Project Description

5.1 Introduction

This chapter provides a summary of the overall BGC Project and shows how the various elements are integrated into the overall project. It gives full descriptions of the elements whose construction is covered by separate licences/permits (as described in **Chapters 2 and 6**), together with detailed descriptions of the design and construction of the GTP and the construction activities of the associated elements, and the overall management and operation of the project.

The following elements of the BCG Project comprise an activity ('the Activity') for the purposes of Part 5 of the EP&A Act, for which approvals 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 to Bunnerong Canal and waste water to sewer; and
- installation of a discharge point into Bunnerong Canal.

The environmental impact of the proposed Activity is assessed in this EIS.

The construction of the pipelines and wells infrastructure referred to below, though part of the BGC Project, are not part of the Activity. The environmental impacts of their construction have been separately assessed as part of other approvals. Some of this approved infrastructure has already been installed. The remainder will be completed by June 2005 (see **Table 5.1** for details). The EIS does, however, consider the cumulative impacts of the full operation of the BGC Project, including the operation of this infrastructure to extract and transfer groundwater to the GTP and transfer treated water for reuse or discharge.

5.2 Overview of BGC Project

The overall BGC Project is illustrated in **Figure 5.1**, which presents a schematic of each of the groundwater extraction, transfer, treatment and reuse/discharge stages. The layout of the BGC Project within the Project Area is shown in **Figure 1.3**.

The BGC Project stages illustrated in **Figure 5.1** are briefly described in the following section, with specific details for each stage provided in **Sections 5.3** to **5.10**.

5.2.1 Extraction

The extraction of contaminated groundwater is designed to:

- stop the movement of identified contaminant plumes; and
- remove the contaminated groundwater for treatment.

Extensive hydrogeological modelling has been undertaken to identify the required number of extraction wells, their locations, depths and extraction rates, to ensure that containment of the plumes would be achieved with minimal impact, as presented in **Chapter 12**.

The existing and proposed well locations are within the hydraulic containment lines specified in the NCUA:

- Primary Containment Line: Core, Line A and Line 1, located along the southern boundary of Southlands Blocks 1 and 2;
- Secondary Containment Line: Lines 2 and 3, located in the median strip of Foreshore Road; and
- DNAPL Containment Line: Lines 5 and 6, located on and parallel to the western boundary of the BIP.

The locations of these containment lines and of the extraction wells located within each are illustrated in **Figure 5.2**. As noted in the descriptions of the contaminant plumes in **Chapter 3**, contamination has been identified in both the shallow and deep layers of the Botany Sands Aquifer (Layers 1 and 2), so two layers of extraction wells are installed or will be installed to ensure that the groundwater flow is fully intercepted and the contamination contained. The two layers for the proposed extraction wells are:

- Layer 1: Shallow wells, with total drilled depth typically up to 9 m; and
- Layer 2: Deep wells, with total drilled depth typically between 10 m and 40 m.

Further details of the groundwater extraction wells are presented in **Section 5.3**.

5.2.2 Transfer

The contaminated groundwater pumped out in the extraction wells would be transferred to the GTP via dedicated transfer pipelines, at a total rate of up to 15 ML/day. There are in existence or will be constructed separate to the Activity three main pipelines, installed for each of the containment lines:

- Primary Pipeline (already operational at low capacity): To transfer groundwater from the Primary Containment Area (Southlands) to the GTP, at a rate of up to approximately 3.38 ML/day;
- Secondary Pipeline (part already operational at low capacity): To transfer groundwater from the Secondary Containment Area (Foreshore Road) to the GTP, at a rate of up to approximately 2.45 ML/day; and
- DNAPL Pipeline (to be installed): To transfer groundwater from the DNAPL containment line (BIP) to the GTP, at a rate of up to approximately 9.17 ML/day.

The route of these transfer pipelines is shown in **Figure 5.2**. Further details of the pipelines and the pipeline routes are presented in **Section 5.3**.

Prior to the construction and commissioning of the GTP, the existing primary and secondary pipelines are being used to transfer groundwater to the SSU, at significantly reduced volumes, as an interim measure.

5.2.3 Treatment

The extracted groundwater would be combined into a single stream and fed to the GTP on Orica-owned land on the BIP.

In addition, the recovered waste EDC liquid generated by the SSU would be fed separately into the GTP for destruction of the contaminants. The SSU was recommissioned in October 2004 as an interim measure, pending construction of the GTP, and is operated under a revised environmental protection licence issued to Orica by the EPA.

The proposed treatment process in the GTP would comprise the following process steps:

- groundwater feed handling;
- air stripping;
- off-gas treatment (thermal oxidation);
- off-gas treatment (gas scrubbing);
- stripped water treatment (iron removal);
- stripped water treatment (removal of non-volatile organics, such as phenol);
- stripped water treatment (reverse osmosis dissolved solids removal);
- stripped water treatment (organic acid and ammonia removal); and
- treated water reuse and discharge.

The exhaust gases from the thermal oxidation and gas scrubbing steps would be discharged to atmosphere via a single stack.

Full details of the GTP, and of each of the process steps and their operation, are presented in **Section 5.5**.

5.2.4 Reuse and Discharge

As part of the development of the BGC Project , Orica investigated the options available to maximise reuse of the treated groundwater, based on proximity of demand and available infrastructure, and balancing the significant capital and operating cost of treatment and distribution with the sustainability and environmental benefits of reuse.

As a result of these investigations, Orica has reached agreements with process operators on the BIP for groundwater reuse, and is currently proposing to install sufficient reverse osmosis (RO) capacity and a treated water distribution network for up to 7.5 ML/day. This would replace existing supply from the Sydney Water townswater system, reducing the current level of demand from the BIP.

In addition, the GTP will be designed so that recycling capacity can be expanded. Orica will continue to work with relevant authorities and potential users of the recycled treated groundwater to maximise the level of reuse.

Treated groundwater that is not recycled would be discharged into Bunnerong Canal and then to Brotherson Dock. The quality of the treated groundwater discharged would meet the ANZECC Marine guideline (2000) for the protection of slightly to moderately disturbed marine ecosystems.

The operation of the GTP would also result in a number of other discharges, including wastewater discharged to sewer as trade waste from the gas scrubbing steps, and solid waste for disposal to landfill from the iron removal and organics polishing and organic acid and ammonia removal steps.

Hydrochloric acid would also be produced during the gas scrubbing step, and would be reused within the feed handling step of the treatment process.

Full details of the reuse and discharge steps are provided in **Section 5.5**.

5.3 Existing and Proposed Infrastructure

Some of the infrastructure for the BGC Project has already been constructed as part of the interim containment works, and some would be constructed prior to completion of the GTP. This infrastructure will be used to extract and transfer groundwater to the GTP and transfer treated water for reuse or discharge. This infrastructure is not part of the Activity for the purposes of Part 5 of the EP&A Act, for which approval is being sought under this EIS. This infrastructure is the subject of other approvals which are discussed in **Chapter 6.** Their current status is briefly summarised in **Table 5.1**, with the following sections presenting details of this infrastructure.

Table 5.1 Status of existing and proposed infrastructure, excluding GTP

Area	Infrastructure	Status
Primary Containment Line	2 Extraction Wells	Installed
	10 Extraction Wells	To be installed by Mar 2005
	Primary Transfer Pipeline	Installed to the SSU
Secondary Containment Line	41 Extraction Wells	Installed
	Secondary Transfer Pipeline	Installed to the BIP
DNAPL Containment Line	60 Extraction Wells	To be installed by May 2005
	DNAPL Transfer Pipeline	To be installed by May 2005
Recovered Waste EDC Liquid Storage (at Terminals Pty. Ltd.)	Storage Tank	Existing
GTP Discharge	Underground Pipeline	Existing – refurbishment to be complete by June 2005

5.3.1 Primary Containment Area

As shown in **Figure 1.3**, the Primary Containment Area (PCA) is located on Southlands.

Groundwater Wells

Groundwater wells for the PCA have been or will be installed on Southlands, at the specific locations shown on **Figure 5.3**, under a bore licence from DIPNR. The types and number of locations of these wells are presented in **Table 5.2**.

Table 5.2 PCA groundwater extraction wells

Type of Wells	Number of Wells
Layer 1 Wells	0
Layer 2 Wells	12

The design and construction of a typical groundwater well extraction shaft is shown in **Figure 5.4**. The upper section of the well is lined with a stainless steel casing, with a cement seal around the top 1m of the shaft and bentonite below. Part of the well casing is constructed as a stainless steel wire wound screen, to allow the well to fill from the required level. The submersible pump is suspended inside the well from the solid discharge piping, connected to the top flange. The well would be drilled to a maximum depth of 40 m below the existing ground level.

The submersible groundwater extraction pumps would be made of 316 grade stainless steel with a polymer coated, armoured cable, and would operate on 415 volt, three-phase power with a variable speed or variable frequency drive to maximise flow control.

The groundwater would be pumped through a 50 mm diameter pipe, through the well head into a collection pipe, which would in turn discharge into the primary pipeline for transfer to the GTP. Each extraction well would also be fitted with a recirculation line back into the well, which could be used to adjust the extraction rate of the well, and to flush out the well for maintenance.

Groundwater monitoring wells would be installed along the hydraulic containment lines to monitor the effectiveness of the hydraulic containment and extraction of the contamination plumes. The monitoring wells would typically be installed between every second extraction well. **Figure 5.5** shows the locations of the monitoring wells that are proposed. **Figure 5.6** illustrates the typical detail of a 'nested' monitoring well. The monitoring well shown contains three piezometers, which allows samples and measurements (such as groundwater level, conductivity and contaminants) to be taken at separate depths within the aquifer. Monitoring wells may have one, two or three piezometers depending on the sampling required at a particular location. It is proposed that selected wells will have level instruments installed and connected to the GTP computer control system, known as the Programmable Logic Controller (PLC) for monitoring of groundwater variation within the well. The well diameter would range from 50 to 180 mm, depending on the number of piezometers (each 50 mm in diameter) installed. The depths of the monitoring wells would vary, to a maximum of approximately 25 m, depending on the sampling to be carried out.

