2.1 Site Location and History

2.1.1 Site Location

The BGC Project incorporates a number of activities on and in the vicinity of the BIP. The overall Project Area is located on lands largely enclosed within the boundary of the Department of Infrastructure, Planning and Natural Resources (DIPNR) Groundwater Extraction Exclusion Area, as shown in **Figure 2.1**. The Botany Sands Aquifer is classified as a "high risk resource" by DIPNR in terms of groundwater quality down-gradient of the BIP. DIPNR has given a direction not to use the groundwater until further notice. Similarly, issue of any new bore licences for groundwater extraction is restricted, except for cleanup and construction activities.

The BIP is located within the Botany/Randwick industrial area to the north-east of Botany Bay, east of Sydney Airport and approximately 12 km south of the Sydney Central Business District (CBD). The blocks of land known as Southlands are owned by Orica, and are located just to the south-west of the BIP, with the Sydenham–Botany goods railway line dividing the two (refer **Figure 1.2**).

The proposed location of the GTP is on land owned by Orica within the BIP, previously the site of a Silicates Plant. The locations of other components of the BGC Project are:

- groundwater wells on Blocks 1 and 2 of Southlands;
- transfer (primary) pipeline for extracted groundwater from the wells on Southlands to the GTP on BIP;
- groundwater wells within the median strip of Foreshore Road;
- transfer (secondary) pipeline for extracted groundwater from the wells on Foreshore Road to the GTP;
- groundwater wells on the western boundary of the BIP;
- transfer (DNAPL) pipeline for extracted water along and parallel to the western boundary of the BIP;
- treated water distribution pipelines across the BIP; and
- transfer pipeline for treated water from the BIP to the Bunnerong Canal.

The works associated with these components are subject to separate approvals and permits (as discussed in **Chapter 6**).

The full operation of the BGC Project would integrate the operations of each of these components and the GTP. Details of the design, construction and operation of the BGC Project are described in **Chapter 5**.

Land uses in and around the Project Area include:

- Industrial: The area is one of Sydney's main industrial regions, and a range of other industrial sites lie within a 2 km radius to the south, north, west, and north-west of the BIP, including the Mobil Oil Terminal, Kellogg's, Solvay Interox, Nuplex Industries Australia Pty Ltd, and Amcor;
- Infrastructure: There are a number of major infrastructure facilities in the vicinity of the BIP, with the Sydenham–Botany goods railway line running along one boundary, Sydney Airport about 3 km to the west of the site and Port Botany to the south on the edge of Botany Bay;
- Residential/Retail: Principal residential areas are located to the north, east and west, with Banksmeadow and Pagewood to the north-west; Hillsdale, Matraville and Maroubra east of Denison Street; Botany residential area to the west, and Eastgardens shopping complex to the north-east; and
- Open Space: As well as a number of golf courses, parks and reserves, the area includes Penrhyn Estuary, to the south-west of the BIP; Botany Bay, located about 1 km to the south; and Botany Wetlands, located about 2 km north-west.

2.1.2 Site History

Botany Industrial Park

Industry was first established in the area from about the turn of the 20th century. The first industries were mainly tanneries, fellmongeries, wool scourers and a paper mill. The 1920s and 1930s saw the first establishment of major industries including Davis Gelatine, Kelloggs and Johnson & Johnson. Many of the chemical industries, including ICI and the then A C Hatrick, were established in the 1940s.

Manufacturing began at the south end of what is now known as the BIP in 1942 under wartime conditions. The range of products manufactured increased rapidly in the early post-war years, when commodities of all types continued to be in short supply throughout the world. The 1960s saw the introduction of larger manufacturing plants and the Botany site became what is now known as a petrochemical complex. The development shifted toward the north end of the site and the area progressively developed as manufacturing plants were modernised, replaced or closed. Particular manufacturing operations that have since closed down include trichloroethene (TCE) and ammonia in the 1970s, Olefines I in the 1980s, and chlorinated solvents (carbon tetrachloride (CTC), tetrachloroethene (PCE) and EDC) and sodium silicates in the 1990s.

