is a former quarry that accepted a range of household and industrial waste as landfill, from 1939 to 1957 and again from 1980 to 1991. Landfill waste is typically present to a depth of 5 to 10 metres below ground.

"Hollis Park" accepted solid and liquid waste such as sand rubble, paper and cloth, timber, sawdust and packaging, food wastes and swill, metals and bottles between 1931 and 1956. Sullage (liquid waste) continued to be accepted until 1976. Unlike other areas of the landfill, waste was disposed of in depressions between natural sand dunes. Waste is typically present to a depth of between 1 to 5 metres below ground, deeper in the southern portion of Hollis Park, near Sandown Park. There is minimal waste in the central northern portion. A composting plant also operated on the southern boundary of Hollis Park during the early 1950s, closing in 1956.

"Sandown Park" is a former quarry that accepted waste such as fly ash, wools and skin, marine bilge oil, tyres, sullage and car bodies between 1956 and 1980. Landfill waste is typically present to a depth of 12 to 14 m below ground. A waste transfer station operated here between 1980 and 1991.

Landfill sites and associated activities, and compost manufacturing, are land uses that have the potential to cause contamination, as specified in the guideline 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

The former South Fremantle landfill has been subject to numerous investigations and assessments since 1985. These include soil and groundwater investigations, groundwater monitoring, geotechnical reports, landfill gas assessments, air quality assessments, a site management plan, hydrogeological studies, a health and environmental risk assessment and redevelopment option studies.

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Based on soil investigations carried out in 2007 or earlier, there is approximately 938,000 cubic metres of waste present beneath the site, across an area of approximately 19.4 hectares in total. Contaminants known to be present in soil, at concentrations exceeding guideline criteria that were relevant at the time of the investigations, include metals (arsenic, cadmium, copper, lead, mercury and zinc) and asbestos. As landfill waste is heterogeneous, concentrations of contaminants vary greatly and other contaminants may also be present.

A sand cap (up to 1.5 metres thick) covers the landfill waste. This layer has been observed by DWER to contain building rubble (such as bricks, tiles and glass) and asbestos fragments. The Department of Health advises that capping material used prior to the regulatory control of asbestos often included asbestos cement building products.

A children's playground is located in the western-most portion of Hollis Park. The area is mostly grassed, but there is a small area of exposed soils along the eastern fence line. Based on a review of historical information, it is unlikely any landfill material was deposited beneath the playground. However, building rubble and asbestos may wash onto this area from within the sand cap at Hollis Park during high rainfall events.

Historical studies (including soil investigations and groundwater monitoring) were summarised in a Detailed Site Review report completed in 2012. That report identified gaps in the available data and prioritised further investigation based on the potential risk to human health, the environment or environmental values.

Landfill gas investigations carried out in 2010, 2014 and 2016 found that landfill waste beneath Daly Street and Sandown Park is decomposing and producing elevated methane and carbon dioxide gas, and reducing oxygen concentrations, in soil. However, landfill gases are flowing at a low rate, indicating that the landfill poses a "low risk" under current conditions. There is no indication of landfill gas generation in Hollis Park, which was ranked as posing a "very low risk" under current conditions. The risk ranking for landfill gas was determined by comparison with the Gas Screening Values published in the guideline, 'Assessing risks posed by hazardous ground gases to buildings' (CIRIA 2007).

A risk assessment concluded that landfill gas was unlikely to pose a risk to off-site receptors while the site is in its current, undeveloped, land use. Further assessment will be required if the site is proposed for development, or if a change in land use is proposed.

Groundwater quality beneath the former South Fremantle landfill, and off-site, was affected by landfill leachate, as per groundwater monitoring from 2007 and earlier. Groundwater quality improved with distance from the landfill. Criteria below for the assessment of water quality are published in 'Assessment and management of contaminated sites' (Department of Environment Regulation, 2014).

Nutrients (ammonia), metals (arsenic, cadmium, copper, lead, mercury, nickel and zinc), benzene, phenol, polychlorinated biphenyls (PCB) and dieldrin are present in groundwater

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beneath the former landfill at concentrations exceeding groundwater investigation levels for the protection of marine ecosystems.

Chloride, total dissolved solids, nutrients (ammonia and nitrate), metals (arsenic, cadmium, chromium, nickel, selenium), benzene, 1,2-dichlorobenzene and methylene chloride are present in groundwater beneath the former landfill at concentrations exceeding groundwater investigation levels for drinking water. Ammonia, metals (arsenic, cadmium, chromium, iron, selenium), benzene, total phenols and 1,2-dichlorobenzene also exceed criteria for the non-potable use of groundwater.

A microbiological indicator of possible pathogens (E.coli) was also present in groundwater beneath the former landfill at a concentration exceeding criteria for the irrigation of urban recreational areas, open spaces, parks and gardens.

An accredited contaminated sites auditor (the auditor) reviewed the investigations and risk assessment for the site. The auditor's findings are documented in a mandatory auditor's report dated 3 August 2017. DWER accepts the auditor's recommendation that the site is suitable for its current use, which is passive recreation with most areas fenced to restrict access, where groundwater is not used for any purpose. However, the auditor found that a site management plan is required to outline ongoing management. Further groundwater assessment is also required to assess the risk to off-site receptors.

The site is contaminated and remediation (such as the development of a site management plan, and further groundwater assessment) is required to reduce risks to human health, the environment and environmental values to acceptable levels. Therefore, the site is classified as 'contaminated - remediation required'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included in this section is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, groundwater contamination present beneath this site has also been identified beyond the site boundary beneath adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

Disclaimer

This Summary of Records has been prepared by Department of Water and Environmental Regulation (DWER) as a requirement of the *Contaminated Sites Act 2003*. DWER makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DWER, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.

