



<b>Licence Number</b>	L7184/1997/11
<b>Licence Holder</b>	Shark Bay Resources Pty Ltd
<b>ACN</b>	079 088 636
<b>Registered business address</b>	Exchange Tower Level 16 2 The Esplanade PERTH WA 6000
<b>Date of amendment</b>	Thursday, 22 December 2016
<b>Prescribed Premises</b>	Category 14: Solar salt manufacturing Category 58A: Bulk material or unloading Category 89: Putrescible landfill site
<b>Premises</b>	Shark Bay Resources M260SA, G9/1 and G9/2 USELESS LOOP WA 6537

## Amendment

The Chief Executive Officer (CEO) of the Department of Environment Regulation (DER) has amended the above licence in accordance with section 59 of the *Environmental Protection Act 1986* as set out in this Amendment Notice.

Date signed: 22 December 2016

**Alana Kidd**

**Manager Licensing – Resource Industries**

an officer delegated under section 20 of the *Environmental Protection Act 1986 (WA)*

## Amendment Notice

This notice is issued under section 59 of the *Environmental Protection Act 1986* (EP Act) to amend the licence issued under the EP Act for a prescribed premises as set out below. This notice of amendment is given under section 59B(9) of the EP Act.

## Amendment Description

Shark Bay Resources Pty Ltd (SBR) operates a solar salt mine at Useless Loop and Useless Inlet, south of Shark Bay, Western Australia. Salt is produced by a series of solar salt water concentration ponds, brine concentration ponds and salt crystallisation ponds.

Licence L7184/1997/11 was reissued to SBR on 2 September 2013. The Licence includes conditions requiring foreshore and groundwater monitoring to enable potential impacts to the marine environment to be determined.

DER received an application on 22 September 2015 to amend the foreshore and groundwater monitoring regime to that proposed by the *Shark Bay Operations Water Monitoring Review, MBS Environmental, March 2015*.

A detailed risk review and update of the licence is required, to align the licence to DER's new risk based Regulatory Framework. Once the review is finalised, this Amendment Notice will be included in the reviewed licence. Changes imposed under this Amendment Notice may occur as part of the review.

## Other Approvals

The Licence Holder holds *Environmental Protection Act 1986* Ministerial Statement 425 and Ministerial Statement 513 which are relevant to the amendment application.

## Amendment Decision

### Background

The SBR solar salt operation consists of a system of salt concentration, bitterns and crystallization ponds, as well as fixed and mobile plant facilities required for harvesting, washing and stockpiling the crystalline solar salt product.

The premises lies within, but is excluded from, the Shark Bay World Heritage Area.

Historically, from late 1960's until 1989, bitterns waste was discharged directly to the ocean - immediately adjacent to the final crystalliser ponds in the near shore environment at the mouth of Useless Loop. This resulted in progressive loss of seagrass. From 1989 bitterns was no longer directly discharged but instead allowed to infiltrate into groundwater underneath the bitterns ponds.

SBR commissioned MBS Environmental (MBS) to review the effectiveness of the current groundwater and foreshore monitoring programme. The '*Shark Bay Operations Water Monitoring Review, MBS Environmental, March 2015*' (the MBS Review) included the following information and recommendations.

## Foreshore monitoring

The Licence has required quarterly foreshore sampling of seawater at eight points (F1 - 8) along the seawall adjacent to the bitterns ponds to monitor for bittern seepage, due to its potential as a marine toxicant. Jetty Control, Shiploader Control and Old Flume Control sites have been monitored as reference sites. The foreshore monitoring locations are shown in Figure 1 below. The parameters monitored are shown in Table 1 below.

**Table 1: Foreshore monitoring programme**

Monitoring sites	Sampling Frequency	Parameters to be measured	Units
Foreshore Monitoring Points (F1 - F8, Jetty Control, Shiploader Control, Old Flume Control).	Quarterly	Calcium Magnesium Density	mg/L mg/L kg/L

MBS reviewed foreshore monitoring data for 2004 – 2014. MBS notes in the Review that all foreshore parameters measured (calcium, magnesium and density) closely matched seawater reference monitoring sites for the period, and there was little variation between monitoring sites. This observation and the observed regrowth of seagrass adjacent to the seawall indicate no observable impact in the near shore marine area from bittern seepage for a ten year period.

