Windsor Bridge replacement project

SOIL, SEDIMENTS, WATER AND WASTE WORKING PAPER – WORKING PAPER 7

NOVEMBER 2012

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Roads and Maritime Services

Windsor Replacement Bridge

Soil, sediments, water and waste working paper – working paper 7

November 2012

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Glossary of terms and abbreviations

Term	Meaning
AASS	Actual Acid Sulfate Soils
ANZECC	Australia and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
DEC	Department of Environment and Conservation (now NSW Office of Environment and Heritage)
DECC	Department of Environment and Climate Change (now NSW Office of Environment and Heritage)
DGRs	Director-General of the Department of Planning and Infrastructure’s Environmental Assessment Requirements
EIL	Ecological Investigation Levels
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
ESCP	Erosion and Sediment Control Plan
GPT	Gross Pollutant Trap
HIL	Human Investigation Levels
HRC	Healthy Rivers Commission
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NSW	New South Wales
NTU	Nephelometric Turbidity Unit
OCP	Organochlorine Pesticides
OEH	NSW Office of Environment and Heritage
OPP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCB	Polychlorinated Biphenyls
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority (now Roads and Maritime Services)
SCA	Sydney Catchment Authority
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfur
TPH	Total Petroleum Hydrocarbons

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Executive Summary

The assessment in this report aims to establish the significance of any potential impacts on soil, sediments, water quality and waste during construction and operation of the project. This report also assesses impact associated with the demolition of the existing bridge. Contamination investigations and hazardous materials audit have also been completed as part of this assessment (SKM 2012b and 2012c). The working paper develops and provides details of measures to mitigate these potential impacts in accordance with relevant guidelines. This would ensure the project's impact on the existing soil, sediment and water regime would be minimised.

Five key aspects of soils, sediments and water were assessed for the construction, demolition and operational phases in this working paper including:

- Soil and water management
- Contaminated soils and sediments
- Hazardous materials
- Acid sulphate soils
- Groundwater
- Waste management.

Assessment of impacts and the development of mitigation measures were undertaken in compliance and consideration of RMS and NSW guidelines, policies and legislation.

Soil and Water

The Hawkesbury River is highly valued by the community as it provides habitat for aquatic organisms, is used for recreational purposes and provides visual amenity. Water quality monitoring found that water quality upstream and downstream of the existing Windsor bridge and project is generally good.

Soil landscape maps indicate the soil at the study area is classified as Freemans Reach (fr). The soils of the Freemans Reach soil landscape are highly erodible. The soil's erosion hazard is very high to extreme for concentrated flows and there is a high streambank erosion hazard.

There would be a high risk to water quality during construction of the new bridge due to the sensitivity of the receiving water, the high erosion hazard of the surrounding soils and water-based construction activities. The risk to water quality will be mitigated and managed during construction by implementing appropriate erosion and sediment controls and controls around water based construction activities such as silt curtains. All terrestrial and maritime mitigation measures will be detailed in a Soil and Water Management Plan.

There would be a risk to water quality during operation from stormwater runoff carrying pollutants from the new road surface to the river. Pollutant sources include atmospheric deposition, vehicles and litter motorists. There would also be a risk of accidental spillage of petroleum, chemicals or other hazardous materials as a result of vehicle leakage or road accidents. The impacts to water quality would be mitigated by the use of water quality control devices incorporated into the project's drainage design. These controls would remove pollutants from stormwater runoff and provide a mechanism for capturing any accidental spills of hazardous liquids that may occur.

Overall there would be an improvement when compared to the current situation at the existing bridge and approach roads, as there are no water quality treatment measures.

Demolition and removal of the existing bridge would also present a potential risk to water quality of the river. The demolition activities would potentially result in rubble and debris entering the river and disturbance of the river bed material, causing a decline in water quality. A number of mitigation and management measures will be implemented to prevent and minimise debris entering the river and to contain any disturbance and adverse impacts.

The mitigation and management measures proposed would address the project's impact on soil and water quality so that potential change to the existing water regime would be minimised. The implementation of appropriate and adequate measures would mitigate potential significant impacts.

Contamination

A Phase 1 and Phase 2 contaminated sites investigations were undertaken for the project. The Phase 1 investigation identified the potential for contaminated soils and material to be present based upon current and historical land uses. However none of soils sampled and analysed for the Phase 2 investigation had contaminant levels exceeding relevant human health and ecological guidelines for contaminated soils.

Previous studies on heavy metal concentrations in the river sediments at Windsor have found that the heavy metal concentrations in sediments are low and below relevant guidelines.

No special mitigation measures will be required for contamination. A procedure for identifying and managing any unknown contaminated soils or material that may be encountered during construction will be developed.

Hazardous materials

A hazardous material audit of the existing bridge was undertaken and lead based paint on some of the iron structural elements of the bridge was identified. During the demolition of the bridge the lead based paint will be either contained, stabilised or removed during the demolition process.

Waste management

Only small volumes of waste would be generated during construction as the project is relatively small. However substantial qualities of waste material could be potentially generated during the demolition of the existing bridge. While a large majority of the materials from the existing bridge would be able to be recycled, some components would require disposal at an appropriately licensed landfall. Also any lead based paint removed from metal elements of the existing bridge would be considered a hazardous material and would require disposal at an appropriately licensed landfill.

Acid sulfate soils (ASS)

Sampling of river bed sediments indicated that there are potentially low strength ASS present within sediments near the southern bank. However as noted in the Acid Sulphate Soils Assessment Guidelines (ASSMAC 1998), estuarine sediments may give false positives to the presence of acid sulphate soil especially if there is a high proportion of organic matter in the sediments. Further sampling and analysis would be required to conclusively determine whether acid sulphate soils are present.

If the presence of ASS is confirmed in the river sediment, an ASS management plan would be developed and implemented. The plan will detail the management, handling, treatment and disposal of ASS.

Groundwater

There are no groundwater bores within the project area and only one groundwater bore near the corner of Freemans Reach Road and Wilberforce Road would be potentially impacted by the project. The construction and operation would not be expected to impact upon groundwater levels and quality. Monitoring of project and the one adjacent groundwater bore will be undertaken to identify any impacts during construction.

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1 Introduction

This chapter introduces the project, providing a brief outline of its need, scope, and location. It also outlines the structure of this working paper.

1.1 Overview

Roads and Maritime Services NSW (RMS) is proposing to construct a new bridge across the Hawkesbury River at Windsor to replace the existing bridge that has reached the end of its economic life. To support the design and approval of the Windsor bridge replacement project, the RMS is preparing an Environmental Impact Statement (EIS) under Part 5.1 of the *Environmental Planning and Assessment Act 1979*. This soil, sediments, water and waste working paper has been prepared as a specialist component of the EIS to identify and assess the impacts of the project on soil, sediments water and waste and advise mitigation measures to avoid or minimise impacts.

1.2 Project description

1.2.1 Overview

The project would comprise:

- Construction of a new bridge over the Hawkesbury River at Windsor, around 35 metres downstream of the existing Windsor bridge.
- Reconstruction and upgrading of existing intersections and bridge approach roads to accommodate the new bridge, including:
    - Removal of the existing roundabout and installation of traffic signals at the intersection of George and Bridge Streets.
    - Construction of a new dual lane roundabout at the intersection of Freemans Reach Road, Wilberforce Road, northern bridge approach road and the access road to Macquarie Park. All roads serviced by the new roundabout would require minor realignments.
    - Realignment of the southern and northern bridge approach roads. The new southern bridge approach road would generally follow the alignment of Old Bridge Street along the eastern side of Thompson Square. The northern bridge approach road would be a new road connecting the bridge to the new dual lane roundabout.
    - Construction of a shared pedestrian/cycle pathway for access to and across the new bridge.
    - Removal of the existing bridge approach roads and then backfilling, rehabilitating and landscaping these areas.
    - Demolition of the existing Windsor bridge including piers and abutments.
    - Landscaping works within Thompson Square parkland and adjacent to the northern intersection of Bridge Street, Wilberforce Road, Freemans Reach Road and the access road to Macquarie Park.
    - Redevelopment of part of The Terrace to provide continuous access along the southern bank of the river and under the replacement bridge to Windsor Wharf.
    - Construction of scour protection works on the southern and northern banks and around three bridge piers.
    - Construction of a permanent water quality basin to capture and treat stormwater runoff from the bridge and northern intersection prior to stormwater being discharged to the Hawkesbury River.

- Architectural treatments for noise mitigation, as required, where feasible and reasonable and in agreement with affected property owners.
- Flood mitigation works at individual properties.
- Ancillary works including:
    - Adjustment, relocation and/or protection of utilities and services, as required.
    - Construction and operation of temporary construction, stockpiling and compound sites.

In **Figure 1-1** the main elements of the project are shown including the construction zone and project boundary.

In addition to the above-listed work elements, early works for further identification, salvage, recording and protection of Aboriginal and historic heritage, would be carried out as part of impact mitigation for the project. These early works would include:

- Salvage excavation at identified Aboriginal heritage sites on the southern bank of the river in accordance with the procedures identified in the Aboriginal heritage chapter of the Environmental Impact Statement for the project.
- Excavation, recording and protection of historic heritage in accordance with the procedures identified in the historic heritage chapter of the Environmental Impact Statement for the project.

1.2.2 The replacement bridge and intersections

The replacement bridge would be located around 35 metres downstream of the existing Windsor bridge. The southern bridge approach road would be via a new realigned section of Bridge Street, which would start at the existing intersection of George Street and Bridge Street and head generally north-west along the alignment of Old Bridge Street on the eastern side of the Thompson Square parkland. The existing roundabout at the George Street and Bridge Street intersection would be replaced by traffic signals. The replacement bridge would connect with the junction of Wilberforce Road, Freemans Reach Road and the Macquarie Park access road at a new dual lane roundabout intersection.

The replacement bridge would be an incrementally launched bridge constructed of reinforced concrete and comprising five spans. The bridge deck would be about 15.5 metres wide and be supported on up to four piers in the river. It would have an overall length of about 160 metres, spanning both the river and The Terrace. This would enable The Terrace to be reconnected to provide vehicular, pedestrian and cyclist access to Windsor Wharf. The clearance under the bridge where it spans The Terrace would be about 3.6 metres, which would allow a range of service and emergency vehicles to pass under the bridge and access Windsor Wharf.

The replacement bridge would initially comprise two traffic lanes (one in each direction), each about 3.5 metres wide and with an adjacent two metre wide shoulder. There would also be a three metre wide shared pedestrian/cycle path on the western side of the bridge. The two metre wide road shoulders of the replacement bridge would allow the bridge to be re-configured to a three lane bridge in the future, when required. The introduction of the three lane configuration would occur when additional traffic capacity is required. The three traffic lanes would consist of two southbound lanes and one northbound lane.

The low point of the replacement bridge would be around 9.8 metres Australian Height Datum (AHD), making it around 2.8 metres higher than the lowest point of the existing bridge.

The height of the replacement bridge may change slightly during the detailed design phase. This would give the replacement bridge a slightly higher level of flood immunity than the existing bridge. While the existing bridge is overtopped in a one in two year flood event, the replacement bridge is predicted to remain above water for the one in two year flood event but be overtopped in an event just smaller than the one in three year flood. This level of flood immunity is consistent with that of the northern approach roads (Wilberforce Road and Freemans Reach Road), which have a flood immunity that lies about midway between the one in two year and one in three year flood levels.

1.2.3 Demolition of the existing bridge

The existing Windsor bridge would be removed following commissioning of the replacement bridge and associated bridge approach roads. The existing bridge superstructure and substructure would be removed in sections, with temporary bracing installed, as required, to maintain the stability of remaining sections during the demolition process. Where possible the process of demolition would involve cutting or dismantling the superstructure and substructure into sections, with each section transported off-site for further demolition at an appropriately approved and licensed facility. Where possible the dismantled bridge elements would be reused or recycled, however some components of the bridge would require disposal at a landfill. Lead based paint has also been found on the bridge, so demolition activities would need to comply with relevant standards for managing lead based paint. Disruption of waterway traffic would be limited to the greatest extent practicable, with alternative navigation channels provided while the existing navigation span is closed for the demolition works.

1.2.4 Pedestrian and cycling facilities

The project would incorporate facilities for pedestrians and cyclists and include a shared pedestrian/cycle pathway that would be constructed from Wilberforce Road and Macquarie Park, across the western side of the replacement bridge and southern approach road to the corner of George and Bridge Streets. Pedestrian and cyclist access along the southern bank of the river would also be improved with the connection and redevelopment of The Terrace. In addition, the following general works would be undertaken to improve pedestrian safety and access:

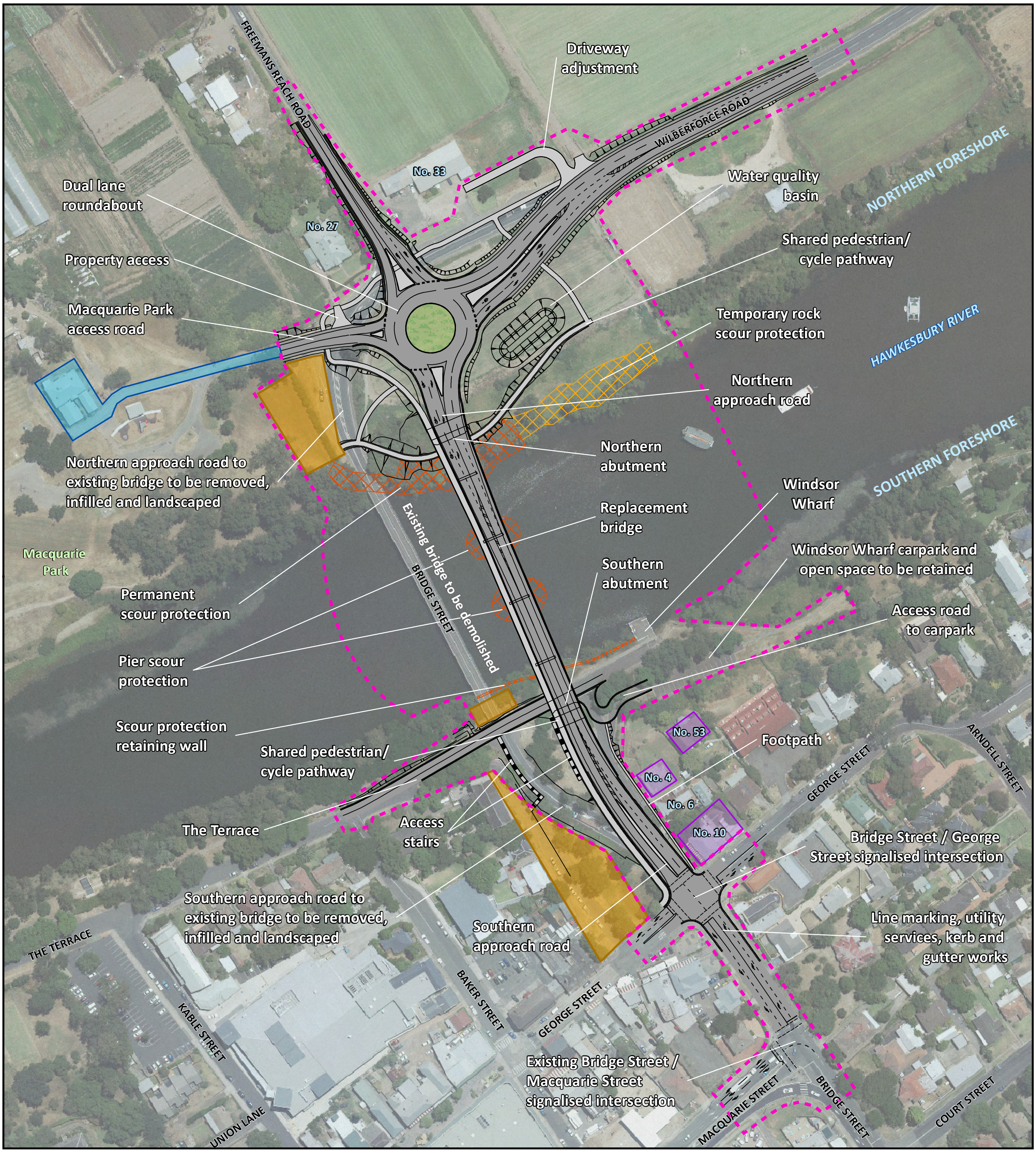
- Provision of a new 1.2 metre wide footpath adjacent to properties fronting Old Bridge Street.
- Provision of a new signalised pedestrian crossing on all four approaches to the intersection of Bridge Street and George Street.
- Provision of new pedestrian footpaths for safe access around and across the proposed dual lane roundabout at the junction of Freemans Reach Road, Wilberforce Road and the Macquarie Park access road including a path under the northern bridge abutment.

1.2.5 Water quality basin

The project would include construction of a permanent water quality basin to capture and treat stormwater runoff from the bridge and northern intersection prior to stormwater being discharged to the Hawkesbury River. The water quality basin would be located on the eastern side of the proposed roundabout at the junction of Freemans Reach Road, Wilberforce Road and the Macquarie Park access road.

For the southern approach road a trash net to collect litter and a shut-off-valve to contain any spills in the stormwater system would be installed at the discharge point of the drainage system near Windsor Wharf.

Figure 1-1 | Key project elements



Indicative only – subject to detailed design

LEGEND

- ≡ Concept design
- ⬚ Construction work zone
- ▨ Permanent rock scour protection (if required)
- ▨ Temporary rock scour protection (if required)
- 🟦 Properties requiring flood mitigation works. Works subject to further consultation with and agreement from affected property owners.
- 🟪 Properties requiring noise mitigation works. Works that are feasible and reasonable would be subject to further consultation with and agreement from affected property owners.
- 🟨 Works subject to further council and stakeholder consultation

GDA 1994 | MGA Zone 56
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0 100
Metres

AUSIMAGE SKM

1.2.6 Scour protection

Scour protection would be provided to protect the bridge abutments and piers from the erosive impacts of high river flows. On the southern bank, the scour protection would consist of a concrete panel retaining wall between Windsor Wharf and the existing bridge. Large diameter rocks (900 millimeters) and/or sandstone blocks would also be used to provide scour protection in some locations on the southern bank.

On the northern bank extensive rock and sandstone block scour protection would be required extending up the bank to about five meters above the usual water level. Other forms of scour protection such as a concrete grid planted with grass would be installed in areas above this where scour protection is required.

Scour protection using large rocks would be provided around three of the four bridge piers. Scour protection for each pier would cover an eight metre radius and would be to a depth of 4.5 metres. Dredging around the piers would be required to place the rocks below the river bed level. For the southernmost pier little or no scour protection would be required as bedrock is close to the surface in this location.

During the detailed design phase further work would be undertaken to minimise the visual impact of all visible scour protection.

1.2.7 Public utility works

The existing bridge supports a number of public utilities which would be replicated on the replacement bridge including:

- A 450 millimetre water main (cement lined steel pipe).
- A 50 millimetre sewer rising main (galvanised iron pipe).
- A 100 millimetre electrical conduit.
- Telecommunications conduits (3 x 80 millimetre galvanised iron conduits).

Other public utilities that may need to be adjusted as part of the project include:

- High voltage overhead power lines from Macquarie Street to Wilberforce Road which cross the river on a similar alignment to the replacement bridge. These power lines would need to be relocated prior to bridge construction.
- Power lines near the corner of Wilberforce Road and Freemans Reach Road.
- Local stormwater drainage infrastructure.
- A rising main from Windsor Wharf to the local sewer system, which is used to pump out boat sewage holding tanks.
- A gravity sewer main, which runs beneath Old Bridge and Bridge Streets.
- A number of water mains on both the northern and southern river banks.
- Street lighting on both the northern and southern river banks.
- Telstra assets located on both sides of the river. In particular, Telstra assets located near the proposed southern bridge abutment would need to be relocated prior to construction of the bridge abutment.
- A new recycled water main for future use if required.
- Traffic signal cables along Bridge Street between George Street and Macquarie Street.

