

DEPARTMENT OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES
SYDNEY SOUTH COAST REGION



Orica Engineering
C/- URS
Attn: F Carosone
116 Miller St
NORTH SYDNEY NSW 2060

PHONE: (02) 9895 7814
NAME: Ms S Flatters
Our Ref: 10BL161996

Dear Sir/Madam,

Re: Bore Licence – Test Bore – Extraction

*SOUTH LANDS
BLOCK 2*

Please find enclosed your licence. Your attention is drawn to the nature and description of the work, terms, limitations and conditions under which the licence is issued.

Please show the licence to the Driller so that he is aware of any conditions affecting the construction of the bore. The Driller must have a current Driller's Licence issued by this Department.

A letter is enclosed to be handed by you to the Driller outlining his obligations under the terms of the Water Act. Three copies of the Form 'A' for recording details of the bore are attached and these should be forwarded to the Driller. One copy will be returned to you when completed by the Driller. This must then be returned to this office together with details of any water analysis and pumping tests carried out.

The Form 'A' requests a sketch of the location of bore site together with the portion number and boundaries. This sketch is required even though you may have already indicated the site to the Department.

Yours faithfully,

Ms Shane Flatters
Natural Resource Officer
Sydney/South Coast Region
27 August, 2003

Department of Infrastructure, Planning and Natural Resources

Sydney South Coast Region
P O Box 3935
10 Valentine Ave
Parramatta NSW 2124
Phone: (02) 98957814

BORE LICENSE CERTIFICATE UNDER SECTION 115 OF THE WATER ACT, 1912

10BL161996

Orica Engineering
C/- U R S, Attn: F Carosone
116 Miller St
North Sydney NSW 2060

LICENSE NUMBER
10BL161996
DATE LICENSE VALID FROM
25-Aug-2003
DATE LICENSE VALID TO
PERPETUITY
FEE
\$0.00

ABN 72726325787 GST NIL

LOCATION OF WORKS

Portion(s) or Lot/Section/DP
2//528680

PARISH
Botany

COUNTY
Cumberland

TYPE OF WORKS

Bore

PURPOSE(S) FOR WHICH WATER MAY BE USED

Test Bore

CONDITIONS APPLYING TO THIS LICENSE ARE

As shown on the attached Condition Statement

COPY

Department of Infrastructure, Planning and Natural Resources

**CONDITIONS STATEMENT REFERRED TO ON
10BL161996
ISSUED UNDER PART V OF THE WATER ACT, 1912
ON 25-Aug-2003**

- (1) THE LICENSEE SHALL MAINTAIN A RECORD OF THE ACTUAL VOLUME OF GROUNDWATER PUMPED (KILLITRES/MEGALITRES) FROM THE EXTRACTION WORK, THE DISCHARGE RATE (LITRES PER SECOND) AND DURATION OF PUMPING (NUMBER OF DAYS/WEEK) AND SUPPLY THIS INFORMATION TO THE DEPARTMENT UPON COMPLETION OF THE TRIAL.
- (2) THE DEPARTMENT MAY REQUEST SUPPLY OF INTERIM INFORMATION RELATING TO CONDITION (1) AT ANY TIME UNTIL THE COMPLETION OF THE TRIAL.
- (3) SPECIAL CONDITION (BEING CONDITION 1) MAY BE VARIED BY THE DEPARTMENT AT ANY TIME.
- (4) WATER SHALL NOT BE PUMPED FROM THE BOREFIELD IN THE BOTANY SANDS AQUIFER AUTHORISED BY THIS LICENCE FOR ANY PURPOSE OTHER THAN A BIOREMEDIATION TRIAL.

End Of Conditions

DEPARTMENT OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES
SYDNEY SOUTH COAST REGION



Orica Engineering
C/- URS
Attn: F Carosone
116 Miller St
NORTH SYDNEY NSW 2060

PHONE: (02) 9895 7814
NAME: Ms S Flatters
Our Ref: 10BL161997

Dear Sir/Madam,

Re: Bore Licence – Test Bore – Re-injection

Please find enclosed your licence. Your attention is drawn to the nature and description of the work, terms, limitations and conditions under which the licence is issued.

Please show the licence to the Driller so that he is aware of any conditions affecting the construction of the bore. The Driller must have a current Driller's Licence issued by this Department.

A letter is enclosed to be handed by you to the Driller outlining his obligations under the terms of the Water Act. Three copies of the Form 'A' for recording details of the bore are attached and these should be forwarded to the Driller. One copy will be returned to you when completed by the Driller. This must then be returned to this office together with details of any water analysis and pumping tests carried out.

The Form 'A' requests a sketch of the location of bore site together with the portion number and boundaries. This sketch is required even though you may have already indicated the site to the Department.

Yours faithfully,

A handwritten signature in cursive script, appearing to read 'S. Flatters'.

Ms Shane Flatters
Natural Resource Officer
Sydney/South Coast Region
27 August, 2003

Department of Infrastructure, Planning and Natural Resources

Sydney South Coast Region
P O Box 3935
10 Valentine Ave
Parramatta NSW 2124
Phone: (02) 98957814

BORE LICENSE CERTIFICATE UNDER SECTION 115 OF THE WATER ACT, 1912

10BL161997

Orica Engineering
C/- U R S, Attn: F Carosone
116 Miller St
North Sydney NSW 2060

LICENSE NUMBER
10BL161997
DATE LICENSE VALID FROM
25-Aug-2003
DATE LICENSE VALID TO
PERPETUITY
FEE
\$0.00

ABN 72726325787 GST NIL

LOCATION OF WORKS

Portion(s) or Lot/Section/DP
2//528680

PARISH
Botany

COUNTY
Cumberland

TYPE OF WORKS

Bore

PURPOSE(S) FOR WHICH WATER MAY BE USED

Test Bore

CONDITIONS APPLYING TO THIS LICENSE ARE

As shown on the attached Condition Statement

COPY

Department of Infrastructure, Planning and Natural Resources

**CONDITIONS STATEMENT REFERRED TO ON
10BL161997
ISSUED UNDER PART V OF THE WATER ACT, 1912
ON 25-Aug-2003**

- (1) THE LICENSEE SHALL MAINTAIN RECORDS OF THE ACTUAL VOLUME AND QUALITY OF TAILWATER RE-INJECTED AND SUPPLY THIS INFORMATION TO THE DEPARTMENT UPON COMPLETION OF CONSTRUCTION.
- (2) THE DEPARTMENT MAY REQUEST SUPPLY OF INTERIM INFORMATION RELATING TO CONDITION (1) AT ANY TIME UNTIL THE COMPLETION OF THE TRIAL.
- (3) SPECIAL CONDITION (BEING CONDITION 1) MAY BE VARIED BY THE DEPARTMENT AT ANY TIME.
- (4) WATER SHALL NOT BE RE-INJECTED INTO THE BOTANY SANDS AQUIFER AUTHORISED BY THIS LICENCE FOR ANY PURPOSE OTHER THAN A BIOREMEDIATION TRIAL.