The MBS Review also notes that two of the three parameters used (calcium and density) are not sufficiently sensitive to detect relative changes needed to offer protection at the ANZECC 2000 Guidelines 99% level, and that bromide and potassium would be sufficiently sensitive and therefore better indicators. MBS note that bromide is considered the best indicator of bitterns /brine influence into seawaters or groundwater.

The MBS Review recommends to:

- Reduce the number of foreshore monitoring locations to sites F4, F7, Jetty Control and Island Control as no variation between sampling points was noted in the ten years of monitoring assessed.
- Replace the current parameter suite with electrical conductivity, total dissolved solids, specific gravity, sodium, potassium, magnesium, sulfate (calculated from S by ICP), boron, chloride and bromide in order to better measure foreshore marine water quality for the ANZECC 2000 Guidelines 99% level of species protection.

The Delegated Officer has reviewed the MBS Review and considers that:

- The proposed foreshore surface water monitoring locations (F4, F7, Jetty Control and Island Control) are adequate to detect potential surface water impacts due to seepage from the bitterns ponds. F1, F2, F3, F5, F6, F8, and Old Flume Control monitoring locations have been removed.
- The proposed foreshore monitoring suite of parameters (electrical conductivity, total dissolved solids, specific gravity, sodium, potassium, magnesium, sulfate

(calculated from S by ICP), boron, chloride and bromide) would better monitor foreshore marine water quality, for the ANZECC 2000 Guidelines 99% level of species protection than the current parameter suite (calcium, magnesium and density).

- The proposed suite of foreshore monitoring parameters would improve the detection and determination of potential toxic impacts to the marine environment.

The Licence conditions have therefore been amended accordingly.

### Groundwater monitoring

The Licence has required quarterly and annual groundwater monitoring of nine bores (GW1 - 9) around various concentrator ponds in order to detect changes to groundwater quality that could potentially impact environmental values in the Shark Bay World Heritage area. The parameters monitored are listed in Table 2 below and the monitoring locations are shown in Figure 1 below.

**Table 2: Groundwater monitoring programme**

Monitoring sites	Sampling Frequency	Parameters to be measured	Units
GW1; GW2; GW3; GW4; GW5; GW6; GW7; GW8 and GW9	Quarterly	Magnesium, calcium Density Conductivity pH	mg/L kg/L µS/cm n/a
GW1; GW2; GW3; GW4; GW5; GW6; GW7; GW8 and GW9	Annually	Total petroleum hydrocarbons Chloride Manganese Barium Sulfate Total Dissolved Solids Sodium Potassium	mg/L

SBR has also voluntarily monitored two additional bores GW10 - 11 which are located south of the Useless Loop inlet primary concentrator ponds (see Figure 1 below). G11 is further inland, some distance from the primary concentrators and serves as a reference for groundwater less affected by seawater intrusion.

The MBS Review noted that:

- pH, conductivity, calcium and manganese are not all considered useful for determining trends and changes relative to background groundwater or seawater, and that other parameters such as potassium, sodium, sulfate, boron and bromide would be more useful for groundwater monitoring.
- Accurate pH determination in high salinity bores may be difficult and inaccurate. Measurement of barium and manganese is not justified for regular annual monitoring given the observed chemistry of the site and operations.

- Given the only source of hydrocarbon within the pond groundwater monitoring area is individual vehicles used on the salt ponds, MBS considers the risk of hydrocarbon contamination of groundwater in this area is low. Any hydrocarbon spill incident detectable in the groundwater monitoring wells would be required to be reported as a significant incident. The Report states that long term monitoring results since 2006 show no reportable total petroleum hydrocarbons (TPH).

The MBS Review recommends:

- Monitoring of bores GW1, GW3, GW4 and GW7 cease as they monitor receptors that are covered by other bores.
- The parameter suite be electrical conductivity, total dissolved solids, specific gravity, sodium, potassium, magnesium, sulfate (calculated from S by ICP), boron, chloride and bromide, with pH, calcium, barium and manganese removed.
- Quarterly monitoring.
- Annual monitoring for hydrocarbons cease at these bores.

