URS

3 March 2005

Carolyn Strange
Director Contaminated Sites
Department of Environment and Conservation (NSW)
PO Box A290
Sydney South, NSW 1232

Re: REMEDIAL ACTION PLAN ADDENDUM
QUIX SERVICE STATION (Mobil Site No. NJ3565)
161 Hume Highway
Lansvale, NSW

Ms. Strange,

1.0 Introduction

On behalf of Mobil Oil Australia Pty Ltd (Mobil), URS Australia Pty Limited (URS) has prepared this Remedial Action Plan Addendum (RAP Addendum) for the Quix Service Station (the site) located at 161 Hume Highway, Lansvale, NSW (Mobil Site No. NJ3565).

The RAP Addendum has been prepared in response to the Department of Environment and Conservation (NSW) (DEC-NSW) letter directed to Mobil regarding the site (HOF51151, dated 8 February 2005). The DEC-NSW requested that a RAP addendum be submitted to provide a voluntary proposal under Section 26 of the Contaminated Land Management Act (CLM Act) for remedial actions at this site.

2.0 Background

The site has been an operating service station since approximately 1961. In 1986 the site was refurbished. It is not known whether the USTs were replaced at this time. Prior to this an auto mechanics may also have been present at the site. In the years prior to 1961 the site was vacant land (Handex, January 2002). The site area is approximately 1,894 m^2 located in Lot 204 in deposited plan 732440. The site is zoned 4(c) Industrial Special. Mobil lease the site from the owners, Modern Motels.

Several environmental investigations, including multiphase extraction remediation events, have been undertaken at the site. Impacted soil and groundwater was detected during the investigations, as well as the presence of phase separated hydrocarbons (PSH).

3.0 Site Geology and Hydrology

The subsurface geology encountered during drilling events at the site comprises an upper unit of sandy, gravely, clayey fill ranging in depth from 0.1 mbgl to a maximum of 1.4 mbgl. Underlying the fill a clay unit was encountered to a maximum depth of 5.7 mbgl. The clay is underlain by brown/grey and fine to medium grained sand and by sandy clay at the eastern end of the site. This unit extends to a depth of 8.0 mbgl. Clay was encountered underlying the sand. This clay is inferred to form the lower confining unit of the aquifer underlying the site (URS, January 2005).

The previous investigations indicated that the hydrogeological regime under the site is comprised of an unconfined water table aquifer within the sand and clay unit, with water encountered at 3.4 mbgl to 4.5 mbgl.

The groundwater flow direction is difficult to assess based on the shallow gradient across the site and the presence of some anomalous groundwater levels. Information collected during the Post Phase 2 Environmental Site Assessment (PP2) (URS, January 2005), suggest groundwater flow could have easterly, southerly and southwesterly components. It is likely that groundwater in the area of the site flows either to the east towards Prospect Creek (approximately 500 m northeast of the site), or to the southeast towards Chipping Norton Lakes (approximately 600 m south-southeast of the site).

Based on the results of the previous URS (May 2003) investigation, the hydraulic conductivity of the formation is inferred to range from 4.57 m/year (clay) to 350 m/year (sand). The effective porosity is likely to vary from 0.1 (clay) to 0.3 (sand), and the hydraulic gradient varies from 0.002 (sandy formation) to 0.009 (clayey formation). Using these data, the average velocity is calculated to range from 0.4 m/year (clay) to 2.3 m/year (sand).

The heterogeneity of the aquifer materials and corresponding variations in the hydraulic conductivity values indicate that the aquifer is likely to be moderately to highly anisotropic.