Details of the monitoring program that would be undertaken as part of the operation of the project, in the context of both the NCUA's requirements and the specific activities of the GCP, are presented in **Section 5.8**.

The proposed extraction rates for the groundwater wells have been developed through hydrogeological modelling work based on compliance with water level, hydraulic gradient and pumping constraints as shown in **Chapter 12**. The total pumping rate and estimated monthly volumes for the PCA are presented in **Table 5.3**.

Table 5.3 PCA extraction rates

Type of Wells	Number of Wells	Total Pumping Rate	Total Monthly Volume
Layer 2 Wells	12	39.1 L/s	102,800 kL/month

The system of groundwater extraction for the project is designed to be flexible, and able to respond to changes in groundwater flow patterns and contaminant levels, through the installation of variable drives and valve arrangements on the pumps, ongoing groundwater monitoring and overall operational control of the GTP via a central PLC. The PLC would control the operation of the whole project, based on specific operating parameters and criteria for the GTP and associated emissions/discharges.

A detailed description of the GTP operating philosophy, control and management system is provided in **Section 5.8**.

The works associated with the installation of the additional PCA extraction wells and the operation of all the wells have been considered and assessed in this EIS as part of the BGC Project. However, they do not form part of the Activity and will be separately approved and installed.

Primary Pipeline

The primary pipeline is a 150 mm diameter pipe, designed to connect the groundwater extraction wells on Southlands Blocks 1 and 2 to the GTP. The pipeline has been installed, and will transfer low volumes of groundwater extracted from some wells to the SSU prior to the commissioning of the GTP. Once the GTP is constructed, the primary pipeline would be connected directly to the GTP.

The 150 mm diameter primary pipeline connects the extraction wells to the GTP along the route shown in **Figure 5.2**. The majority of the pipeline is installed above ground on a low-level pipe rack, except where it crosses Nant Street and the Sydenham–Botany goods railway line. At this point, the route crosses EnergyAustralia and RailCorp land, and the pipeline is installed underneath the rail line within a synthetic polymer conduit. Once under the railway line, the pipeline emerges on the BIP and it would be installed on pipe racks to the GTP.

The pipeline has a capacity of at least 3.38 ML/day, and is designed to operate 24 hours a day, seven days a week. The operation of the groundwater transfer process and emergency control/management is described in **Section 5.8**.

The design of the three transfer pipelines has taken into consideration the need to minimise the risk of leaks and to ensure the integrity of the pipeline. The general measures incorporated into the design include:

- the use of dual-contained pipe in the underground sections (between Foreshore Road and Southlands (secondary pipeline), and the section that crosses beneath the railway line (primary and secondary pipelines);
- pipe thickness has been designed to handle hydraulic surges if a power failure results in pump failure;
- largely fully-welded pipe, with minimal number of flanges, minimises potential leak points and potential fugitive emissions;
- thermal relief has been provided around any points of potential isolation in the pipe. These relief devices relieve into the pipework to the feed tank or wells and not to atmosphere;
- aboveground sections of the piping have been externally painted to prevent external corrosion;
- use of chemically-resistant PVDF for the inner pipe of the underground dual-contained pipe;
- periodic inspections of the aboveground pipe sections to investigate the pipe condition and check for any leaks; and
- weekly monitoring of the inspection port in the outer sleeve of primary underground pipe to detect leakage in the underground section.

The works associated with the construction and interim operation of the primary pipeline were assessed in a separate environmental impact assessment, titled the *Environmental Impact Assessment Document for Botany Groundwater Remediation Project – Phase 2 Tanker Loading Facility, Steam Stripping Unit Recommissioning and Transfer Pipeline*, prepared by Orica in April 2004, as part of the approvals process for the pipeline. This assessment concluded that the works were not likely to significantly affect the environment.

5.3.2 Secondary Containment Area

As shown in **Figure 1.3**, the secondary containment area (SCA) is located along Foreshore Road, approximately 500 m hydraulically down-gradient from the PCA.

Groundwater Wells

Groundwater wells for the SCA were installed during September/October 2004, within the central median strip along a 600 m length of Foreshore Road, under a bore licence from DIPNR. The specific well locations and the secondary pipeline route are shown on **Figure 5.7**, with the types and numbers of wells presented in **Table 5.4**.

Table 5.4 SCA groundwater extraction wells

Type of Wells	Number of Wells
Layer 1 Wells	27
Layer 2 Wells	14

The design of the extraction and monitoring wells would be similar to that described for the PCA above, except that the well head arrangement would be located in a pit below the ground level, as shown in **Figure 5.4**. The pit would be accessible via a steel cover, at the same height as the existing ground level, designed to safely absorb the weight of vehicle movements on top of it and to avoid presenting any form of hazard to traffic movements on Foreshore Road.

As with the PCA, the extraction rates for the groundwater wells have been developed through hydrogeological modelling work based on compliance with water level, hydraulic gradient and pumping constraints. The total pumping rates and estimated extraction rates are presented in **Table 5.5**.

Table 5.5 SCA extraction rates

Type of Wells	Number of Wells	Total Pumping Rate	Total Monthly Volume
Layer 1 Wells	27	4.86 L/s	12,780 kL/month
Layer 2 Wells	14	23.6 L/s	62,050 kL/month

The works associated with the installation and interim operation of the SCA wells were assessed in a separate environmental impact assessment, titled the *Environmental Impact Assessment Document for Botany Groundwater Remediation Project – Phase 4 Hydraulic Containment – Secondary Containment Area* prepared by Orica in August 2004, as part of the approvals process for the wells. This assessment concluded that the works were not likely to significantly affect the environment.

The works associated with the operation of the SCA extraction wells for the Activity have been considered and assessed in this EIS.

Secondary Pipeline

The secondary pipeline is a 150 mm diameter pipe designed to connect the groundwater extraction wells in the median strip of Foreshore Road to the GTP. The southern section of the pipeline (between Foreshore Road and BIP) has already been installed, and currently connects to the primary pipeline on Southlands Block 2. This section is being used as part of interim containment measures to transfer low volumes of groundwater extracted from existing wells to the SSU, prior to the commissioning of the GTP. The northern section of the pipeline on the BIP is yet to be installed. This will be approved and constructed separately from the Activity.

The secondary pipeline from Foreshore Road to the GTP is shown in **Figure 5.7**. The installation comprises two distinct sections:

- Underground section: The pipeline has been underbored to a maximum depth of 15 m below ground level, between the extraction wells on Foreshore Road and Southlands Block 2. The route runs south under the westbound lane of Foreshore Road, and then north under both lanes (the ‘u-turn’ is required to achieve the necessary depths under Foreshore Road). The pipeline then runs north beneath Botany Golf Course and Botany Road adjacent to Floodvale Drain, under McPherson Street and onto Southlands.

- Aboveground section: The pipeline has been installed on the pipe rack constructed for the primary pipeline, and follows the same route across Southlands Block 2, beneath the EnergyAustralia and RailCorp land to the GTP.

The pipeline has a capacity of at least 2.45 ML/day, and has been designed to operate 24 hours a day, seven days a week. The operation of the groundwater transfer process and emergency control/management is described in **Section 5.8**.

Specific details of the design integrity and risk minimisation parameters of the secondary pipeline are as described for the primary pipeline, above. The pipe to Foreshore Road from the PCA has similar double containment and detection to the railway underbore to that described for the PCA line. In addition, the pipe under the median strip of Foreshore Road has a separate collection point for leakage with automatic detection.

The works associated with the construction and interim operation of the secondary pipeline were assessed in a separate environmental impact assessment, titled the *Environmental Impact Assessment Document for Botany Groundwater Remediation Project – Phase 4 Hydraulic Containment – Secondary Containment Area* prepared by Orica in August 2004, as part of the approvals process for the wells. This assessment concluded that there would be no significant impacts associated with the works.

The works associated with the operation of the secondary pipeline for the Activity have been considered and assessed in this EIS.

5.3.3 DNAPL Containment Line

As shown in **Figure 1.3**, the DNAPL containment line would be located along and parallel to the western boundary of the BIP, hydraulically up-gradient from the PCA. Containment Lines 5 and 6 are designed for the hydraulic containment of a number of identified DNAPL source areas on the BIP. Containment of inferred DNAPL source areas on Southlands would be achieved by the PCA.

Groundwater Wells

Groundwater wells are to be installed in a number of lines along and parallel to the BIP boundary, under a bore licence from DIPNR. The specific well locations and the DNAPL pipeline route are shown in **Figure 5.8**, with the types and numbers of wells presented in **Table 5.6**.

Table 5.6 DNAPL area groundwater extraction wells

Type of Wells	Number of Wells
Layer 1 Extraction Wells	23
Layer 2 Extraction Wells	37

The design of the extraction and monitoring wells and the connecting pipework will be similar to that described for the PCA.

As with the PCA and SCA, the extraction rates for the groundwater wells have been developed through hydrogeological modelling work based on compliance with water level, hydraulic gradient and pumping constraints. The total pumping rates and estimated monthly volumes are presented in **Table 5.7**.

Table 5.7 DNAPL extraction rates

Type of Wells	Number of Wells	Total Pumping Rate	Total Monthly Volume
Layer 1 Extraction Wells	23	12.4 L/s	32,600 kL/month
Layer 2 Extraction Wells	37	93.8 L/s	246,000 kL/month

The works associated with the operation of the DNAPL line extraction wells for the Activity have been considered and assessed in this EIS.