The Delegated Officer has reviewed the MBS Review and agrees that:

- The proposed groundwater bores are located so that groundwater monitoring will be adequate to monitor seepage from the ponds. Monitoring at GW1, GW3, GW4 and GW7 can be removed as they monitor receptors that are covered by other bores, and GW10 and GW11 added as background reference bores.
- The proposed groundwater parameters (electrical conductivity, total dissolved solids, specific gravity, sodium, potassium, magnesium, sulfate (calculated from S by ICP), boron, chloride and bromide) would serve as better indicators of potential trends and changes in groundwater relative to background groundwater or seawater at this site. (calcium, barium and manganese removed; magnesium, boron, bromide added).

The Licence condition requiring annual monitoring for hydrocarbons will not be amended by this Amendment Notice. The Delegated Officer notes that risk of hydrocarbon contamination and monitoring requirements will be considered in a Licence review which will be undertaken separate to this amendment notice.

The Delegated Officer considers that pH should remain as a standard parameter. Removal of pH parameter will be reviewed in further detail in a Licence review separate to this amendment.

The Licence conditions have been amended accordingly.

### **Bitterns monitoring wells**

In 2012 SBR commissioned Groundwater Resource Management to conduct an investigation into the fate of bitterns disposed of to the bittern waste ponds. Two deep monitoring wells (BW1 and BW2 Figure 2) were installed in 2013 to investigate a conceptual model that suggested seepage would migrate downwards and flow along the upper boundary of the sandy clay aquitard at approximately 45 metres (m)

depth out to an unknown deep marine discharge point. The wells were monitored for Electrical Conductivity (EC) versus depth in 2013.

The seawall wells were assessed for Electrical Conductivity relative to depth in May, June, August, September, October and December 2013. The MBS Review noted that:

- Electrical conductivity of both wells match that of seawater from 3 metres to until at least 25 metres (BW1) to 30 metres (BW2) in the area of the bittern ponds - well below the average depth of water in Shark Bay of 9 metres.
- Overall the results for BW1 (which extends deep enough for all layers to be seen) infer a three layer system in the superficial aquifer with minimal mixing due to differences in salinity and therefore density. This comprises:
  - Surface to 25 metres – seawater/intruded seawater.
  - 25 metres to 40 metres – natural groundwater similar to GW11 flowing outwards underneath the seawater.
  - 40 metres to 45 metres – brine/bitterns seepage outwards.

The MBS Review concludes that the data strongly supports the proposed hydrogeological model that bitterns is flowing out at depths (40 to 45 metres) well below that of Shark Bay (average 9 metres) to a deep ocean discharge point well offshore outside the Shark Bay World Heritage Area.

The MBS Review recommends that new monitoring points BW1 and BW2 be included in the monitoring program, for annual monitoring of electrical conductivity versus depth in order to further investigate and confirm the hydrogeological model. Annual monitoring is considered sufficient because there was little variation of electrical conductivity versus profile over the months monitored in 2013. Locations of proposed monitoring sites are shown in Figure 2 below.

The Delegated Officer has reviewed the MBS Review and considers that the proposed annual monitoring of electrical conductivity versus depth at monitoring locations BW1 and BW2 will assist in confirming the hydrogeological model of bitterns seepage movement. The Licence conditions have been amended accordingly.

#### **Administrative error**

Licence L7184/1997/11 was issued with an administrative error in that condition 7(c) was not included. Condition 7(c) is added to the Licence to ensure that all groundwater sampling is conducted in accordance with AS/NZS 5667.11.

A definition of AS/NZS 5667.11 is added to Definitions.