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Government of Western Australia
Department of Water and Environmental Regulation

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 3:39:06PM, 08/12/2017

Land affected by groundwater contamination originating from beneath this site is classified separately under the Act, with a different classification.

Landfill waste in "Sandown Park" extends off-site to the south onto a property used as a caravan park. That site is classified separately under the Act, with a different classification.

Action Required:

This site is considered to be high priority for action to be taken to address contamination, as described below.

A site management plan is required to outline long-term management measures, including for asbestos and landfill gas. The plan is to be prepared in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia' (Department of Health, May 2009).

The Department of Health requires the site management plan to include regular inspections of all accessible areas, including the footpath and the playground at the western end of Hollis Park, to identify and remove any asbestos-containing materials from the surface. It is to include detailed information on how site inspections will be conducted and how suspect asbestos-containing materials will be handled, removed and disposed. Occupational health and safety requirements should also be included.

Further groundwater monitoring is also required to assess the risk to any off-site bore water users and the marine environment 300 metres to the west. Investigations should be carried out in accordance with the Department of Water and Environmental Regulation's Contaminated Sites Guidelines and the 'National Environment Protection (Assessment of Site Contamination) Measure 1999'.

A high pressure gas main traverses the boundary between Sandown Park and Hollis Park in an east-west direction. Utility companies carrying out works on the gas main should manage potential health risks to intrusive maintenance workers.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "Contaminated - remediation required". An instrument affecting land which comprises all, or part of, this site will not be registered or accepted for registration, unless the CEO of the Department of Environment & Conservation consents to the registration in writing. For further information on the contamination status of this site, or this restriction, please contact the Contaminated Sites section of the Department of Environment & Conservation.

Current Regulatory Notice Issued

Type of Regulatory Notice: Nil

Date Issued: Nil

Disclaimer
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Department of Water and Environmental Regulation

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 3:39:06PM, 08/12/2017

General	No other information relating to this parcel.

Disclaimer

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Appendix B – Development proposals

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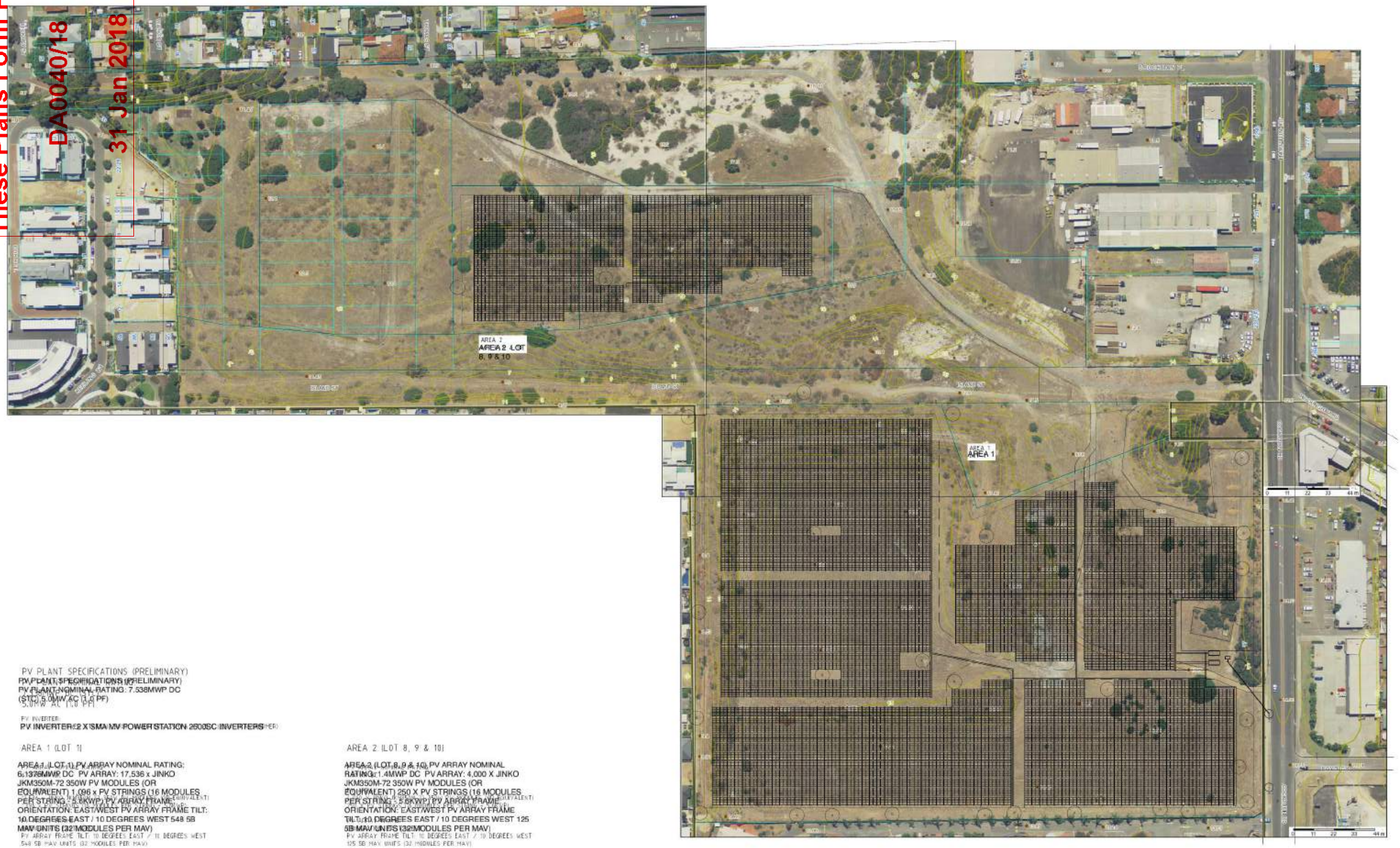