DNAPL Pipeline

The DNAPL pipeline is designed to connect the groundwater extraction wells along and parallel to the western boundary of the BIP. The pipeline route would follow the containment lines along the western boundary, installed on a new pipe rack, before connecting into an existing pipe rack to connect to the GTP, as shown in **Figure 5.8**.

The pipeline will have a capacity of at least 9.17 ML/day, and will be designed to operate 24 hours a day, seven days a week. The operation of the groundwater transfer process and emergency control/management is described in **Section 5.8**.

Specific details of the design integrity and risk minimisation parameters of the DNAPL pipeline are as described for the primary pipeline, above.

The works associated with the operation of the DNAPL pipeline for the Activity have been considered and assessed in this EIS.

5.3.4 Storage of Recovered Waste EDC Liquid

One of the initial short-term measures presented in the GCP for hydraulic containment of the contaminants in the groundwater was the recommissioning of the SSU on the BIP, to process extracted groundwater and recover the waste EDC liquid for subsequent treatment/disposal.

The recovered waste EDC liquid will initially be stored in an existing tank adjacent to the SSU, before being transferred to Terminals Pty Ltd's existing bulk liquid storage facility at Port Botany. This facility is licensed by the EPA for *Chemical Storage – Storage of Petroleum and/or Petroleum Products > 5,000 – 100,000 kL of active storage capacity* (licence number 1048), and was designed to store dangerous goods including compounds such as EDC. The location of Terminals Pty Ltd's facility is shown in **Figure 5.9.**

These tanks are fully bunded to contain potential leaks, and are provided with a dedicated stainless steel truck loading line and pump capable of loading at approximately 600 to 700 L/min. The tank(s) used for storage are provided with nitrogen blanketing, with vapours directed to the facility's existing vapour emission control plant, which consists of activated carbon beds to adsorb organic compounds and prevent emission to the atmosphere, as per the existing licence for operation with the NSW EPA.

These premises have previously been used for the storage of EDC, and include tanker facilities. Orica has inspected these premises and conducted a HAZOP of the unloading facility, attended by Terminals Pty Ltd and Orica personnel, to verify the safety, environmental and operational performance of the facility.

It is estimated that about 500 tonnes of recovered waste EDC liquid will be transported from the SSU and stored at Terminals Pty Ltd's bulk liquid storage facility as part of the approved interim containment measures.

Once the GTP is commissioned, the SSU would cease operation. The recovered waste EDC liquid would be transferred to the GTP's dedicated isotainer, which would have a capacity of 20 m^3, and injected directly into the thermal oxidiser for destruction along with the air stream from the air strippers in the GTP. The recovered material would be injected over a period of time, once the contaminant concentration in the groundwater had begun to fall, so that the load on the thermal oxidiser would remain within the design limits.

5.3.5 Discharge Pipeline

An existing underground pipeline, installed in the 1960s, connects the storage tanks located at the southern end of the BIP with the bulk liquids storage facility at Port Botany, crossing Bunnerong Canal alongside Bumborah Point Road. This pipeline was previously used (until around 2002) to transfer caustic soda between the storage facility and the tanks on the BIP. The route of this pipeline is shown on **Figure 5.10**.

This pipeline would be used to transport the excess treated groundwater from the GTP that cannot currently be reused under the agreements with process users on the BIP or by other potential users, along with the salty wastewater from the Reverse Osmosis unit, to the point of discharge into Bunnerong Canal. The pipeline has a total hydraulic capacity of 12 ML/day.

The pipeline would be refurbished before use, by relining with a resin liner to minimise corrosion over the project time frame. A diffuser would be installed at a discharge point at Bunnerong Canal, to regulate discharge into the canal.

The works associated with the refurbishment of the pipeline are not part of the Activity and will be separately assessed, approved and constructed. The construction of the discharge point and the operation of the pipeline are part of the Activity and have been considered and assessed in this EIS.

5.4 Overview of Groundwater Treatment Plant

5.4.1 The GTP Site

The GTP site is located on Orica-owned land within the BIP, as shown on **Figure 1.2**. It was previously the site of the Silicates Plant, a manufacturing facility that ceased operations and was partly demolished (to grade) in 2000.

Subsequently, the northern end of the site was levelled and surfaced with asphalt, and it is currently used as a tanker parking area. The southern end has not been redeveloped, and comprises a mix of building rubble and foundations.

The locations of the GTP and relevant BIP infrastructure are shown in **Figure 5.11**. The relevant infrastructure includes:

- internal roads (10th Avenue and 2nd Street) providing access to two sides of the GTP, with existing parking on the GTP site; and
- an existing pipe rack across the southern end of the site, on which the transfer pipes would be installed to access the GTP.

5.4.2 GTP Layout

The proposed layout of the GTP is shown on **Figure 5.12**. It consists of four principal process areas:

- the Materials Storage Area at the southern end of the site, adjacent to the pipe rack, with the contaminated groundwater feed tank and hydrochloric acid tank in a bunded area, the treated water tank, and the bunded isotainer parking area;
- the Gas Operations Area in the north-eastern section of the site, with the bank of air strippers towards the south, and the off-gas treatment (thermal oxidation, acid recovery and caustic scrubbing) and discharge stack towards the north;
- the Water Treatment Area on the western side of the site, with the iron removal, organics polishing, organic acid and ammonia removal, dissolved solids removal processes and wastewater storage tanks in a bunded area; and
- a dedicated Control/Amenities Building located on the northern part of the site. This would include staff amenities such as toilet and washroom facilities and locker/change rooms.

The relative locations and connections between these areas are shown in the 3D visual simulation of the GTP in **Figure 5.13**.

5.4.3 GTP Site Access

External road access would be via Gate 3 located on Denison Street, as shown in **Figure 5.11**. Denison Street is a sealed four-lane road that is extensively used by industrial traffic.

Gate 3 is the main access point to the BIP and has a security office staffed 24 hours a day, as well as weighbridges and a boom gate to control traffic in and out of the BIP. The proposed site for the GTP would be accessed via existing internal roads, which are managed by the BIP. No new roads or access points are required for the BGC Project.

5.4.4 GTP Operation

The GTP has been designed for continuous operation, treating up to 15 ML/day of groundwater, 24 hours a day, seven days a week, with a 95% availability for a period of up to 30 years. As an integrated project, all elements of the BGC Project would operate on the same basis, with groundwater pumps continuously pumping the groundwater to achieve the hydraulic containment, and the GTP treating the groundwater for distribution and reuse.

In addition, the recovered waste EDC liquid from the SSU would be transported by tanker truck from the storage tank at Terminals Pty Ltd's bulk liquid storage facility to the GTP for treatment. It is estimated that a 20 m^3 isotainer load would be transported to the site at regular intervals, so that all the stored material would be treated within two to three years.

Other materials transported to and from the GTP site would include caustic soda, to be delivered to site from internal supplies within the BIP, and activated carbon for the organics polishing, to be delivered by external suppliers. Minor quantities of other materials, such as hydrochloric acid, sodium metabisulphite, flocculant, sodium hypochlorite and zeolite, would also be delivered to the GTP.

Spent activated carbon (if not regenerated) and dewatered solid waste would be removed periodically for disposal off site.

5.5 Groundwater Treatment Plant Process

5.5.1 Introduction

The proposed process to be used for treatment of the contaminated groundwater is shown in the block flow diagram in **Figure 5.14**.

The four key treatment process stages are:

- feed handling and air stripping;
- off-gas oxidation;

- stripped water treatment; and
- treated water reuse/discharge.

A detailed description of these stages of the GTP treatment process is given in the following sections.

5.5.2 Feed Handling

Contaminated Groundwater Feed Tank

Contaminated groundwater would be pumped at a total rate of up to 15 ML/day from the three containment areas and combined in the groundwater feed tank prior to treatment. The groundwater would mix within the tank to provide a homogenous feed into the GTP. The tank would also act as a buffer to ensure a constant feed forward flow.

Feed Treatment

Due to the iron content of the groundwater, the groundwater feed to the treatment plant would be dosed with hydrochloric acid (HCl) to reduce the pH level from between 4.5 and 6 to approximately 2.7. Reduction of the pH to a strongly acidic level would minimise the potential for precipitation of the iron content (the design pH level is above the solubility limits of iron oxides), and prevent biofouling (the design pH level is outside the range for biomass viability), thus minimising the potential for fouling of the air strippers.

The pH of the groundwater feed would be monitored, and automatic dosing of HCl undertaken to account for variation in groundwater composition.

The HCl would be stored in a tank of approximate capacity 40 m^3, adjacent to the groundwater feed tank, within a separate sealed concrete bund. The tank would be constructed of fibre reinforced plastic (FRP). The primary source of the HCl would be the acid absorption process in the off-gas treatment stream, as described below. In the event that the required quantity of HCl is not available from the GTP itself, HCl would be sourced from existing BIP production.

Recovered Waste EDC Liquid

The recovered waste EDC liquid from the SSU would be stored in a stand-alone isotainer on the back of the delivery truck, located within a separate bunded area. This bunded area would be roofed to minimise the inflow of rainwater to the bund.

The liquid would be injected directly into the thermal oxidiser for destruction, along with the air stream from the air strippers, at a rate up to 30 m^3 per month. As the concentration of groundwater contamination is expected to decrease over time (as discussed further in **Chapter 12**), the mass of contaminants treated in the thermal oxidiser would be reduced proportionately. As the contaminant load from the groundwater decreases, the recovered waste EDC liquid would be injected into the thermal oxidiser for treatment at a rate that maintains the operation of the thermal oxidiser within the original design specification.