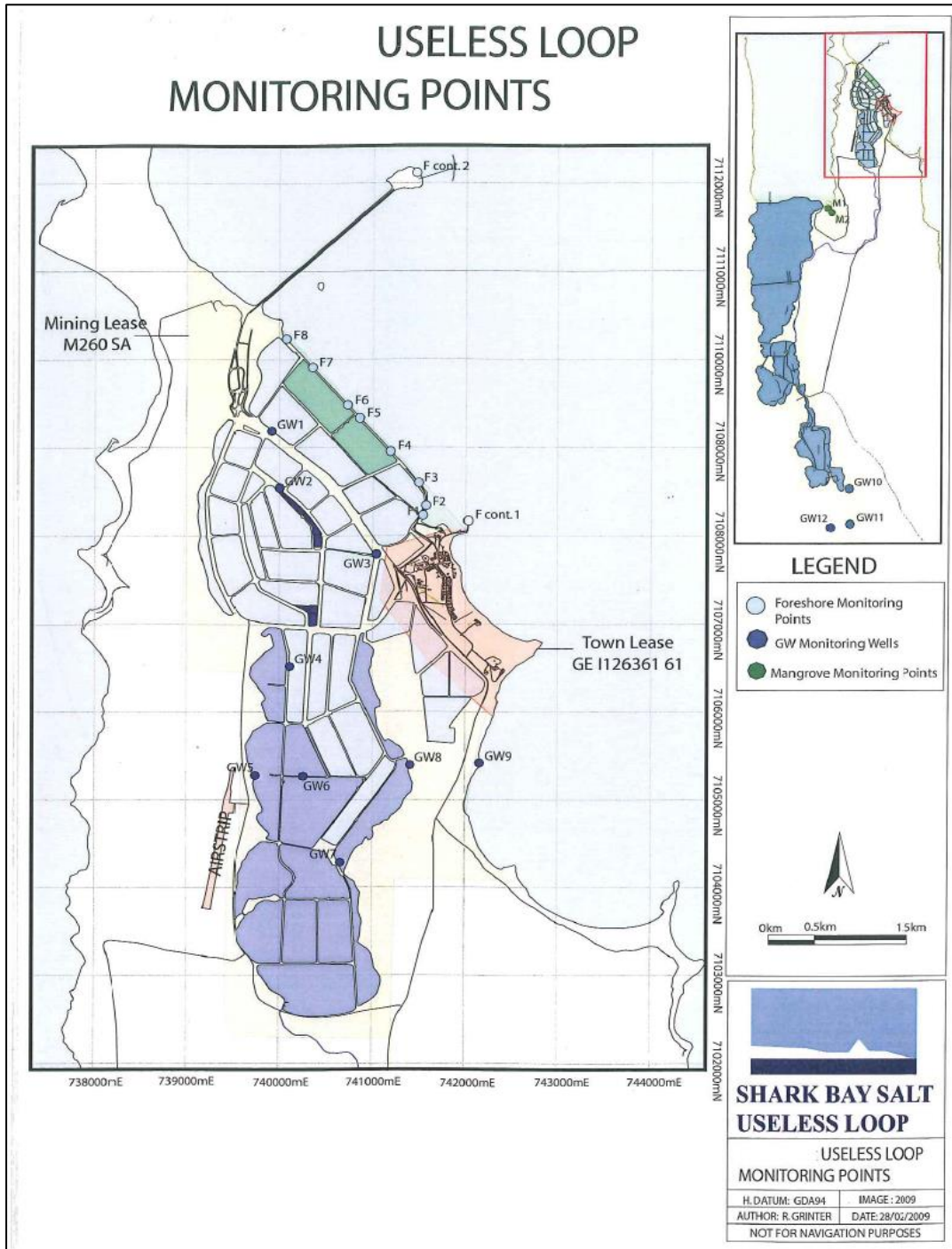