PV PLANT SPECIFICATIONS (PRELIMINARY)

PV PLANT NOMINAL RATING: 7.538MWP DC
(STC) 5.0MW AC (1.0 PF)

PV INVERTER:
PV INVERTER:2 X SMA MV POWER STATION 2500SC INVERTERS

AREA 1 (LOT 1)

AREA 1 (LOT 1) PV ARRAY NOMINAL RATING:
6.1376MWP DC PV ARRAY: 17,536 x JINKO
JKM350M-72 350W PV MODULES (OR
EQUIVALENT) 1,096 x PV STRINGS (16 MODULES
PER STRING - 5.6KWP) PV ARRAY FRAME
ORIENTATION: EAST/WEST PV ARRAY FRAME TILT:
10 DEGREES EAST / 10 DEGREES WEST 548 SB
MAV UNITS (32 MODULES PER MAV)

AREA 2 (LOT 8, 9 & 10)

AREA 2 (LOT 8, 9 & 10) PV ARRAY NOMINAL
RATING: 1.4MWP DC PV ARRAY: 4,000 X JINKO
JKM350M-72 350W PV MODULES (OR
EQUIVALENT) 250 X PV STRINGS (16 MODULES
PER STRING - 5.6KWP) PV ARRAY FRAME
ORIENTATION: EAST/WEST PV ARRAY FRAME
TILT: 10 DEGREES EAST / 10 DEGREES WEST 125
SB MAV UNITS (32 MODULES PER MAV)

	TD/KR	TD	ISSUED FOR TENDER	JW		29.11.19	A	DO NOT SCALE DRAWINGS IN PDF	
EPU00	KK	TD	DEVELOPMENT APPLICATION LAYOUT	TD		29.11.19	B		
EPU00	KK	TD	ADD EAST WEST ORIENTATION	TD		29.11.19	C	SCALE	1:1000
								DRN	TD 29.11.20
								CHKD	TD 29.11.20
								EXAM	JW 29.11.20
JOB NO	DRN	CHKD	AMENDMENT	EXAM	APPD	DATE	ISS	APPD	

CPS NATIONAL ABN 45 163 201 453

EPURON
FREMANTLE LANDFILL PROJECT

SITE LAYOUT

DWG NO. EPU00022.2 SHT 2 REV C

CPS-PM-017a Revised

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								DRN TD 28.11.17		FREMANTLE LANDFILL PROJECT
								CHKD TD 28.11.17		AREA 1 LOT 1
								EXAM JW 28.11.17		SITE LAYOUT
JOB NO	DRN	CHKD	AMENDMENT	EXAM	APPD	DATE	ISS	APPD		DWG NO EPUR000022 SH 2

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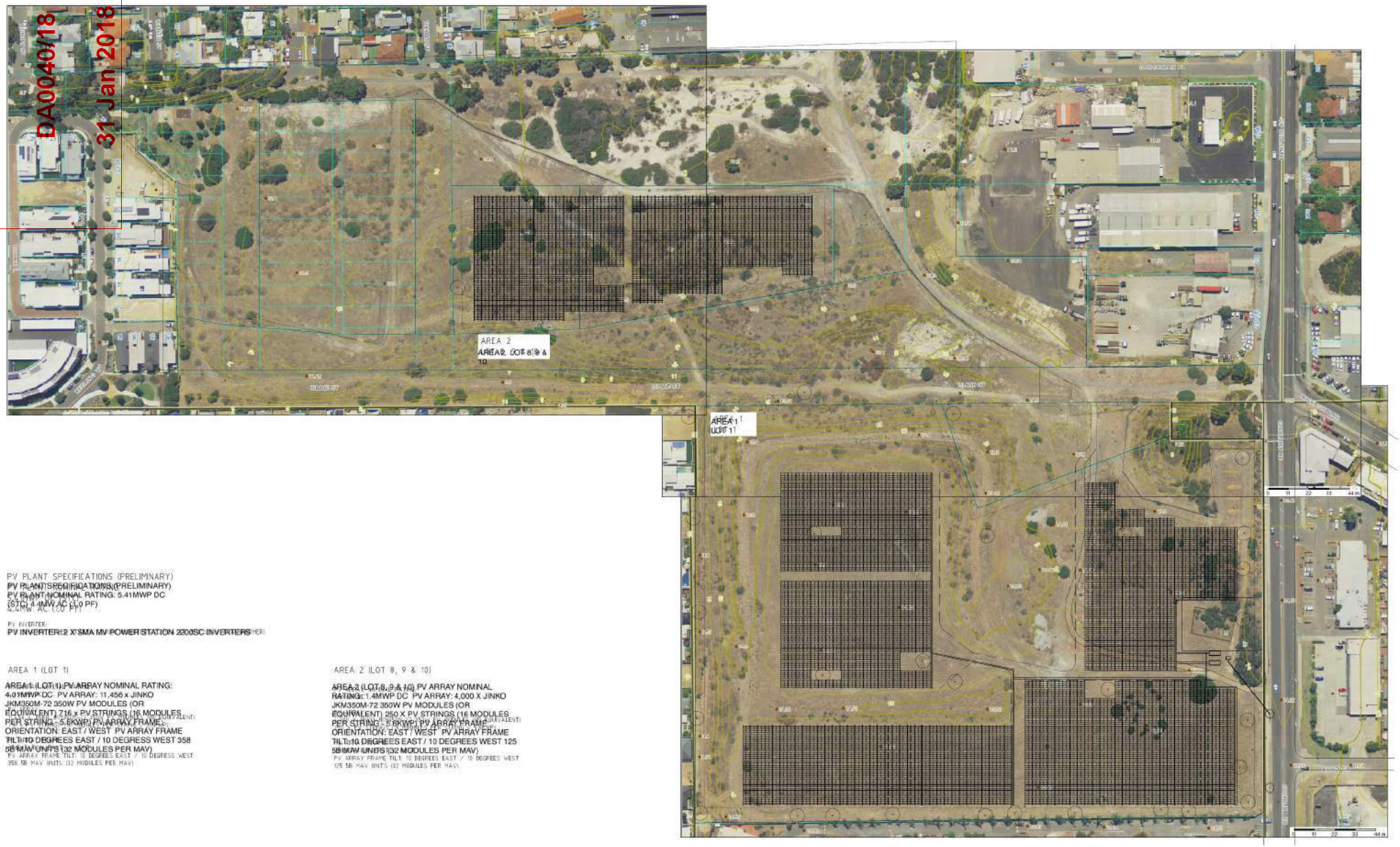