End Of Conditions

DEPARTMENT OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES
SYDNEY SOUTH COAST REGION



Orica Engineering
C/- URS
Attn: F Carosone
116 Miller St
NORTH SYDNEY NSW 2060

PHONE: (02) 9895 7814
NAME: Ms S Flatters
Our Ref: 10BL161998

Dear Sir/Madam,

Re: Bore Licence

Please find enclosed your licence. Your attention is drawn to the nature and description of the work, terms, limitations and conditions under which the licence is issued.

Please show the licence to the Driller so that he is aware of any conditions affecting the construction of the bore. The Driller must have a current Driller's Licence issued by this Department.

Condition (2) of the licence applies whether the bore is successful or not and it is the Driller's responsibility to supply the information. A letter is enclosed to be handed by you to the Driller outlining his obligations under the terms of the Water Act. Three copies of the Form 'A' for recording details of the bore are attached and these should be forwarded to the Driller. One copy will be returned to you when completed by the Driller. This must then be returned to this office together with details of any water analysis and pumping tests carried out.

The Form 'A' requests a sketch of the location of bore site together with the portion number and boundaries. This sketch is required even though you may have already indicated the site to the Department.

Yours faithfully,

S. Flatters

Ms Shane Flatters
Natural Resource Officer
Sydney/South Coast Region
26 August, 2003

monitoring bores

LET 67

Department of Infrastructure, Planning and Natural Resources

Sydney South Coast Region
P O Box 3935
10 Valentine Ave
Parramatta NSW 2124
Phone: (02) 98957814

BORE LICENSE CERTIFICATE UNDER SECTION 115 OF THE WATER ACT, 1912

10BL161998

Orica Engineering
C/- U R S, Attn: F Carosone
116 Miller St
North Sydney NSW 2060

LICENSE NUMBER
10BL161998
DATE LICENSE VALID FROM
25-Aug-2003
DATE LICENSE VALID TO
PERPETUITY
FEE
\$0.00

ABN 72726325787 GST NIL

LOCATION OF WORKS

Portion(s) or Lot/Section/DP
2//528680

PARISH
Botany

COUNTY
Cumberland

TYPE OF WORKS

Bore

PURPOSE(S) FOR WHICH WATER MAY BE USED

Monitoring Bore

CONDITIONS APPLYING TO THIS LICENSE ARE

As shown on the attached Condition Statement

ORIGINAL

Department of Infrastructure, Planning and Natural Resources

**CONDITIONS STATEMENT REFERRED TO ON
10BL161998
ISSUED UNDER PART V OF THE WATER ACT, 1912
ON 25-Aug-2003**

- (1) THE LICENCE SHALL LAPSE IF THE WORK IS NOT COMMENCED AND COMPLETED WITHIN THREE YEARS OF THE DATE OF THE ISSUE OF THE LICENCE.
- (2) UPON FORMAL APPLICATION, THE LICENSEE SHALL, UPON COMPLETION OF THE TRIAL, FURNISH TO THE DEPARTMENT OF LAND AND WATER CONSERVATION:-
 - (A) DETAILS OF THE WORK SET OUT ON THE APPROPRIATE FORM.
 - (B) A PLAN SHOWING ACCURATELY THE LOCATION OF THE WORK, IN RELATION TO PORTION AND PROPERTY BOUNDARIES.
 - (C) DETAILS OF ANY WATER ANALYSIS AND/OR PUMPING AND RE-INJECTION TESTS.
- (3) THE LICENSEE SHALL MAINTAIN RECORDS ON GROUNDWATER LEVELS ON THE BIOREMEDIATION TRIAL SITE THROUGHOUT THE PERIOD OF THE TRIAL AND SUPPLY THIS INFORMATION TO THE DEPARTMENT.
- (4) THE DEPARTMENT MAY REQUEST SUPPLY OF INTERIM INFORMATION RELATING TO CONDITION (3) AT ANY TIME UNTIL THE COMPLETION OF THE TRIAL.
- (5) SPECIAL CONDITION (BEING CONDITION 3) MAY BE VARIED BY THE DEPARTMENT AT ANY TIME.
- (6) THE LICENSEE SHALL ALLOW (SUBJECT TO OCCUPATIONAL HEALTH AND SAFETY PROVISIONS) THE DEPARTMENT OF LAND AND WATER CONSERVATION OR ANY PERSON AUTHORISED BY IT, FULL AND FREE ACCESS TO THE WORKS (BOREFIELD), EITHER DURING OR AFTER CONSTRUCTION, FOR THE PURPOSE OF CARRYING OUT INSPECTION OR TEST OF THE WORKS AND ITS FITTINGS AND SHALL CARRY OUT ANY WORK OR ALTERATIONS DEEMED NECESSARY BY THE DEPARTMENT FOR THE PROTECTION AND PROPER MAINTENANCE OF THE WORKS, OR THE CONTROL OF THE WATER EXTRACTED AND FOR THE PROTECTION OF THE QUALITY AND THE PREVENTION FROM POLLUTION OR CONTAMINATION OF SUB-SURFACE WATER.
- (7) IF A WORK IS ABANDONED AT ANY TIME THE LICENSEE SHALL NOTIFY THE DEPARTMENT OF LAND AND WATER CONSERVATION THAT THE WORK HAS BEEN ABANDONED AND SEAL OFF THE AQUIFER BY:-
 - (A) BACKFILLING THE WORK TO GROUND LEVEL WITH CLAY OR CEMENT AFTER WITHDRAWING THE CASING (LINING); OR
 - (B) SUCH METHODS AS AGREED TO OR DIRECTED BY THE DEPARTMENT OF LAND AND WATER CONSERVATION.
- (8) WORKS USED FOR THE PURPOSE OF CONVEYING, DISTRIBUTING OR STORING WATER FROM THE WORK AUTHORISED BY THIS LICENCE SHALL NOT BE CONSTRUCTED OR INSTALLED SO AS TO OBSTRUCT THE FREE PASSAGE OF FLOODWATERS FLOWING IN, TO OR FROM A RIVER OR LAKE.
- (9) IF THE BORE AUTHORISED BY THIS LICENSE IS LINED WITH STEEL OR PLASTIC CASING THE INSIDE DIAMETER OF THAT CASING SHALL NOT EXCEED 220 MM.
- (10) THE LICENSEE SHALL NOTIFY THE DEPARTMENT OF LAND AND WATER CONSERVATION IF A FLOWING SUPPLY OF WATER IS OBTAINED.