1.2.8 Urban and landscape concept design

The urban design and landscape concept design associated with the project was developed by applying project specific urban design principles and treatments. Works associated with the current concept design are described below.

Southern bank and Thompson Square area

At this stage of project development, the scope of works in Thompson Square parkland has yet to be fully defined and would be subject to further consultation with the community, government stakeholders and most importantly Hawkesbury City Council – who would be responsible for managing Thompson Square parkland in the longer term. For the purposes of assessment in the EIS, preliminary urban design and landscaping works for Thompson Square have been identified. These works have been developed with the objectives of providing pedestrian and cyclist access from the replacement bridge to various areas in Thompson Square and providing a base for additional urban design and landscaping works arising from the consultation process. The consultation process for the additional urban design and landscaping works for Thompson Square is ongoing and if possible the full scope of works would be presented and assessed in the Submissions Report. However, it is recognised that the full scope of works may not have been agreed before the completion of the Submissions Report and a post-approval Urban Design and Landscaping Plan for Thompson Square parkland maybe be required.

The scope of works assessed in the EIS include:

- Infilling the southern approach road to the existing bridge.
- Removal of some trees which are either in poor condition or would be impacted by the project.
- Minor earthworks in the Thompson Square lower parkland area to improve the connection of the parkland to the river.
- Construction of stairs from the bridge pedestrian/cyclist path to The Terrace and from Thompson Square road to The Terrace to provide pedestrian access.
- Reinstatement of the section of The Terrace and river bank currently bisected by the existing bridge and approach roads.
- Planting of trees and other vegetation in Thompson Square parkland.
- Landscaping in the road reserve between the three properties on Old Bridge Street and the southern approach road.

Bridge

The project specific urban design principles have been used to refine the visual appearance of the replacement bridge. This includes refinements to the pier shape, bridge superstructure and abutments to minimise its visual impact and provide context to the heritage values of Windsor.

Northern bank

- Infilling the northern approach road to the existing bridge.
- Minor earthworks to improve the visual appearance of the bank.
- Construction of pedestrian/cyclist paths to Wilberforce Road and Macquarie Park.
- Planting of trees and other vegetation.

1.2.9 Construction works

Temporary construction and compound sites

There would be two main construction and compound sites required for the duration of the project (about 18 months, excluding pre-construction and early works). One of these sites would be located within the turf farm between the Hawkesbury River and Wilberforce Road (Lot 2 DP 1096472 and Lot 2 DP65136); while the other would be sited on land between Old Bridge Street and Windsor Wharf (refer to Figure 1-1). The lower Thompson Square parkland would also be closed to public access and used to provide access for the construction of the southern abutment and approach road. The majority of the construction activity would be concentrated on the northern bank as this would be the location of casting yard for the incrementally launched bridge and would be the location where access to the river would predominately occur.

The construction compound on the southern bank would be located in the car parks and grassed areas and would support the construction of the southern approach road and other minor works.

Offices may be leased near Thompson Square for construction personnel.

Order of Construction Works

The order of construction works would be implemented to minimise environmental and traffic impacts as far as practical. The likely order of construction works would consist of the following:

- Pre-construction activities and early works – including construction compound and casting bed establishment, installation of environmental controls, public utility relocations or adjustments and additional investigations and heritage salvage.
- Construction of the bridge - including construction of the piers in the river, two bridge abutments and construction and launching of the bridge superstructure.
- Installation of scour protection on the banks and in the river.
- Construction of the northern roundabout and approach road and most of the southern approach road.
- Construction of temporary pavement both at Wilberforce Road and near the corner of George and Bridge Streets to provide additional road width to enable construction of the subsequent stages.
- Construction of the remainder of the southern approach road and the new sections of Freemans Reach Road, Wilberforce Road and Macquarie Park access road.
- Commissioning and opening of the replacement bridge to traffic.
- Demolition of the existing bridge and urban design works in Thompson Square, on the southern bank, northern bank and other adjacent areas.
- Removal of temporary structures and demobilisation of the construction facilities.

This proposed order of construction works is indicative and may change once detailed construction planning is completed. It is likely that some aspects of construction may overlap.

Construction period

It is anticipated that a construction period of around 18 months (excluding pre-construction and early works) would be required to complete the proposed works including demolition of the existing bridge.

Work hours

The majority of the construction works would be carried out during standard working hours, as detailed in **Table 1-1**. Some construction activities, in particular those requiring road closures, would need to be undertaken outside of standard working hours to prevent major disruptions to traffic and access. Other construction activities such as service relocations and cutovers may also need to be undertaken outside normal working hours. Low noise activities may also be undertaken outside of normal working hours to optimise construction efficiency.

Table 1-1 Standard working hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday and public holidays	No work	

Construction equipment

The types of construction equipment likely to be used for the project would include (but would not necessarily be limited to) the following:

- Excavation plant, such as excavators, back hoes and front end loaders for pavement cutting, removal and general earthworks.
- Bobcats and sweepers.
- Compaction plant, including rollers, vibrating rollers, concrete vibrators and trench plate compactors.
- Pneumatic jack hammers.
- Profiling, milling and road paving plant.
- Jet-blasting and shot-blasting machines.
- Miscellaneous vehicles, including utilities, trucks, bogies and semi-trailers.
- Miscellaneous hand tools and equipment.
- Generators, lighting towers, signage and variable message boards.
- Various barges, workboats and pontoons.
- Piling rigs and various mobile and fixed cranes.
- Concrete and grouting pumps and transport vehicles.
- Support trusses, stress jacks and scaffold systems.

1.3 Objectives

The assessment in this report aims to establish the significance of any potential impacts on soils, sediments and water quality during construction and operation of the project. It develops and provides details of measures to mitigate these potential impacts in accordance with relevant guidelines so that the project's impact on soil, sediments and water quality would be minimised.

1.3.1 Study requirements

The Director General of the Department of Planning and Infrastructure’s Environmental Assessment Requirements (DGRs) for the project identify key issues, which include soils, sediments and water. The DGRs for soils, sediments and water and where they are addressed are provided in **Table 1-2**. Waste handling is addressed in Chapter 8 of the EIS (RMS, 2012a) and the DGRs relating to hydrology and bed and bank stability impacts from the new bridge, as well as a detailed discussion of scour protection measures, are addressed in the Hydrology working paper (RMS, 2012b).

Table 1-2 Director General requirements

DGRs	Where addressed in report?
Erosion and sediment impacts on the Hawkesbury River during construction/ operation;	Section 4
- including an assessment of water quality;	Section 3
- mitigation measures to prevent water pollution;	Section 5
- details of the proposed storm water management measures for the containment of pollutants; and	Section 5.2.2
- waste handling.	Section 4 and Section 5

There are no specific requirements for contamination assessment detailed in the DGRs.

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2 Assessment methodology

2.1 Soil, sediment and water management

The process of assessing the impact of the project on soil, sediment and water quality and developing mitigation measures has included:

1) A review of existing project literature, including the following documents:
    - *Windsor Bridge Replacement Options Report* (RTA*,* 2011).
    - Director-General's Environmental Assessment Requirements (24 November 2011).
    - Letter submissions from:
        - The NSW Office of Environment and Heritage, Nov 2011.
        - NSW Department of Primary Industries Office of Water, Nov 2011.
        - Heritage Council of NSW, Oct 2011.
        - NSW Department of Primary Industries, Oct 2011.
        - Hawkesbury City Council, Oct 2011.
        - A review of existing conditions using available non-project literature.
2) A review of the available existing water quality data.
3) An assessment of the catchments based on the proposed drainage system.
4) An assessment of the impact of construction on soils, sediments and water quality.
5) A review of water quality treatment measures that could be used to mitigate the impact of construction on water quality, following the principles of *Managing Urban Stormwater - Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2D* (DECC, 2008).
6) An assessment of the soil, sediment and water impacts of the project during its operation.
7) A review of water quality treatment measures that could be used to mitigate the impact of the operation of the project on water quality following the principle of *Procedure for Selecting Treatment Strategies to Control Road Runoff'* (RTA, 2003), *RMS Water Policy* (RTA, 1997), and *RMS Code of Practice, Water Management* (RTA, 1999).
8) A review of suitable locations and sizes for a sediment basin and a spill containment basin.

The soil, sediment and water management assessment requires an understanding of several critical factors for both construction and operational phases. For the construction phase of the project, these factors include local soil characteristics, climatic conditions, construction methods, extent of land disturbances and construction staging and duration. The construction phase assessment approach is based on meeting the design criteria and water quality objectives that are outlined in the *Managing Urban Stormwater - Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2D* (DECC, 2008).

For the operational phase of the project, the critical factors include the proposed road geometry and drainage system, local climatic conditions and the downstream waterways and their proximity to the site.

The operational phase assessment approach is based on meeting the design principles outlined in the *Procedure for Selecting Treatment Strategies to Control Road Runoff* (RTA, 2003) and the project's performance requirements of managing stormwater as close to its source as possible so that the project changes the existing water regime by the smallest amount practicable.

2.2 Contamination

A preliminary and detailed site investigation was undertaken to identify potential contamination and acid sulfate soils which may be impacted by the project. The site investigations were undertaken in general accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (EPA 2000).

2.2.1 Stage 1 Preliminary Site Investigation

A Stage 1 preliminary site investigation was undertaken in April 2012. This included assessing potential contamination issues at the site that may have arisen from past and/or present activities undertaken on and/or adjacent to the site which may represent a risk to human health or the environment. This involved:

- Review of publically available data (i.e. historical aerial photographs, geological plans, topographic maps, groundwater resource maps).
- Review of information held by state government departments including the NSW Office of Environment and Heritage (OEH).
- Review of historical land title information.

Several sources were investigated to determine the history of land use at the site.

- NSW Land and Property Management Authority, Land and Property Information Division: Historical aerial photographs *1947 – 2005) and Historical Title Search.
- NSW Contaminated Sites Register.
- NSW Natural Resource Atlas: Groundwater Bore Database.

Table 2-1 details historical land uses of the site and historical title information where available.

Table 2-1 Historical title / land use information

Year	Historical land use / title	Location	Reference
1793	Settlement of the subject area	Hawkesbury River, Windsor	Austral Archaeology Pty Ltd (2009a), *Built heritage and archaeological landscape investigation: Windsor bridge options*, Austral Archaeology Pty Ltd, Stanmore, NSW.
Between 1793 and 1794	Land clearing for agricultural purposes	On Hawkesbury River between South Creek and Canning Reach	Austral Archaeology Pty Ltd (2009b), *Preliminary aboriginal archaeological and cultural baseline investigation*, Austral Archaeology Pty Ltd, Stanmore, NSW.
1795 (replaced in 1799)	Granary for grain storage	Windsor (in the area of Thompson Square)	Austral Archaeology Pty Ltd (2009a)
1804	Grazing commons	Pitt Town, Richmond and Wilberforce	Austral Archaeology Pty Ltd (2009b)
1807	Wharf	Windsor	Austral Archaeology Pty Ltd (2009b)
1808	Tanning industry	West Hill Farm, between South Creek and McGraths Hill.	Austral Archaeology Pty Ltd (2009a) and (2009b)

Year	Historical land use / title	Location	Reference
1810/11	Town Reserves	Windsor remains on its original location and extends to the north from Arndell Street to South Creek from 1842, and to the south towards Bligh Park in the 1980s.	Austral Archaeology Pty Ltd (2009b)
1814	Punt (cable ferry)	At the site of the current Windsor Bridge	Spackman Mossop Michaels (2011) *Preliminary urban design and heritage review for options 1 & 3*, Spackman Mossop Michaels, Sydney, NSW.
1820	Kings Wharf (aka Hawkesbury River Bridge). The construction and maintenance of this bridge, as well as the wharfs and access roads, has involved several earth cutting works along the southern bank of the Hawkesbury River in the vicinity of Thompsons Square	Windsor (close to the location of the present day Windsor Bridge).	Austral Archaeology Pty Ltd (2009b)
1835	Steam driven mill for grinding flour	Wilberforce	Austral Archaeology Pty Ltd (2009b)
1842	Police horse stables	Catharine Street, Windsor	Biosis (2011), *Figure 5: Historic plan overlay*, Biosis Research Pty Ltd, Alexandria, NSW.
1844	John Odell and Thomas Cadell's brewery	A site bounded by The Terrace, Fitzgerald and Kable Streets	Austral Archaeology Pty Ltd (2009b)
1874	Construction of Windsor Bridge	Current site of the Windsor Bridge	Spackman Mossop Michaels (2011)
1890	Milk and butter factories	Windsor and Pitt Town	Austral Archaeology Pty Ltd (2009a) and (2009b)
1910	Noon Cordial Factory	Corner of Kable and Macquarie Streets, Windsor	Austral Archaeology Pty Ltd (2009b)

Historical aerial photographs from the NSW Land and Property Management Authority, Land and Property Information Division were reviewed for the years: 1947, 1955, 1961, 1965, 1970, 1971, 1972, 1978, 1982, 1986, 1991, 1994, 1998, 2002, 2004 and 2005.

The key findings of the Stage 1 investigations resulted in the recommendation for a Stage 2 detailed site investigation to be undertaken for the project.

2.2.2 Stage 2 Detailed Site Investigation

Soil sampling for the detailed site investigation was undertaken on 28 May 2012 by a suitably qualified environmental scientist. A targeted sampling approach was implemented during the investigation, during which ten soil locations and four sediment locations were sampled across the site. These sampling locations are shown in **Figure 2-1**.

All soil and sediment samples were excavated using a decontaminated steel hand auger. Hand auger logs are presented in **Appendix A.** All sampling was undertaken in a manner that minimised disturbance to the site as far as practicable. All hand auger locations were properly backfilled, with soils replaced in the sequence that they were excavated.

Soil sampling involved the following:

- Samples taken from the turf farm were collected at depths of 0 to 0.1, 0.5 and 1.0 metres below ground level.
- Samples taken from fill material underneath the existing bridge were generally collected at 0 to 0.1, 0.2 and 0.3 metres below ground level.
- Acid sulfate soil samples taken from sediments underneath the existing bridge were collected at 0.25 and 0.5 metres below the water table.
- Fourteen samples were selected for laboratory analysis.

All fieldwork was undertaken using procedures in accordance (where applicable) with Australian Standard AS4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds*. The management of samples collected for laboratory testing was documented using chain of custody forms, which can be found in **Appendix B**. Quality control procedures are also presented in the same appendix.

A total of 21 soil samples and four sediment samples were collected by hand directly from the hand auger using new sterile gloves with each sampling event. The soil samples were collected in 250 millilitres jars supplied by the laboratory, and the sediment samples were collected in zip locked bags (air evacuated). Samples were immediately stored on ice in a portable cooler. Jars and bags were labelled with the investigation location ID, depth of sample, project number and date. Samples were couriered to Envirolab Services under the chain of custody for the required analyses.

Ten representative soil samples and four sediment samples were selected for analysis. The soil samples were analysed for the following contaminant compounds:

- Heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury).
- Total Petroleum Hydrocarbons (TPH).
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX).
- Polycyclic Aromatic Hydrocarbons (PAH).
- Organochlorine and Organophosphorus Pesticides (OCP/OPP).
- Polychlorinated Biphenyls (PCB).
- Asbestos.

The presence of odours as a result of contamination was continually assessed during the soil and sediment sampling process and reported on field notes (where present).

Site Assessment Criteria

To address possible health and environmental impacts associated with potential contamination at the site, the analytical testing results were compared against human health and ecological based soil investigation levels appropriate to the current and intended land use. These levels are referred to as the site assessment criteria. The site assessment criteria have been set at a level that provides confidence that contaminant concentrations below the site assessment criteria will not adversely affect ecological or human health. The current land use has been identified to generally comprise open space (that is, non residential but with possible access to soil). To be conservative the most stringent (or lowest) soil contaminant concentration from the following guidelines was selected:

- NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure* Health Investigation Levels recommended for exposure setting 'E', which includes parks, recreational open space and playing fields
- NSW EPA (1994) *Contaminated Sites: Guidelines for Assessing Service Station Sites* with respect to hydrocarbons (TPH and BTEX)
- NEPC (1999) *Interim Ecological Investigation Levels*.

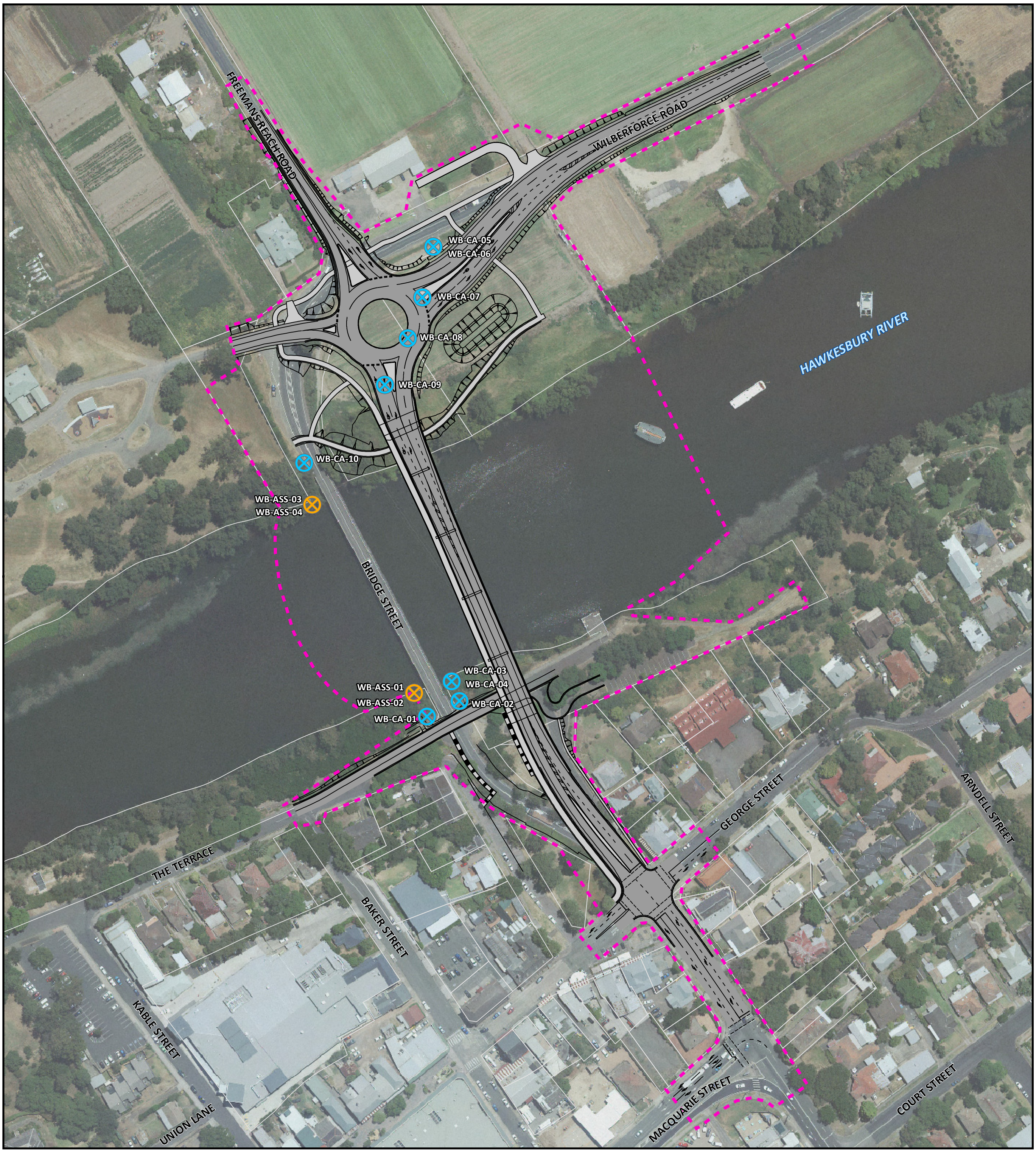
There are no national or NSW OEH endorsed guidelines for asbestos in soil relating to human health. NSW guidelines (DEC, 2006) states that auditors must exercise their professional judgement when assessing whether a site is suitable for a specific use. The OEH states that the position of the NSW Department of Health is that there should be no asbestos in surface soil. A criterion of no asbestos in surface soil has therefore been adopted for this investigation. A summary of the adopted soil investigation levels is provided in **Table 2-2** below.