The BIP incorporates approximately 73 hectares previously owned by Orica. Three principal companies now share the BIP, with a number of others providing additional services.

In 1998, the site was subdivided to create the BIP. The principal plants now operating on the BIP, as shown on **Figure 2.2**, comprise:

- Qenos Olefines Plant, to the north of the site;
- Qenos Alkathene and Alkatuff Plants, in the central part of the site;
- Huntsman Surfactant Plant, at the southern part of the site;
- Orica Chlor-Alkali Plant, to the south-east of the site; and
- Qenos operated Site Utilities, including steam and effluent plants on the west side of the site.

In addition, a number of tenants occupy portions of the site.

Southlands

Southlands (Block 1 and Block 2) is located just to the south-west of the BIP. It occupies a region once known as Veterans Swamp, part of the Botany Swamps that formed an important part of Sydney's water supply in the 1830s and 1840s. As water was drained, peat lenses were exposed, and peat cutting and sand extraction was carried out on a commercial basis into the mid 20th century. The pits and ponds resulting from the peat excavation (some of which remain on Block 1) were subsequently used for dumping of bottom end furnace ash from coal-fired boilers used by industry in the area (including Bunnerong Power Station).

In the 1950s Southlands was acquired by Australian Paper Manufacturers (APM), and the site was used for the discharge of paper waste slurries and for the storage of waste paper. It was then purchased by ICI in 1980, providing a 'buffer' between its Botany operations and the commercial and residential development to the west.

2.2 The Groundwater Issue

2.2.1 Overview

An extensive chronological history of the groundwater issue and the activities undertaken by various parties to investigate, assess and address the issue is presented on the Orica Botany Groundwater Site website, at http://www.oricabotanygroundwater.com/history.html.

This history is briefly summarised in **Table 2.1**, which provides the historical context for the regulatory activities and proposed works to be undertaken.

Table 2.1 Summary history of the groundwater issue

Dates	Activities
1970s	Potential contamination of groundwater by organic chemicals reported following initial investigations.
1980/81	High levels of organic contamination found in shallow groundwater during excavation work on State Rail Authority (now RailCorp) land between the BIP and Southlands.
1989/90	Stage 1 Environmental Survey of the BIP undertaken by ICI (now Orica). Survey identified volatile chlorinated hydrocarbons (CHCs) in soils, groundwater, surface water and sediments, and semi-volatile CHCs in soils, sediments and biota. Identified CHCs were all related to present and past products and by-products produced on the BIP.
1993/96	Second Stage of the Environmental Survey carried out, providing further information on the extent of CHC contamination. The second stage included the formation of the Community Liaison Committee for consultation with local communities, and initial evaluation of potential remediation strategies for cleanup of the contamination.
Nov 1996	Third Stage of the Environmental Survey initiated. ICIA issued a proposed Stage 3 Remediation Plan to the NSW EPA. The third stage works included routine monitoring of groundwater, surface water, air and biota, and feasibility assessment of remediation technologies.
Mar 1997	Consolidated Groundwater Report issued to the EPA, which included recommendations for further investigations and ongoing groundwater monitoring.
Mar 1998	First signs of Central EDC Plume migration detected on Southlands.
Feb 1999	Installation of pilot-scale reactive iron barrier to assess effectiveness in degrading volatile CHCs at elevated concentrations.
May 1999	NSW EPA directed Orica to identify options for containment of central EDC plume.
June 1999	Updated Consolidated Groundwater Report issued to the EPA, which reported three main plume groups: the Northern, Central and Southern Plumes.
Feb 2000	Orica entered into a Voluntary Investigation and Remediation Agreement (VRA) with the EPA under the *Contaminated Land Management Act* 1997. The VRA formalised the ongoing monitoring, investigation and remediation assessment activities being undertaken.
Oct 2000	Results from pilot-scale reactive iron barrier confirmed technology as appropriate for remediation of CHC contamination (not including EDC).
Feb 2001	First annual report under the VRA issued to the EPA.
Feb 2002	Second annual report under the VRA issued to the EPA.
Aug 2002	Development Application (DA) submitted to the Council of the City of Botany Bay for bioremediation field trials.
Feb 2003	Third annual report under the VRA issued to the EPA.