Department of Infrastructure, Planning and Natural Resources

Sydney South Coast Region
P O Box 3720
10 Valentine Ave
Parramatta NSW 2124
Phone: (02)98957814

BORE LICENSE CERTIFICATE UNDER SECTION 115 OF THE WATER ACT, 1912

10BL163917



Orica Engineering
C/- U R S, Attn: F Carosone
116 Miller St
North Sydney NSW 2060

LICENSE NUMBER
10BL163917
DATE LICENSE VALID FROM
03-Sep-2004
DATE LICENSE VALID TO
02-Nov-2007
FEE
\$0.00

ABN 27380445450 GST NIL

LOCATION OF WORKS		
Portion(s) or Lot/Section/DP	PARISH	COUNTY
Part Road Fronting 203//712991	Botany	Cumberland
Part Road Fronting 7024//752015	Botany	Cumberland
Part Road Fronting 7025//752015	Botany	Cumberland

TYPE OF WORKS	PURPOSE(S) FOR WHICH WATER MAY BE USED
Well	Test Bore

CONDITIONS APPLYING TO THIS LICENSE ARE

As shown on the attached Condition Statement

ORIGINAL

Department of Water Resources

BORE LICENSE RENEWAL CERTIFICATE UNDER SECTION 115 OF THE WATER ACT, 1912

53-02
Bore License Section
Box 952, P.O.
North Sydney, N.S.W., 2059
Phone: (02) 922 0121



BL 03

I.C.I. AUSTRALIA OPERATIONS P/L
16-20 BEAUCHAMP ROAD

MATRAVILLE N.S.W. 2036

LICENSE NUMBER
V132800
DATE LICENSE VALID FROM
29.07.88
DATE LICENSE VALID TO
28.07.93
FEE
\$ 137.00 PAID

6006

LOCATION OF WORKS		
PORTION	PARISH	COUNTY
2	BOTANY	CUMBERLAND
TYPE OF WORKS	PURPOSE(S) FOR WHICH WATER MAY BE USED	CONDITIONS APPLYING TO THIS LICENSE ARE (see Reverse and any attached conditions)
BORE	INDUSTRIAL	21 22 24 25 40 41 42 43 44 61

61. The volume of groundwater extracted from the works authorised by this license shall not exceed 600 megalitres in any 12 month period commencing 1st July.

original
copies
DROUGHT
TMC
RESER
ERA

Department of Water Resources

BORE LICENSE RENEWAL CERTIFICATE

UNDER SECTION 115 OF THE WATER ACT, 1912

Bore License Section
Box 952, P.O.
North Sydney, N.S.W., 2059
Phone: (02) 922 0121



BL 03

I.C.I. AUSTRALIA OPERATIONS P/L
16-20 BEAUCHAMP ROAD

MATRAVILLE N.S.W. 2036

LICENSE NUMBER
V132801
DATE LICENSE VALID FROM
29.07.88
DATE LICENSE VALID TO
28.07.93
FEE
\$ 137.00 PAID

6007

LOCATION OF WORKS		
PORTION	PARISH	COUNTY
2	BOTANY	CUMBERLAND
PURPOSE OF WORKS	PURPOSE(S) FOR WHICH WATER MAY BE USED	CONDITIONS APPLYING TO THIS LICENSE ARE (see Reverse and any attached conditions)
BORE	INDUSTRIAL	21 22 24 25 40 41 42 43 44 61

61. The volume of groundwater extracted from the works authorised by this license shall not exceed 500 megalitres in any 12 month period commencing 1st July.

Wayne Conners
garry.fox@qenos.com.au
CC: Greg Russell; obrienw@botanybay.nsw.gov.au; robert.evans@orica.com
Date: 14/10/2009 2:55 pm
Subject: Renewal of groundwater licences held by Qenos/Orica
Attachments: Bore 23.pdf; Bore 25.pdf; Bore 12.pdf

Garry,

Thank you for your time this morning in relation to the issues regarding renewal of the Qenos/Orica groundwater licences.

Prior to renewal action, certain matters need to be resolved.

~~Bore 23~~ (10BL112762)
~~Bore 25~~ (10BL030245)
Bore 12 (10BL132801)
Bore 13 (10BL132800)
Bore 20 (10BL019507)

Bore 23:- This bore is located on Lot 182 DP752015, which is located on crown land administered by the Department of Lands. Please provide what legal occupation Qenos has to site the bore on these lands. Does Council have care, control & management of these lands?

Bore 25:- This bore is located on Lot 3 DP79069, which is owned by Botany Bay City Council. Please provide what legal occupation Qenos has to site the bore on these lands?

Is both Lot 182 DP752015 & Lot 3 DP79069 watered from both bores 23 & 25?

Please note that Bores 23 & 25 have a conjunctive entitlement of 450.0 megalitres.

(17) Bore 12:- This bore is located on Lot 11 DP1039919 owned by Orica Limited. The licence will be renewed in this name

Bore 13:- This bore is located on Lot 11 DP1039919 owned by Orica Limited. The licence will be renewed in this name

Please note that Bores 12 & 13 have a conjunctive entitlement of 600.0 megalitres.

Bore 20:- This bore is located on Lot 11 DP1039919 owned by Orica Limited. This old bore licence needs to be updated with contemporary conditions & an appropriate annual entitlement. The Department will correspond with the licence holder on this issue soon, and it proposed to include this licence conjunctively with bores 12 & 13.