5.5.3 Air Stripping

The air stripping stage is designed to remove the volatile organic compounds (VOCs) from the groundwater, and transfer them into the air stream (the off-gas stream), by blowing air through a falling column of groundwater. Air stripping takes advantage of the high volatility of the organic compounds within the groundwater to effect a rapid removal by employing a very large surface area in combination with a large volume of air flowing in the opposite direction ('counter-current') to the influent groundwater. The process maximises the volume of groundwater in contact with the air, so that VOCs are removed quickly.

The air strippers are very effective at removing VOCs from water, with efficiencies greater than 99%. The technology is relatively simple to operate and maintain, and is proven in many applications. The stripping equipment has been designed for easy cleaning, if necessary. However, given the pH control of the feed, the potential requirement for cleaning is expected to be minimal.

It is proposed to use low-height air strippers of modular design for the GTP, within which a number of multi-pass trays are packed into a compact chamber to maximise air–water contact while minimising space requirements. These units are approximately 2 m high, and would be installed as 20 parallel trains of two air strippers in series.

The groundwater would be pumped to the top stripper unit, and pass through the two strippers (one after the other) in direct contact with the air stream. Ambient air would be sucked into the bottom unit, and pass through the two strippers in direct contact with the groundwater stream.

The stripped groundwater is collected in a sump in the bottom of the stripper unit, from where it would be transferred to the stripped water treatment section of the process.

The off-gas from the strippers, now containing all the volatile organic compounds from the groundwater, would be transferred to the off-gas treatment section of the process.

The volume of off-gas produced is estimated to be around 51,000 m^3 per hour.

5.5.4 Off-Gas Treatment

Thermal Oxidiser

Thermal oxidation is the process of oxidising materials by raising the temperature of the material in the presence of oxygen, and maintaining it at a high temperature (1000°C) for sufficient time (2 seconds) to complete destruction of the contaminants to carbon dioxide and water (and HCl, where CHCs are present in the gas stream). Well designed and operated thermal oxidiser systems (such as the one proposed for the BGC Project) demonstrate 99.99% or greater destruction efficiencies.

The indicative reaction for EDC illustrates the oxidation reaction as follows:

$$2C_2H_4Cl_2\ (g) + 5O_2\ (g) \rightarrow 2H_2O\ (g) + 4CO_2\ (g) + 4HCl\ (g)$$

or

EDC + oxygen → water + carbon dioxide + hydrogen chloride

The anticipated operating temperature would be 1000°C, with an off-gas residence time within the thermal oxidiser of two seconds to achieve the required contaminant destruction and achieve best practice dioxin control. Natural gas would be used in the oxidiser to maintain the required operating temperature.

The typical process stages for the thermal oxidiser unit would comprise the following:

- Heat Exchanger: Off-gas from the air strippers would pass through a heat exchanger to raise its temperature by recovering heat from the gas leaving the oxidiser. This improves the energy efficiency of the process by recovering up to 50% of the heat, minimising the amount of support fuel required.

- Reaction Chamber: The temperature of the off-gas would be raised to oxidation temperature by using a burner fuelled by natural gas, and the organic compounds in the gas. The chamber would be designed to provide good mixing to maximise destruction of the contaminants.

- Waste Heat Boiler: The gas leaving the reaction chamber would initially be cooled by generating steam in a waste heat boiler. This would be followed by the heat exchanger to preheat the off-gas, as noted above.

- Quench: Following heat recovery, the treated off-gas temperature would be reduced very rapidly, from about 500°C to 100°C, by spraying weak acid through the gas stream. The weak acid would be obtained from the HCl recovery column. The rapid quench minimises potential 'de novo' synthesis (in which chemicals such as dioxins and furans can be formed following the destruction of CHCs in a thermal oxidiser) to meet the stringent international emission limits as discussed in **Chapter 22**.

- HCl Acid Recovery: After quenching, the gas would pass through a packed column in which weak acid is circulated. This would recover HCl from the gas for use in feed acidification. Process water would be added as make-up.

- Caustic Scrubber: Before the gas is discharged (see below), it would pass through a caustic scrubber to remove traces of hydrogen chloride (HCl) and chlorine (Cl_2).

Operation and control of the oxidiser would be managed through monitoring of various key operating parameters, linked to alarm and control actions to ensure that the tight emission specifications are met. These controls are presented in more detail in **Section 5.8**, and include:

- temperature control. Temperature is the key control parameter for the thermal oxidiser. Natural gas would be automatically added to the off-gas to maintain the required destruction temperature and hence destruction efficiency. Temperature increase or decrease in excess of specified limits would result in the thermal oxidiser, and hence the GTP, being shut down to stop extraction of contaminants into the off-gas;

- carbon monoxide (CO) control. CO concentration is a proven measure of the combustion efficiency within the thermal oxidiser, and would be continuously monitored to verify the effectiveness of the reaction process and thermal oxidiser operation.

Waste Heat Boiler

Demineralised water would be supplied from the existing demineralisation plant on the BIP. Steam would be raised by cooling the gas leaving the thermal oxidiser reaction chamber. The steam would be used to preheat the off-gas and for other process uses. The condensate would be recycled to the Waste Heat Boiler for reuse.

Quench

The liquid flows and temperature levels in and out of the quench scrubbing system would be continuously monitored to ensure that very rapid cooling through the specified temperature range was achieved. These would be monitored against conservative set points, and exceedances would result in alarms and shut-down of the thermal oxidiser, and hence the GTP, to avoid the potential for dioxin formation. This is achieved by avoiding ‘de novo’ synthesis, where chemicals such as dioxins and furans can be formed following the destruction of chlorinated hydrocarbons in a thermal oxidiser in the critical temperature range, 450°C to 250°C, particularly in the presence of some metals such as copper, which act as catalysts. These critical controls for preventing de novo synthesis (rapid cooling through the critical temperature range, and avoiding the presence of metal catalysts) will ensure that the strict emission limits are met.

Acid Gas Absorption/HCl Recovery

The off-gas from the quench system would then be passed forward to the acid absorber recovery system. As noted above, HCl is produced as a by-product of the oxidation process and would be recovered in an acid absorber unit. The acid absorber would consist of an absorption column filled with a packing material, designed to maximise contact between the gas stream and the circulating weak acid, maximising the efficiency of the absorption process. The off-gas would be passed into the bottom of the column and the circulating weak acid and make-up water into the top, and the HCl absorbed into the liquid flow as the two streams flow counter-currently within the column.

The water would be sourced from the treated groundwater supply (with a back-up of BIP process water) and recirculated within the column, absorbing HCl to form a weak HCl acid. Once a concentration of approximately 5% acid is achieved, the liquid would be bled off into the HCl acid storage tank, with a continuous top-up of water to maintain the flow of the absorption liquid.

Operating parameters would be monitored continuously, and in the event of a departure from normal operating conditions, the whole GTP would be shut down until the problem was isolated and repaired.

The recovered HCl acid transferred to the acid storage tank would be used in the feed handling process, as described above.

Caustic Scrubber

The off-gas stream from the acid absorber would then pass to the caustic scrubber system, which provides a final ‘polishing’ step to remove any remaining HCl and chlorine gas content. The scrubber would be a packed scrubbing column, operating counter-currently, with gas flow from bottom to top and the caustic scrubbing medium (caustic soda, or NaOH) flow from top to bottom.

The reaction between the caustic soda and HCl would result in salt and water:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

or

hydrogen chloride + caustic soda → sodium chloride (salt) and water

A reducing agent (sodium metabisulphite) would be added to the circulating caustic scrubbing solution to ensure that there was no free available chlorine in the scrubber effluent.

The sodium metabisulphite would be obtained in 1,000 kg bulk bags and dissolved into 2,000 kg of water in a 3 m^3 mixing tank. A 1.5 m^3 storage tank for the dissolved solution would be located adjacent to the scrubber unit, installed within a compliant bund. A batch of 33% sulphite solution would be prepared every 40 days to maintain the scrubber liquid for the required duty.

The caustic soda concentration would be automatically monitored and topped up with fresh caustic soda to maintain the scrubbing efficiency, with the effluent bled off and discharged to sewer via the BIP trade waste discharge, under the Trade Waste Agreement with Sydney Water Corporation.

Operating parameters such as flow and pH would be monitored continuously, and in the event of a departure from normal conditions, the whole GTP would be shut down until the problem was isolated and repaired.

The top of the absorption column would incorporate a mist eliminator, designed to retain liquid droplets and prevent carry-over in the discharge to the atmosphere.

Air Emissions

The treated off-gases would be discharged to the atmosphere via a single stack about 20 m above ground level, at a rate of around 78,000 m^3/hour and a temperature of approximately 67°C.

Emissions from the stack would be continuously monitored for HCl, CO, temperature, flow, total VOCs, EDC, VC, moisture content and oxygen.

These online analyses, in conjunction with other operating measurements (e.g. temperature) will ensure that the thermal oxidiser is operating within specification, achieving the required levels of destruction and, by inference, meeting specified emission limits (e.g. dioxins). This would be regularly validated through the manual sampling and analysis described below.

Quarterly manual sampling and analysis would be undertaken for oxides of nitrogen (NO_X), particulate matter (PM_{10}), sulphur dioxide (SO_2), hydrogen sulphide (H_2S), chlorine (Cl_2) and dioxin. Subsequent frequency of monitoring would be agreed with the EPA, dependent on the results.

All monitoring would be in accordance with NSW EPA approved methodologies, as specified in the EPA Guidelines *Approved methods for the sampling and analysis of air pollutants in NSW* (NSW EPA, 2001).

Further details and a full assessment of the emissions to air are presented in **Section 22**.

