



15. Discussion and Recommendations

15.1 Significance of Activities and Contamination Sources

In order to establish the relative impacts of the effect of historical and current sources of contamination on the beneficial uses of the lower Maribyrnong and Yarra Rivers, and a qualitative ranking of the risk to human health and to the river environment has been carried out using the ranking basis outlined in Table 58. Note that this ranking focuses on risks to human health and the environment as the auditor understands this to be of most importance for the purposes of this audit; other issues such as compliance with regulatory requirements can also be important when determining the priority for management of the various contamination sources.

Table 58 Risk Ranking of Audit Findings

Ranking	People (public using the river segment and its surrounding land)	Environment of the river segment and backwash	Regulatory compliance
Low	Unlikely to give rise to detectable adverse effects on human health	Unlikely to give rise to a significant and observable effect on the aquatic ecosystems of the river or backwash	Not included in this ranking
Medium	Unlikely to give rise to any observable effect in the short term that would need attention by a medical practitioner, but likely to give rise to some increased incidence of ill health over a life time	May give rise to an extensive but reversible effect on the aquatic ecosystems of the river or backwash, or may give rise to severe but localised effects on the aquatic ecosystems of the river or backwash	Not included in this ranking
High	Likely to give rise to a serious effect on the health of many persons	Likely to give rise to a severe and extensive and potentially irreversible effect on the aquatic ecosystems of the river	Not included in this ranking

In carrying out the assessment, consideration has been given to:

- ▶ Potential impacts of the Precinct sites and operations on the beneficial uses of the river segment; and
- ▶ Deficiencies in the present knowledge base and the uncertainties that arise in determining the level of risk associated with the Precinct sites.

It needs to be recognised that many of the variables associated with the quantity, quality and effect of groundwater and land contamination in the Precinct have not been quantified or have been unable to be quantified with the information available to the auditor, and this has been noted in the specific sections of the report. The assessment undertaken in this audit has involved consideration of the body of information and data, and although there is a high level of uncertainty in the assessment, and the conclusions cannot be firm, the assessment has helped to further develop an understanding of the probable situation within the Precinct.

The results of the risk assessment and the recommendations that flow from this are summarised in Table 59.



Table 59 Summary of Risks Posed by the Precinct on the River Segment

Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Contaminated soils and fill on the sites	Toxicants: arsenic, copper, zinc, ammonia	Groundwater	Ecosystems associated with the river bank and sediments	Concentrations of these contaminants in groundwater are very high and can be expected to adversely affect ecosystems associated with the riverbank.	Low	Medium	PoMC site (221 Whitehall St) Lesser levels associated with Orica main site and Albright & Wilson site	Further assess the extent and significance of impacts on the ecosystems associated with the riverbank, and therefore the management and remedial actions that are required.
Contaminated soils and fill on the sites	Toxicants: arsenic, copper, zinc, ammonia	Groundwater	Ecosystems associated with the river water	Concentrations of these contaminants in groundwater are very high but it appears that after dilution the concentrations in the river water will not exceed the guidelines for protection of the river ecosystems	Low	Low	PoMC site (221 Whitehall St) Lesser levels associated with Orica main site and Albright & Wilson site	Further investigation to confirm that fish and eels caught in the vicinity of the Precinct do not have contaminant levels in excess of food residue levels. Quantification of the concentrations of contaminants in groundwater discharging to the river (i.e. close to the shore line) and the flux of contaminants discharging from each site, and dispersion of these contaminants in the river water with distance from the river bank. This should specifically use analytical methods appropriate for the levels of contamination and the saline water matrix. Develop a clearer understanding of the sources and conditions on each site that lead to the contamination of groundwater, and the practicability of reducing this contamination.



Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Contaminated soils and fill on the sites	Nutrients: nitrogen, phosphorus	Groundwater	Ecosystems associated with the river bank and sediments	As for toxicants	Low	Medium	PoMC site (221 Whitehall St) Orica main site Albright & Wilson Possibly CSR Limited land	As for toxicants
Contaminated soils and fill on the sites	Nutrients: nitrogen, phosphorus	Groundwater	Ecosystems associated with the river water	Concentrations of these contaminants in groundwater are very high but it appears that after dilution the concentrations in the river water will not exceed the guidelines for protection of the river ecosystems. No reported evidence of nutrient effects	Low	Low	PoMC site (221 Whitehall St) Orica main site Albright & Wilson Possibly CSR Limited land	Confirmation that adverse effects of nutrient discharges to the river (such as algal blooms) are not observed in the river segment
Contaminated soils and fill on the sites	Petroleum hydrocarbons	Groundwater	Ecosystems associated with the Stony Creek Backwash water	Analysis of the water in the backwash suggests that the contaminant levels do not exceed aquatic ecosystem protection criteria, although the sediments are highly contaminated	Low	Low	Mobil	Further quantification of the contaminant levels in the backwash water. Identification of the use of the backwash by birds and other species, and the potential for adverse effects of contamination



Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Contaminated soils and fill on the sites	Petroleum hydrocarbons	Groundwater	Ecosystems associated with the Stony Creek Backwash sediments	The sediments are highly contaminated with petroleum hydrocarbons and metals. This may have arisen from contaminated groundwater from the Mobil site, although it appears most likely to have been caused by historic discharges upstream in Stony Creek or direct to the backwash. It appears that the public does not access the backwash.	Low	High	Mobil	<p>Confirm that the public does not access the backwash; provide measures to prevent access if necessary.</p> <p>Confirm that there are no current sources that give rise to contamination of the backwash.</p> <p>Assess the need for remediation of the sediments in the backwash.</p>
Contaminated soils and fill on the sites	Petroleum hydrocarbons	Groundwater	Ecosystems associated with the rivers	There are plumes of free phase on the Mobil site, while the interception trench may prevent these plumes from flowing to the river, some dissolved phase may flow to the river	Low	Low	Mobil	Confirmation of the effectiveness of the interception trench for containing PSH and quantification of the concentrations of dissolved phase hydrocarbon discharging to the river
Contaminated soils and fill on the sites	Petroleum hydrocarbons	Groundwater	Ecosystems associated with the rivers	There is a plume of free phase hydrocarbons in the vicinity of Holden Dock. The source for this has not been identified.	Low	Medium	Mobil PoMC with respect to Holden Dock area	<p>Inspection to confirm that there are no sheens arising on the river from free phase hydrocarbons in this area.</p> <p>Investigation to confirm that the free phase is not affecting the river system through dissolved phase discharges</p>



Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Contaminated soils and fill on the sites	Other contaminants (eg chlorinated organics)	Groundwater	Ecosystems associated with the river	Some contamination present in deeper aquifers but appears limited in extent and at low concentrations, and unlikely to discharge to the river due to a westerly flow in the vicinity of this contamination (related to the groundwater sink around the North Yarra Main Sewer)	Low	Low	Orica main site Albright & Wilson	As for toxicants
Contaminated soils and fill on the sites	General	Groundwater	Ecosystems associated with the river	Flow of groundwater on western areas of sites is prevented from flowing to the rivers by the North Yarra Main Sewer	Low	Medium	All sites	Assessment of likelihood that the North Yarra Main Sewer (beneath Whitehall) may be refurbished in the future and the situation that will result if this were to occur
Contaminated soils and fill on the sites	Metals, nutrients, other contaminants	Historic discharges from the sites	Ecosystems associated with the river sediments	Sediment sampling indicates that contamination levels are typical of urban catchments, although there are some localised areas of higher contamination that are not well characterised or delineated. Dredging of the river sediments will have removed historically contaminated sediments.	Low	Medium	PoMC site (221 Whitehall St) Holden Dock area	Continue program of sampling and analysing sediments to better delineate areas of contamination and to identify any current sources. Expand analysis suite to include contaminants of relevance to the Precinct (including nutrients, hydrocarbons and chlorinated organics)



Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Contaminated soils and fill on the sites	Petroleum hydrocarbons, metals	Historic discharges	Ecosystem associated with the Stony Creek backwash sediments	The sediments are highly contaminated with petroleum hydrocarbons and metals. This may have arisen from contaminated groundwater from the Mobil site, although it appears most likely to have been caused by historic discharges upstream in Stony Creek or direct to the backwash. It appears that the public does not access the backwash.	Low	High	Mobil	<p>Confirm that the public does not access the backwash; provide measures to prevent access if necessary.</p> <p>Confirm that there are no current sources that give rise to contamination of the backwash.</p> <p>Assess the need for remediation of the sediments in the backwash.</p>
Waste materials currently present on the land	Various, including gypsum, phosphorus and nitrogen	Rainfall runoff	Ecosystems associated with the river sediments	<p>Insufficient information to determine the occurrence and significance of rainfall runoff from the sites.</p> <p>It is probable after dilution in the river water that such discharges will not be significant to the river ecosystems, although runoff could give rise to areas of contaminated sediments.</p>	Low	Medium	All sites	<p>Inspect stormwater flows under rainfall conditions, particularly to identify situations that might lead to significant waste materials being discharged to the river, and quantify levels of contamination under these conditions.</p> <p>Include measurements of nutrients in river sediment analyses.</p> <p>As necessary, improve management of stormwater (such as collection of first flush and diversion to sewer), and remove or contain waste materials and exposed contaminated soil and fill to ensure that contaminated runoff to the river does not occur</p>