Table 2-2 Adopted soil investigation levels

Chemical name	Units	Estimated Quantitative Limit	NEPM 1999 EIL (ecological investigation levels)	NEP 1999 HIL E (human investigation levels)
Arsenic	mg/ kg	4	20	200
Cadmium	mg/kg	0.5	3	40
Chromium (III + VI)	mg/kg	1	-	-
Copper	mg/kg	1	100	2000
Lead	mg/kg	1	600	600
Mercury	mg/kg	0.1	1	30
Nickel	mg/kg	1	60	600
Zinc	mg/kg	1	200	14000
Benzo(a) pyrene	mg/ kg	0.05	-	2
PAHs (sum of total)	mg/ kg	1	-	40
Total TPH C10 – C36	mg/ kg	101	-	1000
Benzene	mg/kg	0.2	-	1
Ethylbenzene	mg/kg	1	-	3.1
Toluene	mg/kg	0.5	-	1.4
C6 –C9	mg/kg	25	-	65
4,4-DDE	mg/kg	0.1	-	400
Heptachlor	mg/kg	0.1	-	20
Asbestos	No detectable asbestos			

Note: Shaded cells indicate levels adopted for assessment

Figure 2-1 | Contaminated land assessment sites



Indicative only – subject to detailed design

LEGEND
- ≡ Concept design
- ⌐ ⌐ Construction work zone
- ☐ Cadastral boundary

Contaminated land assessment sites
- ⊗ Acid Sulfate Soil assessment site
- ⊗ Contaminated land assessment site

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2.3 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring sediments and soils containing iron sulfides (principally iron sulfide, iron disulfide or their precursors). Oxidation of these soils through exposure to the atmosphere or through lowering of groundwater levels results in the generation of sulfuric acid. Oxidation produces hydrogen ions in excess of the buffering or neutralising capacity of the soil, resulting in pH 4 or less when measured in dry-season conditions (1:5 soil:water). Potential acid sulfate soils are soils containing iron sulfides or sulfidic material (usually ferrous iron disulfide or pyrite) which have not been exposed to the air and oxidised. These soils have a field pH 4 or more and may be neutral or slightly alkaline.

As part of the preliminary site investigation, ASS Risk Maps from the NSW Natural Resource Atlas database were reviewed to ascertain the presence of ASS within the project area. Based on this information, there is a high risk of ASS present within the sediment in the Hawkesbury River and a low risk of ASS present in the northern land based sections of the site. The NSW National Resources Atlas database has not identified the ASS risk on the southern land based section of the site.

The *Acid Sulfate Soils Assessment Guidelines* (ASSMAC 1998) contain criteria which if exceed, trigger the preparation of a detailed ASS management plan. These criteria are based upon the type of soils, the volume excavated and the acidity and available sulfur in a soil samples (See **Table 2-3**). The soils and sediments in the project area would be considered medium textured soils (ie sandy loams to light clays) and more than 1,000 tonnes would require excavation.

The sediment samples were subject to an SPOCAS Suite (Suspension Peroxide Oxidation Combined Acidity and Sulfur) analysis, which provides an indication of ASS presence.

Table 2-3 Soil assessment criteria for ASS

Type of material		Action criteria for 1 -1000 tonnes disturbed		Action criteria if >1000 Tonnes disturbed	
Texture range	Approx clay content %<0.002 mm	Sulfur trail % S oxidisable (oven-dry basis) eg S_{TOS} or S_{POS}	Acid trail mol H+/tonne (oven-dry basis) eg TPA or TSA	Sulfur trail % S oxidisable (oven-dry basis) eg S_{TOS} or S_{POS}	Acid trail mol H+/tonne (oven-dry basis) eg TPA or TSA
Coarse texture Sands to loamy sands	<5	0.03	18	0.03	18
Medium texture Sandy loams to light clays	>5 to <40	0.06	36	0.03	18
Fine texture Medium to heavy clays and silty clays	>40	0.1	62	0.03	18

Note: Shaded cells indicate levels adopted for assessment

2.4 Hazardous materials audit

2.4.1 Overview

The audit took the form of a visual inspection of the existing bridge structure and bridge supported services and sampling of suspect building materials. Where it was not possible to collect a sample of material, the inspector has used professional experience to make a judgement on the status of the material or the areas concerned. Where the inspector believed or suspected that the material may contain asbestos, Synthetic Mineral Fibres (SMF), lead based paints, Ni-Cd batteries or PCBs, this was recorded in the survey report.

No suspected SMF, Ni-Cd batteries or PCB containing fittings were observed during the inspection of the bridge structure.

2.4.2 Asbestos and SMF sample methodology

A representative sample (Sample ID: WB3) of material suspected of containing asbestos or SMF were collected from the gasket/seal from the water main on the underside of the eastern side of the bridge platform (southern end). No other materials suspected of containing asbestos or SMFs was observed during the inspection.

All asbestos/SMF identification was undertaken by Envirolab Services Pty Ltd using the NATA accredited Polarised Light Microscopy method. These samples were recorded as either containing or not containing asbestos and / or SMF.

2.4.3 Lead based paint sample methodology

Samples of paint from painted surfaces were collected from the following metal components of the bridge structure and supported services:

- Iron piers (Sample ID: WB5)
- Iron cross bracing (Sample ID: WB6)
- Tubular crash railing (Sample ID: WB7)
- Water main 450mm (steel cement) line pipe (Sample ID: WB4)
- Rolled steel joist girders (Sample ID: WB1)
- Kerb anchor strap (Sample ID: WB2).

All paint samples were submitted to Envirolab Services Pty Ltd for NATA accredited analysis for lead in paint.

2.5 Waste management and handling

Where possible, the quantity, type and likely classification of wastes generated from the project were identified from reports on the existing bridge and concept design reports. Mitigation measures were developed to handle, manage and dispose of waste. Resource use for the project was assessed by reviewing existing information including the Concept Design Report (SKM, 2012) and estimating the resources required for construction and their likely sources.

2.6 Groundwater

Existing groundwater users and aquifers were identified from NSW Office of Water (NOW) groundwater bore databases and information on the presence of groundwater from the geotechnical studies undertaken for the project.

The construction methodology and design of the project was reviewed to identify potential impacts on groundwater users and aquifers – and whether the project constituted an activity that caused “aquifer interference” under the *Water Management Act 2000*. If the project was assessed as having the potential to cause impacts, appropriate mitigation measures would be developed. The location of groundwater bores adjacent to the project and geotechnical bores which also included monitoring for the presence of groundwater is presented in **Figure 2-2**.

2.7 Legislation and guidelines

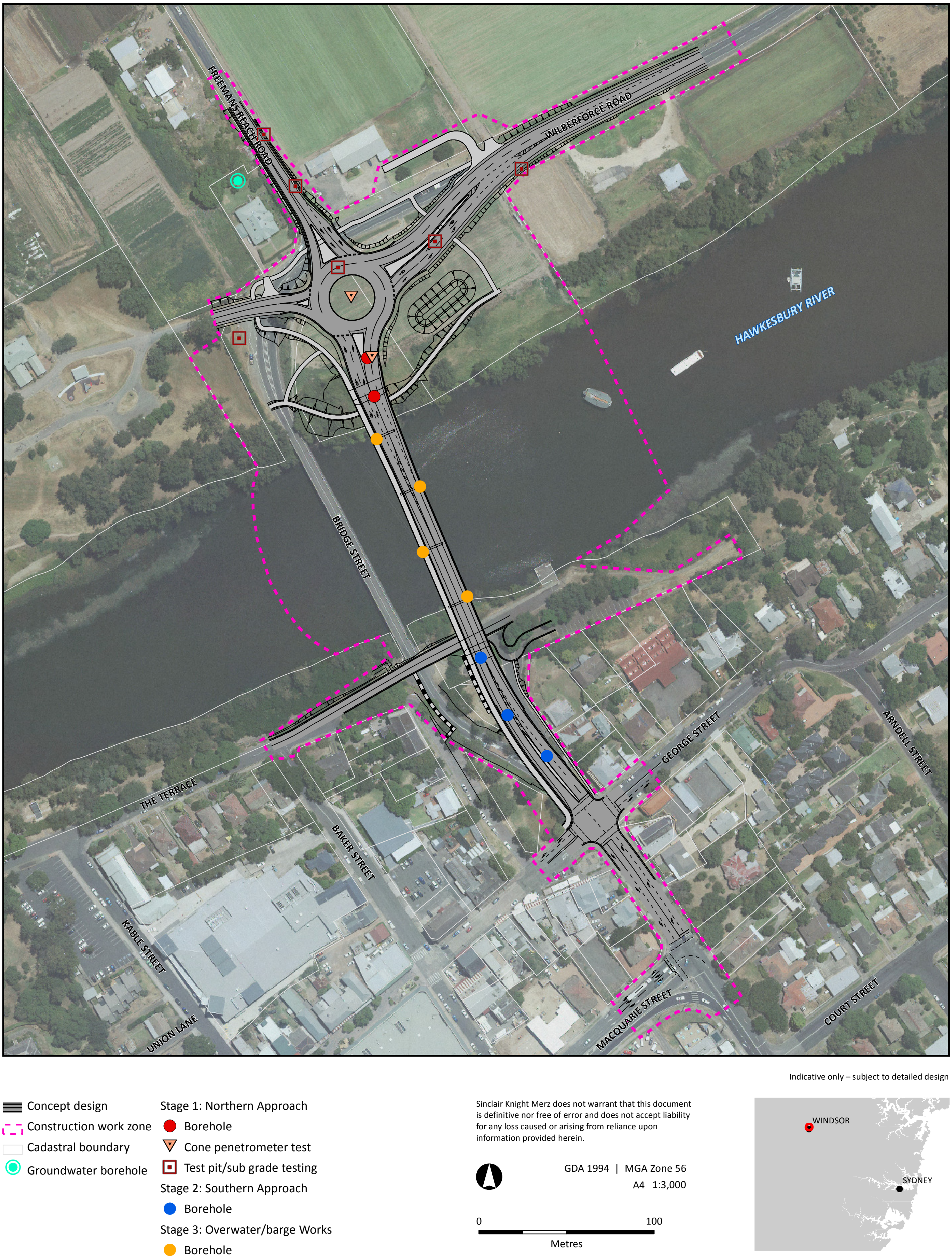
Key environmental legislation relating to soil, sediment and water management includes:

- *Protection of the Environment Operations Act 1997*
- *Fisheries Management Act 1994*
- *Soil Conservation Act 1938*
- *Dangerous Goods Act 1978*
- *Local Government Act 1993*
- *Environmentally Hazardous Chemicals Act 1985*
- *Water Management Act 2000*
- *Contaminated Land Management Act 1994.*

The following design guidelines and management procedures are relevant for the assessment of soil, sediment and water quality, for determining the existing conditions along the project area, as well as the appropriate management and mitigation measures to be implemented during the construction and operational phases of the project. The key environmental guideline documents relating to soil, sediment and water management include:

- *RMS Water Policy* (RTA, 1997)
- *RMS Code of Practice, Water Management* (RTA, 1999)
- *RMS Erosion and Sedimentation, Section 8 of Road Design Guide* (RTA, 2009)
- *RMS Guideline for Construction Water Quality Monitoring* (RTA, no date)
- *RMS Erosion & Sedimentation procedure, Environmental Policy* (RTA, 2008)
- *RMS Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze* (RTA, 2005)
- *RMS Procedure for Selecting Treatment Strategies to Control Road Runoff* (RTA, 2003)
- *RMS Environmental Management of Construction Site Dewatering* (RTA, 2011)
- *RMS Stockpile Site Management Guideline* (RTA, 2011)
- *Managing Urban Stormwater - Soils and Construction Volume 1* (Landcom, 2004)
- *Managing Urban Stormwater - Soils and Construction Volume 2D Main road construction* (DECC, 2008)
- *Austroad Road Runoff and Drainage: Environmental Impacts and Management Options* (Austroads, 2000)
- *Austroad Guidelines for Treatment of Runoff from Road Infrastructure* (Austroads, 2003).
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (EPA 2000).

Figure 2-2 | Location of groundwater bores and geotechnical investigation sites



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Sydney Spatial Team - Prepared by : DD
Checked by : JC

3 Existing environment

3.1 Overview

The footprint of the project covers portions of the southern bank, the northern bank and the main channel of the Hawkesbury River at Windsor. The project's footprint on the southern bank consists predominantly of urbanised development of Windsor, while the footprint over the northern bank is generally a cleared area of the river's floodplain and the vegetated river bank.

The Hawkesbury River is part of the largest river system in the Sydney region and one of the most important river systems in NSW. It is highly valued by the community as it provides habitat for aquatic organisms, is used for recreational purposes, and provides visual amenity. Water quality objectives and recommendations have been prepared to provide a benchmark for assessing water quality of the river, which is affected by various catchment landuse types and activities such as:

- Stormwater runoff from nearby urban areas
- Surface runoff from surrounding agricultural and horticultural areas
- Effluent discharge from sewage treatment plants
- Boating and recreational activities.

There is one known existing water quality treatment device in close proximity to the project site. It is a gross pollutant trap located at Baker Street on the southern bank of the river, about 100 metres west of the project. The gross pollutant trap treats stormwater runoff from a local urban catchment and is owned and maintained by Hawkesbury City Council.

The existing Windsor bridge and approach roads do not have any water quality mitigation measures such as water quality treatment ponds or litter capture devices.

3.2 Water quality

3.2.1 Environmental values

The now defunct Office of the Hawkesbury-Nepean (www.ohn.nsw.gov.au/Your-river/values/default.aspx) has identified the environmental values that apply to all the waterways within the Hawkesbury-Nepean catchment as:

- Protection of aquatic ecosystems
- Secondary contact recreation (boating, wading, fishing etc.)
- Visual amenity.

Some sections of the river and its tributaries have also been recognised as providing additional environmental values such as:

- Water for irrigation and general use.
- Livestock drinking.
- Human consumption of aquatic food.
- Raw drinking water.
- Primary contact recreation.

3.2.2 Water quality objectives

The NSW Healthy Rivers Commission has determined water quality objectives for the Hawkesbury-Nepean River (HRC, 1998). The Australia and New Zealand Environment and Conservation Council (ANZECC/ARMCANZ, 2000) also have guidelines for water quality. These objectives and guidelines provide benchmarks for assessing the existing water quality of the river. The NSW Healthy Rivers Commission Hawkesbury-Nepean River objectives have precedence where there is duplication.

The water quality guidelines and objectives are presented in **Table 3-1**. The ANZECC/ARMCANZ water quality guidelines presented are for slightly disturbed lowland rivers – which are the same set of guidelines used by DECC (2009) in their water quality assessment described in the following section.

Table 3-1 Benchmarks for water quality

Parameter	ANZECC guideline	HRC objectives
Chlorophyll-a (µg/L)	5	10 - 15
Total Phosphorus (µg/L)	50	30
Filterable reactive phosphate (µg/L)	20	n/a
Total Nitrogen (µg/L)	500	500
Oxides of nitrogen (µg/L)	40	n/a
Ammonium (µg/L)	20	n/a
Dissolved Oxygen (% Saturation)	85 - 110	n/a
pH	6.5 - 8.0	n/a
Conductivity (µS/cm)	125 - 2200	n/a
Turbidity (NTU)	6 - 50	n/a

Note: Shaded cells indicate levels adopted for assessment

3.2.3 Existing water quality

Water quality monitoring at many sites in the Hawkesbury River has been routinely undertaken since the 1980's. Most monitoring has been undertaken by the Sydney Catchment Authority and Sydney Water. In 2009 the then NSW Department of Environment and Climate Change completed a full compilation and assessment of available water quality data (DECC, 2009). The assessment included an analysis of temporal trends in water quality at individual sites along the Hawkesbury River, including at the Windsor bridge.

The analysis and comparison of water quality data with the ANZECC/ARMCANZ (2000) guidelines prepared by DECC (2009) is provided in **Appendix C**. Site number N38 corresponds to the Windsor bridge. The assessment of water quality at Windsor bridge suggests:

- Conductivity, pH, and turbidity levels were frequently within the ANZECC guideline values over the whole record
- Dissolved oxygen levels have been steady over time and the majority were within guideline values
- There has been an improvement in phosphorus (total and filterable phosphorus) levels over time, and the majority of recent monitoring data has met the ANZECC guideline values.
- Nitrogen (total, oxides of nitrogen, and ammonium) levels and chlorophyll-a levels frequently exceed the ANZECC guideline values over the whole record.

Water quality of the Hawkesbury River was also recorded upstream and downstream of the proposed bridge crossing on 21 March 2012 (RMS, 2012c). Water quality parameters were measured using a calibrated Hydrolab Quanta water quality probe.

The monitoring found that water quality upstream and downstream of the existing Windsor bridge and proposed replacement bridge is generally good for the parameters tested, and consistent with the assessment by DECC (2009). Average concentration of all parameters except dissolved oxygen was within the ANZECC/ARMCANZ (2000) guidelines for slightly disturbed lowland rivers (refer **Table 3-2**). Dissolved oxygen concentrations at both sites exceeded the upper limit for dissolved oxygen (110 per cent saturation) with 114.3 per cent saturation upstream and 110.8 per cent saturation downstream.

Visibility at both sites was low which was partially attributed to the floods which had occurred within the Hawkesbury River three weeks prior to sampling and rainfall within the past week. However, the average turbidity was within the guidelines (6-50 NTU) both upstream (18.57 NTU) and downstream (26.73 NTU) of the project.

Table 3-2 Water quality upstream and downstream of the project

Parameter	ANZECC guideline*	Upstream of project	Downstream of project
Turbidity (NTU)	6 - 50	18.57	26.73
Temperature (°C)	n/a	21.31	21.63
pH	6.5 - 8.0	7.82	7.97
Conductivity (µS/cm)	125 - 2200	170	150
Dissolved Oxygen (% Saturation)	85 - 110	**114.30^**	**110.81^**
Dissolved Oxygen (mg/L)	n/a	10.40	9.86

** ANZECC/ARMCANZ 2000 default Trigger Values for slightly disturbed lowland rivers*

^*Exceeds ANZECC/ARMCANZ Guidelines*

3.3 Soil landscape

The 'Soil Landscapes of the Penrith 1:100 000 Sheet' (Bannerman and Hazelton, 1990) indicates the soil landscape at the project site is classified as Freemans Reach (fr). This soil landscape is an alluvium derived from the Narrabeen Group, Hawkesbury Sandstone and Wianamatta Group materials. The soils are typically deep brown sands and loams. It is a dynamic soil landscape where streambank erosion and deposition constantly occur, and the floodplains are subject to scour or sheet and rill erosion during floods.

The soils of the Freemans Reach soil landscape are highly erodible. They generally contain a high percentage of fine sand and have low to very low organic matter contents, and are moderately dispersible. The soil's erosion hazard is very high to extreme for concentrated flows and there is a high streambank erosion hazard.

3.4 Contamination

3.4.1 Stage 1 – Contamination assessment

Historical Photography

The findings of the historical aerial photograph investigation are summarised in **Table 3-3**. The historical land use information and historical aerial photography review has indicated that the northern section of the site has primarily been used as agricultural land since 1793, and the southern section of the site as residential since 1810. Several small scale industrial activities have also occurred in this area, however they are no longer active.

Use of the river for transportation purposes began in 1807 with the construction of a wharf on the southern bank of the Hawkesbury River, and Windsor Bridge at its present location, were constructed in 1874.