PV PLANT SPECIFICATIONS (PRELIMINARY)

PV PLANT NOMINAL RATING: 5.41MWP DC (STC) 4.4MW AC (1.0 PF)

PV INVERTER:
PV INVERTER:2 X SMA MV POWER STATION 2200SC INVERTERS

AREA 1 (LOT 1)

AREA 1 (LOT 1) PV ARRAY NOMINAL RATING: 4.01MWP DC PV ARRAY: 11,456 x JINKO JKM350M-72 350W PV MODULES (OR EQUIVALENT) 716 x PV STRINGS (16 MODULES PER STRING - 5.6KWP) PV ARRAY FRAME ORIENTATION: EAST / WEST PV ARRAY FRAME TILT: 10 DEGREES EAST / 10 DEGREES WEST 358 SB MAV UNITS (32 MODULES PER MAV)

AREA 2 (LOT 8, 9 & 10)

AREA 2 (LOT 8, 9 & 10) PV ARRAY NOMINAL RATING: 1.4MWP DC PV ARRAY: 4,000 X JINKO JKM350M-72 350W PV MODULES (OR EQUIVALENT) 250 X PV STRINGS (16 MODULES PER STRING - 5.6KWP) PV ARRAY FRAME ORIENTATION: EAST / WEST PV ARRAY FRAME TILT: 10 DEGREES EAST / 10 DEGREES WEST 125 SB MAV UNITS (32 MODULES PER MAV)

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EPU00	KR	TD	OPTION 2 DEVELOPMENT APPLICATION LAYOUT	TD		28.11.19	B	SCALE 1:1000		EPURON FREMANTLE LANDFILL PROJECT OPTION 2 SITE LAYOUT
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								CHKD TD 29.11.20		
								EXAM JW 29.11.20		
JOB NO	DRN	CHKD	AMENDMENT	EXAM	APPD	DATE	ISS	APPD		DWG EPU00022-S1 SHT 1 SH

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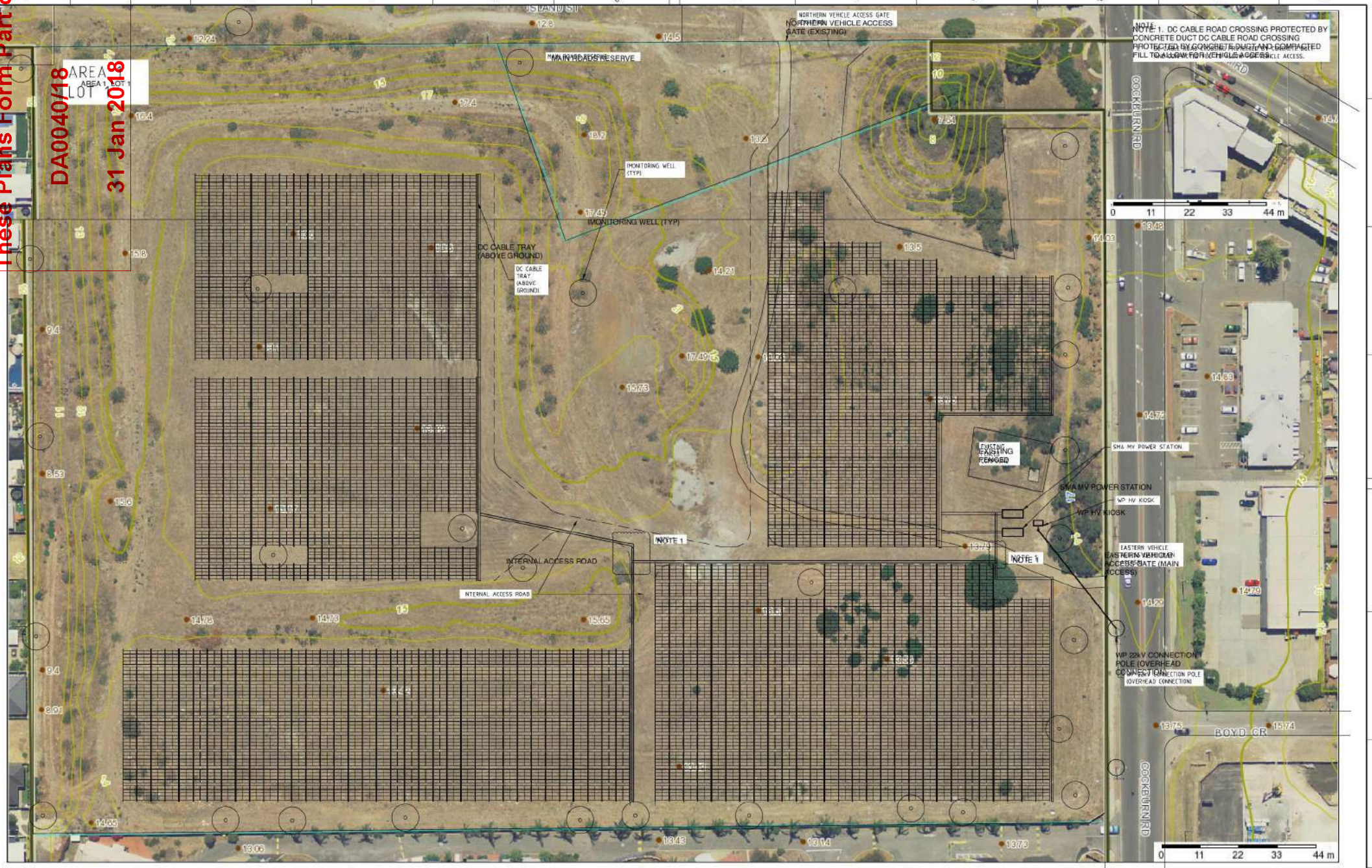