4.0 Summary of Previous Investigations

The following investigations have been conducted at the site:

- MassTech, *UST Integrity Testing*, March to April 2001 and June 2002;
- Handex Australia Pty Ltd, *Environmental Site Assessment*, 9 January 2002;
- Handex Australia Pty Ltd, *Additional Well Installation and Groundwater Monitoring*, 5 September 2002;
- Handex Australia Pty Ltd *Multi-phase Extraction Program Summary Report*, 22 November 2002;
- URS Australia Pty Ltd, *Groundwater Monitoring Event*, 26 May 2003;
- URS Australia Pty Ltd, *Remediation Action Plan*, 7 July 2003;
- URS Australia Pty Ltd, *Post Phase 2 Environmental Site Assessment*, 14 January 2005 ; and
- URS Australia Pty Ltd, *Quantitative Risk Assessment*, Quix Service Station Lansvale, (NJ3565) 161 Liverpool Road, Lansvale, 28 January 2005.

A summary of the results of the most recent investigation (URS, January 2005) is provided below.

4.1 Post Phase 2 Environmental Site Assessment (URS, January 2005)

To delineate the affected area and potential source of the impacted groundwater at the site, a Post Phase 2 Environmental Site Assessment (PP2) was performed. This assessment was conducted after the Remediation Action Plan (URS, July 2003) was prepared for the site. The assessment included the following field investigations:

- In July 2003 and June 2004, drilling of two additional on-site soil bores and five off-site bores, with each converted into groundwater monitoring wells; and
- In July and September 2004, a groundwater monitoring event, two pumping tests and one recovery test.

The results of the investigation are summarised below:

- The site and the vicinity of the site are underlain by up to 1.4 m of fill comprising sand, gravel, and clay. Underlying the fill, clay was encountered to a maximum depth of 5.7 m below ground level (bgl). The clay is underlain by brown/grey and fine to medium grained sand. This unit extends to a maximum depth of 8.0 mbgl. Clay was encountered underlying the sand;
- Groundwater gauging found that corrected water levels (CWLs) varied across the site and ranged from 2.99 m Australian Height Datum (AHD) in LMW14 and 3.56 mAHD in LMW9. CWLs in off-site wells ranged between 3.21 mAHD in LMW22 and LMW23 and 4.23 mAHD in LMW21.The groundwater flow direction is inferred to be towards the east and south, in the direction of Prospect Creek and Chipping Norton Lakes, respectively;
- The concentration of total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) was greater than the relevant investigation levels (Ils) in soil at depths of between 3.8 mbgl and 4.0 mbgl at soil bore LMW15, located to the northeast of the diesel and LRP USTs. Previous investigations found that impacts to soil were centred around the underground storage tank (UST) farm and dispensers;
- PSH was observed in monitoring wells LMW1, LMW2, LMW4, LMW9, LMW15, located in the vicinity of the tank farm, and in LMW6, located approximately 15 m northeast of the tank farm and dispensers. A hydrocarbon sheen was observed in the purged groundwater from monitoring well LMW3, which is located approximately 10 m east of the USTs and dispensers;
- PSH was observed in monitoring wells LMW6 and LMW9, where it had previously not been detected, with an apparent thickness of 0.39 m in LMW6 and 0.20 m in LMW9. The appearance of PSH at these wells indicates that the PSH migrated to the east and south;
- Elevated concentrations (>1,000 µg/L) of TPH fraction (C_6-C_9) and TPH fractions (C_{10}-C_{36}) were detected in groundwater obtained from monitoring well LMW3. The concentrations of PAHs in groundwater at this well exceeded the ILs;

- Elevated concentrations of TPH fractions (C_{10}-C_{36}) and concentrations of PAHs that exceeded the site investigation levels were detected in the groundwater sample obtained from LMW13, which is located along the northeastern boundary of the site;

- Low concentrations of TPH fractions (C_{10}-C_{36}) were detected in groundwater samples collected from monitoring wells LMW14 and LMW23. LMW14 is located in the southeast corner of the site and LMW23 is located south of the site, across the Hume Highway. Both monitoring wells are inferred to be located down gradient of the site;