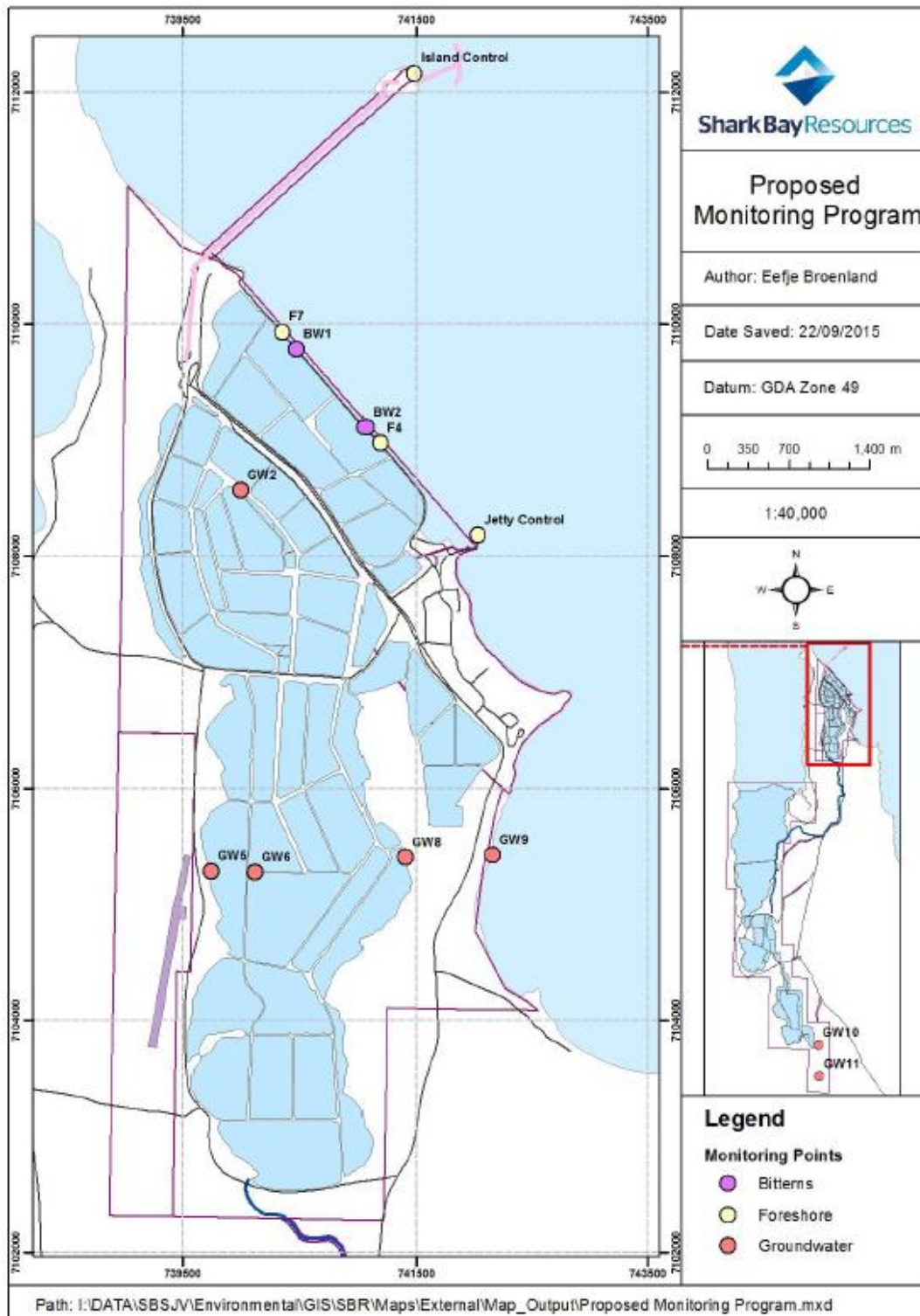