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								DRN	TD 28.11.17		FREMANTLE LANDFILL PROJECT
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								EXAM	JW 29.11.17		SITE LAYOUT
JOB NO	DRN	CHKD	AMENDMENT	EXAM	APPD	DATE	ISS	APPD			DWG NO EPU0002-S1 SH 2 REV B

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SOLAR FARM COMPONENTS

PRE-FABRICATED MODULAR BLOCKS ON SELF-BALLASTED PRE-CAST CONCRETE STRIPS (5B Technology)

In relation to some landfill-specific concerns, 5B advises:

- There is adequate air flow beneath a MAV, given the generous gaps between modules and at the peak of the MAV.
- Ground screws are sunk to 50cm depth, which we've been told is acceptable given the majority of landfill caps are 1m or more. Minimal ground screws are used as only the start and end of each 'row' of MAVs needs to be anchored: adjacent MAVs beams are connected together.
- Bearing pressure during deployment is well within most landfill's limits (200-400 kPa, depending on whether using forklft or telehandler). For this reason we don't think ground bearing pressure will be an issue. The loading is minimal once the MAV is in place; the MAV area once deployed is 100m2.
- The rubber pads used to level the MAV beams ensure there is clearance underneath each beam, and the beam only has 3 points of contact to the ground.

(Have also provided GHD with "Maverick" brochure)

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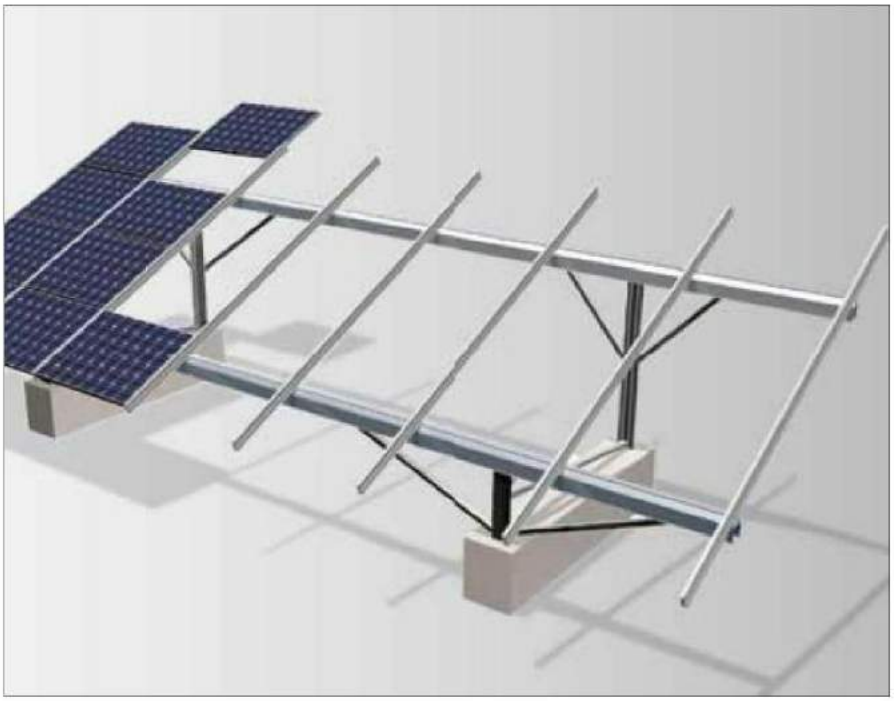
ALTERNATIVE FIXED TILT OPTION ON PRE-CAST CONCRETE FOOTINGS