Table 3-3 Historical aerial photography review

Date of aerial photography	Subject site	Surrounding area
1947	The Windsor bridge, surrounding roads and residential areas are all present as part of the site in 1947. The northern section of the site appears to be cleared agricultural land, with little to no vegetation along the river banks and several small buildings on the sub-divided land. The river banks on the southern section are sparsely vegetated, with residential development the primary land use. Bridge Street crosses George Street at an intersection, with no roundabout present.	The area to the north of the site is sub-divided agricultural land. Agriculture appears to be cropping and an apparent orchard is also present. Land to the west of the northern section appears to be cleared, vacant land with 14 buildings adjacent to the site. Land to the east of the northern section is also sub-divided agricultural land with several buildings present. Land to the west, south and east of the southern section is dense residential land, with what appears to be unsealed roads.
1955	The site remains largely unchanged from the previous photograph.	The land surrounding the site remains largely unchanged from the previous photograph.
1961	Few significant changes are noted since the previous photograph except that the vegetation on the northern and southern river banks appears denser, and development of the northern river bank for river access has occurred.	The agriculture to the north of the site appears to have changed from what appeared to be an orchard to what may now be crops or turf. Light industry/construction has been established to the east of the northern section of the site. The residential areas to the south of the site appear to be denser than the previous photograph.
1965	Previous developments for river access on the northern bank appear to have been removed and vegetation reinstated.	Clearing of the site to the west of the northern section has occurred. Changes to the formation of the sub-divisions of agricultural land to the north have also occurred.
1970	Vegetation along the northern river bank appears denser and more uniform.	The property to the west of the northern section of the site has been further developed with the establishment of several new buildings. Some roads in the residential areas to the south of the site appear to have been sealed.
1971	Few significant changes are noted since the previous photograph except that the vegetation along the southern river bank appears denser.	Changes to the formation of the sub-divisions of agricultural land to the north have occurred.
1972	The site remains largely unchanged from the previous photograph.	The land surrounding the site remains largely unchanged from the previous photograph.

Date of aerial photography	Subject site	Surrounding area
1978	The site remains largely unchanged from the previous photograph.	The removal of the small buildings from the property to the west of the northern section of the site has occurred. The construction site to the east of the northern section of the site appears to have been completed /removed.
1982	The site remains largely unchanged from the previous photograph.	The land surrounding the site remains largely unchanged from the previous photograph.
1986	Vegetation on the northern and southern river banks appear to have been cleared due to an apparent recent flood.	Land to the west of the northern section of the site appears to have endured a recent flood and previously agricultural land now has exposed sands/soils.
1991	A small roundabout has been constructed at the intersection of Bridge and George Streets. Vegetation on the northern river bank has begun to re-establish. Vegetation on the southern river bank has been cleared for the development of several tracks along the foreshore.	The land surrounding the site remains largely unchanged from the previous photograph.
1994	The roundabout at the intersection of Bridge and George Streets has been further developed and now appears to be well established. The tracks along the foreshore on the southern bank have been paved.	The land surrounding the site remains largely unchanged from the previous photograph.
1998	The site remains largely unchanged from the previous photograph.	Flood affected land to the west of the northern section of the site has been re-vegetated.
2002	The site remains largely unchanged from the previous photograph except for the construction of a footpath adjacent to the northern bank of the Windsor Bridge, through the turf farm.	The land surrounding the site remains largely unchanged from the previous photograph.
2004	The site remains largely unchanged from the previous photograph.	The land surrounding the site remains largely unchanged from the previous photograph.
2005	The site remains largely unchanged from the previous photograph.	Some areas to the south of the site appear to have been developed into larger commercial areas.

Contaminated sites register

A search of the NSW OEH Contaminated Sites Register (under Section 58 of the *Contaminated Land Management Act 1997*) indicated that there are four notices for land within the suburb of Windsor. **Table 3-4** describes these sites in relation to the project location. Considering the proximity of the sites to the project, potential contamination types and migration pathways, it is unlikely that the contamination from the registered sites would impact upon the project area.

Table 3-4 Notices for land within Windsor

Suburb	Notified Site Address	Notified Activity	Location
Windsor	Former Caltex Service Station 46-52 Macquarie St	Service Station	Approximately 500 m south-west of the subject site
Windsor	Caltex Service Station 48-50 Mileham St	Service Station	Approximately 1.2 km south west of the subject site
Windsor	Caltex Service Station Corner Macquarie & Baker Streets	Service Station	Approximately 250 m south-southwest of the subject site
Windsor	Woolworths Service Station Corner Macquarie & Baker streets	Service Station	Approximately 250 m south-southwest of the subject site

Site inspection

The following observations were made during a site inspection:

- Locations on the retaining walls underneath the existing bridge on the northern and southern banks of the river were observed to comprise fill material. The fill generally consisted of concrete, plastic (miscellaneous), glass, general rubbish, and reworked natural material. Depths at these locations were limited by a wire mesh that appeared to cover the entire rock wall, and the presence of gabions.
- The grassed edge of the turf farm closest to the foot path appeared to be yellowing, indicating possible herbicide application. No other evidence of vegetation die-off was visible across the turf farm. The turf farm appeared to be natural material to a depth of one metre below ground level.
- No odours or unusual staining were observed.

Potential sites and sources of contamination

Based upon the site history and a site inspection potential sites and sources of contamination are identified in **Table 3-5.**

Table 3-5 Sites and sources of potential contamination

Site/ source	Contaminants of concern	Location
Turf farm / agricultural areas	Organochlorine Pesticides (OCP), Organophosphorus Pesticides (OPP), herbicides and heavy metals.	To the north and east of the northern approach of Windsor Bridge. Forms part of the proposed roundabout on the northern bank.
Deterioration of bridge structures underneath Windsor Bridge (i.e. crossbeams, break walls and pylons).	Heavy metals (associated with paints), asbestos, and Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) (associated with fill material behind the break walls).	Underneath the entrance to the bridge on both the northern and southern approaches.
Deposition of potentially contaminated sediments from upstream during flooding events.	Heavy metals, OCP, OPP, TPH, BTEX, PAH and PCB	Along river banks and sediments throughout the site.

The key findings of the Stage 1 investigations resulted in the recommendation for a Stage 2 detailed site investigation to be undertaken for the project.

3.4.2 Stage 2 - Soil analytical results

The soil analytical results are presented in **Appendix D** and laboratory reports are included in **Appendix B**. A description of the laboratory results is presented in **Table 3-6**. Soil sampling locations are shown in **Figure 2-1**.

Table 3-6 Soil analytical results

Contaminant	Description of results
Total petroleum hydrocarbons	A total of ten soil samples were analysed for the presence of total petroleum hydrocarbons compounds. All samples recorded concentrations below the site assessment criteria.
Benzene, toluene, ethylbenzene and xylene (BTEX)	A total of ten soil samples were analysed for the presence of BTEX. All samples recorded concentrations below the site assessment criteria.
Heavy metals	A total of ten soil samples were analysed for the presence of heavy metals. All samples recorded concentrations below the site assessment criteria.
Polycyclic aromatic hydrocarbons	A total of ten soil samples were analysed for the presence of polycyclic aromatic hydrocarbons. All samples recorded concentrations below the site assessment criteria.
Polychlorinated biphenyls	A total of ten soil samples were analysed for the presence of polychlorinated biphenyls. All samples recorded concentrations below the limit of reporting and site assessment criteria.
Organochlorine pesticides	A total of ten soil samples were analysed for the presence of organochlorine pesticides. All samples recorded concentrations below the site assessment criteria.
Organophosphorus pesticides	A total of ten soil samples were analysed for the presence of organophosphorus pesticides. All samples recorded concentrations below the limit of reporting and site assessment criteria.
Asbestos	A total of ten soil samples were analysed for the presence of asbestos. Asbestos fibres were not identified in any of the samples.

3.4.3 Sediments

In 1998 a major study was published on the concentrations of heavy metals in the sediments of Hawkesbury-Nepean River (Birch et al, 1998) which included the sediments in the river around Windsor. The results of this study are summarised in the following paragraphs.

Sediment samples were collected along the length of the Hawkesbury-Nepean River and from major embayments, creeks and reference locations. The sediments were analysed for a range of heavy metals including copper, lead, zinc, nickel, cobalt, cadmium, manganese and iron. Where possible, heavy metal concentrations in sediments were compared to reference locations and other estuaries in NSW to provide an indication of the comparative contamination.

Generally the concentrations of heavy metals in the sediments in the main channel increased marginally with distance upstream, with the sediments at Windsor recording the highest concentrations in the main channel. Typical average concentrations of key heavy metals in the sediments around Windsor are about 26 micrograms per kilogram of copper, 39 micrograms per kilogram of lead and 110 micrograms per kilogram of zinc.

These concentrations are below the low range Interim Sediment Quality Guidelines (ANZECC/ARMCANZ, 2000) and would be considered uncontaminated.

The sediment heavy metal concentrations in the main channel were substantially below other areas in Hawkesbury-Nepean River, especially some of the poorly flushed embayments near the mouth of the river and creeks with urbanised catchments. Sediment heavy metal concentrations in Hawkesbury-Nepean River are also substantially below concentrations recorded in other urban estuaries in Sydney such as Port Jackson.

3.5 Acid sulfate soils

The sediment ASS analytical results are presented in **Appendix D** and laboratory reports are included in **Appendix B**. A total of four sediment samples were analysed using the Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) analytical method. A summary of the laboratory analytical results is presented in **Table 3-7.**

Table 3-7 also provides a comparison of the difference between sulfate component S_{KCl} and the sulfide component S_P (*i.e.* S_{POS} or sulfur trail) used to determine the presence of potential acid sulfate soils. The difference between sulfate component S_{KCl} and the sulfide component S_P (*i.e.* S_{POS}) did not exceed the ASSMAC (1998) criteria of 0.03 per cent for WB-ASS-02, WB-ASS-03 and WB-ASS-04. However, S_{POS} for WB-ASS-01 exceeded the ASSMAC (1998) criteria at 0.12 per cent. Additionally, the highest level of acidity anticipated as a consequence of soil oxidation (TPA) did not exceed the criteria of 18 mol H+/tonne at any of the sampled locations.

Table 3-7 ASS analysis results

Sample number	Depth (m)	pH_{kcl} --	S_P %	S_{KCL} %	S pos %	TAA	TPA	TSA
						mol H+/tonne		
WB-ASS-01	0.25	5.8	0.13	<0.005	**0.12**	<5	<5	<5
WB-ASS-02	0.5	6	0.02	<0.005	0.02	<5	<5	<5
WB-ASS-03	0.25	5.6	0.02	<0.005	0.02	<5	<5	<5
WB-ASS-04	0.5	5.2	0.02	<0.005	0.02	<5	<5	<5
Assessment criteria	**-**	**-**	**-**	**-**	**0.03**	**-**	**18**	**-**

Note: Shaded cell indicates exceedance
pH_{kcl} – The pH of the soil solution
S_P (%) – percentage of oxidisable sulfur
S_{kcl} - potassium chloride extractable sulfur
S_{pos} - Sulfur oxidised by peroxide digestion and calculated as (S_p – S_{KCl})
TAA - Titratable Actual Acidity
TPA - Titratable Peroxide Acidity
TSA - Titratable Sulfidic Acidity

The results indicate that there is the potential for acid sulfate soils to be present within sediments near the southern bank. However as noted in the *Acid Sulfate Soils Assessment Guidelines* (ASSMAC 1998), estuarine sediments may give false positives to the presence of acid sulfate soil especially if there is a high proportion of organic matter in the sediments. Further sampling and analysis would be required to conclusively determine whether acid sulfate soils are present.

3.6 Hazardous materials audit

No suspected Synthetic Mineral Fibres, Nickel Cadmium batteries or items containing Polychlorinated Biphenyls were observed during the inspection of the bridge structure.

Asbestos or Synthetic Mineral Fibres were not identified in sample WB3 collected from the gasket/seal from the water main.

Lead based paints (ie. lead at concentrations of greater than 1% w/w) were detected in paint samples WB5 and WB6 collected from the iron piers and iron cross bracings. Lead was not detected at concentrations above 1% in other samples submitted for laboratory analysis.

3.7 Groundwater

A search of the NSW Natural Resources Atlas database identified no registered groundwater wells within the project area. However one well (GW106373) is immediately adjacent to the project near the corner of Wilberforce and Freemans Reach Roads. Seven other wells were registered within a 1 kilometre radius of the site, however these were of sufficient distance away from the project as to not be impacted by it or monitoring well. Information on five of the wells was available for review, which is summarised in **Table 3-8**. The groundwater bore information suggests:

- That in areas where there are gravels and sands in the top soil profile layers, there is an aquifer of good quality and low salinity water
- That in areas where there are no are gravel and sands in the top soil profile layers, groundwater is only encountered at depths greater than at least 25m below surface and the groundwater is of relatively high salinity.

Table 3-8 Registered National Resources Atlas database boreholes

Borehole ID	Easting	Northing	Depth (m)	Water bearing zones (m below surface)	Salinity (Total Dissolved Solids mg/L)	Bore Usage
GW101009	297703	6280636	107	27-30m 42-45m	6000	Domestic Stock
GW106373	297878	6279899	15	10-15m	467	Domestic
GW109520	297309	6278401	6	Not applicable	No data	Monitoring Bore
GW109521	297371	6278340	6	Not applicable	No data	Monitoring Bore
GW103069	206676	6279119	84	75-76m	2200	Domestic Stock

Apart from the salinity data contained in registered drilling bore logs there was no other information on the quality of groundwater in the study area.

Groundwater level measurements were undertaken at all geotechnical investigation locations where free groundwater or seepage was observed in boreholes (see **Figure 2-2)**. A summary of the groundwater level observations recorded during the site investigations are presented in **Table 3-9**, which is close to the level of the river during normal flow periods (-0.5 to 0.7 m AHD). Groundwater flow would be expected to be towards the river as generally this would the lowest point in the aquifer.

Table 3-9 Groundwater observation levels during investigations

Location ID	Surface RL (metres AHD)	Water Level (m bgl)	Water Level (m AHD)
NA-BH02	7.80	6.90	0.90
NA-CPT01	9.20	8.05	1.15
NA-CPT02	10.00	8.90	1.10

Note 1. m AHD = Metres Australian Height Datum
Note 2. m bgl = Metres Below Ground Level
Note 3. RL = Relative level

4 Impact assessment

4.1 Soil, sediment and water management

4.1.1 Overview

The construction and operation of the project would potentially lead to adverse impacts on soil, sediment and water quality of the Hawkesbury River if appropriate management measures are not employed. Construction activities would expose soils and disturb sediments, increasing the risk of erosion and sedimentation in the river. Operation would potentially lead to increased quantities of pollutants or accidental spills on the paved road surface being discharged directly to the river. Demolition and removal of the existing bridge could also result in rubble or debris potentially entering the river, causing a decline in river water quality.

4.1.2 Construction

The construction phase of the project would involve both land-based and water-based construction activities. These would present a risk to soil, sediment and water quality if management measures are not implemented, monitored and maintained throughout the construction process.

4.1.3 Land-based construction

The risks from land-based construction would largely be during rainfall and wind events, when sediments or pollutants resulting from construction can flow or be blown to sensitive receiving environments. The highest risk to soil, sediment and water quality would occur during construction activities such as:

- Earthworks, including stripping of vegetation and topsoil, excavation or filling.
- Stockpiling of topsoil, vegetation and other construction materials.
- Transportation of cut or fill materials.
- Movement of heavy vehicles across exposed earth.
- Removal of riparian vegetation.
- Construction in any areas of highly erodible soils.
- Construction in any contaminated land.
- Construction in any acid sulfate soils.

These activities expose soils and, without proper management, may result in sediments and associated pollutants being washed during rainfall events or blown into downstream watercourses, with consequent potential degradation of water quality. The impact of unmitigated construction activities on receiving surface waters could include:

- Increased sedimentation smothering aquatic life and affecting the ecosystems of the river.
- Increased levels of nutrients, metals and other pollutants, transported via sediment to the river.
- Fuel, chemicals, oils, grease and petroleum hydrocarbon spills from construction machinery directly polluting the river and soils.
- Spills of concrete during concrete pours directly polluting the river and soils.
- Contamination from site compounds, chemical storage areas and washdown locations.
- Increased levels of litter from construction activities polluting the river.

- Contamination of the river as a result of disturbance of contaminated land.
- Acidification of the river as a result of disturbance of acid sulfate soils during construction.
- Tannin leachate from clearing and mulching of vegetation. This impact would be unlikely as vegetation clearance would be minimal and any cleared vegetation would be removed from site shortly after clearing.

4.1.4 Water-based construction

Water-based construction activities would be conducted from barges or jetties and would include construction of the bridge piers and installation of scour protection. Construction of the bridge piers would involve the installation of piles to the required depth at each pier location, and installing pile caps and the pier columns. Scour protection in the form of rock will be installed at the bridge abutments and piers. Removal of bed and bank material is needed to allow for the required volume of rock scour protection.

The water-based construction activities, such as dredging, would cause disturbance of bed sediments. If unmitigated or inadequately managed, this would cause a decline in water quality and visual amenity around the construction activities, particularly due to increased turbidity levels from suspension of solids.

4.1.5 Operation

During the operational phase of the project, the approach roads and bridge would be sealed, cleared areas landscaped and scour protection installed. There would be no exposed topsoil and therefore little or no risk of soil erosion and transport of eroded sediments to the river. Water quality risks during operation would instead be associated with the runoff of pollutants from the new road surface, with pollutant sources including atmospheric deposition, vehicles and litter from motorists.

Pollutants deposited onto road surfaces by vehicles typically include:

- Hydrocarbons and combustion derivatives
- Lubricating oil
- Rubber
- Heavy metals such as lead, zinc, copper, cadmium, chromium, and nickel
- Brake pad dust and potentially asbestos from older brake pads.

These deposits build up on road surfaces and pavement areas during dry weather and would be washed off and transported to waterways during rainfall periods. Other pollutants in the atmosphere, such as nitrogen, that are derived from local and regional sources would also be deposited and build up on the road pavement and contribute to operational impacts on water quality.

Pollutants deposited by motorists, such as non-biodegradable garbage and food wastes, could also impact water quality, amenity and aquatic conditions during operation of the project by washing into downstream watercourses.

During the operation there would also be a risk of accidental spillage of petroleum, chemicals or other hazardous liquids as a result of vehicle leakage or road accidents on the new bridge or approach roads. Although the likelihood of a potential spill would be low, the consequence to the environment could be considerable as spills of this nature would pollute the river if unmitigated.

4.1.6 Demolition

Demolition and removal of the existing bridge would also present a potential risk to the water quality of the river. The demolition of the existing bridge would take place after the bridge replacement becomes operational.

Removal of the bridge deck and piers would involve cutting these bridge elements into discrete sections, lifting the sections out by crane and placing them on trucks for transportation to a disposal facility. The demolition activities could potentially result in rubble and debris entering the river and disturbance of the river bed material. Without appropriate management measures in place this would lead to adverse impacts on the river's water quality such as increased turbidity.

4.2 Contamination and hazardous materials

4.2.1 Construction

The risk from contaminated soils during with construction of the project would be low as all soil samples collected were below site assessment criteria. These risks would be further reduced as earthworks for the project would be relatively minor (i.e. the majority of works involve placing fill on the existing land surface). However despite the low risk, contaminated soils and materials may still be encountered especially on the southern bank as this area has a long history of urban use and not all areas were able to be sampled. Soil at the turf farm presents a lower risk with respect to contamination as it is relatively homogenous and has generally been used for agricultural purposes.

Based up studies of the river sediments in the Hawkesbury River (Birch et al, 1998), the river sediments at Windsor are not contaminated with heavy metals and therefore the risk of ecological impacts due to mobilising contaminated sediment during construction would be negligible.

4.2.2 Operation

Accidental events such as vehicle crashes on the new bridge or approach roads could cause a spill of contaminants on to the bridge or approach roads. If these spills were not contained they could be discharged into the river via the drainage system and could cause water quality and aquatic ecosystem impacts.

4.2.3 Demolition

The hazardous material audit found that paint samples from the iron piers and iron cross bracings of the existing bridge contained high levels of lead. If during demolition of the existing bridge, this paint was to find its way into the river it could cause aquatic ecosystem, sediment quality and water quality impacts.