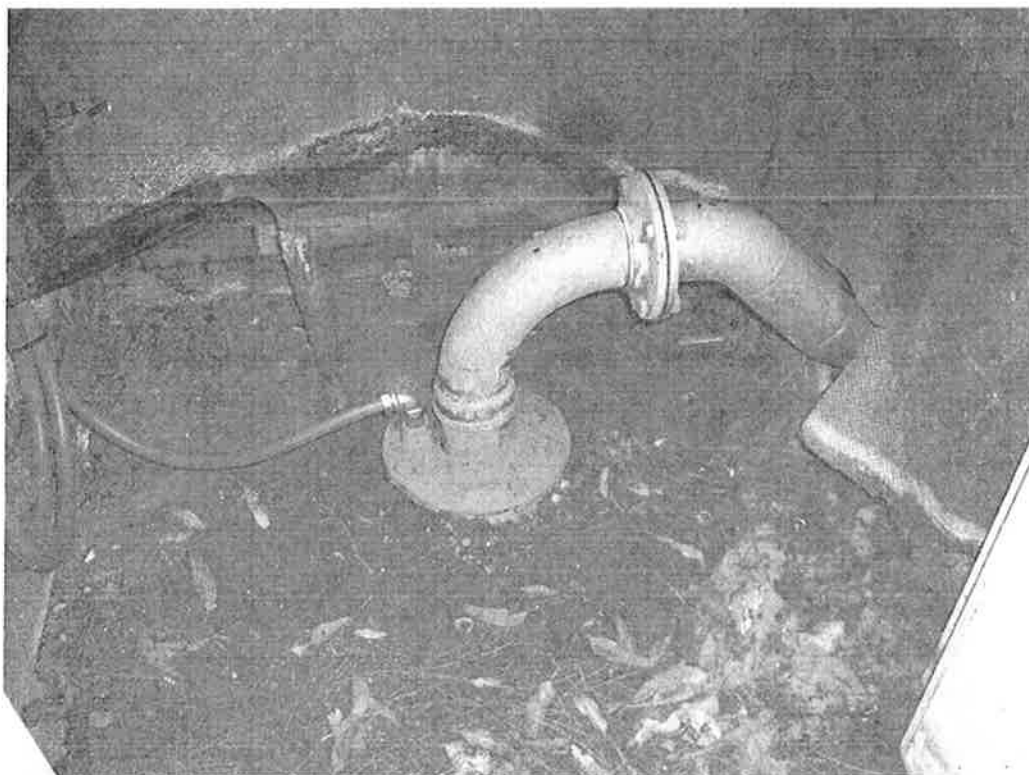
It is understood that the 5 bores supply a common pipeline which is transferred to a cooling tower. Can you please supply a plan of the location of the cooling tower together with the land description (Lot/DP)?

Due to the size, I will send 2 emails (1st with Bores 23, 25 & 12), (2nd with Bores 13 & 20)

Wayne Conners
Natural Resource Project Officer
NSW Office of Water
Level 11, 10 Valentine Ave Parramatta 2150 PO Box 3720 Parramatta 2124



View of bore 20 (10BL019507) located in locked brick shed. Sited near Cor. ish Circuit (33.94831, 151.22324)



Closer view of bore 20



Our Ref: JBS40336-12373

17 June 2008

Natural Resources Project Officer
Department of Water and Energy
PO Box 3720
Parramatta NSW 2124

Bore Licence Application – Botany Groundwater Cleanup Plan (GCP)

Dear Sir,

1. Introduction

Orica Australia Pty Ltd (Orica) have engaged JBS Environmental Pty Ltd (JBS) to prepare this letter as background and support for bore licence applications for the Secondary Containment Area (SCA), Primary Containment Area (PCA) and Botany Industrial Park (BIP) hydraulic containment lines.

2. Background

In September 2003 (subsequently amended and consolidated in February 2004) the EPA (now incorporated within the DECC) issued a Notice of Clean Up Action (NCUA) No 1030236 to Orica requiring remediation of the chlorinated hydrocarbon contaminant plumes emanating from the BIP and present in areas to the south and west of BIP. The NCUA was issued by the EPA under Section 91 of the POEO Act.

In response to the NCUA, Orica submitted its draft Groundwater Cleanup Plan (GCP) (Orica Document No. EN1591-00-10-001 Revision 0) to the EPA, and commenced work implementing proposed actions, including preparation of an Environmental Impact Statement (EIS) for the Botany Groundwater Cleanup (BGC) Project. The EPA then issued Orica with a Variation to the initial NCUA (reference number 1033107), authorising and requiring the implementation of the GCP.

The GCP is centred on the following key elements:

- The extraction of groundwater from wells installed in three containment lines:
 - Primary Containment Area (PCA) at Southlands
 - Secondary Containment Area (SCA) at Foreshore Road, and
 - Containment at the Botany Industrial Park (BIP).
- Transfer of groundwater via pipelines to the Groundwater Treatment Plant (GTP); and
- Recycling of treated water.

Since implementation of the GCP a Groundwater Treatment Plant (GTP) has been constructed and commissioned and is currently in operation with groundwater being pumped from the three containment lines (SCA, PCA and BIP). Operation of the GTP is regulated under conditions

presented in the Joint Determining Authority Report (DEC 2005/13, February 2005) and Environmental Protection Licence (EPL) 2148.

The Joint Determining Authority report includes detailed conditions relating to licensing of extraction bores under Part 5 of the Water Act (1912) as well as requirements for groundwater management and monitoring (see Attachment 1).

This letter presents bore licence applications for operation of the three hydraulic containment lines associated with implementation of the Botany Groundwater Cleanup Plan (GCP) and are required as part of the conditions presented in the Joint Determining Authority Report.

3. Background

Partial commissioning and groundwater extraction commenced at the SCA and PCA in October 2004. From October 2004 to January 2006 extracted groundwater was treated at the Steam Stripping Unit (SSU) located at BIP. In January 2006, the GTP was commissioned and larger scale groundwater extraction commenced. Initial capacity at the GTP was limited and extraction occurred only at selected containment locations. Over time the GTP capacity has increased with the majority of extraction wells now operating consistently.

The initial basis for design of the hydraulic containment system (well locations, well depths, pump sizing, capacity of the GTP) was a numerical groundwater model that predicted total flow rates of 12.1 ML/day (and up to 15 ML/day) to ensure hydraulic containment. During an extensive revision of the model an error was identified in water level data used during calibration. Correction of this error resulted in a significant decrease in required flow rates for hydraulic containment. The revised model predictions ranged from 6.2 ML/day to 8.4 ML/day for hydraulic containment. The ranges in predictions were due to uncertainty with respect to interaction between Floodvale and Springvale Drains with the shallow aquifer.

Based on the uncertainty of flow rates required to ensure hydraulic containment the Department of Infrastructure Planning and Natural Resources (DIPNR) now the Department of Water and Energy (DWE) advised that issue of extraction bore licences would occur once an improved understanding of flow rates was available. In the intervening period the extraction wells have been operated with permission from DWE under the test bore licences obtained prior to drilling of the extraction bores. The following table lists the existing test bore licences for hydraulic containment at part of the GCP.

Table 1 Test Bore Licence Numbers

Containment Line	Test Bore Licence Number
Secondary Containment Area	10BL163917
Primary Containment Area	10BL163914
Primary Containment Area	10BL161996*
BIP Containment Area	10BL164878

* Note: This test bore licence number refers to extraction wells installed during the Bioremediation Pilot Program at Southlands. Three of these test bores (EWB02, EWB05, EWB06) are now utilised as part of the PCA.