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OTHER SOLAR FARM PICTURES INCLUDED TO DEPICT ROW ORIENTATIONS

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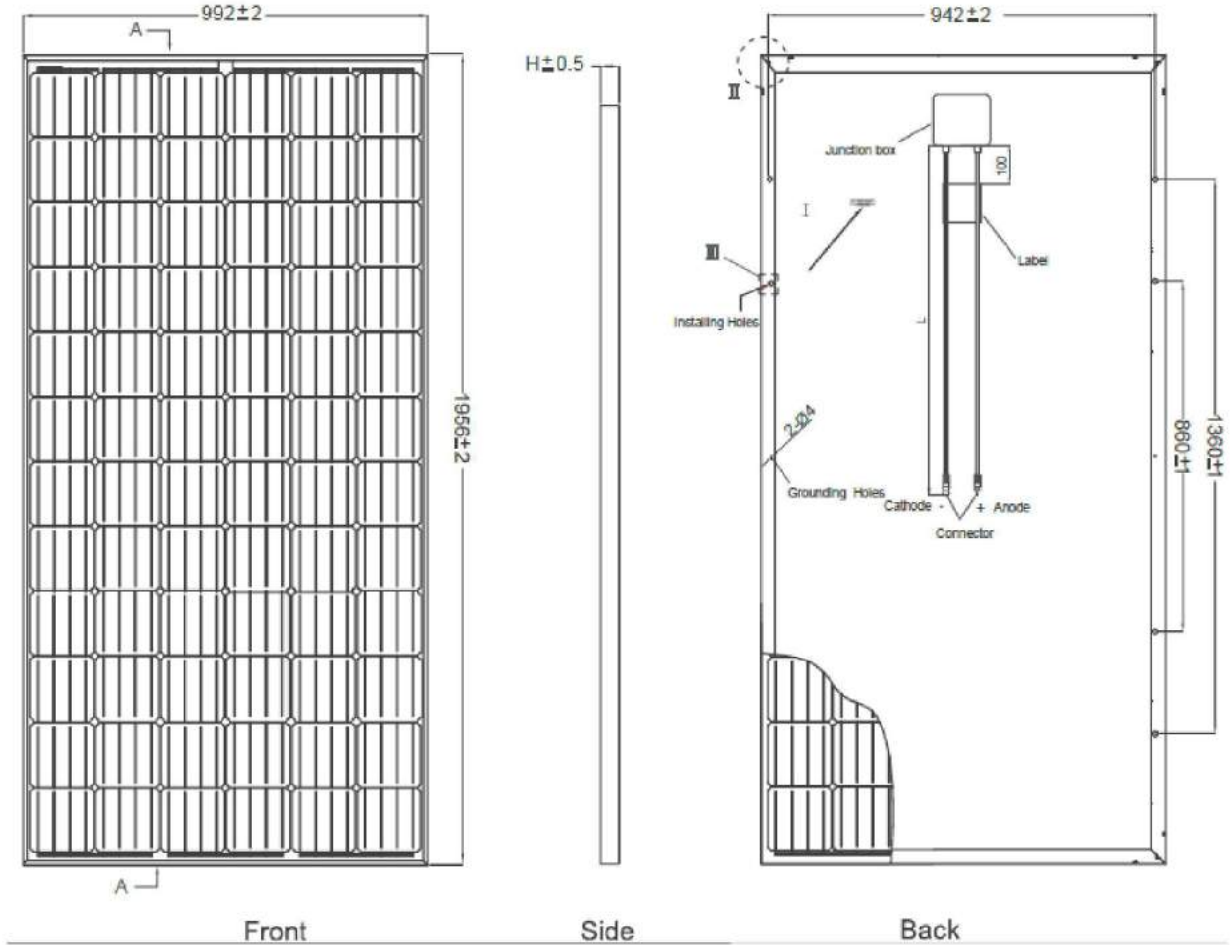
Solar Panel drawing (indicative dimensions)



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INVERTER EXAMPLES

Note: Inverters convert DC output from panels to AC output; and transformer steps up voltage to 22kV; inverters in general can be centralised or string

SMA 2500 MVPS (central inverter example)

Side & front views

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30 – 60kW string inverters (alternative inverter option)

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ABOVE GROUND CABLE TRAY EXAMPLE (Ignore driven pile aspect of photo)

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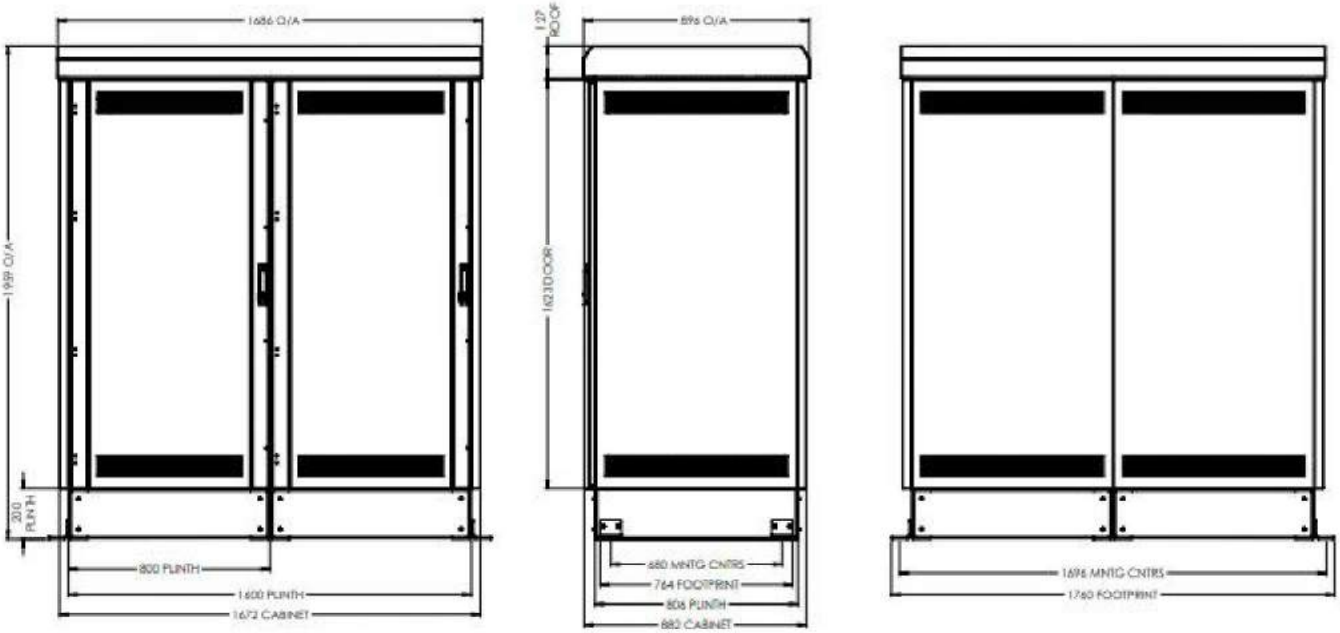
GRID CONNECTION INFRASTRUCTURE