4.3 Acid sulfate soils

4.3.1 Construction

ASS have been identified within the river sediment near the southern bank. However as noted in **Section 3.5** further sampling would be required to conclusively confirm their presence. There would be the risk of ASS disturbance and exposure during piling and dredging works (SKM, 2012b). Based upon the analytical results the ASS in the river sediments is potential acid sulfate soil. This means the soil has not been exposed to air and has not yet oxidised. Therefore the risk from the ASS would occur once the sediment is brought to surface and is exposed to air. This would start the process of oxidation of the ASS in the sediment – which would result in the production of acid.

If the oxidised ASS where not managed, acid runoff from the soil could be discharged into aquatic or terrestrial environments causing impacts on ecosystems and infrastructure. It should be noted that the oxidation of the ASS would not be instantaneous and would occur over a period of weeks or months.

4.3.2 Operation

There would be no impact from ASS due to the operation of the project.

4.3.3 Demolition

While the demolition of the existing bridge piers may result in the disturbance of ASS in the river sediments, it would be unlikely that significant quantities of ASS would be brought to the surface. Therefore the risk from ASS soils during demolition would be low.

4.4 Waste management and handling

4.4.1 Construction

As the project only consists of the bridge, short sections of approach roads and other relatively minor works, the construction of the project would not generate significant quantities of waste. Demolition of the existing bridge which would generate substantial quantities of waste is discussed below. The type of wastes that would be generated during construction and their management is presented in **Table 4-1**.

Although the project would require the importation of about 10,800 cubic metres of fill material, some excess spoil would be generated including:

- Soils – This includes topsoil and natural B horizon soils (ie. soils between the topsoil and underlying bedrock).
- Fill material – This includes imported soils and other material that has been used for infilling (eg. old concrete, wood).
- Natural rock – This material would be generated from bored piling activities and where excavation of bed rock is required (eg. for service relocations).
- Road construction material – This would include material generated from the demolition of the existing roads such as asphalt, geotechnically stabilised road sub-base and base material.
- River bed sediments – This material would originate from dredging for the installation of scour protection.

The natural rock and the road construction material would be geotechnically suitable for reuse for road construction. However they may not be able to be reused on the project as the northern river bank is flooded in a 1 in 3 year flood event and there is limited space on the southern bank, so stockpiling on-site for later reuse may not be possible. If this material is unable to be reused on site alternative off-site reuse opportunities would be investigated.

Although the soils from the northern river bank would be suitable for landscaping, again because of the restrictions in on-site stockpiling, the reuse of these soils for the project may not be possible. These soils would either be stockpiled off-site for later use on the project or sent to recycling facilities.

All other excess spoil materials would be likely to be geotechnically unsuitable for road construction or unsuitable for landscaping. On the southern bank, small quantities (<500 cubic metres) of geotechnically unsuitable fill and soil material would be generated. Based on initial contamination testing this would likely be classified as General Solid Waste (non-putrescible) and would be disposed of an appropriately licensed landfill.

Initial sampling of the river bed sediments indicates that low strength acid sulphate soils may be present near the southern bank. Further sampling would be required to confirm the presence of acid sulphate soils. The river bed sediments would not be suitable for reuse and would require disposal at an appropriately licensed landfill.

Table 4-1: Type and management of waste materials generated during construction

Material	Management
General office waste – These would include paper, food packaging, food scraps and other general waste.	Where possible, recyclable material would be separated and sent to recycling facilities. Non-recyclable waste would be classified and disposed of at an appropriately licensed facility.
Vegetation – Removal of small areas of existing vegetation would be required.	All woody vegetation such as trees would be mulched and reused either on site for landscaping or sent to recycling facilities. Weeds would be bagged and sent to landfill
Concrete – Small volumes of excess concrete would be generated from the construction of the replacement bridge and structures. Also the demolition of existing kerbs and other concrete structures may generate small volumes of concrete	Any excess concrete would send off-site to a licensed concrete recycling facility.
Steel - Small amounts of excess steel reinforcement would be generated from the construction of bridge and structures	All excess steel would be sent off-site to a licensed steel recycled facility.
General construction waste – This would consist of bags, packaging, off-cuts and other general waste generated by construction activities	Where possible, recyclable material would be separated and sent off-site to licensed recycling facilities. Non-recyclable waste would be classified as General Solid waste and disposed of at an appropriately licensed facility.
Special construction waste – This would include batteries, waste oil and containers and other potentially hazardous materials	Where possible, recyclable material would be separated and sent to recycling facilities. Non-recyclable waste would be classified as per the Waste Classification guidelines and disposed of at an appropriately licensed facility.

Resource use

The construction of the project would require raw and processed materials such as concrete, steel, imported fill and fuel to power construction equipment. As the project is relatively small in size, the quantities of different materials required for construction would not be significant and would be able to be sourced within the region. Apart from flyash in concrete, the opportunity to use recycled material in construction would be limited as the replacement bridge and approach roads would have higher quality specifications that typically required as they would have to withstand regular immersion by flood waters. The use of recycled material in the replacement bridge may increase its chance of failure or deterioration due to risks of inconsistencies in the quality of recycled materials. The only recycled material that would be used during construction would be the imported fill (about 10,800 cubic metres). Where possible, suitable fill material may be sourced from another construction project which has excess spoil.

Table 4-2 Approximate quantities of materials used for construction

Description	Approximate quantities
Road works	
Earthworks (cut to fill)	1500 m^3
Earthworks (imported fill)	10,000 m^3
Concrete	3500 m^3
Asphalt	1000 tonnes
Dense grade base (DGB)	650 m^3
Structural steel	30 tonnes
Bridge works	
Concrete	2400 m^3
Steel reinforcement	450 tonnes
Asphalt	500 tonnes
Imported fill	800 m^3

4.4.2 Operation

During operation of the project, small quantities of waste would be generated and would potentially include spills and leakages from vehicles, litter generated by road users and sediment from the water quality control basin. In addition, small quantities of waste would be generated from road maintenance and repair activities. The volume of operational waste would be minor and would be classified and disposed of at an appropriately licensed landfill.

In terms of resources use, small quantities of asphalt, concrete and other materials would be used to maintain the project.

4.4.3 Demolition

The existing Windsor bridge would be demolished following commissioning of the replacement bridge and associated approach roads. The existing bridge superstructure and substructure would be removed in sections, with temporary bracing installed, as required, to maintain the stability of remaining sections during the demolition process. Where possible the process of demolition would involve cutting the superstructure and substructure into sections, with each section transported off-site for further processing at a licensed facility. This approach would minimise environmental impacts, such as noise, dust, disturbance of roads and contamination of the river.

Bridge materials resulting from the demolition would be recycled where possible. Metals that have the potential to be reused include the iron piers, railings and the service conduits. Lead-based paint has been identified on some metal elements of the existing bridge and would need to be removed before recycling or reuse of materials. Any lead based paint removed from the metal elements of the existing bridge would be likely to be classified as hazardous waste under the Waste Classification Guidelines and would require disposal at an appropriately licensed facility. The concrete sections of the existing bridge would be sent to a concrete recycling facility – where it would be crushed and sold as temporary road base or for other uses. Up to 2000 tonnes of concrete would be generated from the demolition of the bridge. Some material from the bridge demolition may not be able to be recycled and would require classification and disposal at an appropriately licensed landfill.

4.5 Groundwater

4.5.1 Construction

The main potential impacts on groundwater would be:

- Inference of the aquifer – resulting in a decrease or change in groundwater levels impacting upon groundwater users and groundwater dependent ecosystems.
- Pollution of the groundwater resources.

The risk of these impacts from construction activities would be very low as:

- There are either no permanent aquifers (southern bank) or groundwater levels are very close to the river level (northern bank) and not close to the ground surface.
- Apart from piling, no construction activities would potentially interfere with any permanent or temporary aquifer. No dewatering would be required for piling activities.
- Predominately the flow of groundwater would be towards the river and therefore the project would be unlikely to decrease groundwater levels at nearby groundwater bores which are further away from the river.
- The foot print of the project would be relatively small and therefore the potential impact on groundwater would also be small.
- The risk of pollution of groundwater would be minimised through the implementation of appropriate management measures detailed in the following sections.

4.5.2 Operation

There would be no impact on groundwater from the operation of the project.

4.5.3 Operation

There would be no impact on groundwater from the demolition of the existing bridge.

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5 Environmental management measures

5.1 Overview

Mitigation and management measures would be implemented during construction, operation, and demolition to minimise the impact on soil, sediment and water quality of the Hawkesbury River. The mitigation and management measures that would be implemented during each project phase are described in the following sections.

5.2 Soil, sediment and water management

5.2.1 Construction

Land-based construction

Potential impacts to soil, sediment and water from the project's land-based construction activities will be mitigated and managed by implementing local erosion and sediment controls. An erosion and sediment control plan will be developed during detailed design in accordance with *Managing Urban Stormwater – Soils and Construction- Volume 1* (Landcom, 2004) and *Volume 2D* (DECC, 2008). The detailed erosion and sediment control plan will incorporate erosion control measures to limit the movement of soil from disturbed areas, and sediment control measures to remove any sediment from runoff prior to discharge into the river. Erosion control measures will include:

- Avoid disturbance where possible, or else minimise the area of disturbance, particularly on river banks
- Designated “no-go” zones for construction plant and equipment
- Installation of upstream diversion channels to direct clean runoff from upstream catchments around or through disturbed areas
- Shaping of disturbed land to minimise slope lengths and gradients and improve drainage.
- Installation and appropriate lining of catch drains to carry any sediment laden runoff to appropriate sediment control measures
- Stockpiling of material would be minimised. Any cleared or excavated materials would be removed off site by truck shortly after excavation and appropriately disposed of or stockpiled off-site
- Seeding of disturbed areas for temporary soil stabilisation
- Employment of appropriate measures to prevent wind-blown dust entering the river
- Designated areas for plant and construction material storage within the site compound
- Ensuring all chemicals and fuels associated with construction are stored in roofed and bunded areas.

Sediment control measures will include:

- Construction and installation of sediment traps and sediment filters, for example silt fences and check dams
- Progressive rehabilitation and re-vegetation of disturbed areas as works are completed
- A proposed permanent water quality basin located on the northern bank (discussed in **Section 5.2.2**) will be used as a sediment retention basin during construction. The basin will be constructed as early in the construction phase as possible to maximise its effectiveness as a sediment control measure.

Water-based construction

Appropriate measures will be implemented to contain any turbid water as best as possible, such as silt curtains or similar and the use of appropriate dredging methods, such as suction dredging. The Soil and Water Management Plan which would include the erosion and sediment control plan for land-based construction works would also include mitigation measures to minimise the impacts of water based construction activities.

Development and implementation of a water quality monitoring program will also assist in identifying impacts and assessing the effectiveness of mitigation measures. The water quality monitoring program will be developed during detailed design, covering pre-construction, construction and post-construction phases, and in accordance with the RMS Guideline for Construction Water Quality Monitoring (RTA, no date).

5.2.2 Operation

Operational impacts to water quality will be mitigated by the use of water quality control devices incorporated into the project's drainage system. The water quality control devices will remove pollutants from stormwater runoff generated from the new bridge and approach roads, and will provide a mechanism for capturing any accidental spills of hazardous liquids that may occur.

The drainage system comprises of two main stormwater outlets discharging to the Hawkesbury River, one at the southern bank of the river and the other at the northern bank. Operational water quality control devices will be provided for each catchment and were selected considering the site constraints at each outlet. A description of the catchments and the operational water quality control devices is provided below, while a sketch of the outlet locations, effective catchment areas, and water quality controls is provided in **Figure 5.1.**

5.2.3 Southern outlet

The southern stormwater outlet would be located about 25 metres east of the proposed southern abutment of the replacement bridge. As shown in **Figure 5.1**, the catchment area collected by the new southern stormwater system would include the southern road approach between George Street and the southern bridge abutment as well as reconstructed areas of The Terrace. The stormwater outlet discharges directly into the river. There is very little available space to provide a water quality control device, such as an in-line gross pollutant trap due to existing development and the proximity of The Terrace to the river's southern bank.

Due to space restrictions an end of pipe net type gross pollutant trap connected to the stormwater outlet will be provided. A photograph of an example in operation is provided in **Figure 5-2**. The net will collect gross pollutants (litter) contained in stormwater runoff, preventing them from entering the river and causing a decline in the river's visual amenity and water quality. The net would be emptied on a regular basis by RMS or HCC to ensure it continues functioning as intended.

Figure 5-2 Photograph of an example end of line net type GPT

To mitigate the potential impact of spills of hazardous liquids, a lockable shut-off valve will be provided at a stormwater pit immediately upstream of the outlet. In the event of an accidental spill, the shut-off valve will be closed manually by the RMS or NSW Fire Brigade Emergency Response Team. Any accidental spill will then be contained within the stormwater system and prevented from entering the river. The spill will then be removed from the stormwater system and appropriately disposed of before reopening the shut-off valve.

5.2.4 Northern outlet

The northern stormwater system will discharge into a permanent water quality basin near the south eastern corner of the new roundabout on the northern bank. The catchment area collected by the northern stormwater system will include the new bridge and portions of Freemans Reach Road, Wilberforce Road and the access to Macquarie Park (refer to Figure 5.1). A permanent water quality basin will be constructed and located immediately downstream of the stormwater outlet. The basin will remove suspended solids and gross pollutants from stormwater runoff before discharging to the river. The basin's dimensions will be about 25 metres long, 12 metres wide, and 1.5 metres in water depth. Regular maintenance will be undertaken by RMS to remove sediment and other captured pollutants from the basin

The basin will be fitted with an underflow baffle arrangement to provide accidental spill capture and containment for a minimum volume of 20 cubic metres. The position and size of the baffle will prevent hazardous liquid spills from entering the river during dry weather and smaller more frequent rainfall events. Any captured spills will be removed from the basin by RMS and disposed of appropriately.

5.2.5 Demolition

Mitigation and management measures that would be implemented during demolition of the existing bridge would include:

- Cutting and removing the existing bridge in large sections and transporting them from the site for demolition and recycling or disposal in a licensed facility. By cutting the bridge into large sections the amount and risk of debris falling into the river is reduced.
- Preventing falling debris and rubble entering the river by installing a safety net under the bridge.
- Containing any disturbance or turbidity by installing self-containment equipment such as silt curtains.

- Monitoring water quality in the river in accordance with the RMS Guideline for Construction Water Quality Monitoring (RTA, no date).
- Scheduling demolition activities to avoid or minimise works taking place during times of higher wind, rainfall and river flows.

5.3 Contamination and hazardous materials

5.3.1 Construction

While no contaminated soils or materials were found in the project area from the Phase 2 investigations, unknown contaminated soils and material maybe encountered during construction. The following mitigation will be implemented to address this risk:

- During excavations, soil and fill material will be visually monitored to identify the potential contaminated material or soils.
- If potentially contaminated material or soils is suspected, works will cease in the area and additional investigations and monitoring will be undertaken.
- If it is confirmed that contaminated material or soils is present on site, an appropriate remediation plan will be developed and implemented.

5.3.2 Operation

The spill containment measures detailed in **Section 5.2.2** will mitigate against any contamination resulting from operation of the project.

5.3.3 Demolition

Lead based paints have been identified on the iron piers and cross bracings of the bridge structure. These painted surfaces will need to be managed during demolition of the existing bridge structure.

Any demolition of bridge structures containing lead based paints will be undertaken in accordance with the following:

- Australian Standard AS 4361.1 – 1995, *Guide to lead paint management, Part 1: Industrial applications.*
- Australian Standard AS 4361.2 – 1998, *Guide to lead paint management, Part 2: Residential and commercial buildings.*
- Australian Standard AS 2601 – 2001, *The demolition of structures*.

There are a number of options for the management of lead painted structures during the demolition of the existing bridge. These management options are recommended to reduce and/or remove the risk of lead impacting upon human health or the environment. The management of lead based paints will also require containment of the work area. Containment includes all procedures and systems that prevent dust and debris spreading beyond the immediate work area. Containment includes physical barriers to prevent travel of dust, the exclusion of occupants or the public from the work area, security of the work area and regular cleaning up and disposal of debris. Regardless of which option is chosen to manage the paint, an appropriate degree of containment based upon the management measures below will need to be installed prior to carrying out the work.

The options for the management of lead based paints during the demolition of the existing bridge structure (based on the respective Australian standards) are as follows:

- Containment – This option will involve the implementation of a high level of containment to prevent dust and debris spreading beyond the immediate works site during demolition.
- Paint stabilisation – Paint stabilisation will require the existing surfaces to be stabilised with another non-hazardous covering. During both stabilisation and structure removal, a moderate level of containment will be required.
- Paint removal – Paint removal will require the existing painted surfaces to be removed prior to demolition. During paint removal, a high level of containment will be required. Little to no containment will be required to manage the demolition of the structure following removal of the lead based paints.

5.4 Waste management and handling

The following mitigation measures would be implemented to minimise the impact of waste generation during construction and demolition:

- Detailed waste management measures and procedures would be included in the CEMP for the project.
- Waste management measures would be based upon the philosophy of reduce, reuse, recycle and appropriate disposal.
- The project induction would cover waste management measures in the CEMP.
- All waste material requiring off-site disposal would be classified using the Waste Classification Guidelines and disposed of at an appropriately licensed facility.
- Procurement and waste management measures will be based upon the philosophy of reduce, reuse, recycle and appropriate disposal.
- Management measures would be consistent with RMS policies for waste management and reuse including the Waste Reduction and Purchasing Plan (RMS, 2009) and the Environmental Sustainability Strategy (RMS, 2010).

No specific waste mitigation measures will be required for operation.

5.5 Acid sulfate soils

5.5.1 Construction

The following mitigation measures will be implemented during construction to minimise the impact of ASS.

- Further ASS investigations will be undertaken before construction of the project.
- If the presence of ASS is confirmed in the river sediment, an ASS management plan will be developed and implemented. The plan will detail the management, handling, treatment and disposal of ASS for both the construction of the project and demolition of the exiting bridge.

5.5.2 Operation

No mitigation measures will be required to manage ASS during the operation of the project.

5.5.3 Demolition

No mitigation measures will be required to manage ASS during the demolition of the existing bridge.

5.6 Groundwater

5.6.1 Construction

While the construction of the project would unlikely impact on groundwater resources, a number of piezometers have been installed as part of the project and these will be monitored to assess any impacts on groundwater. The existing groundwater bore adjacent to corner of Freemans Reach Road and Wilberforce Road will be also be monitored. A preparation of a specific groundwater management plan for the project is not warranted. All groundwater monitoring requirements will be detailed in the Soil and Water Management Plan.