The following sections provide details of the three containment lines and the completed licence applications and associated supporting documentation are provided as attachments to this letter.

4. Well Drilling and Installation Programme

4.1. Locations and Depths

The locations of the hydraulic containment extraction wells are based on the results of the initial hydraulic containment model. At a number of locations multiple extraction wells have been installed screened across different depths/aquifers. The screen locations were determined by an assessment of groundwater contamination, the location of thin low permeability layers (peat/clay) and requirements for hydraulic containment. The number of wells at each containment line is summarised below:

- Secondary Containment Area: Forty one (41) shallow and deep extraction wells at twenty eight (28) locations;
- Primary Containment Area: Twelve (12) deep extraction wells including three (3) existing wells; and
- BIP Containment Area: Sixty (60) shallow, intermediate and deep extraction wells at twenty eight (28) locations.

Detailed bore logs, well construction details, easting/northing and surveyed relative level (mAHD) for each well is provided as supporting documentation to the licence applications attached to this letter.

4.2. Well Design

The extraction wells were designed for hydraulic efficiency using materials selected to provide maximum longevity. Details of the wells design and materials used are given below:

- Nominal borehole diameter: 273 mm;
- Casing: 150 mm NB 316L Stainless Steel pipe, Schedule 10, ID 161.5 mm, OD 168.3 mm, Wall Thickness 3.4 mm;
- Well Screens: 150 mm NB 316L Johnson Stainless Steel continuous wire wound, 0.8 mm slot with welded couplings;
- Plastic bow centralisers placed at the top and bottom of each screen. Additional centralisers were placed on screens exceeding 6.0 m length;
- 2 mm washed sand filter pack around the screens; and
- Bentonite seals placed above the screen.

Details of the well construction is attached as supporting documentation to the licence applications.

4.3. Drilling Contractor

The drilling contractor (K.H. Adams & Sons Pty Ltd of Wangaratta (KH Adams), Victoria) employed to install the extraction wells used two Edson 6000 drilling rigs to complete the works. The rigs were fully self-contained and equipped with duplex mud pump and air compressor. A steel portable mud tank with a capacity of 2.2 m³ provided containment for soil and groundwater during drilling and development of the wells. Both rigs were operated by drillers suitably licensed for drilling/well installation in the formations encountered at the SCA/PCA and BIP containment areas.

4.4. Drilling and Development

Drilling was carried out by mud rotary techniques using a biodegradable polymer (Loloss ®) as a viscosifier and hole stabiliser. Mud viscosity was specified at between 45 and 50 seconds Marsh Funnel in order to allow settling of the fine aquifer sand in the mud re-circulation tank. Soil samples were collected at one metre interval and logged by a URS scientist/engineer on site.

After installation of the extraction well, the well screens were jetted with a high pressure jetting tool using a pyrophosphate based drilling mud dispersant (Well Clean ®) to settle the gravel pack, degrade the drilling mud and improve the hydraulic efficiency of the screen/formation interface.

Final development of the extraction wells to produce clean and clear groundwater was completed by pumping with a centrifugal pump at rates of approximately 1 to 3 L/sec.

All drill cuttings and fluids were collected in 200 L drums and/or 1000 L Intermediate Bulk Containers (IBC) for disposal in accordance with procedures approved by the Department of Environment and Conservation (DEC). Development water was pumped directly into a liquid waste tanker and transported by a licensed contractor to BIP for treatment.

A 25 mm diameter PVC pipe with a machine slotted screen section has been installed in the annular space between the drilled borehole and the extraction well casing to allow manual measurement of the water level and for the installation of a level sensor for pump control.

5. Pumping Equipment

5.1. Pumps

All extraction wells have been fitted with Grundfos stainless steel submersible pumps coupled to variable speed drives. The pumps were selected with materials (stainless steel with Teflon seals) to ensure maximum longevity in contaminated groundwater.

The pumps initially installed were sized based on the output from a groundwater model developed by AccessUTS in October 2004. Once hydraulic containment commenced it became evident that many of the pumps were oversized and a number have been replaced with smaller models. Each of the three attached licence applications includes a table that outlines the currently installed pump at each location.

With the exception of SP30 pump models, each pump is fitted with a Stainless Steel shroud to ensure adequate cooling flow over the submersible motor.

5.2. Risers and Well Heads

The pumps are connected to the wellhead flange by 50 mm risers custom-built in Sch 10 316L Stainless Steel. The wellheads incorporate a re-circulation pipe to allow the by-pass of a portion of the pump discharge for gross flow rate control. The by-pass line is a 32 mm diameter Polypipe and returns the excess groundwater to the top of the pump. Fine flow rate control is provided by a variable speed drive installed at each well location.

The well heads are built in 316 Stainless Steel Schedule 10, with the welds having been snoop tested to a proof pressure of 1000 kPa. The wellhead flanges are Stainless Steel 150# NC and supplied with a NATA certificate.

5.3. Pipe Work to the GTP

At each containment line the extraction wells are connected by a header pipe. The header pipe then conveys water to the GTP. Approvals for construction of the header pipe have been obtained from the relevant authorities and land owners.

6. Hydrogeological Tests

As part of the well development, a one hour pumping test was carried out at each well. Groundwater extracted during these tests was collected in a 200 L drum for visual inspection of the development progress and for measurement of field parameters. The results of the pump tests are as follows:

- Secondary Containment Area: shallow aquifer average hydraulic conductivity 21 m/day;
- Secondary Containment Area: deep aquifer average hydraulic conductivity 20 m/day;
- Primary Containment Area: deep aquifer average hydraulic conductivity 13 m/day (significant vertical gradients were developed in adjacent monitoring wells during the pump tests indicating the presence of low hydraulic conductivity confining layers);
- BIP Containment Area: shallow wells reported an average hydraulic conductivity of 28 m/day;
- BIP Containment Area: deep wells on 2nd Street reported an average hydraulic conductivity of 32 m/day; and
- BIP Containment Area: intermediate and deep wells on 1st Street reported an average hydraulic conductivity of 18 m/day.

The pump tests were performed over relatively short durations and should be considered as approximate values only. In addition, the values presented above are averages and variations of up to a factor of two were observed for wells screened within the same geological layer.

7. Flow Rates

Each extraction well is equipped with a level transducer that is connected to the GTP and monitored continuously. Target water levels for each extraction well were initially developed based on the revised groundwater model. Operation of the containment lines is controlled by adjusting the pump speed (using variable speed drives) until the target extraction well level is achieved. As a result, aggregate flow rates from the containment lines are subject to variations with recharge.