Note: Exact configuration to be determined based on detailed design & discussions with Western Power

Outdoor cabinet (indicative) – to be located on-site – for switchboards, SCADA panel, transformers, metering, etc



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NEW 22kV POWER POLE TO BE LOCATED ON-SITE BASED ON WESTERN POWER GRID CONNECTION DISCUSSIONS

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INDICATIVE FENCING EXAMPLE (note small concrete footings)

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5B MAVERICK

What would a solar farm look like, if we reinvented it today? 5B started with a clean slate and developed the simplest, fastest way to deploy PV modules into the field. Our answer is the Maverick: a modular PV system built up from our 12 kW MAV array blocks.

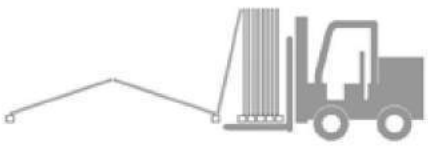
Maverick is the solar farm of the future: A pre-fabricated, low-cost solar array that shifts construction, labour and risk from the project site into the factory.

100% Prefabricated

The MAV DC solar unit arrives on site entirely electrically and mechanically prefabricated, simplifying design, slashing site time and labour.

Streamlined Logistics

MAV streamlines solar array procurement to a single source and simplifies on-site logistics: four MAVs ship in a standard 20 ft container.



Rapid Deployment

A MAV unit is deployed with a standard site vehicle in six minutes, with a crew of two, with minimal site preparation. Our continuous array means no trenching for DC cables.

Portable Solar

5B's MAV is the only cost-effective, portable solar array that unlocks the possibility of a solar fleet, giving customers control of how they use their site and solar in the future.

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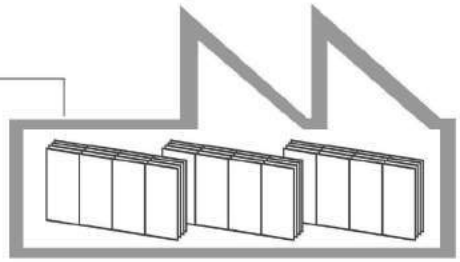
5B MAVERICK

Prefabricated in our factory

The Maverick is the solar farm of the future. We've slashed costs and project risks, by moving the bulk of work off the work site, and into a safe, controlled, low-cost factory environment. 5B's two-person teams can assemble one MAV every five hours.

Our first Sydney factory can produce 120 kW of MAVs per day, or 30 MW per year. Because Maverick is a modular solution, you get full flexibility in the design of the DC array, cabling runs and inverter locations.

Each MAV leaves the factory pre-commissioned, fault-tested and electrically complete up to the MC4 connectors for each string. We have developed a plug-and-play DC cabling solution and pre-fabricated inverter stands to reduce cabling costs and on-site electrical work.



Optimised for logistics

1 The MAV ships in standard shipping containers: Four 32-module MAVs fit in a 20-ft container. Instead of managing complex shipping arrangements with multiple suppliers, the MAV drastically simplifies on-site logistics: your 5B shipment will contain one-hundred per cent of your solar farm components, up to the AC terminals of the inverter. We can also ship MAV on flatbed trucks for smaller applications.

2 MAVs can be stored on site before deployment, adding flexibility to your installation schedule.

Deployed in minutes

3 Before we deploy a MAV, we survey the site with a drone. We then mark out the locations for the recycled rubber pads, which act to level the concerete beams

Like everyone in solar, we like flat sites the best! We can also handle sites with even slopes, up to five degrees in incline.

4 We deploy MAV on site with a five tonne telehandler or forklift in six minutes. A two-person 5B deployment crew can deploy 100 kW per day or one megawatt in 10 days.

5 When deploying, the leading MAV is secured with 2 ground anchors, and the following units are daisy-chained. Our concrete beams provide full wind-rated ballast so these are our only ground penetrations.

FAST FACTS:

Because MAV is a continuous array, we can fit more solar MW per hectare than conventional fixed tilt and single axis tracking designs.

MAV is pre-ballasted, so it can go places that are off limits for most solar farms. We are planning MAV deployments on landfill sites and tailings dams for mines.

We've even made our factory mobile: for your next project we can ship you MAVs or a MAV factory

About 5B

5 billion years of sun. How will you use it? 5B are redefining solar energy from the ground up. We are an team of renewable energy experts who care about making energy projects cheaper, faster and smarter.

For pricing and ordering:

Visit our website: **5b.com.au**

Email us: **info@5b.com.au**

Call us: (02) 9550 9239

Relocated to your next site

We remove MAV from site with the reverse of our deployment process, in the same timeframe. Our ground anchors are removed and MAV is re-loaded into shipping containers and ready to be relocated.

Maverick is certified for installation up to wind regions C, with minor additional ballast.