Dates	Activities
Mar 2003	DA for bioremediation field trials approved by the Council of the City of Botany Bay.
July 2003	High concentrations of CHCs noted in the Herford Street, Banksmeadow production bore.
Sept 2003	EPA issued Orica with a Notice of Clean Up Action (NCUA), reference number 1030236.
Oct 2003	In response to the NCUA, Orica submitted its draft Groundwater Cleanup Plan (GCP) to the EPA, and commenced work implementing proposed actions.
Feb 2004	The EPA issued Orica with a Variation to the NCUA (reference number 1033107), authorising and requiring the implementation of the GCP.

2.2.2 The Groundwater Cleanup Plan

The GCP (October, 2003) was prepared in response to the NCUA, and presents the proposed actions to be implemented in response to each of the NCUA's major elements. Given the nature of the groundwater issue and the challenging requirements and time frames in the NCUA, the GCP was necessarily complex. Multiple options needed to be considered and, in many cases, possible parallel implementation of options needed to be reviewed and revised as appropriate at key milestones. The content of the GCP is summarised in the following sections, with the full document available on the Orica Botany Groundwater Site website, at http://www.oricabotanygroundwater.com.

The context of the BGC Project within the overall GCP is shown in **Figure 2.3**.

Primary Containment Area

The NCUA requires hydraulic containment and maximum reduction of concentrations in the PCA (target 80% by 31 October 2005), including use of *ex situ* treatment.

The GCP included a number of options for short-term and long-term hydraulic containment and treatment:

- trial of groundwater extraction for short-term off-site disposal at Waste Service NSW's Lidcombe Liquid Treatment Plant;
- recommissioning of the former Vinyls Plant effluent stripping equipment (the Steam Stripper Unit (SSU)) on the BIP, to process extracted groundwater in the short term (with recovery of CHCs for subsequent treatment/disposal);
- active bioremediation trials, to assess the long-term effectiveness of in situ treatment providing full scale contaminant containment; and
- long-term implementation of full scale hydraulic containment (groundwater extraction) and ex situ treatment (in the proposed groundwater treatment plant).

Secondary Containment Area

The NCUA requires establishment of a secondary containment area for contamination that has migrated, or may migrate, from the primary containment area by 31 October 2004.

The GCP proposed parallel implementation of various bioremediation and hydraulic containment/*ex situ* treatment projects:

- passive bioremediation barrier along Foreshore Road;
- active bioremediation barrier on Botany Golf Course (to be implemented in addition to a passive bioremediation barrier); and
- in the event of the bioremediation trials not being proven in time, secondary containment by groundwater extraction and treatment, in the SSU in the short-term, and in the proposed groundwater treatment plant in the long-term.

DNAPL Identification, Containment and Removal

The NCUA requires Orica to identify all DNAPL source areas on Orica premises by 31 May 2004, containment of all sources by 30 November 2004, and removal of identified sources areas to the extent practicable by 31 October 2005.

The GCP proposed a number of actions to meet these requirements:

- staged approach for investigation of each inferred source area;
- implementation of appropriate options for contaminant containment, to be in situ wherever practicable, including bioremediation barriers, permeable reactive barriers, and hydraulic containment, as well as ex situ treatment (in the proposed groundwater treatment plant). It is noted that the GCP assumed DNAPL containment to be containment of dissolved phase contamination from DNAPL source areas.

Monitoring

The NCUA requires implementation of a comprehensive monitoring program within an area defined in the NCUA.

The GCP proposes a detailed monitoring program to deliver this objective, including measurement protocols for assessing conditions against the ANZECC guidelines.

2.3 Proposed Groundwater Containment and Treatment Activities

2.3.1 Short-term Containment/Treatment

Off-Site Treatability Trials

In the GCP, the first proposed short-term containment and treatment option for management of the Central EDC Plume was extraction and off-site treatment at NSW Waste Service's Lidcombe Liquid Treatment Plant.

The initial treatability trials were undertaken in early 2004 to assess the feasibility of groundwater extraction at Southlands Block 2 and treatment at Lidcombe, with the potential to proceed as a short-term measure for groundwater containment and treatment in the event that the trials proved successful.