Initially, flow gauges (Magflo type) were installed on each pump on the three containment lines. However, it was found that these were being coated with a precipitate from the groundwater and were ineffective in accurately measuring flow rates. Subsequently, flow meters have been installed on the Primary and Secondary containment lines. This will allow more accurate measurement and calculation of flow rates from each bore field.

Following the results of extensive monitoring (both continuously with level transducers in monitoring wells as well as quarterly with stand alone data loggers) the target levels at each extraction well have been modified to ensure hydraulic containment. This process has been completed for all extraction wells.

However, due to capacity constraints at the GTP and pump maintenance issues all extraction wells have rarely been operated at the same time. As a result some uncertainty still exists with respect to the total maximum flow rate required to ensure hydraulic containment. The most recent flow rate data for the three containment lines operating with the maximum number of pumps available (31 July to 7 August 2007) indicate that the average flow rate at the GTP has been 6.5 ML/day. During this period flows peaked at 7.5 ML/day when GTP capacity was available even though a number of BIP Containment Area extraction wells (including EWD24 to EWD28) did not operate during the monitoring. Based on earlier monitoring these extraction wells are expected to supply at least an additional 0.5 ML/day.

Table 2 provides details of the flow rate estimates from the groundwater flow models and a summary of recently observed flow data at the GTP. The table also includes an estimate of the required flow rates to ensure hydraulic containment is maintained.

Table 2 Predicted and Observed Containment Line Flow Rates (ML/day)

	BIP Containment Area	Primary Containment Area	Secondary Containment Area	Total Flow Rate
Original Model	8.3	2.1	1.7	12.1
Revised Model Scenario A	3.4	1.7	1.6	6.8
Revised Model Scenario B	3.4	2.0	1.7	7.1
Revised Model Scenario C	3.4	2.6	1.4	7.5
Revised Model Scenario D	3.4	3.1	1.4	7.9
Revised Model Scenario E	3.4	3.6	1.4	8.4
Revised Model Scenario F	3.5	1.3	1.4	6.2
Observed Maximum Rates July/August 2007 ¹	4.2 ²	1.8 ³	1.4 ³	7.4
Observed Average Rates July/August 2007 ¹	3.6 ²	1.4 ³	1.2 ³	6.2
Flow For Hydraulic Containment	4.8	1.8	1.4	8.0

Notes: 1. Capacity constraints at the GTP have resulted in limited operation of some extraction wells and as a result some increase in flow rates is required to ensure hydraulic containment is maintained and the conditions of the NCUA are met.

2. Flow rate determined by subtracting the SCA and PCA flow rates from the total inflow to the treatment plant.

3. Flow rates measured using meters installed on the SCA and PCA header pipes.

An analysis of the data presented in **Table 2** indicates that the observed and anticipated flow rates for the SCA and PCA are very similar to those presented in both the original and revised groundwater models. In contrast, the observed and anticipated flow rates are somewhat higher than those predicted by the revised groundwater model (although they are still significantly lower than the original model, due primarily to the erroneous calibration data used for the original model requiring a significantly higher flow to be captured) for the BIP Containment Area. The higher BIP flow rates are primarily required due to slight variations in hydraulic conductivity along 2nd Street (refer **Section 5**) and thicker permeable sediments along 1st Street than modelled. In addition, the revised model incorporated relatively high extraction rates at bores along Denison Street which have subsequently been found to be lower (up to 0.3 ML/day) than modelled. The difference directly translates to increased pumping at the BIP Containment Area wells and accounts for the majority of the difference between the observed and modelled flow rates.

Additionally, the groundwater model is based on average rainfall conditions and the monitoring data collected to date has occurred during relatively low rainfall periods. As a result, while the required flows for hydraulic containment presented in **Table 2** are at the upper range of observed rates the rates are considered to be representative of those required for long term hydraulic containment.

In addition to the flow required for hydraulic containment, Orica requests that additional groundwater extraction is included in the licensed quantity. Due to the unused treatment capacity at the GTP there is significant opportunity for additional water treatment and recycling. The additional extraction will also increase the rate of mass removal from the subsurface with the long term benefit of decreasing the duration of remediation. The proposed licence limits are as follows:

- BIP Containment Area – **6.3 ML/day**;
- Primary Containment Area – **1.8 ML/day**; and
- Secondary Containment Area – **1.4 ML/day**.

The total licensed extraction rate would be **9.5 ML/day** which is significantly less than that proposed (15 ML/day) after completion of the original modelling. Prior to implementation of extraction exceeding that required for hydraulic containment Orica proposes to complete additional groundwater modelling, geotechnical assessment of potential settlement due to the additional drawdown and additional groundwater level/ settlement monitoring. The results of these assessments will be submitted to DWE for consideration prior to commencement of additional extraction.

8. Licence Applications

Based on discussions with DWE it is understood that single licences will be issued for each of the three containment lines (as opposed to licensing individual bores). The licence applications are attached to this letter. Approval for the Botany Groundwater Cleanup Project was given under Part 5 of the *Environmental Planning and Assessment (EP&A) Act 1979* and the EP&A regulation 2000. This approval process considered a detailed environmental assessment (EIS) of the impacts of the project including an assessment of the effects of groundwater extraction. As a result it was considered that the Environmental Assessment Forms were not required as part of this licence application.

Should you have any queries or require further clarification, please feel free to contact Greg Dasey by phone on (02) 8338 1011 or by email at gdasey@jbsgroup.com.au.

Yours sincerely,



Greg Dasey
Principal Hydrogeologist
JBS Environmental Pty Ltd

Attachment (1) Conditions under Part V (Section 116) of the Water Act
Attachment (2) Figure 1 – Hydraulic Containment Line Locations
Attachment (3) Completed Application Forms - Secondary Containment Area
Attachment (4) Completed Application Forms - Primary Containment Area
Attachment (5) Completed Application Forms - BIP Containment Area

Attachment 1 - Conditions under Part V (Section 116) of the Water Act

Pursuant to Part V of the *Water Act 1912* the Department of Infrastructure, Planning and Natural Resources (DIPNR), having reviewed the documentation associated with the proposal as described in a report titled *Botany Groundwater Cleanup Project - Environmental Impact Statement* (EIS) dated November 2004 and submitted to the Department by Orica Australia Pty Ltd, proposes to grant a Licence subject to a formal application being received from the proponent for such. In addition to the licence, DIPNR proposes general and specific conditions for management of groundwater resources and dependent ecosystems in the area of the proposed groundwater clean up development.

The general terms of approval are set out below.