5.5.5 Stripped Water Treatment

Iron Removal

From the air strippers, the stripped water would be transferred to the iron removal process.

The first stage is pre-treatment, where caustic soda (at 46% concentration) would be added to the flow into the precipitation vessel to raise the pH to approximately 8, at which level the iron in solution precipitates. Mixing within the precipitation vessel ensures a consistent pH level, maximising the iron precipitation. To improve the settlability of the precipitate, a polymer and fine sand would be added.

Caustic soda would be stored in a 45 m^3 tank adjacent to the filter beds. The tank would be constructed of mild steel, installed in a sealed concrete bund equivalent to 110% of the capacity of the tank. The tank would be directly connected to the existing caustic soda supply system on the BIP, to maintain required volumes.

Within the proposed unit, a lamella filter would be used to continuously remove the iron precipitate. The internal plates in the lamella filter would cause the precipitate to concentrate for removal as a solution at 2% solids concentration. The water would then pass on to a series of filter beds to remove any fine precipitate. These filters would be backwashed periodically, with the solids collected with the iron precipitate (see below). The iron precipitate solution would pass through a cyclone to recover the fine sand, which would be recycled back into the filter unit. The solids removed from the fine sand would then be sent to the dewatering unit.

Organics Polishing

The filtered water would then pass to the organics polishing stage, comprising an activated carbon filter system with five sets of two beds installed in series.

The activated carbon system is designed to remove any organic compounds remaining in the stripped water (typically heavier, less volatile components such as phenols) by physical adsorption. It has extensive proven use for the removal of hydrocarbons in a range of applications.

Two beds would be used in series to ensure that there would be no ‘breakthrough’ of the organic compounds. That is, the second bed would catch any contaminants passing through if the first bed were reaching saturation. It is proposed to operate five beds in parallel, and to have a second group of five beds in series with these. This duplication means that while a bed is being recharged, the combined flow will still pass through two beds. This operation can be performed while the plant remains online.

The spent activated carbon would be sent to landfill as solid waste, based on the standards set out in Table A4 of the DEC Guidelines (2004) and the EPA’s *General Approval of the Immobilisation of Contaminants in Waste: Activated Carbon* (EPA, 1999).

The activated carbon would be changed before the concentration of contaminants within the carbon exceeded the requirements for regeneration or the thresholds for landfill disposal as solid waste (more detail is given in **Chapter 15**). The material would be tested and classified based on waste guidelines before being sent to landfill. It is anticipated that, based on the GTP design capacity, the process would generate up to 72 tonnes of waste activated carbon a year, requiring regular replacement of the same amount.

Reverse Osmosis

The full flow of the extracted groundwater—up to 15 ML/day—would be treated through the water treatment stages described above, designed to ensure that the final treated water quality meets the specified ANZECC (2000) Marine guidelines.

Around 10 ML/day of this treated water would undergo further treatment for reuse to remove the dissolved solids and produce a final water quality product that meets both Australian Drinking Water Guidelines and the process water standards on the BIP.

To achieve this quality, the water would pass through a reverse osmosis (RO) unit, within which the water stream is filtered under pressure through a porous membrane. The porosity of the membrane is sized so that only water molecules pass through the membrane and the dissolved solids are retained, resulting in a high quality water stream and a salty wastewater stream.

The RO units are of modular design, and space would be retained on the GTP site to allow for expansion of the RO treatment system to treat a greater quantity of water in future, in order to meet any potential additional demand for the treated water.

Ammonia and Organic Acid Removal

In order to meet the relevant ANZECC (2000) guidelines for marine discharge, the stripped water that does not pass through the RO unit, along with the salty wastewater stream from the RO unit, would need further treatment to remove the organic acids (e.g. acetic acid) and ammonia before discharge. The high levels of organic acids would lead to an excessively high Biological Oxygen Demand (BOD). A biological process is proposed for treatment of nitrogen and organic acids.

Removal would be achieved in a structured biological reactor, using a robust bacteria supported on a manufactured medium. The microbes would convert the organic acids and ammonia to carbon dioxide, nitrogen and water. When the GTP is offline, an alternative 'food' source for the microbes (e.g. purchased acetic acid or dilute aqueous ammonia) would be supplied with the unit in recycle mode, to maintain the viability of the microbes and ensure the quality of the groundwater discharge when the GTP is returned online. Regular backwashing of these units would remove the sludge generated, for disposal with the iron precipitate. This backwash would be sent to the dewatering stage.

Further polishing of the water would occur to ensure that the very tight ammonia specification is met, either by passing the water through a synthetic zeolite bed or using breakpoint chlorination.

The synthetic zeolite process captures the ammonia on a bed of synthetic zeolite. The bed would be regenerated before saturation, to produce a dilute ammonia stream that would either be sold or disposed of, in accordance with its classification. The synthetic zeolite bed would require occasional replacement. The bed would either be sent to the supplier for the manufacture of alternative products or disposed of as solid waste to landfill, based on waste classification guidelines (DEC, 2004).

Breakpoint chlorination uses a reaction between the ammonia and chlorine, supplied as sodium hypochlorite, to produce nitrogen gas.

Both approaches would meet the required discharge specifications, and the final selection will be based on robustness and other operational criteria.

Dewatered Solid Waste

The iron precipitate from the lamella filter would be combined with the backwash from the filter units and the sludge from the organic acid and ammonia removal unit. This combined flow would pass through an automated centrifuge to produce a dewatered solid waste (or 'cake') with an 18% solids concentration.

This cake would be collected in a skip for landfill disposal, in accord with DEC guidelines, as discussed in **Chapter 15**.

The water from the centrifuge would be recycled back into the water treatment unit.

Treated Groundwater Reuse on BIP

As part of the development of the BGC Project, Orica investigated the options available to maximise reuse of the treated groundwater, based on proximity of demand and available infrastructure, and balancing the significant capital and operating cost of treatment and distribution with the sustainability and environmental benefits of reuse.

As a result of these investigations, Orica has reached agreements with process operators on the BIP for groundwater reuse, and is currently proposing to install sufficient RO capacity and a treated water distribution network for up to 7.5 ML/day. This would replace existing supply from the Sydney Water townswater system, reducing the current level of demand from the BIP.

The treated water would be distributed to the various users through a dedicated distribution pipeline network which would be approved and constructed separately to the Activity, as shown on **Figure 1.3**. The proposed users and their normal process demands are presented in **Table 5.8.** While the average is 6.24 ML/day, 7.5 ML/day will be available to cover peak demand. A treated water storage tank will be used to buffer most fluctuations in demand.

Table 5.8 Treated Water Users on BIP

User	Purpose	Typical Treated Groundwater Usage (ML/day)
Orica Chlorine	Cooling Tower Make Up	0.48
Qenos Alkatuff	Cooling Tower Make Up	0.48
Qenos Utilities	Demineralisation Plant Feed	2.4
Qenos Olefines	Cooling Tower Make Up	2.4
Qenos Olefines (E-1000 Column)	Cooling Tower Make Up	0.48
TOTAL		**6.24**

In the event that the process plants on the BIP cannot use the treated water, for example during process upset or shutdown, the unused water would be diverted to the discharge pipeline (as described below). The total capacity of the discharge pipeline is 12 ML/day, so in the unlikely event that all process operators were not operating at the same time (e.g. site wide maintenance), the full discharge capacity of the pipeline would be utilised, with an excess of 3 ML/day to be managed.

If this scenario were to occur, the groundwater extraction rate would have to be reduced accordingly to reduce the flow to the GTP to 12 ML/day, to achieve a water flow balance. This scenario is very unlikely, and may only occur once every seven years, for up to three weeks. The short-term nature would not affect the hydraulic containment of the contaminated groundwater.

Additional Reuse

Orica will continue to investigate potential options to maximise reuse of the treated groundwater. Although the process users on the BIP can only reuse 7.5ML/d of treated water, Orica will try to identify other consumers in the Botany area who could use the treated water. If a demand is identified, Orica will treat additional water through an expanded RO unit and supply this to customers, in order to reduce demand on Sydney's water supply. This additional reuse would reduce the amount of water to be discharged to Botany Bay, as described below.

Marine Discharge

The 5 ML/day of treated groundwater discharged from the activated carbon filters (that did not pass through the RO unit) would be combined with the 2.5 ML/day of salty wastewater (from the RO unit). This 7.5 ML/day would then pass through the ammonia and organic acid removal unit, before discharge via the refurbished discharge pipeline to Bunnerong Canal, and hence to Brotherson Dock and Botany Bay.

The discharge pipeline route and discharge point are shown on **Figure 5.10.** The water quality parameters of the discharge are discussed in **Chapter 13**.

The quality of the water discharge would be monitored continuously for pH and other parameters as required, to indicate compliance with discharge specifications. Continuous monitoring would be supplemented by regular grab samples and analysis of key performance indicators.

A flow diffuser would be installed in Bunnerong Canal to reduce the energy of the discharge and minimise the potential for disturbance of the sediment in the canal.

5.6 Materials Storage and Handling

All materials—raw materials, chemicals or wastes—used or generated during operation would be stored at the GTP site. There would be no storage of such materials at any other area.

Contaminated Groundwater

The contaminated groundwater would be continuously extracted from the three containment lines, and transferred to the GTP on the BIP. The three streams would be combined in the groundwater feed tank to form an homogenous groundwater mixture before treatment. The full specification of the contaminated groundwater is presented in **Appendix L**, based on the extensive groundwater investigation and monitoring works that have been undertaken to characterise the contaminant plumes since 1996. The main components and predicted composition of the groundwater feed are presented in **Table 5.9**.