Although the trials were completed successfully, it was concluded that this was not a viable ongoing treatment option, because there were problems with HCl emissions from the Lidcombe Treatment Plant's odour control system during treatment of the groundwater.

Accordingly, this EIS does not assess off-site treatment impact at Lidcombe.

Interim Containment: Steam Stripping Unit

A second short-term containment and treatment option presented in the GCP was the recommissioning of the former Vinyls Plant effluent stripping equipment (the Steam Stripper Unit (SSU)) on the BIP, to process extracted groundwater and recover CHCs for subsequent treatment/disposal.

This option had been implemented at the time of the preparation of this EIS, with transfer pipelines and groundwater wells installed on Southlands and at Foreshore Road, to enable extraction of initially 300 kL/day (increasing to 2,000 kL/day) of groundwater from the Primary Containment Area and the Secondary Containment Area for treatment in the SSU.

The steam stripping process would transfer the organic contaminants from the groundwater to the steam, which in turn would be condensed to form a recovered CHC liquid, containing predominantly EDC. The SSU and associated infrastructure became operational in late October 2004, and is intended to operate until the proposed GTP is operational. It would then be shut down, and the groundwater transferred directly to the GTP for treatment.

The estimated 500 tonnes of recovered waste EDC liquid generated by the process would initially be stored in the existing tanks adjacent to the SSU, then transferred to an existing aboveground storage tank located in Terminals Pty Ltd's bulk liquids storage facility at Port Botany.

As described in **Chapter 5**, the stored recovered waste EDC liquid would subsequently be progressively transported back to the GTP once commissioned for processing with the extracted groundwater.

2.3.2 Bioremediation

At the time of the preparation of the GCP, Orica's preferred approach (wherever proven and practical) was to use the *in situ* treatment technologies of enhanced bioremediation and permeable reactive iron barriers, rather than *ex situ* treatment technologies.

Under a DA approved by the Council of the City of Botany Bay in March 2003, bioremediation field trials were implemented on Southlands Block 2 to assess the potential effectiveness of the *in situ* treatment to achieve contaminant containment and treatment for the PCA. Depending on the results of these trials, further works were planned for passive bioremediation (along Foreshore Road) and active bioremediation (on the Botany Golf Course) for the SCA. The development of the bioremediation works were to be undertaken in parallel to the development of the BGC Project, and Orica and the EPA would subsequently assess and agree on the best approach (i.e. either bioremediation or the GTP) for achieving the required containment and treatment.

However, at the time of preparation of this EIS, the bioremediation trials on Southlands Block 2 have not been concluded and the GTP is now the primary approach being implemented by Orica to achieve containment of the contaminant plumes and to prevent discharge into Botany Bay, in order to meet the requirements of the EPA's NCUA.

2.3.3 Full Scale Hydraulic Containment

The full scale hydraulic containment comprises the extraction of groundwater from the primary, secondary and DNAPL containment lines for *ex situ* treatment in the GTP.

2.4 The Planning Context

The BGC Project is an extensive project with many inter-related components, including the Activity (which is described below), and other components which have been or will be separately approved and constructed to achieve the requirements of the NCUA.

While this EIS is required only in respect of the Activity, it does consider the potential cumulative impacts of the overall BGC Project, including potential construction impacts for all those components yet to be constructed, and the potential impacts associated with the full operation of the BGC Project from groundwater extraction, through transfer, treatment and reuse/discharge.

The following elements of the BGC Project comprise an activity ('the Activity') for the purposes of Part 5 of the EP&A Act, for which approval will be supported by the assessment in this EIS:

- the extraction of groundwater from the wells installed in the three containment lines (primary containment area, secondary containment area and DNAPL containment line);
- transfer of groundwater via pipelines to the GTP;
- construction and operation of the GTP;
- transfer of treated water via pipelines to BIP users or Bunnerong Canal and waste water to sewer; and
- installation of a discharge point into Bunnerong Canal.

The environmental impact of the proposed BCG Project (which includes the Activity) is assessed in this EIS.

°