A. General conditions - Water Licence (Part V Water Act)

1. Under the provisions of Part V (s116) of the Water Act, this licence shall be valid for the period of ten (10) years and may be renewed upon application.
2. The licensee shall allow the Department of Infrastructure, Planning and Natural Resources, or its authorised representatives, subject to appropriate occupational health and safety provisions, full and free access to the works (ie groundwater extraction bores and groundwater investigation/monitoring bores), during or after construction, for the purpose of undertaking inspection or test of works and its fittings, and shall carry out any work or alterations deemed necessary by DIPNR to ensure the protection and maintenance of the works, or the control of the water extracted and for the protection of the quality and the prevention from pollution/contamination of surface and subsurface water.
3. The licensee shall notify DIPNR if the works (ie groundwater extraction bores, investigation/monitoring bores) are to be abandoned and, contingent with safety requirements, seal off the works by:
 - a. backfilling the work to ground level with clay or cement, or
 - b. other methods agreed to or directed by DIPNR.
4. Prior to the construction of any bore for purposes of groundwater extraction, investigation and/or groundwater monitoring, a bore licence application shall be submitted and a licence obtained from DIPNR. Completion details (Form A - Particulars of completed bore) of all bores are required to be forwarded to DIPNR within three (3) months of completion of construction.
5. Any drilling contractor engaged to construct a groundwater extraction, investigation and/or monitoring bore must hold a current NSW Water Bore Drillers Licence, with appropriate endorsements for the proposed work, that has been issued under the Water Act by DIPNR.
6. All groundwater extraction, investigation and/or monitoring bores shall be constructed in accordance with bore construction requirement given in *Minimum Construction Requirements for Water Bores in Australia* - Land and Water Biodiversity Committee Edition No 2, September 2003.
7. Appropriate occupational health and safety provisions required by NSW WorkCover must be observed during the construction of all water bores for the project.
8. Any licence granted that authorises pumping from the specified extraction areas viz Primary Containment Area on Southlands, Secondary Containment Area along Foreshore Road and DNAPL Containment line on the Botany Industrial Park is to be used for containment of contamination and groundwater remediation purposes only.

9. All groundwater extracted for containment and remediation shall be transferred to the GPT via dedicated transfer pipelines, which should be monitored to ensure pipeline failure does not occur.
10. Works used for the purpose of conveying water taken by means of the licensed work shall not be constructed or installed so as to obstruct the reasonable passage of flood water flowing into or from a water course.

Specific conditions – groundwater management

1. The licensee shall maintain records of the gross and individual volume of groundwater extracted from all bores utilised for containment of contamination and groundwater remediation and provide this information to DIPNR on an annual basis or upon request from the Department.
2. The licensee shall install and maintain groundwater monitoring bores as part of the Environmental Monitoring Plan (EMP) and obtain the endorsement of DIPNR for the location, design and technical data to be obtained from the monitoring bore network.
3. The licensee shall install automatic water-level recording devices with provision for downloading and archiving groundwater level data for the endorsed groundwater monitoring network.
4. DIPNR reserves the right to request an audit of the groundwater monitoring data and archiving quality assurance/quality control (QA/QC) procedures and request the licensee take corrective measures if found to be necessary as a consequence of the audit findings.
5. The licensee shall prepare interpreted reports on a schedule endorsed in the EMP that provides technical information about the groundwater level behaviour for the area impacted by the extraction borefields, with reference to previous groundwater simulation predictions cited in the EIS.
6. The licensee shall install and maintain a settlement monitoring network in accordance with the EMP endorsed by DIPNR.
7. The licensee shall obtain as part of the EMP groundwater quality data from both the production borefields and monitoring bore network and provide technical reports on this information, with reference to performance indicators for groundwater clean up, in accordance with the endorsed EMP.

Groundwater monitoring program

1. Orica must, as a component of the Environmental Monitoring Plan, prepare and implement a groundwater monitoring program by 30 June 2005 and prior to commencement of operation of the groundwater treatment plant.

The objectives of this monitoring program are:

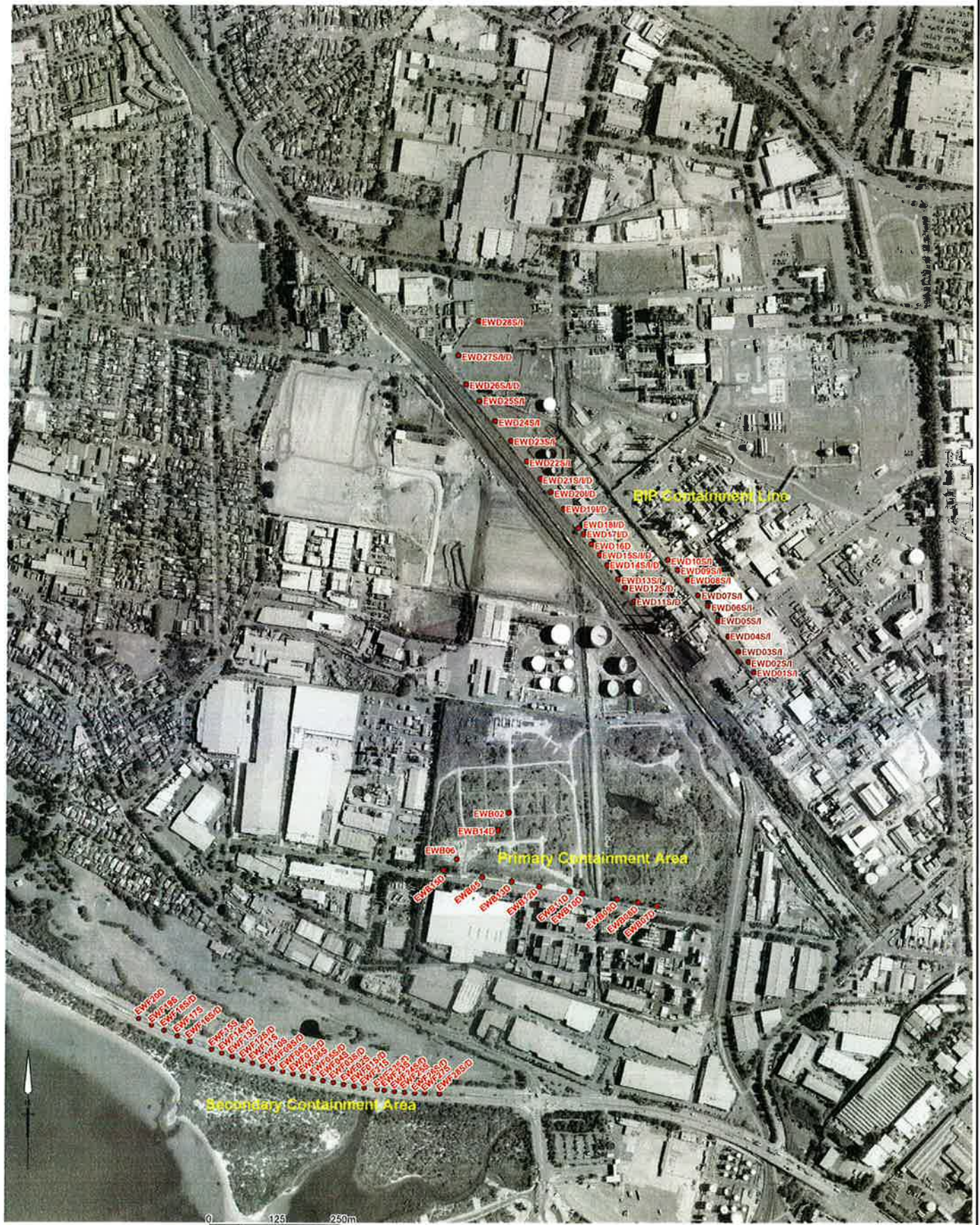
- a. to detect groundwater flow and direction at depths relevant to the proposed extraction points
- b. to document the effectiveness of the groundwater pumping containment activity
- c. to assess the remediation of the sand beds aquifers groundwater system by reference to performance indicators.