Source of risk	Key contaminants	Pathway	Key receptors	Commentary	Level of risk to human health	Level of risk to the environment	Key sites	Recommendations
Process water and wastewater discharges to the river	Various	Direct discharge	Ecosystems associated with the river sediments	It appears that licensed discharges, although noting there is evidence of some breaches of licence limits, do not pose a significant risk to the river ecosystems.	Low	Low	Licensed sites within Precinct: Sugar Australia Albright & Wilson Mobil	Continue monitoring of EPA licensed discharge points



15.2 Higher Priority Recommendations

This audit has identified many data gaps and areas of uncertainty that could be followed up, and these have been identified in the various sections of this report. Of these, the recommendations that are considered to have a higher priority in order to resolve important uncertainties in the conclusions of this audit are outlined below.

15.2.1 Protection of public health

- ▶ River - consumption of fish and eels: Further investigation to confirm that fish and eels caught in the vicinity of the Precinct do not have contaminant levels in excess of food residue levels.
- ▶ Backwash – recreational exposure: Confirm that the public does not access the backwash; provide measures to prevent access if necessary.

15.2.2 Protection of the ecosystems of the river segment

River segment aquatic ecosystems (river water)

- ▶ Further assess the extent and significance of impacts on the ecosystems associated with the riverbank, and therefore the management and remedial actions that are required.
- ▶ Continue program of sampling and analysing river sediments to better delineate areas of contamination and to identify any current sources. Include nutrients and other contaminants found on the sites in the sediment analysis suite.
- ▶ Confirm that adverse effects of nutrient discharges to the river (such as algal blooms) are not observed in the river segment.
- ▶ Confirm that phase separated hydrocarbons in the vicinity of Holden Dock are not giving rise to sheens on the river.
- ▶ Assess likelihood that the North Yarra Main Sewer will be refurbished in the future, the situation that will result if this occurs, and whether there is a need for action in view of the risk that this would present.

River segment aquatic ecosystems (sediments)

- ▶ Continue program of sampling and analysing river sediments to better delineate areas of contamination and to identify any current sources. Include nutrients and found on the sites in the sediment analysis suite.

River bank aquatic ecosystems

- ▶ It is confirmed that the ecosystems in the riverbank require protection under the SEPP WoV and therefore the extent and significance of the affect on the ecosystems of the riverbank from discharges of contaminated groundwater requires further assessment.

Stony Creek Backwash

- ▶ Determine the extent of usage of the backwash by birds and other species and the potential for adverse effects from the contaminated sediments.
- ▶ Confirm that there is no current sources that give rise to contamination of the backwash.
- ▶ Develop as necessary an appropriate remediation action plan for the sediments in the backwash.



Stormwater discharges from sites to river

- ▶ Inspect stormwater flows under rainfall conditions, particularly to identify situations that might lead to significant waste materials being discharged to the river, and quantify levels of contamination under these conditions.
- ▶ As necessary, improve management of stormwater (such as collection of first flush and diversion to sewer), and remove or contain waste materials and exposed contaminated soil and fill to ensure that contaminated runoff to the river does not occur.

The auditor notes that many of the Precinct sites are undertaking environmental audits and other forms of site assessment for their sites, and this work will assist in filling some of the data gaps and meeting the requirements of some of the auditor's recommendations. The status of some of this ongoing work has been summarised in Table 4. It is acknowledged that EPA has programs in place for the rivers, such as ongoing environmental quality monitoring and broader fish studies, and this information will also contribute to filling some areas of uncertainty.