- Concentrations of copper, which slightly exceeded the adopted ILs, were detected in groundwater samples collected from monitoring wells LMW12, LMW16, LMW18, LMW21, LMW22 and LMW23. Concentrations of zinc slightly above the adopted ILs were detected in groundwater samples obtained from monitoring wells LMW10, LMW12, LMW13, LMW13, LMW18, LMW19, LMW20, LMW22 and LMW23. Elevated copper and zinc concentrations may be representative of background groundwater quality;

- Concentrations of mercury in groundwater samples collected from monitoring wells LMW10 and LMW11 were above the adopted ILs. These monitoring wells are located upgradient of the site and therefore the elevated concentration of mercury are likely to be representative of background conditions;

- The pumping tests indicated that a groundwater abstraction rate of greater than 1.8 L/min will be required to achieve hydraulic control over the plume in the areas of the site were groundwater resides in sand;

- Biologically mediated degradation of hydrocarbons by aerobic metabolism may be occurring at the edges of the plumes, where dissolved oxygen is present at sufficient concentrations in the groundwater. Once the DO has been consumed, nitrate and sulphate may be present in sufficient concentrations for further degradation of the hydrocarbon impact by anaerobic decay. This is evident in monitoring wells LMW7, LMW13, LM17 and LMW18.

4.2 Previous Multiphase Extraction Events

Previous multiphase extraction events have been conducted at the site with varying results. A summary of these events is shown below:

- On 26 and 29 July 2002, Handex conducted a multiphase extraction and treatment event (MPE). A total of 17,500 litres of fluid (PSH and hydrocarbon impacted groundwater) was extracted on 26 July 2002 and 16,700 litres of fluid on 29 July 2002. The PSH thickness in the extraction well decreased from 0.361 m to 0.010 m.

- On 27 February 2004, Handex conducted a multiphase extraction and air treatment event (MPEAT). The MPE was conducted for 8.45 hours and extracted 6,960 litres of fluid with a liquid equivalent of 35.39 litres of hydrocarbon vapours.

- On 14 and 15 September 2004, Handex conducted a MPEAT event. This event extracted 12,400 litres of fluid and a liquid equivalent 59.36 litres of hydrocarbons in the vapour phase.

5.0 Objective

This RAP Addendum outlines the protocol for implementing a remediation plan for treating impacted groundwater beneath the site. The plan includes the installation of a total fluids pumping and treatment system and an in-situ enhanced bioremediation treatment system. The objective of the remediation plan is to remove phase separated hydrocarbons (PSH) in groundwater and mitigate the potential off-site migration of dissolved phase groundwater contamination through hydraulic control of the dissolved phase plume.

6.0 Extent of Impacts

Soil

Soil impact was identified in the vicinity of the USTs and the southern most dispenser island where elevated concentrations of TPH C6-C9, TPHC10-C36 and BTEX compounds were reported at boreholes LVB3, LVB4-LVB7, LVB9, LMW4 and LMW15. The impacted soils were detected between 3.2 m bgs and 6.0 m bgs, within the natural sand and clayey sand unit. The impact generally corresponds to the saturated zone within the aquifer and is expected to be associated with the hydrocarbon contamination in groundwater.

Groundwater

Groundwater impact has been identified on site as both dissolved phase and PSH. Data collected by URS in 2004 indicates PSH has been encountered in monitoring wells LMW1, LMW2, LMW4, LMW6, LMW9 and LMW15, and a hydrocarbon sheen was noted in LMW3 (refer to Figure 1 for sample locations). The PSH has been identified through fingerprinting as leaded petrol and UST3 is the probable source. Dissolved phase impact associated with the PSH has been identified in a number of wells in the central portion of the site these include monitoring wells LMW3, LMW4, LMW5, LMW6, LMW7 and LMW9. The dissolved phase impact associated with the petrol PSH is characterised by elevated TPH C6-C9 and BTEX concentrations.
Dissolved phase impact has also been identified in the eastern portion of the site in monitoring well LMW13. The dissolved phase impact was identified by fingerprinting as likely to be diesel in origin and is characterised by elevated levels of TPH C10-C36.