The groundwater monitoring program must be developed in consultation with DIPNR, DEC, the Department of Primary Industries and Sydney Ports Corporation. The groundwater monitoring program must include details on but need not necessarily be limited to the following:

- a. location of monitoring bore holes - including the depth at which they are screened to enable access of groundwater
- b. monitoring of the reduced level (m AHD)
- c. monitoring the groundwater gradient and determination the direction of groundwater flow
- d. monitoring methodologies and standards to be employed
- e. reporting and assessment of results
- f. opportunities to integrate the monitoring program with other monitoring requirements in the vicinity
- g. monitoring frequency
- h. representativeness of the sampling.

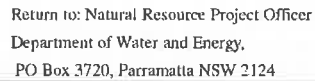
The applicant must submit a pre-extraction baseline groundwater monitoring report to DIPNR and any other relevant government agencies by 30 September 2005 for the operation of the groundwater treatment plant.

Attachment 2 - Figure 1 – Hydraulic Containment Line Locations



Client ORICA AUSTRALIA PTY LTD	Project ORICA BOTANY ENVIRONMENTAL SURVEY STAGE 4 - REMEDIATION	Title HYDRAULIC CONTAINMENT SYSTEM
	Drawn: ST Approved: GD Date: 03-01-05 Job No: 43346038 File No: 43217457-PH-010.WOR	Figure: 1-1

Attachment 3 Completed Application Forms - Secondary Containment Area



Applicant(s) Name(s) (Note 1)	Surname(s) Orica Australia Pty Ltd			First Name(s)		
Full Postal Address	16-20 Beauchamp Road, Matraville				Postcode 2036	Telephone 02 9352 2017
Full Property Address					Postcode	Telephone
Location of work to be licensed (Note 2)	Portion / Lot & DP Part road fronting 203/712991, 7024/752015, 7025/752015		Parish Botany		County Cumberland	
Nature of work to be licensed (Note 3)	<input type="checkbox"/> Proposed Is work to replace an abandoned work? <input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Alteration Is work to be altered already licensed? <input type="checkbox"/> Yes <input type="checkbox"/> No		Proposed depth in metres <input checked="" type="checkbox"/> Existing Is application replacing an existing licence? <input checked="" type="checkbox"/> Yes 10BL163917 <input type="checkbox"/> No	
Type of work	<input checked="" type="checkbox"/> Bore <input type="checkbox"/> Well <input type="checkbox"/> Excavation <input type="checkbox"/> Spearpoint(s) <input type="checkbox"/> Artesian Bore					
Purpose for which water is to be used (Note 4)	<input type="checkbox"/> Stock <input type="checkbox"/> Test Bore <input type="checkbox"/> Domestic <input type="checkbox"/> Waste Disposal <input type="checkbox"/> Farming <input type="checkbox"/> Drainage (Not Irrigation) <input type="checkbox"/> Monitoring		<input type="checkbox"/> Irrigation <input type="checkbox"/> Sand & Gravel <input type="checkbox"/> Town Water <input type="checkbox"/> Washing <input type="checkbox"/> Recreation <input checked="" type="checkbox"/> Industrial/Commercial <input type="checkbox"/> Mining		Estimated annual usage in megalitres 520	
Complete if other landholders to be supplied with water	Name	Portion	Parish	County	Purpose of Supply	
If application is for Town Water Supply, please provide details of all Town Water bores and wells		Number of existing works		Volume of water taken annually in megalitres		

Description of property (from local council) (Note 5)	Portion/Lot & DP		Parish	County	Total Area (hectares)	Is property leased?
						<input type="checkbox"/> Yes
						<input type="checkbox"/> No
Crops to be irrigated (Note 6)		<input type="checkbox"/> Orchard <input type="checkbox"/> Vines <input type="checkbox"/> Other			Area to be irrigated in Hectares	
Any other irrigation from Bores & Wells (Note 7)	No. of Bores & Wells	Existing Bore licences	Type of Crop(s)			Area in Hectares
Any other Irrigation	From Rivers, Lakes etc.	licence No/s	Area Authorised	From Department Channels		Area Authorised
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No		

I/We apply for a licence to construct and use the works described above and to use the water obtained only for the purpose that I/We have specified on the application, and forwarded the following:

- (Note 9a) 1. A PLAN (topographical or DP map) showing the portion/Lot&DP, parish and county of the:-
 ♦ Boundaries of the land occupied by Me/Us ♦ Site to be licensed
 ♦ Boundaries of any land to be irrigated
 ♦ Boundaries of any other property other than My/Our own to be supplied with water under this application
- (Note 9b) 2. THE SUM of \$151.00 being the prescribed FEE. (NOT applicable to Stock/Domestic/Farming/Monitoring or Test)
- (Note 10) Applicant(s) Signature(s) Dated/...../.....

If the subject application is being applied for by the driller on the authorisation of the applicant for the purpose of stock, domestic, farming or test bores only, and the applicant has been informed of the proposed limitations and conditions that will attach to the licence when issued and does not wish to make any submission prescribed by the Act, then please sign below.

SIGNED: (Licensed Driller) _____ Driller's Licence Number _____ Dated: _____
 Licence No. 10BL ☐ ☐ ☐ ☐ ☐ ☐ **DEPARTMENTAL USE ONLY**
☐ Fee ☐ Plan ☐ Environmental Form Application recommended.....
 Application approved.....