16. Audit Conclusions

Key findings of the audit are:

- ▶ Shallow groundwater is generally present in fill along the eastern boundary of the Precinct adjacent to the lower Yarra River, lower Maribyrnong River and the Stony Creek Backwash. This groundwater is expected to discharge to surface water.
- ▶ Shallow groundwater on some of the sites is contaminated at concentrations that are in excess of the river ecosystem protection levels. The main contaminants of concern are copper (as a toxicant to ecosystems) and ammonia (as a nutrient and stressor of ecosystems).
- ▶ The Maribyrnong and Yarra Rivers are tidal in the Precinct. Tidal flushing provides a very high level of dilution to that groundwater reaching the river, and reduces the concentrations of contaminants discharging in the groundwater to concentrations that are generally less than the ecosystem protection guidelines.
- ▶ The concentrations of contaminants measured in the river waters are less than the ecosystem protection guidelines. This is consistent with the predicted levels of dilution of groundwater in the river water.
- ▶ The discharges of contaminated groundwater can be expected to adversely affect the ecosystems of the riverbank, however the extent and significance of this effect is uncertain.
- ▶ The concentrations of contaminants contained in sediments within the river segment do not appear to be significantly different from those expected in an urbanised catchment. The contaminants are generally below or in the order of the Interim Sediment Quality Guideline – Low Trigger Values, other than at some localised areas.
- ▶ The erosion and runoff of contaminated waste materials and fill from the sites into rivers at times of rainfall is not well defined. It appears that stormwater management measures prevent this on some sites, but this is an area of significant uncertainty. If such runoff occurs, the high level of dilution will reduce any effects on the ecosystems of the river water, however it is possible that runoff could give rise to contaminated sediments in the vicinity of where runoff may enter the river system.
- ▶ The sediments of Stony Creek backwash are contaminated with petroleum hydrocarbons and heavy metals. The contamination may pose a risk to ecosystems, and to foraging birds in particular. It is recommended that further investigations be conducted in relation to the source of contamination, and assessment of the need for remediation of these sediments.
- ▶ The concentrations of contaminants measured in fish caught in the Maribyrnong and Yarra Rivers, which are likely to be associated with the Precinct activities, complied with the Australian and New Zealand Food Standards. This conclusion is consistent with observations regarding the concentrations of contaminants in the river water and sediments. The information on fish and eels caught within the Precinct was limited, and precedes a broader study of fish and eels that is currently being undertaken by EPA.
- ▶ Many individual sites within the Precinct have commissioned their own site-specific environmental assessment, and engaged environmental auditors as part of this process. The results of these further studies can be expected to add useful information and fill some of the data gaps identified in this report, and provide a better understanding of the extent of contamination and its significance.



- ▶ There are many areas of uncertainty in the findings of this audit and its conclusions, and recommendations have been made regarding further investigations and actions that can be carried out to reduce this uncertainty. This would provide for improved management of certain activities that occur within the Precinct.

DATED: _____ 9 October 2006

SIGNED: _____ Peter Nadbaum

PETER NADEBAUM

ENVIRONMENTAL AUDITOR

(Appointed pursuant to the *Environment Protection Act 1970*)



17. Limitations of this Report

This environmental audit report has been conducted in accordance with Section 53V of Part IXD of the *Environment Protection Act 1970* (the Act), and prepared by GHD for EPA Victoria for the purposes as specified in the scope (Section 3) of this report. In very broad terms, the environmental audit involved an assessment of the risk to the lower Yarra River, lower Maribyrnong River and Stony Creek backwash by the wastes and activities on the land that is included within the audit area.

The advice provided herein relates only to these purposes and must be reviewed by a competent Engineer, experienced in contaminated site investigations, before being used for any other purpose. GHD Pty Ltd (GHD) and the auditor accept no responsibility for other use of the advice.

No warranties, expressed or implied, are offered to any third parties and no liabilities will be accepted for use of this report by any third party. The audit has relied on inspection of relevant documents provided by the client and other stakeholders (as specified in Section 5). Reasonable efforts were made to obtain information relevant to the scope of the audit. The accuracy with which specific issues have been identified depends on the information provided, general client awareness of the issues identified, and the quality of information reviewed. The audit did not include any sampling or analysis, testing of equipment or emergency operation procedures, or occupational health and safety issues. The scope of this environmental audit has been to review information about the sites, and this being the case, GHD has had limited control over data set of information on which the audit has relied. This should be borne in mind when assessing the report. Requests to access information referred to in this audit report and that is not appended to the report should be directed to the custodians of the information, as referenced in the report.

This report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances that arise from the issue of the report that has been modified in any way as outlined above.

This document does not purport to provide legal advice and any conclusions or recommendations herein must not be relied upon as a substitute for such advice.



18. References

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Refer to Appendix B for additional documents referred to during the course of the audit

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