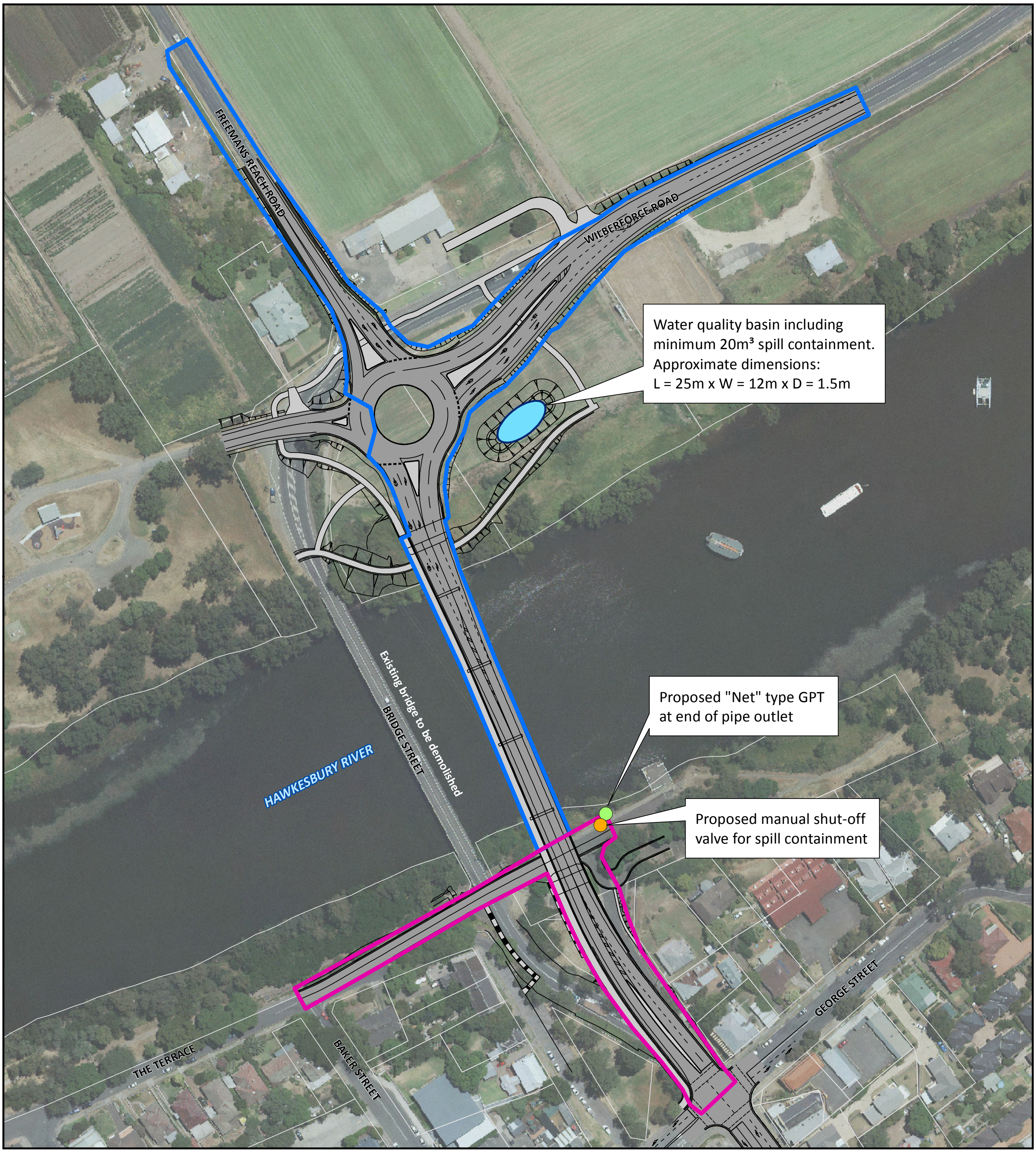
5.6.2 Operation

No mitigation measures will be required to manage groundwater during the operation of the project.

5.6.3 Demolition

No mitigation measures will be required to manage groundwater during the demolition of the existing bridge.

Figure 5.1 | Proposed operational phase water quality controls



Water quality basin including minimum 20m³ spill containment. Approximate dimensions: L = 25m x W = 12m x D = 1.5m

Proposed "Net" type GPT at end of pipe outlet

Proposed manual shut-off valve for spill containment

Indicative only – subject to detailed design

LEGEND

▤ Concept design

☐ Cadastral boundary

Effective catchment areas

🟦 Northern catchment

🟪 Southern catchment

Site

⬭ WQ basin

● Proposed GPT

● Proposed shut-off valve

GDA 1994 | MGA Zone 56

A4 1:2,500

0 50

Metres

26/10/2012 | I:\NBIF\Projects\NB11459\Technical\GIS\GIS_Directory\ArcMap\Specialist_Reports\Soil_and_Water\NB11459_002_S&W_Figure.mxd
Sydney Spatial Team - Prepared by : DD
Checked by : JC

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6 Conclusion

6.1 Soil and water management

The Hawkesbury River is highly valued by the community as it provides habitat for aquatic organisms, is used for recreational purposes, and provides visual amenity. Water quality monitoring found that water quality upstream and downstream of the existing Windsor bridge and proposed crossing is generally good.

The local soils are highly erodible. The soils' erosion hazard is very high to extreme for concentrated flows and there is a high streambank erosion hazard.

There would be a high risk to water quality during construction of the new bridge due to the sensitivity of the receiving water, the high erosion hazard of the surrounding soils, and pier and other water based construction activities occurring in the river. The risk to water quality will be mitigated and managed during construction by implementing appropriate erosion and sediment controls, using a pier construction method to minimise disturbance of the river bed material and by implementing other mitigation measures for water-based construction such as silt curtains. These mitigation measures would be detailed in a Soil and Water Management Plan.

There would be a risk to water quality during operation from stormwater runoff carrying pollutants from the new road surface to the river. Pollutant sources include atmospheric deposition, vehicles and motorists. There would also be a risk of accidental spillage of petroleum, chemicals or other hazardous materials as a result of vehicle leakage or road accidents. The impacts to water quality will be mitigated by the use of water quality control devices incorporated into the project's drainage systems. These controls will remove pollutants from stormwater runoff and provide a mechanism for capturing any accidental spills of hazardous liquids that may occur. Overall there will be an improvement over the current situation as the existing bridge and approach roads do not have any water quality treatment measures.

Demolition and removal of the existing bridge would also present a potential risk to water quality of the river. The demolition activities would potentially result in rubble and debris entering the river and disturbance of the river bed material, causing a decline in water quality. A number of mitigation and management measures will be implemented to prevent and minimise debris entering the river and to contain any disturbance and adverse impacts.

6.2 Contamination

While the historical and current landuses on both sides of the river had the potential to contaminate soils and other materials, all soil samples collected for the project had contamination concentrations lower than the relevant site assessment criteria. Previous studies on river bed sediments found that heavy metal concentrations in the river bed sediment around Windsor were below relevant criteria and relatively low in comparison to other urbanised estuaries in the Sydney region.

Overall the risk of environmental impacts from contaminated soils and river sediment would be very low. There may be unknown contaminated soils and material especially on the southern bank which may be discovered during construction. Mitigation measures to identify and manage unknown finds of potentially contaminated material have been developed.

6.3 Hazardous materials

Paint sampling of the existing bridge indicated that some components had been painted with lead-based based paints. Before demolition of the existing bridge occurs a methodology based on Australian Standards will be developed and implemented to minimise any loss of lead based paint into the environment.

6.4 Acid sulfate soils

Low strength acid sulfate soils have been identified in the river bed sediment near the southern bank. However additional sampling needs to be undertaken to conclusively confirm their presence. The volume of river bed sediment removed for construction on the southern bank would be relatively small and would be easily managed via an acid sulfate soil management plan.

6.5 Waste management and handling

Only small volumes of waste would be generated during construction as the project is relatively small. However substantial qualities of waste material could be potentially generated during the demolition of the existing bridge. While a large majority of the materials from the existing bridge would be able to be recycled, some components would require disposal at an appropriately licensed landfall. Also any lead based paint removed from metal elements of the existing bridge would be considered a hazardous material and would require disposal at an appropriately licensed landfill.

6.6 Groundwater

Aquifers in the project area are either at the level of the river or non-existent. The potential for the project to impact significantly on either groundwater levels or quality would be very low and specific mitigation measures are not required to mitigate groundwater impacts. Groundwater monitoring at monitoring bores installed for the project and at an existing groundwater well at the corner of Freemans Read and Wilberforce Road would be undertaken to identify any impacts.

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Appendix A – Soil classifications

WB-CA-01

Depth (mbgl)	Soil classification
0 - 0.2	FILL: Sandy CLAY with gravel, dark brown mottled yellow, medium to coarse sand, subrounded to angular gravel, plastic, fishing wire
0.2	Refusal at 0.2 mbgl on wire mesh covering wall

WB-CA-02

Depth (mbgl)	Soil classification
0 - 0.1	FILL: Sandy CLAY, dark brown, rootlets
0.2	Sandy CLAY: light brown mottled dark brown, medium to coarse sand
0.3	Clayey SAND: with gravel, medium to coarse sand, angular gravel, dark brown
0.35	Refusal on gabion wall rocks (coarse cobbles) at 0.35 mbgl

WB-CA-03

Depth (mbgl)	Soil classification
0 - 0.1	SAND: with some clay, brown mottled grey, rootlets, fine to coarse sand, trace of fine, sub rounded to angular gravel
0.2	SAND: with some clay, brown mottled grey, rootlets, fine to coarse sand, trace of coarse angular gravel
0.3	SAND: with some clay, brown mottled grey, rootlets, fine to coarse sand, trace of coarse angular gravel, brown weathered rock mottled orange
0.4	Gravelly SAND: with some clay, brown mottled grey, rootlets, fine to coarse sand, fine gravel
0.4	Refusal at 0.4 mbgl on concrete in fill/gravel

WB-CA-06

Depth (mbgl)	Soil classification
0 - 0.3	CLAY: with rootlets, dark brown
0.3 – 0.5	CLAY: dark brown, mottled orange, with trace of weathered sandstone
0.5 – 1.0	CLAY: dark brown
1.0	Limit of investigation at 1.0 mbgl

WB-CA-07

Depth (mbgl)	Soil classification
0 - 0.3	CLAY: with rootlets, dark brown
0.3 – 0.5	CLAY: dark brown, mottled orange, with trace of weathered sandstone
0.5 – 1.0	CLAY: dark brown
1.0	Limit of investigation at 1.0 mbgl

WB-CA-08

Depth (mbgl)	Soil classification
0 - 0.3	CLAY: with rootlets, dark brown
0.3 – 0.5	CLAY: dark brown, mottled orange, with trace of weathered sandstone
0.5 – 1.0	CLAY: dark brown
1.0	Limit of investigation at 1.0 mbgl

WB-CA-09

Depth (mbgl)	Soil classification
0 - 0.3	CLAY: with rootlets, dark brown
0.3 – 0.5	CLAY: dark brown, mottled orange, with trace of weathered sandstone
0.5 – 1.0	CLAY: dark brown
1.0	Limit of investigation at 1.0 mbgl

WB-CA-10

Depth (mbgl)	Soil classification
0 – 0.1	Clayey SAND: with trace of gravel, brown, fine to medium grained sand, subrounded gravel
0.2	Clayey SAND: with trace of gravel, brown mottled grey, fine to medium grained sand, subrounded gravel
0.3	Clayey SAND: with coarse gravel, brown mottled grey, fine to medium grained sand, subrounded gravel
0.4	Gravelly SAND: brown mottled grey, fine to medium grained sand, subrounded, medium gravel
0.6	Sandy GRAVEL: with organic matter, coarse gravel
0.6	Refusal at 0.6 mbgl on coarse gravels

Appendix B Laboratory certificates and QA/QC

10722

CHAIN OF COSTODY - Client

ENVIROLAB GROUP

Client:	~~[illegible]~~ SKM
Contact person:	A. HUNTER
Project Mgr:	M. STACEY
Sampler:	A. HUNTER
Address:	100 CHRISTIE ST ST LEONARDS NSW 2065
Phone:	9928 2243
Mob:	
Fax:	9928 2504
Email:	ahunter@globalskm.com

Client Project Name / Number / Site etc (ie report title): NB11459

PO No.: —

Envirolab Quote No. : —

Date results required:

Or choose: [✓ standard] / same day / 1 day / 2 day / 3 day

Note: Inform lab in advance if urgent turnaround is required - surcharge applies

Lab comments:

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Shuk Li

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	COMBO 6A	SPOCAS	ON HOLD													Provide as much information about the sample as you can
	~~[illegible]~~		28/5/12																	
1	WB-ASS-01	0.25	~~0.25~~	SOIL		X														
2	WB-ASS-02	0.50	~~0.50~~			X														
3	WB-ASS-03	0.25	~~0.25~~			X														
4	WB-ASS-04	0.50	~~0.50~~			X														
5	WB-CA-01	0.1			X															
6	WB-CA-02	0.3			X															
7	WB-CA-03	0.2			X															
8	WB-CA-02	0.1					X													
9	WB-CA-02	0.2					X													
10	WB-CA-03	0.1					X													
11	WB-CA-03	0.3					X													
12	WB-CA-10	0.1	↓	↓	X															

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No. 74058
Date Received: 28.05.12
Time Received: 16.30
Received by: Dia Liu
Temp: [✓ Cool]/Ambient
Cooling: Ice/[✓ Icepack]
Security: [✓ Intact]/Broken/None

by (company): SKM
A. HUNTER
28/5/12 4.30 PM

Received by (company): ELS
Print Name: Dia Liu
Date & Time: 28.05.12 / 16.30
Signature:

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No: 1/2

10723

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: ~~Em~~ SKM
Contact person: A. HUNTER
Project Mgr: M. STACEY
Sampler: A[illegible]UNTER
Address: 100 CHRISTIE ST
ST LEONARDS
NSW 2065
Phone: 9928 2243 **Mob:**
Fax: 9928 2504
Email: ahunter@globalskm.com

Client Project Name / Number / Site etc (ie report title): NB11459
PO No.: —
Envirolab Quote No. : —
Date results required:
Or choose: [✓ standard] / same day / 1 day / 2 day / 3 day
Note: Inform lab in advance if urgent turnaround is required - surcharge applies
Lab comments:

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Shuk Li

Sample Information					Tests Required		Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	COMBO 6A	ON HOLD	Provide as much information about the sample as you can
13	WB-CA-10	0.50	28/5/12	SOIL		X	
14	WB-CA-09	0.1			X		
15	-09	0.5				X	
16	-09	1.0				X	
17	-08	0.1			X		
18	-08	0.5			X		
19	-08	1.0				X	
20	-07	0.1			X		
21	-07	0.5				X	
22	-07	1.0				X	
23	-06	0.1			X		
24	-06	0.5				X	
25	-06	1.0			X		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No. 74058
Date Received: 28.05.12
Time Received: 16.30
Received by: Jia Liu
Temp: [✓ Cool]/Ambient
Cooling: Ice/[✓ Icepack]
Security: [✓ Intact]/Broken/None

Relinquished by (company): SKM
Print Name: A. HUNTER
Date & Time: 28/5/12 4.30 PM
Signature: A Hunter

Received by (company): ELS
Print Name: Jia Liu
Date & Time: 28.05.12/ 16.30
Signature:

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book Page No: 2/2

Form: 302 - Chain of Custody-Client, Issued 16/03/10, Version 4, Page 1 of 1.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

Sinclair Knight Merz Pty Ltd	ph: 9928 2100
100 Christie St	Fax: 9928 2504
St Leonards NSW 2065	

Attention: M Stacey

Sample log in details:

Your reference:	**NB11459**
Envirolab Reference:	**74058**
Date received:	28/05/2012
Date results expected to be reported:	**4/06/12**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	25 Soils
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice Pack
Sampling Date Provided:	YES

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 74058

Client:

Sinclair Knight Merz Pty Ltd
100 Christie St
St Leonards
NSW 2065

Attention: M Stacey

Sample log in details:

Your Reference:	**NB11459**		
No. of samples:	25 Soils		
Date samples received / completed instructions received	28/05/2012	/	28/05/2012

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	4/06/12	/	1/06/12
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Rhian Morgan
Rhian Morgan
Reporting Supervisor

Hinoko Miyazaki
Chemist

M. Mansfield
Matt Mansfield
Approved Signatory

Alex MacLean
Chemist

Paul Ching
Approved Signatory

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

vTRH & BTEX in Soil						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	88	82	83	96	91

vTRH & BTEX in Soil						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	74	84	90	81	95

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
TRHC_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRHC_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRHC_{29} - C_{36}	mg/kg	270	<100	<100	<100	<100
Surrogate o-Terphenyl	%	96	94	97	94	95

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
TRHC_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRHC_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRHC_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	93	94	94	93	94

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	74058-5 WB-CA-01 0.1 28/05/2012 Soil	74058-6 WB-CA-02 0.3 28/05/2012 Soil	74058-7 WB-CA-03 0.2 28/05/2012 Soil	74058-12 WB-CA-10 0.1 28/05/2012 Soil	74058-14 WB-CA-09 0.1 28/05/2012 Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	30/05/2012	30/05/2012	30/05/2012	30/05/2012	30/05/2012
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	0.1	1.1	0.2	<0.1
Anthracene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Fluoranthene	mg/kg	0.2	0.2	1.8	0.5	<0.1
Pyrene	mg/kg	0.2	0.2	1.7	0.5	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.8	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	0.6	0.2	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	1.1	0.4	<0.2
Benzo(a)pyrene	mg/kg	0.1	0.1	0.81	0.27	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.5	0.2	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0.5	0.2	<0.1
Surrogate p-Terphenyl-d_{14}	%	111	110	113	108	115

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	74058-17 WB-CA-08 0.1 28/05/2012 Soil	74058-18 WB-CA-08 0.5 28/05/2012 Soil	74058-20 WB-CA-07 0.1 28/05/2012 Soil	74058-23 WB-CA-06 0.1 28/05/2012 Soil	74058-25 WB-CA-06 1.0 28/05/2012 Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	30/05/2012	30/05/2012	30/05/2012	30/05/2012	30/05/2012
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	0.4	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	0.4	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	0.17	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
Surrogate p-Terphenyl-d_{14}	%	109	111	113	109	115

Organochlorine Pesticides in soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	74058-5 WB-CA-01 0.1 28/05/2012 Soil	74058-6 WB-CA-02 0.3 28/05/2012 Soil	74058-7 WB-CA-03 0.2 28/05/2012 Soil	74058-12 WB-CA-10 0.1 28/05/2012 Soil	74058-14 WB-CA-09 0.1 28/05/2012 Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	119	98	118	97	97

Organochlorine Pesticides in soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	74058-17 WB-CA-08 0.1 28/05/2012 Soil	74058-18 WB-CA-08 0.5 28/05/2012 Soil	74058-20 WB-CA-07 0.1 28/05/2012 Soil	74058-23 WB-CA-06 0.1 28/05/2012 Soil	74058-25 WB-CA-06 1.0 28/05/2012 Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	0.1	<0.1	<0.1	0.2	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	96	95	99	100	97

Organophosphorus Pesticides Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	119	98	118	97	97

Organophosphorus Pesticides Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	96	95	99	100	97

PCBs in Soil						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	119	98	118	97	97

PCBs in Soil						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	96	95	99	100	97

Acid Extractable metals in soil						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Arsenic	mg/kg	6	5	<4	<4	6
Cadmium	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	14	13	26	9	14
Copper	mg/kg	26	15	15	10	12
Lead	mg/kg	41	29	29	23	17
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	16	13	21	8	13
Zinc	mg/kg	140	60	56	41	49

Acid Extractable metals in soil						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Arsenic	mg/kg	5	6	6	5	5
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	14	16	16	14	18
Copper	mg/kg	14	16	16	14	14
Lead	mg/kg	18	15	20	28	16
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	14	18	16	13	16
Zinc	mg/kg	54	59	57	58	49

Moisture						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	30/05/2012	30/05/2012	30/05/2012	30/05/2012	30/05/2012
Moisture	%	29	18	9.5	9.1	13

Moisture						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/05/2012	29/05/2012	29/05/2012	29/05/2012	29/05/2012
Date analysed	-	30/05/2012	30/05/2012	30/05/2012	30/05/2012	30/05/2012
Moisture	%	14	17	14	15	20

Asbestos ID - soils						
Our Reference:	UNITS	74058-5	74058-6	74058-7	74058-12	74058-14
Your Reference	-------------	WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-10	WB-CA-09
Depth	------------	0.1	0.3	0.2	0.1	0.1
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	01/06/2012	01/06/2012	01/06/2012	01/06/2012	01/06/2012
Sample mass tested	g	Approx 35g	Approx 35g	Approx 35g	Approx 35g	Approx 35g
Sample Description	-	Brown fine-grained soil	Brown fine-grained soil	Brown coarse-grained soil	Brown coarse-grained soil	Brown fine-grained soil
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