Potential for Off Site Migration

The available groundwater data indicates that dissolved phase hydrocarbon appears to have migrated off-site with the presence of TPH and PAHs in groundwater at monitoring well LMW23. PSH has not been encountered in any off site monitoring wells.
The closest water bodies to the site are Prospect Creek (to the north east) and Chipping Norton Lake (to the south), which are located approximately 500 m and 600 m from the site,

respectively. The key mechanism by which these surface waterbodies may be affected by the site-related hydrocarbon impacts is via the ingress of groundwater into the stormwater drainage system and/or migration and subsequent discharge of groundwater from beneath the site and discharge to the Creek or Lake. However, considering the distance to the nearest waterbodies, processes of natural attenuation and expected dilution, it is considered unlikely that significant concentrations of hydrocarbons will migrate to and discharge into the waterbodies. In addition the depth to groundwater is approximately 4 mbgs and is therefore below the depth of stormwater drains which are typically in the top 1 m bgs.
On the basis of the available data, URS considers that the potential for hydrocarbon impacted groundwater identified beneath the Lansvale Quix Service Station to adversely affect the water quality and environment of Prospect Creek and Chipping Norton Lake is essentially negligible.

In the event that further off-site monitoring or modelling indicates that the hydrocarbon plume will or has migrated off-site with the potential for discharge of significant concentrations of site-related chemicals, then the assessment of potential risks to the environment will need to be revised.

7.0 Preferred Remediation Approach

The RAP (URS, July 2003) defined the remediation goals and end points for the site and assessed appropriate remediation methods to achieve the remediation end points. Based on this evaluation and the results of the PP2, a final remedial approach has been developed to initially target the impacts which may present a significant risk of harm – the PSH and dissolved phase impacts. The following section provides a general outline of the proposed remediation systems to be implemented at the site.

7.1 Total Fluids Pumping and Treatment System

A total fluids pump and treatment system is proposed to address the PSH and elevated dissolved phase hydrocarbon plume within the sand layer beneath the site in the vicinity of the USTs located in the southwest corner of the site (Figure 1). The benefit of this approach is that it will provide hydraulic control of the plume , while also allowing effective recovery of the contaminant plume.

The total fluids pumping system will consist of eight (8) 40 mm submersible pneumatic groundwater extraction pumps, installed in existing 50 mm monitoring wells LMW1, LMW2, LMW3, LMW4, LMW6. LMW15 and LMW16 (remediation wells). With the exception of LMW16, these wells were selected due to the presence of PSH and/or elevated dissolved phase hydrocarbons detected during the PP2. Elevated concentrations of dissolved phase hydrocarbons were not detected in LMW16, but due to the location of the well relative to the known extent of impacts, this well will be included in the design. Subsequent sampling of LMW16 will be conducted and if elevated concentrations of the contaminants of concern are detected, the well will be included in the groundwater treatment stream. The submersible pneumatic pumps will be top loading pumps designed to collect and remove PSH and groundwater from the subsurface.

Prior to implementation of the proposed pumping system, numerical modelling will be conducted to ascertain that the total fluids pumping using the well network outlined above is sufficient to obtain hydraulic control of the plume..

The treatment system, located in the proposed remediation compound (Figure 1), will consist of a oil/water separator tank, a PSH collection tank, a dissolved phase hydrocarbon collection tank, transfer pumps, particulate filters and a dissolved phase treatment system. The dissolved phase treatment system will treat the dissolved phase hydrocarbons in the groundwater treatment stream to concentrations that meet regulatory requirements for discharge to the storm water or sewer. The system will be one of two designs, depending on initial concentrations entering the system.

- Option 1: An air stripper, liquid phase granular activated carbon (GAC) vessels connected in series, vapour phase GAC connected in series.
- Option 2: Liquid phase granular activated carbon (GAC) vessels connected in series.