Table 5.9 Concentrations of principal components in groundwater

Common Name(s)	Chemical Formula	Predicted Conc. (mg/L)
Organic Compounds		
1,2 dichloroethane (EDC)	$C_2H_4CL_2$	169.3
Carbon tetrachloride	CCl_4	15.8
Tetrachloroethylene (PCE)	C_2Cl_4	13.6
Trichloroethylene (TCE)	$C_2H_2Cl_2$	7.2
Vinyl Chloride (VC)	C_2H_3Cl	6.0
Chloroform	$CHCl_3$ 3	5.0
Benzene	C_6H_6	1.2
Other chlorinated hydrocarbons (VOCs)	C_1C_2Cl	< 6.0
Other chlorinated hydrocarbons (non-VOCs)	C6x-Clx, C6x-Ohx	< 15.0
Non-Organic Compounds		
PH		4.5 – 6
Sodium	Na^+	395.9
Potassium	K^+	9.4
Calcium	Ca^{2+}	50.3
Magnesium	Mg^{2+}	16.6
Chloride	Cl^-	617.0
Sulphate	SO_4^{2-}	184.2
Sulphide	S^{2-}	5.5
Alkalinity as $CaCO_3$	as $CaCO_3$	57.3
Reactive Silica	Si	10.2
Total Hardness as $CaCO_3$	as $CaCO_3$	194.0
Iron	Fe	13.5
Ammonia as N		10.6
Biochemical Oxygen Demand	BOD	72
Suspended Solids		0.5
Organic Acids		
Acetic Acid		45.6
Butyric Acid		10.4
Hexanoic Acid		5.4

The approximate feed tank dimensions would be 9 m in height with a diameter of 7.5 m, and a total design capacity of approximately 400 m^3. The feed tank would be constructed of duplex stainless steel to prevent corrosion. As shown on **Figure 5.12**, the tank would be installed within a sealed concrete bund of minimum 110% capacity of the tank, designed to meet the requirements of AS 1940 (1993): The Storage and Handling of Flammable and Combustible Liquids.

The tank would be fitted with a 'nitrogen gas blanket' system to reduce the potential formation of flammable vapours within the tank. The nitrogen system would be maintained from the nitrogen supply on the BIP site, and the gas vented to the thermal oxidiser to ensure destruction of any organic vapours. The system would be designed to normally contain all its vapour in the headspace of the tank and the pipework if the GTP is offline. Under extreme conditions, where the feed tank may be subject to a large temperature change, some vapour may be discharged to a separate activated carbon vapour collection system. The activated carbon would be replaced as required, and the spent carbon sent for either regeneration or approved disposal.

The whole extraction and transfer system would be designed to be a 'sealed' system, operating under a central PLC for the overall Activity, to avoid handling of the contaminated groundwater by site operators at any stage.

Recovered Waste EDC Liquid from the SSU

The recovered waste EDC liquid produced in the SSU and temporarily stored in Terminals Pty Ltd's bulk liquid storage facility would be transferred by isotainer to the GTP for treatment. The isotainer, with a capacity of 20 m^3, would be filled from the storage tank by the existing loading facility and transferred to the GTP by truck. The isotainer would be parked in a specific parking bay, roofed and bunded to provide full containment of any spills or leaks. The isotainer would be connected to the GTP for treatment directly within the thermal oxidiser.

As the concentration of groundwater contamination is expected to decrease over time, the associated contaminant load from the groundwater destroyed in the thermal oxidiser would also decrease accordingly. The recovered waste EDC liquid would be injected into the thermal oxidiser as the groundwater contaminant load reduces, to maintain the operation of the unit within the original design specifications. Once all the recovered waste EDC liquid had been disposed, the thermal oxidiser would revert to treating the lower concentration from the groundwater. The thermal oxidiser has been designed to operate within specification for these lower concentrations. The typical specification of the recovered CHC stream produced in the SSU is presented in **Table 5.10**.

Table 5.10 Specification of recovered stream from SSU

Substance	Percentage by Mass (%)
H_2O (water)	0.26
1-2 dichloroethane (EDC)	95.13
Vinyl Chloride (VC)	1.56
Trans 1,2 Dichloroethylene	2.37
1,1,2 Trichloroethane	0.23
1,1,2,2 Tetrachloroethane	0.10
Benzene	0.12
Chloroform	0.22

5.6.1 Process Chemicals

The types and quantities of chemicals to be used and stored at the GTP are listed in **Table 5.11.**

These process chemicals would be stored on site in designated chemical storage facilities, which would be constructed and bunded in compliance with:

- Australian Standard AS 1940 (1993): The Storage and Handling of Flammable and Combustible Liquids;
- Australian Standard AS 4452 (1997): The Storage and Handling of Toxic Substances;
- Australian Standard AS 3780 (1994): The Storage and Handling of Corrosive Substances; and
- the *Dangerous Goods Act* 1975 and associated Regulations.

Table 5.11 Process chemicals used in the GTP

Process Chemical	Use	Annual Consumption (tonnes)	Storage Capacity (tonnes)	Type of Storage
Caustic Soda (NaOH) –from BIP supply	Scrubber liquor to neutralise hydrogen chloride gas evolved in the thermal oxidiser Raise pH to precipitate iron in the water treatment stages	3650	45	Steel storage tanks
Hydrochloric Acid (HCl) – either recovered in acid absorber or supplied from BIP supply	Acidify groundwater feed to maintain iron in solution	876	40	Fibre glass tank
Activated Carbon	Adsorption medium to remove organics and other contaminants in water treatment system	72	-	Used directly in adsorption beds.
Polymer Flocculant	Coagulant for precipitated iron in water treatment system	5.5	6	Fibre glass tank
Sodium Metabisulphite	Reducing agent used in Caustic Scrubber	18	4.5	Fibre glass tank
Fine Sand	Precipitation aid	1	1	Fabricated steel addition vessel
Zeolite (i)	Ammonia polishing	30	-	Used directly in adsorption beds
Sodium Hypochlorite (ii)	Ammonia removal	22	7	Fibre glass tank

Notes:

(i) Zeolite use is one option for ammonia removal by adsorption, following biological treatment.

(ii) Sodium hypochlorite is an alternative option for ammonia removal by breakpoint chlorination, following biological treatment.

Material storage quantities are based on the 15 ML/day design capacity of the GTP.

5.6.2 Process Wastes

The type, quantities and disposal routes for the process wastes generated in the GTP are listed in **Table 5.12.**

Under normal operation, these process wastes would be disposed of directly, with no intermediate storage on site. Full details of the waste management and disposal routes are presented in **Chapters 13 and 15**.

Table 5.12 Process wastes generated in the GTP

Process Waste	Source	Annual Generation	Disposal Route
Spent Caustic Soda	Caustic scrubber in gas treatment system – liquid waste following reaction with hydrogen chloride gas evolved in the thermal oxidiser	Acid recovery 11,300 m^3	Discharge to sewer under trade waste agreement
Dewatered Solid Waste	Centrifuge to remove water from iron precipitate, filter backwash and organic acid and ammonia removal sludge.	1900 tonnes (@18% solids)	Disposed to landfill in accordance with EPA waste classification guidelines
Weak Ammonia Stream	Regeneration of ammonia polishing zeolite	100 m^3 of 20% solution	Sale or discharge to sewer under trade waste agreement
Spent Zeolite	Ammonia polishing	30 tonnes	Disposed to landfill in accordance with EPA immobilisation guidelines or accepted by supplier for alternative use
Spent Activated Carbon	Activated carbon – solid waste of activated carbon and adsorbed contaminants	72 tonnes	Disposed to landfill in accordance with EPA immobilisation guidelines or regenerated if possible
Waste oils and greases	Maintenance of plant equipment	Minor	As per existing recycling/disposal systems on the BIP

Waste generation quantities are based on the 15 ML/day design capacity of the GTP.

5.7 Site Utilities and Ancillary Facilities

The Activity and other components of the BGC Project would largely use existing utilities and ancillary facilities at the BIP, with an additional electrical supply for the primary and secondary extraction pumps.

5.7.1 Water Usage

All water requirements for the GTP, such as water for the acid absorber and for backwash of the iron filters, would be sourced from the treated water produced by the plant. The treated water supply would be backed up with a connection to the existing water supply from Sydney Water to the BIP.

5.7.2 Energy Usage and Power Supply

Electrical power would be required for all elements of the overall BGC Project, with different sources and estimated consumption summarised in **Table 5.13**.

While the GTP would be supplied with power from existing supplies on the BIP, extraction pumps on Southlands and Foreshore Road are and will continue to be supplied from an existing Energy Australia substation at McPherson Street.

The power for the Foreshore Road pumps is and will continue to be fed via a step-up transformer on Southlands and underground cable to a step-down transformer located on land to the south of Foreshore Road. The step-down transformer then feeds power (via another underground cable) to the Foreshore Road pumps.

The installation has been approved by Energy Australia, and the transformer located to the south of Foreshore Road was approved by the NSW Maritime Authority and assessed in the *Review of Environmental Factors for Installation of a Transformer on Waterways Authority Land* prepared by Orica in August 2004.

Table 5.13 Electrical power requirements

Location	Use	Source	Annual Consumption
Primary Containment Area	Groundwater extraction pumps	Energy Australia Southlands	4,820 MWh
Secondary Containment Area	Groundwater extraction pumps	Energy Australia fed from Southlands	
DNAPL Line	Groundwater extraction pumps	Existing BIP power supply	
Groundwater Treatment Plant	Pumps, fans, instrumentation, lighting, control circuits	Existing BIP supply	20,150 MWh
Treated Water Distribution	Pumps located at GTP	Existing BIP supply	

Power consumption rates are based on the 15 ML/day design capacity of the GTP.