Asbestos ID - soils						
Our Reference:	UNITS	74058-17	74058-18	74058-20	74058-23	74058-25
Your Reference	-------------	WB-CA-08	WB-CA-08	WB-CA-07	WB-CA-06	WB-CA-06
Depth	------------	0.1	0.5	0.1	0.1	1.0
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	01/06/2012	01/06/2012	01/06/2012	01/06/2012	01/06/2012
Sample mass tested	g	Approx 35g	Approx 35g	Approx 35g	Approx 35g	Approx 35g
Sample Description	-	Brown fine-grained soil	Brown fine-grained soil	Brown fine-grained soil	Brown fine-grained soil	Brown fine-grained soil
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

sPOCAS					
Our Reference:	UNITS	74058-1	74058-2	74058-3	74058-4
Your Reference	-------------	WB-ASS-01	WB-ASS-02	WB-ASS-03	WB-ASS-04
Depth	------------	0.25	0.5	0.25	0.5
Date Sampled		28/05/2012	28/05/2012	28/05/2012	28/05/2012
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	29/5/2012	29/5/2012	29/5/2012	29/5/2012
Date analysed	-	29/5/2012	29/5/2012	29/5/2012	29/5/2012
pH $_{kcl}$	pH units	5.8	6.0	5.6	5.2
TAA pH 6.5	moles H$^+$/t	<5	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01
pH $_{Ox}$	pH units	4.5	6.8	6.1	6.3
TPA pH 6.5	moles H$^+$/t	<5	<5	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01
TSA pH 6.5	moles H$^+$/t	<5	<5	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01
ANC$_E$	% CaCO$_3$	<0.05	0.21	<0.05	<0.05
a-ANC$_E$	moles H$^+$/t	<5	41	<5	<5
s-ANC$_E$	%w/w S	<0.05	0.07	<0.05	<0.05
S$_{KCl}$	%w/w S	<0.005	<0.005	<0.005	<0.005
S$_P$	%w/w	0.13	0.02	0.02	0.02
S$_{POS}$	%w/w	0.12	0.02	0.02	0.02
a-S$_{POS}$	moles H$^+$/t	76	14	14	11
Ca$_{KCl}$	%w/w	0.08	0.04	0.08	0.06
Ca$_P$	%w/w	0.11	0.06	0.12	0.07
Ca$_A$	%w/w	0.031	0.013	0.035	0.019
Mg$_{KCl}$	%w/w	0.014	0.012	0.015	0.009
Mg$_P$	%w/w	0.030	0.021	0.019	0.010
Mg$_A$	%w/w	0.016	0.009	0.005	<0.005
Fineness Factor	-	1.5	1.5	1.5	1.5
a-Net Acidity	moles H$^+$/t	79	15	17	15
Liming rate	kg CaCO$_3$/t	5.9	1.1	1.3	1.1
a-Net Acidity without ANCE	moles H$^+$/t	NA	NA	NA	NA
Liming rate without ANCE	kg CaCO$_3$/t	NA	NA	NA	NA

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-008	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
vTRH C_6 - C_9	mg/kg	25	Org-016	<25	74058-5	<25 || <25	LCS-1	100%
Benzene	mg/kg	0.2	Org-016	<0.2	74058-5	<0.2 || <0.2	LCS-1	94%
Toluene	mg/kg	0.5	Org-016	<0.5	74058-5	<0.5 || <0.5	LCS-1	86%
Ethylbenzene	mg/kg	1	Org-016	<1	74058-5	<1 || <1	LCS-1	106%
m+p-xylene	mg/kg	2	Org-016	<2	74058-5	<2 || <2	LCS-1	108%
o-Xylene	mg/kg	1	Org-016	<1	74058-5	<1 || <1	LCS-1	110%
Surrogate aaa-Trifluorotoluene	%		Org-016	82	74058-5	88 || 86 || RPD: 2	LCS-1	94%

QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	74058-5	<50 || <50	LCS-1	93%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	74058-5	<100 || <100	LCS-1	104%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	74058-5	270 || 260 || RPD: 4	LCS-1	94%
Surrogate o-Terphenyl	%		Org-003	97	74058-5	96 || 98 || RPD: 2	LCS-1	137%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			30/05/2012	74058-5	30/05/2012 || 30/05/2012	LCS-1	30/05/2012
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	LCS-1	104%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	LCS-1	98%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	0.1 || <0.1	LCS-1	107%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	0.2 || <0.1	LCS-1	105%
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	0.2 || <0.1	LCS-1	115%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	LCS-1	99%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(b+k)fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	74058-5	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	74058-5	0.1 || 0.05 || RPD: 67	LCS-1	97%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		Org-012 subset	116	74058-5	111 || 111 || RPD: 0	LCS-1	104%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
HCB	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	96%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	103%
Heptachlor	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	89%
delta-BHC	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	93%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	97%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	101%
Dieldrin	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	105%
Endrin	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	101%
pp-DDD	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	109%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	LCS-1	99%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-005	98	74058-5	119 || 127 || RPD: 7	LCS-1	91%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Diazinon	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	LCS-1	110%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	LCS-1	121%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	74058-5	<0.1 || <0.1	LCS-1	131%
Surrogate TCLMX	%		Org-008	98	74058-5	119 || 127 || RPD: 7	LCS-1	96%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	LCS-1	114%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	74058-5	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	98	74058-5	119 || 127 || RPD: 7	LCS-1	102%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date digested	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Date analysed	-			29/05/2012	74058-5	29/05/2012 || 29/05/2012	LCS-1	29/05/2012
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	74058-5	6 || 5 || RPD: 18	LCS-1	98%
Cadmium	mg/kg	0.5	Metals-020 ICP-AES	<0.5	74058-5	0.5 || 0.5 || RPD: 0	LCS-1	103%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	74058-5	14 || 13 || RPD: 7	LCS-1	98%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	74058-5	26 || 24 || RPD: 8	LCS-1	99%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	74058-5	41 || 41 || RPD: 0	LCS-1	97%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	74058-5	<0.1 || <0.1	LCS-1	97%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	74058-5	16 || 16 || RPD: 0	LCS-1	99%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	74058-5	140 || 130 || RPD: 7	LCS-1	98%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			[NT]
Date analysed	-			[NT]
Moisture	%	0.1	Inorg-008	[NT]

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			29/5/2012	74058-1	29/5/2012 || 29/5/2012	LCS	29/5/2012
Date analysed	-			29/5/2012	74058-1	29/5/2012 || 29/5/2012	LCS	29/5/2012
pH_{kcl}	pH units		Inorg-064	[NT]	74058-1	5.8 || 5.7 || RPD: 2	LCS	99%
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	74058-1	<5 || <5	LCS	105%
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	74058-1	<0.01 || <0.01	[NR]	[NR]
pH_{Ox}	pH units		Inorg-064	[NT]	74058-1	4.5 || 5.0 || RPD: 11	LCS	101%
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	74058-1	<5 || <5	LCS	105%
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	74058-1	<0.01 || <0.01	[NR]	[NR]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	74058-1	<5 || <5	LCS	105%
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	74058-1	<0.01 || <0.01	[NR]	[NR]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	74058-1	<0.05 || <0.05	[NR]	[NR]
a-ANC_E	moles H^+/t	5	Inorg-064	<5	74058-1	<5 || <5	[NR]	[NR]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	74058-1	<0.05 || <0.05	[NR]	[NR]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	74058-1	<0.005 || 0.007	LCS	88%
S_P	%w/w	0.005	Inorg-064	<0.005	74058-1	0.13 || 0.10 || RPD: 26	LCS	99%
S_{POS}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.12 || 0.1 || RPD: 18	LCS	104%
a-S_{POS}	moles H^+/t	5	Inorg-064	<5	74058-1	76 || 60 || RPD: 24	LCS	104%
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.08 || 0.08 || RPD: 0	LCS	89%
Ca_P	%w/w	0.005	Inorg-064	<0.005	74058-1	0.11 || 0.11 || RPD: 0	[NR]	[NR]

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Ca_{A}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.031 || 0.028 || RPD: 10	[NR]	[NR]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.014 || 0.014 || RPD: 0	LCS	91%
Mg_{P}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.030 || 0.025 || RPD: 18	[NR]	[NR]
Mg_{A}	%w/w	0.005	Inorg-064	<0.005	74058-1	0.016 || 0.011 || RPD: 37	[NR]	[NR]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-S_{NAS}	moles H^{+}/t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
Fineness Factor	-	1.5	Inorg-064	<1.5	74058-1	1.5 || 1.5 || RPD: 0	[NR]	[NR]
a-Net Acidity	moles H^{+}/t	10	Inorg-064	<10	74058-1	79 || 61 || RPD: 26	LCS	104%
Liming rate	kg $CaCO_{3}$/t	0.75	Inorg-064	<0.75	74058-1	5.9 || 4.6 || RPD: 25	LCS	103%
a-Net Acidity without ANCE	moles H^{+}/t	10	Inorg-064	<10	74058-1	NA || NA	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_{3}$/t	0.75	Inorg-064	<0.75	74058-1	NA || NA	[NR]	[NR]

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
vTRH C_{6} - C_{9}	mg/kg	[NT]	[NT]	74058-6	88%
Benzene	mg/kg	[NT]	[NT]	74058-6	82%
Toluene	mg/kg	[NT]	[NT]	74058-6	74%
Ethylbenzene	mg/kg	[NT]	[NT]	74058-6	92%
m+p-xylene	mg/kg	[NT]	[NT]	74058-6	96%
o-Xylene	mg/kg	[NT]	[NT]	74058-6	100%
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	74058-6	99%

QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
TRHC$_{10}$ - C$_{14}$	mg/kg	[NT]	[NT]	74058-6	82%
TRHC$_{15}$ - C$_{28}$	mg/kg	[NT]	[NT]	74058-6	101%
TRHC$_{29}$ - C$_{36}$	mg/kg	[NT]	[NT]	74058-6	90%
Surrogate o-Terphenyl	%	[NT]	[NT]	74058-6	135%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	30/05/2012
Naphthalene	mg/kg	[NT]	[NT]	74058-6	102%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	74058-6	98%
Phenanthrene	mg/kg	[NT]	[NT]	74058-6	107%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	74058-6	108%
Pyrene	mg/kg	[NT]	[NT]	74058-6	114%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	74058-6	100%
Benzo(b+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	74058-6	129%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d$_{14}$	%	[NT]	[NT]	74058-6	83%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	74058-6	104%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	74058-6	107%
Heptachlor	mg/kg	[NT]	[NT]	74058-6	97%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	74058-6	99%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	74058-6	102%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	74058-6	104%
Dieldrin	mg/kg	[NT]	[NT]	74058-6	110%
Endrin	mg/kg	[NT]	[NT]	74058-6	103%
pp-DDD	mg/kg	[NT]	[NT]	74058-6	112%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	74058-6	102%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	74058-6	101%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ronnel	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	74058-6	104%
Fenitrothion	mg/kg	[NT]	[NT]	74058-6	112%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	74058-6	130%
Surrogate TCLMX	%	[NT]	[NT]	74058-6	97%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
Arochlor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	mg/kg	[NT]	[NT]	74058-6	116%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	74058-6	101%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	[NT]	[NT]	74058-6	29/05/2012
Date analysed	-	[NT]	[NT]	74058-6	29/05/2012
Arsenic	mg/kg	[NT]	[NT]	74058-6	92%
Cadmium	mg/kg	[NT]	[NT]	74058-6	91%
Chromium	mg/kg	[NT]	[NT]	74058-6	92%
Copper	mg/kg	[NT]	[NT]	74058-6	97%
Lead	mg/kg	[NT]	[NT]	74058-6	90%
Mercury	mg/kg	[NT]	[NT]	74058-6	98%
Nickel	mg/kg	[NT]	[NT]	74058-6	90%
Zinc	mg/kg	[NT]	[NT]	74058-6	81%

Report Comments:

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.

Asbestos ID was analysed by Approved Identifier:	Paul Ching
Asbestos ID was authorised by Approved Signatory:	Paul Ching

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batched of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

7.1.1 Field quality assurance and quality control

The Quality Assurance and Quality Control (QA/QC) procedures applied during the soil and sediment component of the detailed site investigation are summarised in **Table B-1.**

Table B-1 **Field QA/QC assessment**

Field procedure	QA procedure description
Sampling team	The fieldwork was carried out by an experienced SKM Environmental Scientist.
Sample collection, handling, transportation, and preservation	Fieldwork was conducted in general accordance with SKM Standard Procedures and the company's ISO 9001 certified QA/QC system. Samples were logged and transferred under completed Chain of Custody Forms included in **Appendix B**. All samples collected in the field were delivered chilled and have a sample receipt notification produced by the laboratory.
Sample receipt notification	Samples were received at the laboratory in appropriately preserved containers, with preservation including packing samples with ice packs or ice in eskies. Sample receipt notifications and laboratory reports can be found in **Appendix B**.
Trip spike and trip blank	No trip blank or trip spike were taken during the fieldwork program. The handling of samples by experienced SKM scientists in accordance with established protocols would provide confidence that samples were handled and transported in such a way to reduce the likelihood of cross-contamination.
Blind replicate samples	No blind replicate sample was collected during the fieldwork program. The general low concentrations of analytes detected indicate that there was unlikely to be significant differences in duplicate sample concentrations (if collected).
Rinsate blank	No rinsate sample was collected during the fieldwork program. All samples were collected using new disposable gloves and equipment was decontaminated between sample locations in accordance with established protocols.

7.1.2 Laboratory quality assurance and quality control

Envirolab was used as the primary analytical laboratory and is accredited by the National Association of Testing Authorities for the analyses undertaken. A data validation process was used to assess the effectiveness of the overall analytical process and to assess the use of laboratory data. **Table B-2** outlines the data validation criteria, qualifications to the data, and the overall QA/QC procedures used for the laboratory testing program.

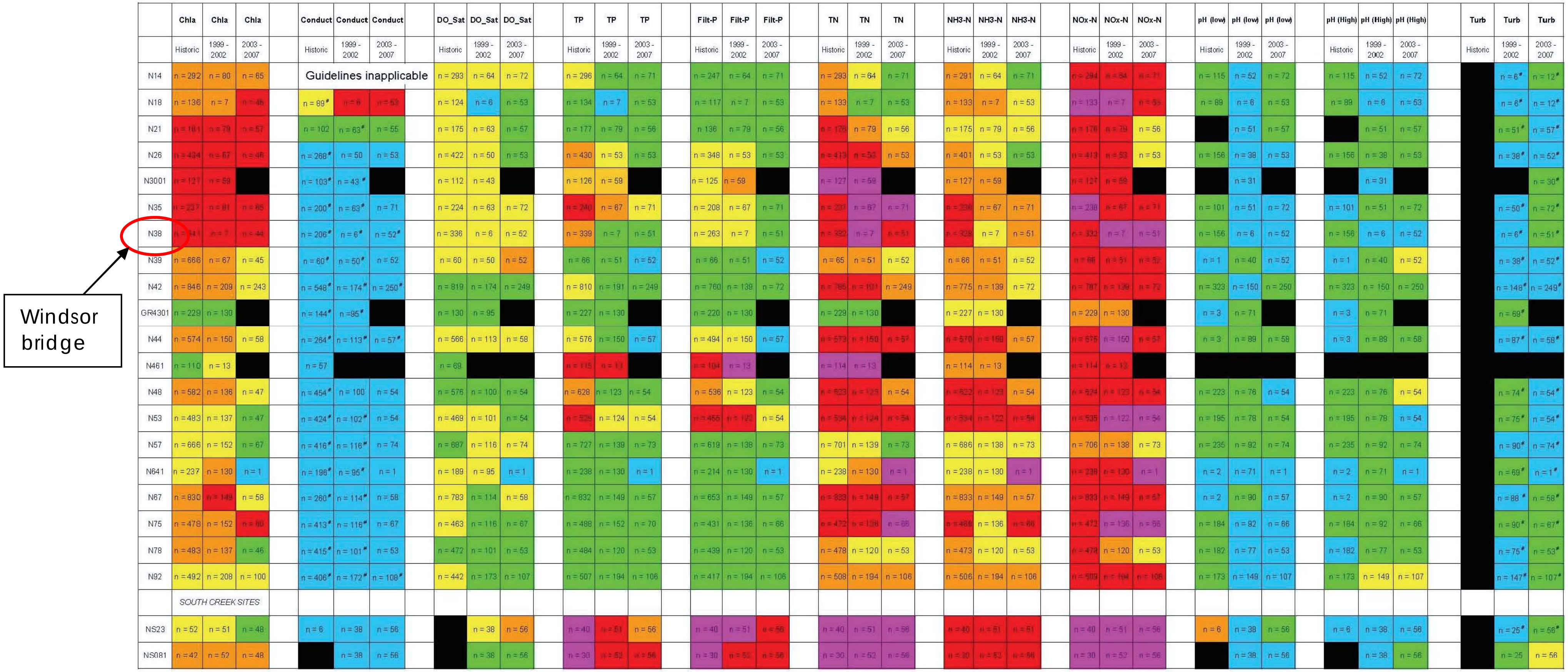
Table B-2 Laboratory QA/QC assessment

Protocol	Description
Holding Times	Holding times are the maximum permissible elapsed time in days from the collection of the sample to its extraction and/or analysis. All extraction and analyses were completed within standard guidelines.
Appropriate Level of reporting	The reporting limits were all less than the respective guidelines.

Protocol	Description
Reagent blanks	The reagent blank sample is a laboratory prepared sample containing the reagents used to prepare the sample for final analysis. The purpose of this procedure is to identify contamination in the reagent materials and assess potential bias in the sample analysis due to contaminated reagents. The QC criteria are no detectable contamination in the reagents. Each analysis procedure was subject to a reagent blank analysis. The results indicated that contaminants were not detected.
Laboratory control samples	Laboratory Control Samples are evaluated to assess overall method performance and are the primary indicators of laboratory performance. All Laboratory Control Samples QC criteria were met in all cases.
Laboratory duplicates	Laboratory duplicates are field samples that are split in the laboratory and subsequently analysed a number of times in the same batch. These sub-samples are selected by the laboratory to assess the accuracy and precision of the analytical method. None of the laboratory duplicates returned high relative percentage differences.
Matrix spikes/ Matrix spike duplicates	Matrix spikes/ Matrix spike duplicates are field samples to which a predetermined stock solution of known concentration has been added. The samples are then analysed for recovery of the known addition. Recoveries should generally be within the stated laboratory control limits of 50 to 150 per cent and duplicates should have relative percentage differences of less than 50 per cent. All the matrix spike recoveries and relative percentage difference were within the accepted limits. The percentage recoveries were within the control limits. Refer to **Appendix B**.
QA/QC conclusion	The laboratories undertook QA/QC procedures such as calibration standards, laboratory control samples, surrogates, reference materials, sample duplicates and matrix spikes. Intra-laboratory duplicates are performed on a frequency of 1 per 10 samples. The QC criterion is 50 per cent relative percentage difference. The relative percentage differences criterion was met in all cases.

The QA/QC indicators generally complied with the required standards or variations were infrequent and generally only slightly outside the control limits. It was therefore concluded that, for the investigation of this site, the QA/QC results are adequate and the quality of the data is acceptable for use.