Figure 1: Locations of the current monitoring sites.





**Figure 2: Locations of proposed monitoring sites**



## Amendment History

Instrument	Issued	Amendment
L7184/1997/11	2/09/2013	Licence reissue.
L7184/1997/11	29/04/2016	Notice of Amendment Of Licence Expiry Dates - licence expiry extended to 1 September 2028.
L7184/1997/11	22/12/2016	Amendment Notice 1 - Licence amendment requested by the Licensee to change the foreshore and groundwater monitoring regime.

## Licence Holder comments

The Licence Holder was provided with the draft Amendment Notice on 2 December 2016. The Licence Holder requested that parameters pH and Electrical Conductivity be excluded from the requirement by conditions 6(c) and 7(b) for samples to be submitted to a NATA certified laboratory, due to holding times. Shark Bay Resources has stated there is on site capability to conduct the analysis.

The request has been considered by the Delegated Officer and has been included in the amendment.

## Amendments

- Table 2 of the Licence is amended by the deletion of the text shown in strikethrough below and the insertion of the bold text shown below:

**Table 2**

Monitoring sites	Sampling Frequency	Parameters to be measured	Units
<del>Foreshore Monitoring Points (as depicted in Attachment 2)</del>	<del>Quarterly</del>	<del>Calcium; Magnesium; and Density*</del>	<del>mg/l *kg/l</del>
<b>F4 F7 Jetty Control Island Control (as depicted in</b>	<b>Quarterly</b>	<b>Specific gravity</b>	<b>-</b>
		<b>Electrical conductivity<sup>1</sup></b>	<b>µS/cm</b>
		<b>Total dissolved solids</b>	<b>mg/L</b>
		<b>Sodium</b>	
		<b>Potassium</b>	
		<b>Magnesium</b>	
<b>Boron</b>			
<b>Chloride</b>			

Attachment 2)		Bromide	
		Sulfate (calculated from S by ICP-MS)	

Note 1: In-field non-NATA accredited analysis permitted.

2. Table 3 of the Licence is amended by the deletion of the text shown in strikethrough below and the insertion of the bold text below:

**Table 3**

Monitoring sites	Sampling Frequency	Parameters to be measured	Units
<del>GW1; GW2; GW3; GW4; GW5; GW6; GW7; GW8 and GW9</del> (as depicted in Attachment 2)	Quarterly	<del>Magnesium; Calcium; Density*; Conductivity**; and pH***</del>	<del>mg/l *kg/l **µS/cm ***units for pH not applicable</del>
<del>GW1; GW2; GW3; GW4; GW5; GW6; GW7; GW8 and GW9</del> (as depicted in Attachment 2)	Annually	<del>Total petroleum hydrocarbons; Chloride; Manganese; Barium; Sulphate; Total Dissolved Solids; Sodium; and Potassium.</del>	<del>mg/l</del>
<b>BW1 BW2</b> (as depicted in Attachment 2)	<b>Quarterly</b>	<b>Electrical conductivity<sup>1</sup> at intervals of 1 metre to 20 metres.</b>	<b>µS/cm</b>
<b>GW2 GW5 GW6 GW8 GW9 GW10 GW11</b> (as depicted in Attachment 2)	<b>Quarterly</b>	<b>Specific gravity</b>	<b>-</b>
		<b>pH<sup>1</sup></b>	<b>-</b>
		<b>Electrical conductivity<sup>1</sup></b>	<b>µS/cm</b>
		<b>Total Dissolved Solids</b>	<b>mg/L</b>
		<b>Sodium</b>	
		<b>Potassium</b>	
		<b>Magnesium</b>	
		<b>Boron</b>	
		<b>Chloride</b>	
		<b>Bromide</b>	
<b>Sulfate (calculated by S by ICP-MS)</b>			

<b>GW2 GW5 GW6 GW8 GW9 (as depicted in Attachment 2)</b>	<b>Annually</b>	<b>Total Petroleum Hydrocarbons</b>	<b>mg/L</b>
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Note 1: In-field non-NATA accredited analysis permitted.

3. The licence is amended by the insertion of the following condition shown in bold below:

**7(c): The Licensee shall ensure that all groundwater sampling is conducted in accordance with AS/NZS 5667.11.**

4. The licence is amended by the insertion of the following definition shown in bold below:

**‘AS/NZS 5667.11’ means the Australian Standard AS/NZS 5667.11 Water Quality – Sampling – Guidance on sampling of groundwaters;**

5. The Licence is amended by the deletion of the Definitions shown in strikethrough below and the insertion of the Definitions and updated attachment in bold text below:

~~“Director” means Director, of the Department of Environment Regulation for and on behalf of the Chief Executive Officer as delegated under Section 20 of the *Environmental Protection Act 1986*;~~

~~“Director” or “Department of Environment Regulation” for the purpose of correspondence means-~~

~~Regional Leader Industry Regulation  
Department of Environment Regulation  
PO Box 72  
Geraldton WA 6531~~ Telephone (08) 9921 5955  
Facsimile (08) 9964 9048