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MAVERICK™

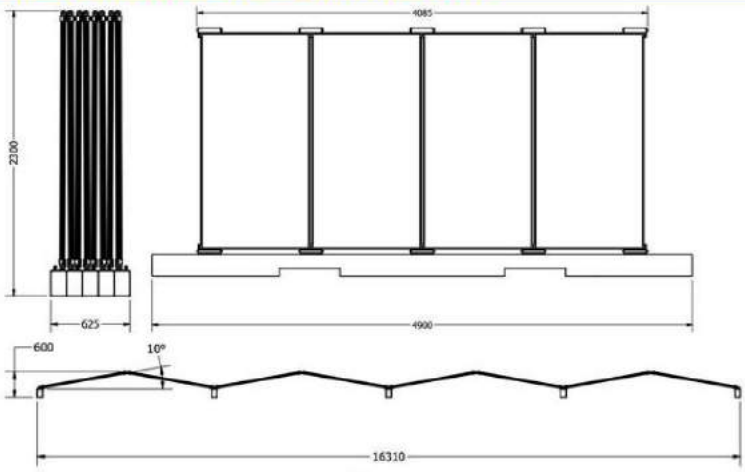
Solar re-invented

Efficient pre-assembly cuts on-site labour by more than 50%

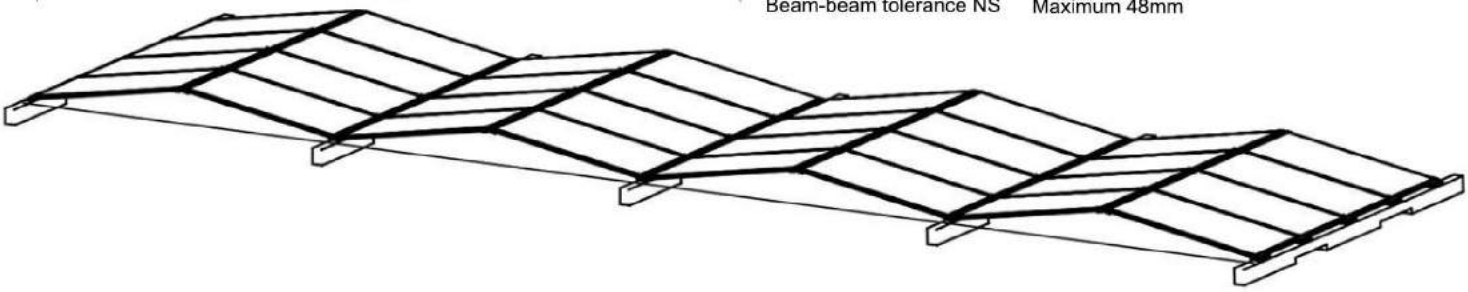
Arrives on site mechanically and electrically prefabricated

Deployed on site in under 10 minutes

MECHANICAL SPECIFICATIONS



Module Dimensions	1956 x 992 x 40 (mm)
Module Configuration	32 modules per MAV, 4 wide x 8 long
Packing Configuration	3 MAV units per 20' HQ container
Dimensions	4900 (W) x 600 (H) x 16,310 (L) mm deployed
Installation type	Telehandler or forklift, with 2 installers
Tilt Angle	10 degrees, excluding ground variation
Weight	2400 kg per MAV
Module connections	Annodised aluminium alloy hinges, module clamps
Tethers	Stainless steel cable
Ballast	Precast 40MPa reinforced concrete beam
Peak wind velocity	Wind region A (60 m/s). Certified for installation up to wind region C, with minor additional ballast
Beam-beam tolerance EW	Maximum 690mm
Beam-beam tolerance NS	Maximum 48mm



Specifications subject to technical changes © 5B Australia Pty Ltd. 5BAU_2017-07_5M_ver02_EN

ELECTRICAL SPECIFICATIONS

MODULE

PV Module Type	Jinko JKM350M-72	
	STC	NOCT
Maximum Power (Pmax)	350Wp	262Wp
Maximum Power Voltage (Vmp)	39.1V	37.2V
Maximum Power Current (Imp)	8.94A	7.05A
Open-circuit Voltage (Voc)	47.5V	46.0V
Short-circuit Current (Isc)	9.38A	7.46A
Module Efficiency STC (%)	18.01%	
Operating Temperature(°C)	-40~ +85	

ARRAY

Power at MPP	11.2 kW
Short circuit current	9.4 A per string, 18.8 A array output
Open circuit voltage	760 V
Current at MPP	8.9 A per string,17.9 A array output
Voltage at MPP	626 V
Power Density	1.1 ha/MW [2]
String Configuration	16 modules, 2 strings (1 east, 1 west)
Terminations	2 x MC4 connectors
String return cable	6mm x 20m

[2] Fixed tilt 3.0 ha/MW (NREL)

CERTIFICATIONS

Australian Patent #2015327772, Intl. Patents Pending.

Compliant with Australian Standards and CEC Solar installation guidelines [AS/NZS 5033, AS 1170.0, AS 1170.1, AS 1170.2, AS 1664.1, AS 3600, AS/NZS 3000, AS/NZS 4777:2005, AS/NZS 1768:2007, AS/NZS 4509:2009].

Structurally certified for transport and operation in wind regions A, B and C to the aforementioned standards.

NOTE: Please read the Installation Guide before using the product.

ABOUT 5B

5B is an Australian engineering team dedicated to developing cutting-edge technologies that reduce the cost of renewable energy. 5B's Maverick is the only re-deployable solar array that is cheaper and faster to install than conventional solar.

Contact: info@5b.com.au **Website:** www.5B.com.au

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GHD

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev 0	N Rogers	S French	On file	S French	On file	13/12/2017
Rev 1	N Rogers	D Todd	On file	D Todd	On file	12/01/2017

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