Appendix C Water quality data assessment (DECC, 2009)



	Chla	Chla	Chla	Conduct	Conduct	Conduct	DO_Sat	DO_Sat	DO_Sat	TP	TP	TP	Filt-P	Filt-P	Filt-P	TN	TN	TN	NH3-N	NH3-N	NH3-N	NOx-N	NOx-N	NOx-N	pH (low)	pH (low)	pH (low)	pH (High)	pH (High)	pH (High)	Turb	Turb	Turb
	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007	Historic	1999 - 2002	2003 - 2007
N14	🟧 n = 292	🟧 n = 80	🟧 n = 65	Guidelines inapplicable			🟨 n = 293	🟨 n = 64	🟨 n = 72	🟨 n = 296	🟩 n = 64	🟩 n = 71	🟩 n = 247	🟩 n = 64	🟩 n = 71	🟧 n = 293	🟨 n = 64	🟩 n = 71	🟧 n = 291	🟨 n = 64	🟩 n = 71	🟥 n = 294	🟥 n = 64	🟥 n = 71	🟩 n = 115	🟦 n = 52	🟩 n = 72	🟩 n = 115	🟦 n = 52	🟦 n = 72	⬛	🟦 n = 6#	🟩 n = 12#
N18	🟧 n = 136	🟧 n = 7	🟥 n = 46	🟨 n = 89#	🟥 n = 6	🟥 n = 53	🟨 n = 124	🟦 n = 6	🟩 n = 53	🟩 n = 134	🟦 n = 7	🟩 n = 53	🟩 n = 117	🟩 n = 7	🟩 n = 53	🟧 n = 133	🟩 n = 7	🟩 n = 53	🟧 n = 133	🟧 n = 7	🟨 n = 53	🟪 n = 133	🟪 n = 7	🟥 n = 55	🟩 n = 89	🟦 n = 6	🟩 n = 53	🟩 n = 89	🟦 n = 6	🟦 n = 53	⬛	🟦 n = 6#	🟦 n = 12#
N21	🟥 n = 161	🟥 n = 79	🟥 n = 57	🟩 n = 102	🟩 n = 63#	🟩 n = 55	🟨 n = 175	🟨 n = 63	🟩 n = 57	🟩 n = 177	🟩 n = 79	🟩 n = 56	🟩 n 136	🟩 n = 79	🟩 n = 56	🟥 n = 176	🟧 n = 79	🟨 n = 56	🟨 n = 175	🟨 n = 79	🟨 n = 56	🟥 n = 176	🟥 n = 79	🟨 n = 56	⬛	🟦 n = 51	🟩 n = 57	⬛	🟩 n = 51	🟩 n = 57	⬛	🟩 n = 51#	🟦 n = 57#
N26	🟥 n = 434	🟥 n = 67	🟥 n = 46	🟦 n = 268#	🟦 n = 50	🟦 n = 53	🟨 n = 422	🟨 n = 50	🟩 n = 53	🟧 n = 430	🟨 n = 53	🟩 n = 53	🟨 n = 348	🟨 n = 53	🟩 n = 53	🟥 n = 413	🟥 n = 53	🟧 n = 53	🟧 n = 401	🟨 n = 53	🟩 n = 53	🟥 n = 413	🟥 n = 53	🟨 n = 53	🟩 n = 156	🟦 n = 38	🟦 n = 53	🟩 n = 156	🟩 n = 38	🟩 n = 53	⬛	🟦 n = 38#	🟦 n = 52#
N3001	🟥 n = 127	🟥 n = 59	⬛	🟦 n = 103#	🟦 n = 43 #	⬛	🟨 n = 112	🟨 n = 43	⬛	🟧 n = 126	🟧 n = 59	⬛	🟨 n = 125	🟧 n = 59	⬛	🟪 n = 127	🟪 n = 59	⬛	🟧 n = 127	🟧 n = 59	⬛	🟥 n = 127	🟥 n = 59	⬛	⬛	🟦 n = 31	⬛	⬛	🟦 n = 31	⬛	⬛	⬛	🟩 n = 30#
N35	🟥 n = 237	🟥 n = 81	🟥 n = 65	🟦 n = 200#	🟦 n = 63#	🟦 n = 71	🟨 n = 224	🟨 n = 63	🟨 n = 72	🟥 n = 240	🟧 n = 67	🟨 n = 71	🟨 n = 208	🟨 n = 67	🟩 n = 71	🟥 n = 237	🟪 n = 67	🟪 n = 71	🟥 n = 236	🟧 n = 67	🟧 n = 71	🟪 n = 238	🟥 n = 67	🟥 n = 71	🟩 n = 101	🟦 n = 51	🟦 n = 72	🟦 n = 101	🟩 n = 51	🟩 n = 72	⬛	🟦 n = 50#	🟩 n = 72#
N38	🟥 n = 341	🟥 n = 7	🟥 n = 44	🟦 n = 206#	🟦 n = 6#	🟦 n = 52#	🟨 n = 336	🟨 n = 6	🟨 n = 52	🟧 n = 339	🟩 n = 7	🟩 n = 51	🟨 n = 263	🟨 n = 7	🟩 n = 51	🟥 n = 332	🟪 n = 7	🟥 n = 51	🟥 n = 328	🟨 n = 7	🟧 n = 51	🟥 n = 332	🟪 n = 7	🟪 n = 51	🟩 n = 156	🟦 n = 6	🟦 n = 52	🟩 n = 156	🟦 n = 6	🟦 n = 52	⬛	🟦 n = 6#	🟩 n = 51#
N39	🟧 n = 666	🟧 n = 67	🟨 n = 45	🟦 n = 60#	🟦 n = 50#	🟦 n = 52	🟨 n = 60	🟨 n = 50	🟧 n = 52	🟩 n = 66	🟩 n = 51	🟦 n = 52	🟩 n = 66	🟩 n = 51	🟦 n = 52	🟧 n = 65	🟧 n = 51	🟨 n = 52	🟧 n = 66	🟧 n = 51	🟨 n = 52	🟥 n = 66	🟥 n = 51	🟥 n = 52	🟦 n = 1	🟩 n = 40	🟦 n = 52	🟦 n = 1	🟩 n = 40	🟨 n = 52	⬛	🟦 n = 38#	🟦 n = 52#
N42	🟧 n = 846	🟧 n = 209	🟨 n = 243	🟦 n = 548#	🟦 n = 174#	🟦 n = 250#	🟩 n = 819	🟩 n = 174	🟩 n = 249	🟨 n = 810	🟩 n = 191	🟩 n = 249	🟩 n = 760	🟩 n = 139	🟩 n = 72	🟥 n = 785	🟥 n = 191	🟧 n = 249	🟧 n = 775	🟧 n = 139	🟨 n = 72	🟥 n = 787	🟥 n = 139	🟥 n = 72	🟩 n = 323	🟦 n = 150	🟩 n = 250	🟩 n = 323	🟩 n = 150	🟩 n = 250	⬛	🟦 n = 148#	🟦 n = 249#
GR4301	🟩 n = 229	🟩 n = 130	⬛	🟦 n = 144#	🟦 n =95#	⬛	🟩 n = 130	🟩 n = 95	⬛	🟩 n = 227	🟩 n = 130	⬛	🟩 n = 220	🟩 n = 130	⬛	🟩 n = 229	🟩 n = 130	⬛	🟨 n = 227	🟨 n = 130	⬛	🟧 n = 229	🟧 n = 130	⬛	🟦 n = 3	🟩 n = 71	⬛	🟦 n = 3	🟩 n = 71	⬛	⬛	🟩 n = 69#	⬛
N44	🟧 n = 574	🟧 n = 150	🟨 n = 58	🟦 n = 264#	🟦 n = 113#	🟦 n = 57#	🟨 n = 566	🟨 n = 113	🟨 n = 58	🟨 n = 576	🟩 n = 150	🟦 n = 57	🟨 n = 494	🟨 n = 150	🟦 n = 57	🟥 n = 573	🟥 n = 150	🟥 n = 57	🟥 n = 570	🟥 n = 150	🟧 n = 57	🟥 n = 575	🟪 n = 150	🟥 n = 57	🟩 n = 3	🟩 n = 89	🟩 n = 58	🟦 n = 3	🟩 n = 89	🟩 n = 58	⬛	🟦 n = 87#	🟦 n = 58#
N461	🟩 n = 110	🟨 n = 13	⬛	🟦 n = 57	⬛	⬛	🟩 n = 69	⬛	⬛	🟥 n = 115	🟥 n = 13	⬛	🟥 n = 104	🟪 n = 13	⬛	🟪 n = 114	🟪 n = 13	⬛	🟧 n = 114	🟧 n = 13	⬛	🟥 n = 114	🟥 n = 13	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛
N48	🟧 n = 582	🟧 n = 136	🟨 n = 47	🟦 n = 454#	🟦 n = 100	🟦 n = 54	🟩 n = 576	🟩 n = 100	🟩 n = 54	🟧 n = 628	🟩 n = 123	🟩 n = 54	🟧 n = 536	🟨 n = 123	🟩 n = 54	🟥 n = 623	🟥 n = 123	🟧 n = 54	🟥 n = 622	🟥 n = 123	🟧 n = 54	🟥 n = 624	🟥 n = 123	🟥 n = 54	🟩 n = 223	🟩 n = 76	🟦 n = 54	🟩 n = 223	🟩 n = 76	🟨 n = 54	⬛	🟩 n = 74#	🟦 n = 54#
N53	🟨 n = 483	🟨 n = 137	🟩 n = 47	🟦 n = 424#	🟦 n = 102#	🟦 n = 54	🟨 n = 469	🟨 n = 101	🟩 n = 54	🟥 n = 529	🟨 n = 124	🟨 n = 54	🟥 n = 455	🟥 n = 122	🟨 n = 54	🟥 n = 534	🟥 n = 124	🟥 n = 54	🟥 n = 534	🟥 n = 122	🟥 n = 56	🟥 n = 535	🟪 n = 122	🟪 n = 54	🟩 n = 195	🟩 n = 78	🟩 n = 54	🟩 n = 195	🟩 n = 78	🟦 n = 54	⬛	🟩 n = 75#	🟦 n = 54#
N57	🟨 n = 666	🟨 n = 152	🟩 n = 67	🟦 n = 416#	🟦 n = 116#	🟦 n = 74	🟩 n = 687	🟨 n = 116	🟨 n = 74	🟩 n = 727	🟩 n = 139	🟩 n = 73	🟩 n = 619	🟩 n = 138	🟩 n = 73	🟨 n = 701	🟨 n = 139	🟩 n = 73	🟨 n = 686	🟨 n = 138	🟨 n = 73	🟧 n = 706	🟧 n = 138	🟨 n = 73	🟩 n = 235	🟩 n = 92	🟩 n = 74	🟩 n = 235	🟩 n = 92	🟩 n = 74	⬛	🟦 n = 90#	🟦 n = 74#
N641	🟨 n = 237	🟧 n = 130	🟦 n = 1	🟦 n = 196#	🟦 n = 95#	🟦 n = 1	🟨 n = 189	🟨 n = 95	🟦 n = 1	🟩 n = 238	🟩 n = 130	🟦 n = 1	🟩 n = 214	🟩 n = 130	🟦 n = 1	🟨 n = 238	🟧 n = 130	🟪 n = 1	🟨 n = 238	🟨 n = 130	🟪 n = 1	🟥 n = 238	🟥 n = 130	🟪 n = 1	🟦 n = 2	🟦 n = 71	🟦 n = 1	🟦 n = 2	🟩 n = 71	🟦 n = 1	⬛	🟩 n = 69#	🟦 n = 1#
N67	🟧 n = 830	🟥 n = 149	🟨 n = 58	🟦 n = 260#	🟦 n = 114#	🟦 n = 58	🟨 n = 783	🟩 n = 114	🟨 n = 58	🟩 n = 832	🟩 n = 149	🟩 n = 57	🟩 n = 653	🟩 n = 149	🟩 n = 57	🟥 n = 833	🟥 n = 149	🟥 n = 57	🟧 n = 833	🟧 n = 149	🟧 n = 57	🟥 n = 833	🟥 n = 149	🟥 n = 57	🟦 n = 2	🟩 n = 90	🟦 n = 57	🟦 n = 2	🟩 n = 90	🟩 n = 57	⬛	🟦 n = 88 #	🟩 n = 58#
N75	🟧 n = 478	🟧 n = 152	🟥 n = 60	🟦 n = 413#	🟦 n = 116#	🟦 n = 67	🟨 n = 463	🟩 n = 116	🟩 n = 67	🟩 n = 488	🟩 n = 152	🟩 n = 70	🟩 n = 431	🟩 n = 136	🟩 n = 66	🟥 n = 472	🟥 n = 138	🟪 n = 66	🟥 n = 466	🟨 n = 136	🟥 n = 66	🟥 n = 472	🟪 n = 136	🟪 n = 66	🟩 n = 184	🟦 n = 92	🟦 n = 66	🟩 n = 184	🟩 n = 92	🟩 n = 66	⬛	🟩 n = 90#	🟩 n = 67#
N78	🟧 n = 483	🟧 n = 137	🟩 n = 46	🟦 n = 415#	🟦 n = 101#	🟦 n = 53	🟩 n = 472	🟩 n = 101	🟩 n = 53	🟩 n = 484	🟩 n = 120	🟩 n = 53	🟩 n = 439	🟩 n = 120	🟩 n = 53	🟧 n = 478	🟨 n = 120	🟨 n = 53	🟧 n = 473	🟨 n = 120	🟨 n = 53	🟥 n = 478	🟧 n = 120	🟨 n = 53	🟩 n = 182	🟦 n = 77	🟦 n = 53	🟦 n = 182	🟩 n = 77	🟩 n = 53	⬛	🟦 n = 75#	🟩 n = 53#
N92	🟨 n = 492	🟨 n = 208	🟨 n = 100	🟦 n = 406#	🟦 n = 172#	🟦 n = 108#	🟨 n = 442	🟩 n = 173	🟩 n = 107	🟩 n = 507	🟩 n = 194	🟩 n = 106	🟩 n = 417	🟩 n = 194	🟩 n = 106	🟧 n = 508	🟧 n = 194	🟧 n = 106	🟧 n = 506	🟧 n = 194	🟧 n = 106	🟥 n = 509	🟥 n = 194	🟥 n = 106	🟩 n = 173	🟦 n = 149	🟦 n = 107	🟩 n = 173	🟨 n = 149	🟨 n = 107	⬛	🟦 n = 147#	🟩 n = 107#
	SOUTH CREEK SITES																																
NS23	🟨 n = 52	🟨 n = 51	🟩 n = 48	🟦 n = 6	🟦 n = 38	🟦 n = 56	⬛	🟨 n = 38	🟧 n = 56	🟪 n = 40	🟥 n = 51	🟧 n = 56	🟪 n = 40	🟪 n = 51	🟥 n = 56	🟪 n = 40	🟪 n = 51	🟪 n = 56	🟥 n = 40	🟥 n = 51	🟥 n = 51	🟪 n = 40	🟪 n = 51	🟪 n = 56	🟧 n = 6	🟦 n = 38	🟩 n = 56	🟦 n = 6	🟦 n = 38	🟦 n = 56	⬛	🟦 n = 25#	🟩 n = 56#
NS081	🟧 n = 42	🟧 n = 52	🟧 n = 48	⬛	🟦 n = 38	🟦 n = 56	⬛	🟩 n = 38	🟩 n = 56	🟪 n = 30	🟥 n = 52	🟥 n = 56	🟪 n = 30	🟥 n = 52	🟥 n = 56	🟪 n = 30	🟪 n = 52	🟪 n = 56	🟥 n = 30	🟥 n = 52	🟥 n = 56	🟪 n = 30	🟪 n = 52	🟪 n = 56	⬛	🟦 n = 38	🟦 n = 56	⬛	🟦 n = 38	🟩 n = 56	⬛	🟩 n = 25	🟨 n = 56

🟦	None > ANZECC Guidelines
🟩	Maximum > ANZECC Guidelines
🟨	75th Percentile > ANZECC Guidelines
🟧	50th Percentile > ANZECC Guidelines
🟥	25th Percentile > ANZECC Guidelines
🟪	Minimum > ANZECC Guidelines
⬛	No available data
#	Values < Lower part of ANZECC Range

Appendix D Soil analytical results

	Field_ID					WB-CA-01	WB-CA-02	WB-CA-03	WB-CA-06	WB-CA-06	WB-CA-07	WB-CA-08	WB-CA-08	WB-CA-09	WB-CA-10
	LocCode					WB	WB	WB	WB	WB	WB	WB	WB	WB	WB
	Sample_Depth_Range					0.1-1	0.3-2	0.2-3	0.1-6	1-6	0.1-7	0.1-8	0.5-8	0.1-9	0.1-10
	Sampled_Date-Time					########	########	########	28/05/2012	########	########	########	########	########	########
Method_Type	**ChemName**	**Units**	**EQL**	**NEPM 1999 EIL**	**NEPM 1999 HIL E**										
8 metals in soil	Arsenic	mg/kg	4	20	200	6	5	<4	5	5	6	5	6	6	<4
	Cadmium	mg/kg	0.5	3	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Chromium (III+VI)	mg/kg	1			14	13	26	14	18	16	14	16	14	9
	Copper	mg/kg	1	100	2000	26	15	15	14	14	16	14	16	12	10
	Lead	mg/kg	1	600	600	41	29	29	28	16	20	18	15	17	23
	Mercury	mg/kg	0.1	1	30	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel	mg/kg	1	60	600	16	13	21	13	16	16	14	18	13	8
	Zinc	mg/kg	1	200	14000	140	60	56	58	49	57	54	59	49	41
Moisture	Moisture	%	0.1			29	18	9.5	15	20	14	14	17	13	9.1
Organophosphorus Pesticides	Bromophos-ethyl	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chlorpyrifos	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chlorpyrifos-methyl	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Diazinon	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dimethoate	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ethion	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fenitrothion	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Ronnel	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAHs in Soil	Acenaphthene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	0.1			<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Anthracene	mg/kg	0.1			<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benz(a)anthracene	mg/kg	0.1			<0.1	<0.1	0.8	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	Benzo(a) pyrene	mg/kg	0.05		2	0.1	0.1	0.81	0.17	<0.05	<0.05	<0.05	<0.05	<0.05	0.27
	Benzo(b)&(k)fluoranthene	mg/kg	0.2			<0.2	<0.2	1.1	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4
	Benzo(g,h,i)perylene	mg/kg	0.1			<0.1	<0.1	0.5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	Chrysene	mg/kg	0.1			<0.1	<0.1	0.6	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	Dibenz(a,h)anthracene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	0.1			0.2	0.2	1.8	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
	Fluorene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.1			<0.1	<0.1	0.5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	Naphthalene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	0.1			0.1	0.1	1.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
	Pyrene	mg/kg	0.1			0.2	0.2	1.7	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
	PAHs (sum of total)	mg/kg	1			1.8	1.8	9.51	2.47	<1.55	<1.55	<1.55	<1.55	<1.55	3.27

Method_Type	ChemName	Units	EQL	NEPM 1999 EIL	NEPM 1999 HIL E										
PCBs in Soil	Arochlor 1016	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1221	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1232	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1242	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1248	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1254	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arochlor 1260	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
sTRH in Soil (C10-C36)	C10 - C14	mg/kg	50		1000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
	C15 - C28	mg/kg	100		1000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
	C29-C36	mg/kg	100		1000	270	<100	<100	<100	<100	<100	<100	<100	<100	<100
vTRH & BTEX in Soil	Benzene	mg/kg	0.2		1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	1		3.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Toluene	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	C6 - C9	mg/kg	25		65	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	Xylene (m & p)	mg/kg	2			<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
	Xylene (o)	mg/kg	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Organochlorine Pesticides	4,4-DDE	mg/kg	0.1		400	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
	a-BHC	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Aldrin	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	b-BHC	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chlordane (cis)	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Chlordane (trans)	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	d-BHC	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	DDD	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	DDT	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Dieldrin	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endosulfan I	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endosulfan II	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endosulfan sulphate	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Endrin aldehyde	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	g-BHC (Lindane)	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor	mg/kg	0.1		20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Heptachlor epoxide	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Hexachlorobenzene	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Methoxychlor	mg/kg	0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

	Field_ID					WB-ASS-01	WB-ASS-02	WB-ASS-03	WB-ASS-04
	LocCode					WB	WB	WB	WB
	Sample_Depth_Range					0.25-1	0.5-2	0.25-3	0.5-4
	Sampled_Date-Time					28/05/2012	28/05/2012	28/05/2012	28/05/2012
Method_Type	**ChemName**	**Units**	**EQL**	**NEPM 1999 EIL**	**NEPM 1999 HIL E**				
sPOCAS	Acid Reacted Calcium	%	0.005			0.031	0.013	0.035	0.019
	Calcium in Peroxide	%	0.005			0.11	0.06	0.12	0.07
	KCl Extractable Calcium	%	0.005			0.08	0.04	0.08	0.06
	KCl Extractable Magnesium	%	0.005			0.014	0.012	0.015	0.009
	Magnesium in Peroxide	%	0.005			0.03	0.021	0.019	0.01
	Peroxide Oxidisable Sulfur	%	0.005			0.12	0.02	0.02	0.02
	Sulfur in Peroxide	%	0.005			0.13	0.02	0.02	0.02