The treated water will be sampled periodically to ensure the effluent chemical concentrations meet the requirements to allow discharge to the storm water or sewer. The location of the total fluids pumping wells, remediation piping and system compound is shown on Figure 1.

7.2 Enhanced Bioremediation System

The enhanced bioremediation system will address potential off-site migration of the dissolved phase hydrocarbon impacts along the east and north east edge of the site (Figure 1). A total fluids pumping system is unlikely to be effective in this part of the site where groundwater resides in low permeability clay. Pumping of groundwater in this area of the site would result in dewatering of the wells within minutes. The enhanced bioremediation system will introduce oxygen to enhance biologically mediated degradation of hydrocarbons by aerobic metabolism.

Oxygen will be delivered either via an iSOC system or ORC compounds in eight (8) monitoring wells: LMW13, LMW14, LMW17 and proposed wells PW1, PW2, PW3, PW4 and PW5.

Such a system may also be applied to the portion of the site near the underground storage tanks to aid the remediation of the dissolved and adsorbed phase impacts in this area, if required. This would be implemented once the PSH had been removed.

7.3 Alternate Remediation Approach

If the site infrastructure does not allow for the installation of the proposed in-situ remediation system, regular MPEAT events will be conducted in place of the total fluids pumping and treatment system. Previous MPEAT events conducted at the site indicate that this approach should be effective in removing impacted groundwater and PSH, which also feasibly would aid in the remediation of the absorbed phase impacts.

8.0 Implementation Schedule

Pending auditor and DEC-NSW approval, the remediation plan will commence as proposed in the following implementation schedule:

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Activity	Implementation Date
System design, drafting of EMP and system monitoring and maintenance manual	May – June 2005
Approvals	July 2005
Equipment procurement and system installation	August – September 2005
Pre-commissioning groundwater monitoring event	October 2005
System Commissioning	October – November 2005

Quarterly monitoring will be conducted throughout the course of the remediation to track the progress and effectiveness of the remediation systems. Amendments and/or changes to the system will be implemented, as required.