A battery backup system would supply instrumentation and control equipment in the event of total power failure. A power failure would lead to a controlled shutdown of the GTP.

5.7.3 Fuel Supply

Natural gas would be used to provide support fuel to the thermal oxidiser in the off-gas treatment system at a rate of up to 1400 kg/hour.

It is anticipated that a continuous natural gas supply would be required to maintain the operating temperature in the thermal oxidiser throughout the estimated 30 year operating life of the Activity. The natural gas would be sourced from the existing supply to the BIP, which is provided from the AGL pipeline supply located adjacent to the BIP.

5.7.4 Wastewater Treatment

The GTP would use the BIP's existing connection to the Sydney Water sewer main and monitoring station.

The discharge to sewer is licensed under a Trade Waste Agreement with Sydney Water, and this agreement would be renegotiated with Sydney Water to ensure that the proposed discharges were acceptable and would not impact on the sewer system.

Toilet and washing facilities would be installed within the Control Room/Amenities Building, and these would be connected to the separate BIP domestic sewer system for off-site discharge to the Sydney Water sewerage system.

5.7.5 Stormwater Management

The GTP would also be connected to the BIP stormwater drainage system, for control and discharge of stormwater via a dedicated first-flush tank.

The majority of the GTP site would be hard-surfaced (concrete slab and asphalt roads/parking), with stormwater drains discharging to the first-flush tank. The first-flush tank would be sized to contain the first 15 mm of rainfall across the site, to retain potential contamination from material spills or leaks. Once full, subsequent rainwater would discharge directly to the BIP stormwater drainage system, which discharges to Springvale Drain.

The total quantity of stormwater discharged to Springvale Drain from the BIP would not change significantly, because the proposed configuration of the plant does not constitute a major alteration to the total BIP site.

Similarly, the installation and operation of the other elements of the BGC Project would result in the same stormwater discharge as currently, because there would be no significant change to the existing paved surfaces or drainage layouts.

Once the storm had finished, the water contained in the first-flush system would be transferred to a holding tank for treatment, before being transferred to either the GTP feed tank or the GTP effluent system.

The bunded areas across the GTP site—the contaminated groundwater feed tank, caustic soda storage tanks and the acid storage tank—would be fitted with sumps. Stormwater collected in the bunds would similarly be transferred to the GTP feed tank for treatment.

The isotainer bund would be roofed, to minimise potential ingress of rainwater. Any water collected in the bund would be managed as described above.

The construction and operation of the groundwater wells and pipelines would not have a significant effect on stormwater drainage, and it is anticipated that current stormwater drainage would be maintained.

5.8 GTP Operation and Control

5.8.1 Overview

The GTP is intended to effectively achieve cleanup of the contaminated groundwater, based on a treatment process designed to minimise air emissions and generation of waste, according to ‘best practice’ design standards.

The GTP would be designed and constructed to be a robust and effective process, operating 24 hours a day, for up to 30 years. The technical design specification includes a 95% availability with a maximum maintenance shutdown period of a week, to ensure that containment of the groundwater movement and associated contaminant plumes is maintained. The groundwater modelling work has established a safety margin for shutdown of the groundwater pumping of at least two weeks without affecting the containment of the contaminant plumes.

The BGC Project—groundwater extraction, transfer, treatment in the GTP and discharge—would be operated as an integral process, with an automatic PLC system designed to operate and control the whole project to ensure that objectives are achieved, based on specific design parameters.

The control system would be located within a dedicated Control Room, and designed for automatic operation with minimal operator input. Operators based permanently at the GTP site would carry out regular inspections, and would be available to respond in the event of abnormal operation or plant upset.

The PLC for the project would be integrated into Orica’s existing operational management systems and monitored at the dedicated control room on the GTP site. In the event of an abnormal condition being detected the GTP would be shut down, isolating all feeds and stopping all discharges.

The extraction pumps would be fitted with variable speed drives and kickback valves, so that the extraction rates for the groundwater at each containment line could be varied depending on the variations in groundwater and contaminant plume conditions, as monitored through the installed monitoring wells.

The process flows and treatment processes within the GTP would be controlled to respond to varying process conditions based on monitoring of key parameters throughout the plant, to ensure that the final water quality and the emissions to air meet the specified standards.

Key monitoring parameters would include groundwater flows, pH levels, operation of air blowers for air stripping, temperature of the thermal oxidiser, quality of emissions to the atmosphere, and treated water quality and flow rates.

To avoid potential impacts at plant start-up and shutdown, the control method for the plant would comprise:

- Start-Up: Treated (or process) water would be recirculated through the GTP as the different process operations are initiated to reach normal operating conditions. Once all operations have achieved normal conditions, contaminated groundwater would be introduced into the GTP;

- Shut-Down: Flow of contaminated groundwater would be stopped, and the individual process operations shut down with treated (or process) water recirculated.

5.8.2 Emergency Shutdown

The GTP would be automatically controlled and monitored through the PLC system, with automatic emergency response to equipment failures and alarms. The primary response to abnormal operation, such as an upset in air stripper operation, would be emergency shutdown of the GTP. This would result in all groundwater feed stopping, resulting in no flow through the GTP, and hence no emissions to the atmosphere or discharges to Brotherson Dock.

Critical automatic protection responses would be performed by a separate, dedicated safety shutdown system meeting the requirements of IEC61511 and IEC61508 (International Electrotechnical Committee standards for Safety Instrumented Systems). These protective systems would be subject to regular proof testing, to maintain the required performance.

Key potential failure modes that would require emergency shutdown of the GTP are discussed below.

Thermal Oxidiser Temperature

As discussed previously, in **Section 5.5.4**, temperature is the key control parameter for the thermal oxidiser. The temperature would be maintained by monitoring against the set point of 1000°C, and adjusting the fuel gas flow accordingly.

Too high a temperature could lead to damage to the thermal oxidiser, and too low a temperature could lead to reduced destruction efficiency. The temperature monitoring would therefore incorporate high/low alarms at 1050°C and 850°C, with full shutdown of the thermal oxidiser initiated if the temperature reaches 1100°C or 800°C.

Dioxin Formation

Correct operation of the gas cooling train is essential to ensure best practice dioxin minimisation is maintained. Temperatures would be measured through the gas cooling train, to ensure that the gas enters the quench system at temperatures higher than 450°C, and exits at temperatures lower than 100°C. If temperatures deviate beyond the operational range, a complete GTP shutdown would be initiated.

Combustion Efficiency

Poor combustion due to maloperation of the thermal oxidiser can result in the emission of excess carbon monoxide (CO) from the unit and poor destruction efficiency. The thermal oxidiser would be regularly maintained in line with manufacturer's requirements to maintain efficient combustion of off-gas.

As CO is representative of combustion efficiency, continuous CO monitoring would be undertaken of the emissions to air to monitor the efficient operation of the oxidiser. Alarm points would be set against appropriate CO concentrations, to be followed by full shutdown of the GTP.

Acid Absorber/Caustic Scrubber Operation

Failures of the HCl absorber could lead to a greater HCl load being placed on the caustic scrubber, with potential for an HCl and/or chlorine release from the caustic scrubber. Loss of performance could be due loss of circulation and loss of inventory (make-up). Alarms and trips would be installed to protect against these failures.

Failure of the caustic scrubbing column could lead to a release of HCl and chlorine. Performance failure could be due to loss of circulation, failure of efficient contact due to a problem with the packing, or loss of available caustic soda in the scrubber. Such failure would be detected through low circulation flow, a drop in pressure across the column and by using an Oxidation Reduction Potential (ORP) meter to check caustic soda strength. Failure detection would initiate a shutdown of the GTP.

Continuous HCl monitoring of the emissions to air would be undertaken to further monitor the effective operation of the absorber and scrubber, with alarm points set against an appropriate set point concentration, to be followed by full shutdown of the GTP.

Treated Water Quality

The quality of the treated water would be monitored to prevent the discharge of water that does not meet discharge criteria. If a treated water quality failure were detected, the water system would automatically go into recycle mode, so that product water is fed into the feed tank, and no fresh groundwater is admitted into the system.

Protection against failure of these systems would be carried out by:

- measuring correct air and water flows and temperatures in the air stripping system; and
- checking for correct pH adjustment and flows of caustic soda and flocculant in the iron removal stage, conductivity of the RO unit permeate and other parameters as discussed in **Chapter 13**.

These automatic systems would be supplemented by regular laboratory analysis of key performance indicators, including nutrient and CHC levels in the discharge to Brotherson Dock.

5.8.3 Emergency Management Systems

Emergency Response Plan

An emergency response plan (ERP) would be prepared for the Activity and other components of the BGC Project—covering the activities across the project area, including the groundwater extraction wells and transfer pipelines, the treatment plant and the discharge—to address both the construction and operational phases of the proposed development. This ERP would outline procedures to be followed in the event of an emergency, such as emergency containment and cleanup procedures for the accidental release of contaminated groundwater into the environment.

The ERP would be approved by relevant agencies, including the EPA and the NSW Fire Brigade, and then incorporated into the existing emergency response procedures for Orica's operations on the BIP. The major hazards associated with the proposed facility are described in **Chapter 23**. An employee would be appointed as Emergency Coordinator, and would be responsible for managing the response to the emergency and for deciding if the emergency is of site or local significance. The ERP would detail measures for both site and local evacuation procedures. A copy of the ERP would be issued to the local Fire Brigade for their information, whilst the Local Emergency Management Committee would be kept informed about the ERP and its approval by the NSW Fire Brigade.

A testing and review program would be implemented for these procedures. All emergency response procedures would be revised and adapted as new industry standards for fire protection are established.

All relevant personnel would be required to attend a GTP induction and training course before they were involved in monitoring or working at the GTP.