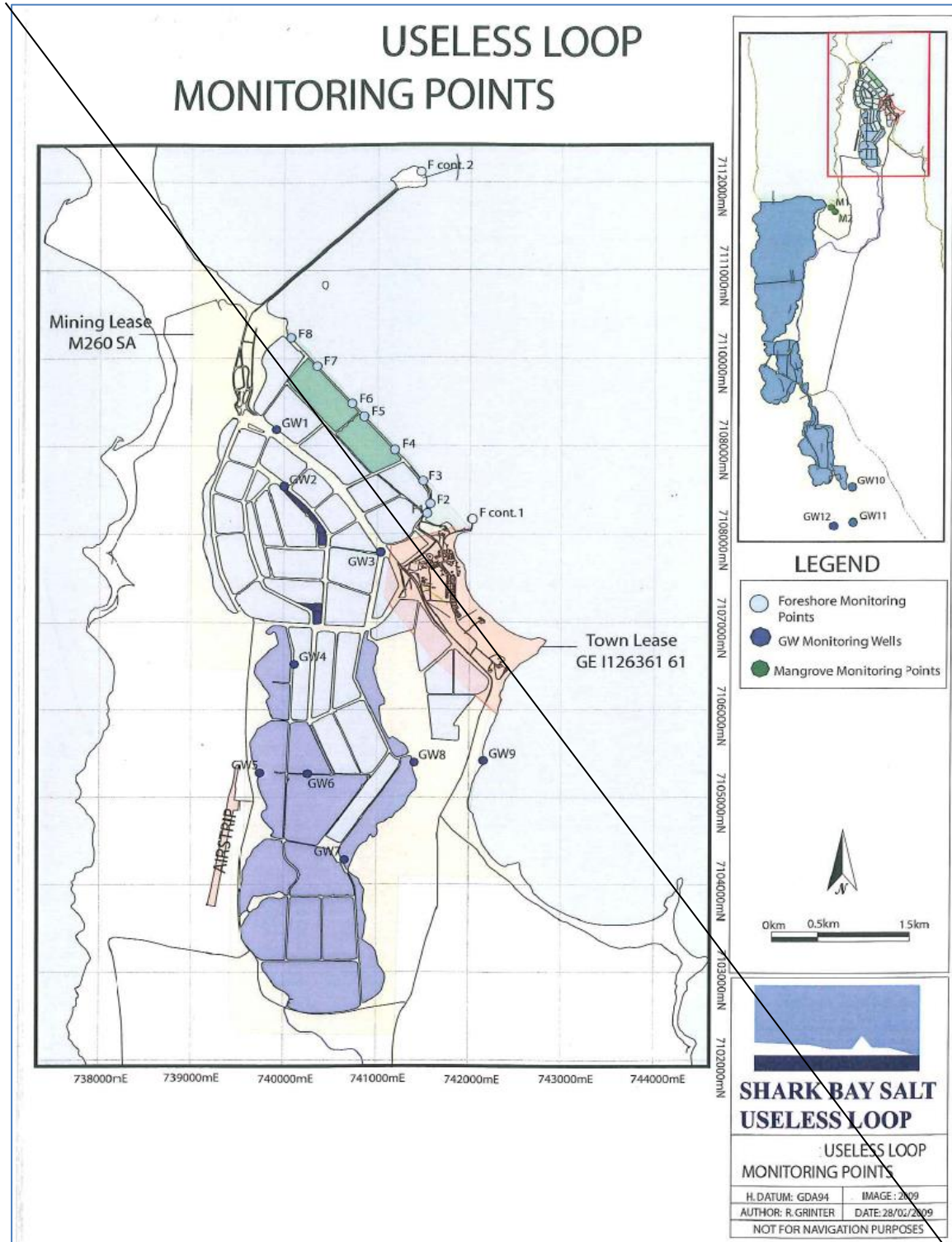
~~“FESA” means Fire & Emergency Services Authority;~~

**“Director” for the purpose of correspondence means:**

**Chief Executive Officer  
Department Div.3 Pt V EP Act  
Locked Bag Cloisters Square  
Perth WA 6850  
[info@der.wa.gov.au](mailto:info@der.wa.gov.au);**

**“FESA” means Department of Fire and Emergency Services.**

**ATTACHMENT 2**



# ATTACHMENT 2

## Monitoring site locations