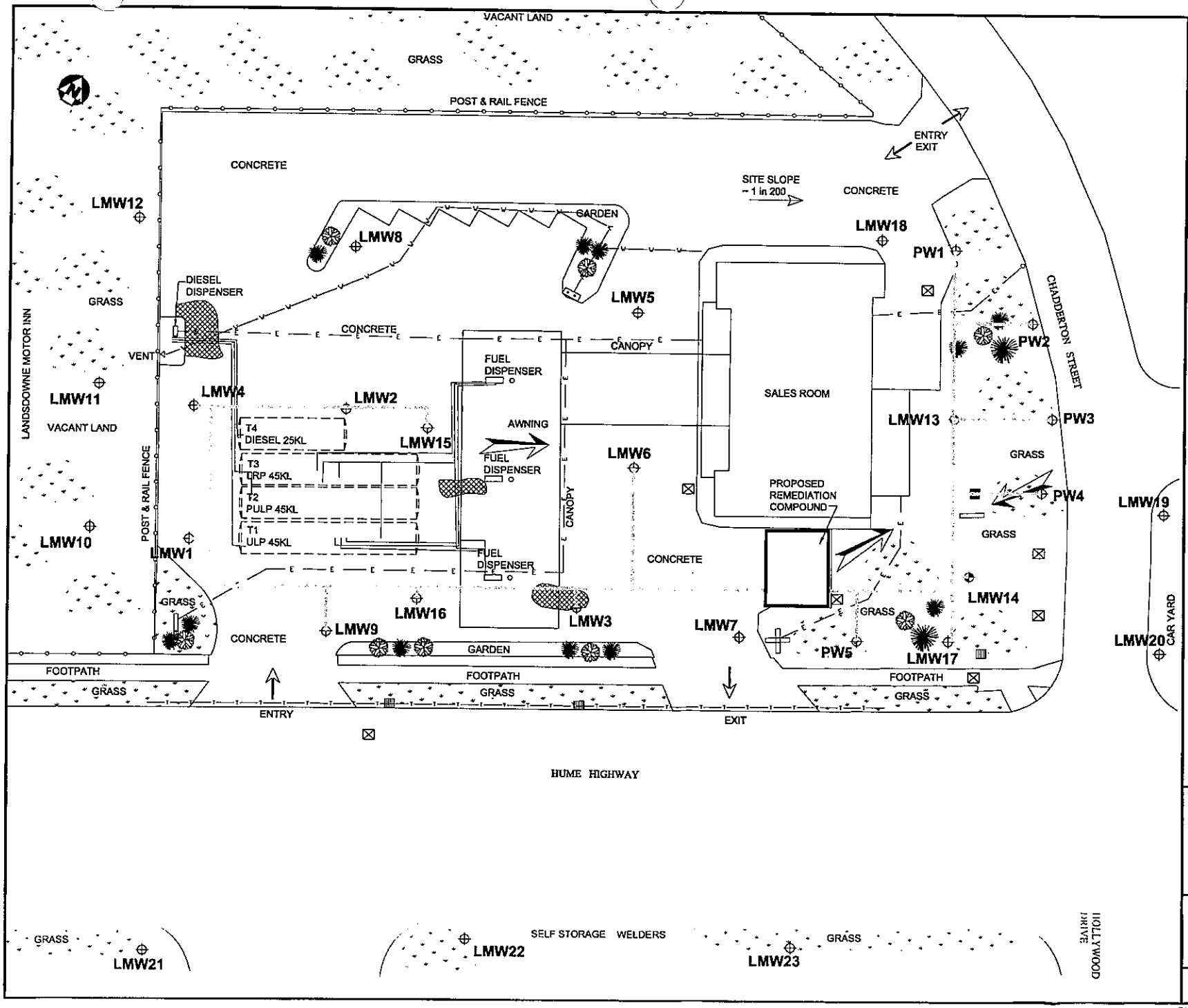
Following removal of the PSH plume, a groundwater sampling round will be conducted. The results of the groundwater sampling will be used to determine if continued groundwater extraction and treatment is required to further reduce dissolved phase impacts at the site. The groundwater sampling results will be provided to the NSW EPA for review.

Should you have any queries, please contact the undersigned on 8925 5500.

Yours sincerely,
URS AUSTRALIA PTY LTD

Teresa Tamburello
Environmental Engineer

for
Graeme Miller
Associate Environmental Scientist



DESIGNED:	TT	APPROVED:	
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DATE:	17/2/05	STATUS:	DRAFT
PROJECT:	43346112 lansvale rap		
CAD FILE:	001.DWG		
REVISION:	A		

0 5 10
1:250 (metres)

LEGEND

- UNDERGROUND STORAGE TANK
- HANDEX INSTALLED MONITORING WELL (MARCH 2001)
- HANDEX INSTALLED MONITORING WELL (JANUARY 2002)
- INFERRED GROUNDWATER FLOW DIRECTION
- TELSTRA
- WATER
- ELECTRICITY
- SEWER PIT
- STORMWATER DRAIN
- TELSTRA PIT
- PRODUCT LINES
- PW2 — ENHANCED BIO-REMEDIATION INJECTING WELLS
- LMW6 — TOTAL FLUIDS PUMPING WELL
- PROPOSED REMEDIATION PIPING

DATE DATA COLLECTED:
FEBRUARY 2003 & JULY 2004

CLIENT
MOBIL OIL AUSTRALIA PTY LTD

PROJECT
RAP ADDENDUM
QUIX SERVICE STATION LANSVALE, 161 HUME HWY, NSW

TITLE
PROPOSED REMEDIATION LAYOUT

A3

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FIGURE 1