Fire Protection

A comprehensive alarm system, monitored from the Orica control room and the BIP security centre, would be installed throughout the GTP. Fire hoses and bunding would be provided.

Specific fire protection measures include nitrogen blanketing of the groundwater feed tank, to prevent flammable vapours, and appropriate electrical instrument systems for identified hazardous areas.

In addition, an emergency vehicle and crew are on constant standby at the BIP, ready to deal with any incident. The specially equipped emergency vehicle can spray water or foam from three hoses on either side. Regular training sessions are held to test the operational readiness of the fire fighting equipment. In addition, about 14 million litres of water are held in storage tanks for fire protection.

Personnel would be trained in fire fighting procedures, and fire fighting equipment locations would be clearly marked.

5.8.4 Security

The GTP would be located within the Orica BIP. Existing security procedures/operations include:

- a boomgate at the entrance to the BIP;

- 24 hour security located in the gatehouse at the entrance to the BIP; and
- a 2.4 m fence surrounding the entire BIP.

Closed circuit TV located in the Control Room would be used to monitor the access areas around the GTP.

The groundwater extraction wells on the primary containment line are situated on Orica's Southlands site, which is fenced, with a locked gate, and subject to regular security patrols.

The wells on the secondary containment line are located in the median strip of Foreshore Road. The wells are at the same height as the ground surface and are fitted with Gattic covers for security.

All pipework off site from the BIP or Southlands is buried underground.

5.9 Construction

5.9.1 GTP Construction

GTP Construction Timing

The GTP has a target construction completion date of August 2005, to meet the deadlines required by the NCUA. The key project construction milestones required to meet this target completion date are summarised in **Table 5.14**, and are subject to approvals being obtained prior to construction.

Table 5.14 Construction timing

Timing	Activity
February– April 2005	Final site preparation, civil foundations and structural steel works
May–August 2005	Equipment, piping, instrumentation and electrical works
August–October 2005	Plant commissioning and operation

The detailed design will be in full compliance with the Building Code of Australia and all other relevant Australian Standards.

Construction Stages

Prior to construction of the GTP, completion of the demolition of the old Silicates Plant would be undertaken to remove heavy concrete. This would either be crushed on site and used as fill, or disposed of to landfill or to a concrete recycler. Minor earthworks would also be conducted to reduce the site ground level by approximately one metre, to create a single level platform for most of the facilities required for the GTP.

The key construction stages of the GTP would involve conventional techniques, as follows:

- **Site Drainage**: Site drainage lines would be laid to carry stormwater via a first-flush system into the established site storm water system.
- **Concrete Work**: Concrete would be imported for use on the GTP site through concrete transit mixers from the nearest batch plant, to provide materials for the concrete work required:
  - first-flush pit(s)
  - site drainage pits
  - equipment slabs
  - tank slabs and bund walls
  - infill slabs (areas between equipment slabs)
  - roads and pathways.
- **Structural Steelwork**: Steelwork would be fabricated off-site and imported to site for use by truck, for:
  - pipe racking
  - stripper structure
  - awning over part of the water processing equipment.
- **Buildings**: A Control Room, Amenities Building and an electrical switch room would be constructed on site to service the plant.
- **Equipment and Plant Installation**: Tank construction/erection, equipment installation, electrical, and pipework would run concurrently.

Construction Equipment

The major vehicles involved in construction would be 35 to 50 tonne crane(s) required to load and unload equipment and for steel erection, and an occasional large crane brought in specifically for one-off heavy lifts.

In addition, trucks would deliver concrete and steelwork, as required.

Construction Staffing

Before starting construction of the GTP, Orica would have a small workforce employed to undertake the final demolition and minor earthworks at the site.

The estimated workforce—a combination of project design, management and construction staff— likely to be required throughout the construction phase is presented in **Table 5.15**.

Table 5.15 GTP construction workforce 2005

Month	1	2	3	4	5	6	7	8	9
Site Labour Force	20	30	45	65	80	95	95	20	15
Design & Mgmt. Team	8	13	20	20	20	20	20	9	9
Total	28	43	65	85	100	115	115	29	24

Access

All construction deliveries, equipment and construction staff would enter the BIP from Denison Street through Gate 3 to access the GTP site.

Construction Hours

The EPA generally recommends the following periods for construction activity:

- between 7.00 am and 6.00 pm from Monday to Friday;
- between 7.00 am and 1.00 pm on Saturday, if inaudible at residential premises, or between 8.00 am and 1.00 pm; and
- at no time on Sundays or public holidays. (Chapter 171 of the EPA *Noise Control Manual*, 1985).

Subject to time constraints on the project and weather contingencies, there may be a requirement to conduct some construction activities outside normal EPA recommended hours. Such works may typically involve fit-out of buildings, installation of wiring and painting that, in themselves, do not generate audible noise outside the BIP boundary.

The regulatory authorities and affected stakeholders would be consulted before such work began.

5.9.2 Discharge Line Refurbishment

Refurbishment Timing

The discharge line refurbishment would be carried out within the overall construction time frame of the GTP.

Refurbishment is expected to take approximately six months (subject to approvals), with the timing of the key stages summarised in **Table 5.16**.

Table 5.16 Construction timing

Timing	Activity
January 2005	Pipe cleaning
February–June 2005	Access and lining
June 2005	Diffuser installation and hydrotesting

Construction Stages

The key stages of the work involved in the refurbishment would involve standard construction activities, as follows:

- **Removal of caustic soda**: The discharge line was previously used to transfer caustic soda, and is connected to existing tanks both on the BIP and on Terminals Pty Ltd's Port Botany site. Hot water (60–70°C) would be used to flush through the pipeline to empty the existing caustic soda content and any other contaminants (e.g. residual mercury) into a bunded 3,000 tonne tank on the BIP. The pipeline would then be 'pigged' as a final cleaning stage (a process similar to pushing a piston through the pipe). The waste caustic soda would be treated in the storage tank and discharged over time to sewer, in accordance with the Trade Waste Agreement with Sydney Water.

- **Pipeline lining**: Excavation of the ground would be undertaken at each major pipe elbow, located as shown in **Figure 5.10**, to provide access to the key points of the underground pipeline. Two elbows would be open at any one time, and the elbows cut off for access to the pipe. A vinyl ester resin liner, in the form of a 'sleeve', would then be pulled through each section of straight pipe between the elbows. Compressed air would be used to push the sleeve onto the side of the pipeline, and the lining cured and sealed using an infrared heat source on a robotic unit. Once completed, one pipeline elbow would be rebuilt with fibreglass, to restore the pipeline, and the excavated area refilled. All excavated material would be replaced, leaving no excess for disposal. The next elbow would then be excavated and the process repeated. It is estimated that each section would take two to three weeks to complete.

- **Completion**: The elbow currently connecting the pipeline to the tanks on the BIP would be cut off, and a new connection to the new pipeline from the GTP installed.

- **Discharge point**: The pipeline crossing Bunnerong Canal would be cut at both ends, with the unused (southern) end flanged and blanked off with a nitrogen blanket. The northern end would similarly be flanged, and the diffuser structure attached, installed on concrete 'stools' located on the concrete base of the canal.

- **Integrity testing**: The refurbished pipeline would be integrity tested by hydrotesting, carried out for the entire pipeline length as a single segment. During hydrotesting, the pipeline would be loaded with water, pumped at a higher pressure than the normal operating pressure of the pipeline, and assessed for any pressure loss. This pressure would be held for a period of eight to 10 hours.

Construction Staffing

It is anticipated that a single crew of up to 10 workers would work through each construction stage in sequence.

Access

Access to specific locations for the construction activities would be with the full agreement of relevant landowners and authorities (e.g. Sydney Ports Corporation and NSW Maritime Authority for works in Bunnerong Canal).

Construction Equipment

The work activities would utilise a number of vehicles such as an excavator, winch truck, air compressor, and mobile yard crane, as well as a 50 tonne crane deployed for a short period of time to remove the pipeline spool at Bunnerong Canal.

5.9.3 Other Construction Activities

The other construction activities would comprise:

- installation of additional extraction wells on the PCA (Southlands) and along the DNAPL containment line (BIP); and
- construction of the DNAPL transfer pipeline on the BIP.

These construction works would be undertaken before completion of the GTP, under separate approvals.

PCA Extraction Wells

The installation of the additional PCA extraction wells will involve the use of two drilling rigs, with access to Southlands from two access points on McPherson Street. The work will involve drilling and installing the wells, followed by installation of pumps and pipeline connections, and commissioning.

DNAPL Containment Line Wells

The installation of the DNAPL containment line wells will involve similar activities, with access to the locations via Gate 3 and the internal road network on the BIP.

DNAPL Transfer Pipeline

The pipeline will be installed on a new low-level pipe rack, until it reached existing pipe racks on the BIP. The construction works will involve installation of the pipe rack supports on concrete foundations, installation of the pipe on the pipe rack and completion of piping connections.

Activities will involve minor clearing and excavation, concrete preparation, welding, fastening and other metal works, and sealing/painting.

It is estimated that piping and structural steel will be delivered to the GTP site on the BIP by semi-trailers via Gate 3, with approximately 12 loads over three months.

Other construction equipment will include cranes, excavators, welders and forklift trucks.

5.10 Decommissioning

Whilst the treatment of contaminated groundwater is expected to cease after approximately 30 years, Orica may continue to treat groundwater from other sources, if available, to provide clean water to industrial users. In the event that this activity is not pursued, the BGC Project and the GTP would be decommissioned in consultation with the EPA.

Following a decision to decommission, a detailed decommissioning plan and program would be developed, which would include post-decommissioning monitoring requirements. This plan would include the program and timetable and the appropriate methods for assessing options for reuse and recycling of equipment.